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Mechanism of Nutrient Release from Slow-Release Fertilizer and its Advantages

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Abstract

Slow-release fertilizer term used interchangeably with controlled release, controlled availability, slow acting and metered release to designate a rate of dissolution (usually in water) much less than completely water-soluble compounds. For enhance fertilizer nitrogen effectiveness, and possibly decrease environmental nitrogen losses through processes, such as nitrate leaching and runoff and gaseous losses of nitrous oxide and ammonia we can apply enhanced-efficiency fertilizers, such as slow and controlled-release fertilizers, nitrification inhibitors, and urease inhibitors as one of the management practices. A reasonably good prediction of nutrient release is possible with slow/controlled-release fertilizers coated with hydrophobic materials, particularly polymer-coated fertilizers because they are less sensitive to soil and climatic conditions. Their synchronized (linear or sigmoidal) nutrient release synchronizes advantageously within certain limits with the plant's nutrient requirements. Therefore, they can contribute to advanced fertilizer management programmes and to innovative, high technology farming systems such as no-till farming with single co-situ fertilizer application.

Keywords: Fertilizers Use Efficiency, Leaching, Nitrification, Runoff, Slow-Release Fertilizer, Urease Inhibitors.

Introduction

1. Background: Surface application of urea often results in high ammonia volatilization, denitrification, leaching, and immobilization, resulting in low fertilizer N-use efficiency. Now a day the fertilizer industry faces a continuing challenge to improve the efficiency of its products, particularly of nitrogenous fertilizers, and to minimize any possible adverse environmental impact (e.g., soil and water acidification, contamination of surface and groundwater resources, increased ozone depletion and greenhouse gas levels, and loss of biodiversity). This is done either through improvement of fertilizers in use, or through development of new specific fertilizer types. Increasing the efficiency of fertilizer use is not easy due to mechanisms of plant nutrition. Normally plants take up their nutrients through roots from the soil or the soil solution. Slow release or time release fertilizers one of the better options that give out small quantities of nutrients over a time period. The release may be controlled by water, temperature, or microbial activity.

2. Definition: Slow-release nitrogen (N) materials are often used to reduce N leaching losses from sandy soils (Wang et al., 1998) and extend N availability over a growing season (Wiedenfeld, 1986). Slow release is a fertilizer term used interchangeably with delayed release, controlled release, controlled availability, slow acting, & metered release to designate a rate of dissolution (usually in water) much less than completely water-soluble compounds. For enhance fertilizer N effectiveness, and possibly decrease environmental N losses through processes, such as nitrate leaching and runoff and gaseous losses of nitrous oxide and ammonia we can apply enhanced-efficiency fertilizers, such as slow- (SRF) and controlled-release fertilizers (CRF), nitrification inhibitors (NI), and urease inhibitors (UI) as one of the management practices. To improve the nutrient efficiency through application of mineral fertilizers, particularly nitrogen fertilizers, which release the nutrients contained according to the plants' requirements, so-called 'intelligent fertilizers', i.e., by application of slow and

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controlled-release, or by ‘stabilized’ nitrogen fertilizers, which preserve the nutrients until plants really require them. By increasing the NUE we can achieve target yield & thus reduce the fertilizer & production costs.

Mechanism of Nutrient Release from CRFs / SRFs

Controlled release fertilizers designed to provide good control over release in soils and to match plant demand are expected to provide high use efficiency (HUE) and minimize adverse effects on the environment. Effective utilization and proper management of nutrient application require tools for predicting the release under varying soil and environmental conditions. Moreover, release models may offer the manufacturer or R&D researcher tools to improve the design of CRFs, and provide environmentalists with the means to better assess potential hazards such as leaching or volatilization losses.

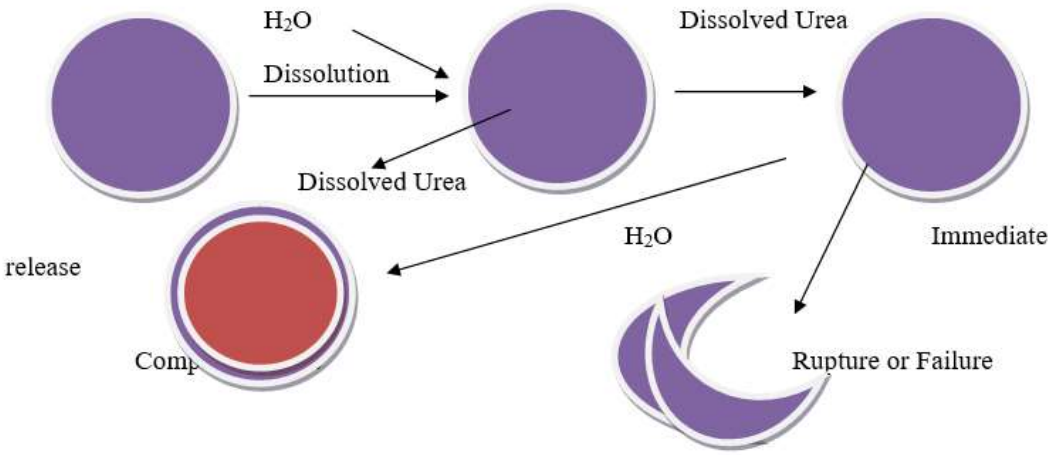

Fig.1- Scheme of stages of nutrient release from a polymer-coated granule (Mode of action of coated Fertilizer)

Most of the organic-N based fertilizers are considered to be mainly slow releasing, involving many factors affecting their release. Urea formaldehyde, for example, releases available nitrogen as a result of the degradation of oligomeric chains. The release depends strongly on chain length, soil properties (biological activity, clay content, pH) and external conditions such as soil moisture content, wetting and drying, and temperature. Release curves of these fertilizers (Raban et al., 1997) are typically characterized by a too high initial release (“burst”) and a too slow release of about the last quarter to third of the nitrogen (“tailing effect”). This pattern of release significantly differs from the sigmoidal form of nutrient uptake by plants (Shaviv, 1996).

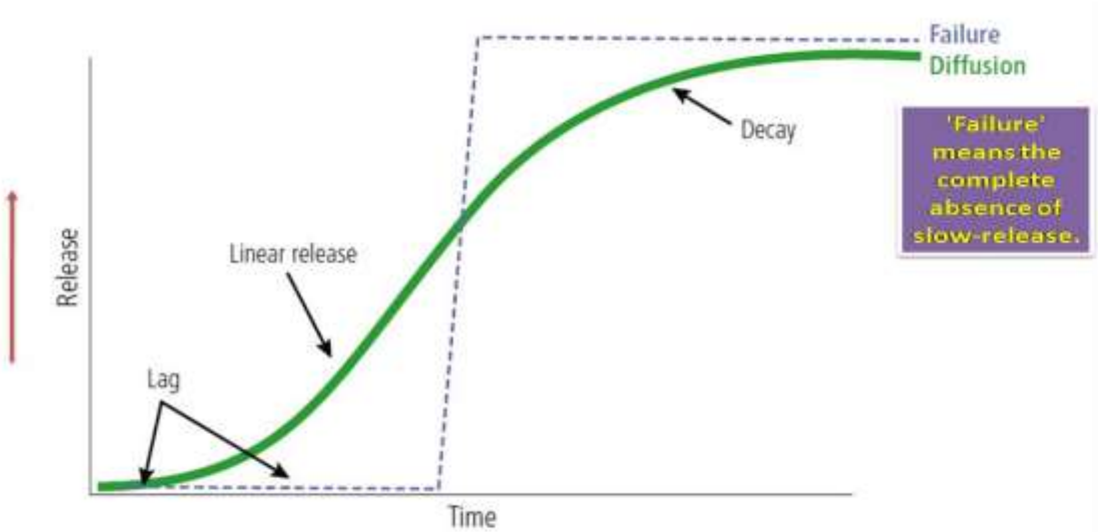

Fig.2- Typical curve of cumulative release from a single granule of coated CRF for “Failure” and “Diffusion” release mechanisms. (Source: Shaviv, 2005)

Few efforts were made to model the release of organic-N SRFs presumably due to the large variation in release behaviour. Fertilizers coated with hydrophobic materials, especially polymer-coated CRFs, provide better control over the release since they are less sensitive to soil conditions. The pattern of temporal release from coated fertilizers ranges from parabolic release (with or without "burst"), through linear release, to sigmoidal release. Noteworthy is the lag period of the sigmoidal release. The linear and sigmoidal patterns can synchronize better with the pattern of nutrient uptake by plants than with the parabolic release (Shoji and Kanno, 1994). The potential of these fertilizers to serve as controlled release nutrient sources has led to a steady and significant increase of their use (Trenkel, 1997).

Advantages of Slow-Release Fertilizer

1. Economic aspects:

a. Maximize fertilizer use efficiency: The majority of coated fertilizers have been used in horticulture & agriculture, in part due to the steady increase in container-grown plants, and for high-value vegetable crops, e.g., Aglukon, Agricote Power TM. Agricote Power offers enhanced-efficiency of nutrient use, which enables application rates to be reduced by up to 50%. It is specifically recommended on light soils where conventional fertilizers are easily leached and in rainy areas when rainfall accelerates nutrient leaching (Achilea et al., 2005; Raban, 2005).

b. Potential for reducing nutrient loss: From a practical point of view, nutrient losses via different processes may be considered "irreversible" at least in the short range. Some of these processes are the main cause for the very poor recovery of N (People et al., 1995), ranging from between 70% in better managed practices to 30 – 40% in poorly managed ones such as paddy rice (Ghosh and Bhat, 1998). Numerous publications deal with the possibility of reducing such losses by using CRF/SRFs or bio-amended ammonium fertilizers (e.g., nitrification inhibitors) (Alexander and Helm, 1990; Shaviv and Mikkelsen, 1993).

c. Better B/C (Benefit-Cost) ratio: Slow-release fertilizers can meet the crop nutrient demand for the entire season through a single application, involving savings in spreading costs. CRFs displaying a lag in release could be used to apply nutrients prior to the "annual spring rush," or when trafficability in the field is less restricted, such as fall application for winter- or spring-planted crops (Randall et al., 1985). Moreover, CRFs can reduce the demand for short-season manual labour for top dressing, such as for rice paddies (Shoji and Gandeza, 1992) that is required during critical periods. It will be considered as a labour & time saving. The addition of bio-amendments, such as nitrification inhibitors, may also save the cost of additional applications (Trenkel, 1997).

2.Physiological aspects:

a. More uniform growth response & maximize crop yield & improve its quality: More uniform growth response will be obtained by the use of SRFs & also it maximizes the crop yield & its quality (Konno, 1999). In intensive vegetable production, slow- or controlled-release fertilizers offer onetime application of the fertilizer with multiple cropping, they also give the possibility to enhance the quality and safety of vegetables and farm produce. Reducing the number of applications and the amount of nutrients applied may compensate, in part, for the much higher cost of polymer-coated fertilizers. On commodity crops such as maize and wheat, the use of controlled-release fertilizers improved economic yield and quality with the same or with only half the amount of N compared to conventional fertilizers.

b. Reduction of stress & specific toxicity: Excessive nutrient supply, commonly resulting from an application of conventional soluble fertilizers, may result in a high concentration of soluble salts in the root zone (Trenkel, 1997). This may induce osmotic stress and cause specific injuries to plants at different growth stages, or undesired development such as lodging (Goyal and Huffaker, 1984). Compared to soluble fertilizers, the use of CRFs involves improved germination and crop quality together with reduced leaf burns; stalk breakage and disease infestation (Trenkel, 1997).

c. Supply of Nutrient forms preferred by plants: A great deal of attention has been paid in the last two decades to the question of the preferred form of plant nutrients, particularly regarding the supply of ammonium or nitrate nutrition. Significant increases in grain yields and protein content induced by mixed ammonium-nitrate nutrition compared to nitrate or ammonium alone have been reported (Shaviv, 1993). These results were obtained only in experiments where reasonable control over the ammonium/nitrate ratio in soil could be achieved.

d. Enhancement of synergistic effects between nutrients: Abundant evidence is available on the synergistic effects between different types or species of nutrients, particularly when they are simultaneously supplied or co-placed near absorption sites on the root surface. For example, it has been shown that ammonium or potassium can significantly increase the availability of Fe in calcareous soils due to the physiological acidification of the rhizosphere. Shaviv and Hagin (1988) suggested the possibility of correcting Fe deficiency by applying K2S04 co-granulated with FeSO4 to a very calcareous soil, whereas Fe and K sulphates alone gave poor results. Similarly, NH4 was found to increase P bio-availability when its nitrification rate was reduced, presumably via the rhizosphere acidification mechanism (Hagin et al., 1990; Shaviv, 1993).

3. Environmental aspects: Minimize negative environmental impact - The nutrient release to the environment depends on their concentration in soil solution. Therefore, any nutrient application method that improves NUE, and consequently reduces the surplus of nutrients over plant needs, also has the potential to reduce losses to the environment (Bockman and Olfs, 1998). Shoji and Kanno (1994) and Shaviv (1996) illustrated this rather simple principle in experiments in which nitrogen release from CRFs was well-synchronized with plant demand.

Future Needs

Several issues related to better NUE and a more environmentally friendly utilization of SRF/CRFs deserves greater attention and deeper insights, as listed below. The main issues are:

1. Better understanding of the mechanisms controlling release rate and pattern, and the main environmental factors (temperature, moisture, microorganisms, acidity, soil type, etc.) that affect them. Users should be exposed to this knowledge to help them choose SRF/CRFs professionally and on quantitative basis.
2. Better assessment of expected benefits to the environment by using CRFs. This should also include estimates of the economic significance of reducing pollution of ecosystems (air, water and soil) and sustaining soil productivity.
3. Improved quantification of the economic advantages resulting from reduced losses of nutrients and savings in labour costs.
4. Improved assessment of economic benefits expected from reduced osmotic stress and specific toxicity as a result of synchronizing nutrient supply (release) with plant demand. Development of soil degradable coatings to reduce the "tailing" effect and the accumulation of undesired polymers in the soil.
5. Utilization of mechanistic-mathematical models for predicting release of nutrients under laboratory and field conditions, and as a design tool for technologists.

Conclusion

The controlled-release fertilizers usually decrease the nutrient losses; enhance nutrient use efficiency (NUE) & also significantly reduce the possible losses of nutrients, viz., nitrate-N loss by leaching and denitrification; and losses of ammonia by volatilization. While maintaining the same yield, a decreased rate in the recommended application dose of a conventional fertilizer is possible when controlled-release fertilizers are used. This substantially decreases the risk of environmental pollution. A reasonably good prediction of nutrient release is possible with slow/controlled-release fertilizers coated with hydrophobic materials, particularly polymer-coated fertilizers because they are less sensitive to soil and climatic conditions. Their synchronized (linear or sigmoidal) nutrient release synchronizes advantageously within certain limits with the plant's nutrient requirements. Therefore, they can contribute to advanced fertilizer management programmes and to innovative, high technology farming systems such as no-till farming with single co-situ fertilizer application.

References

1. Achilea, O., Levi, Y., Shaviv, A., Altissimo, A., Aubertin, L., Raban, S., Ronen, E. and Barak, E. (2005): Haifa CoteNTM – Continuous Nitrogen Nutrition for Arable Crops. Poster presentation 13th IFS Annual Conference and 2005 Dahlia Greidinger Symposium, Efficient Crop Nutrition: Challenge and Opportunities. International Fertiliser Society, York, UK.
2. Alexander, A., and H.U. Helm. (1990): Ureaform as a slow-release fertiliser: A review. Z Pflanzenernaehr Bodenkd. 153, 249-255.
3. Bockman, O. C., and Olfs, H.W. (1998): Fertilizers, agronomy and N2O. Nutr. Cycling Agroecosyst. 52,165-170.
4. Ghosh, B.C., and Bhat, R. (1998): Environmnetal hazards of nitrogen loading in wetland fields. Environ. Pollut. 102, 123-126.
5. Goyal, S.S., and Huffaker, R.C. (1984): Nitrogen toxicity in plants. In "Nitrogen in crop production", (R.D. Hauck, Ed.) , 97-118. ASA, Madison, WI.
6. Hagin, J., Olsen, S.R., and Shaviv, A. (1990): Review of interaction of ammonium-nitrate and potassium nutrition of crops. J Plant Nutr. 13, 1211-1226.
7. Konno, C. (1999): In: Meister Controlled Release Fertilizer. Shoji S. (ed). Konno Printing Company Ltd. Sendai. Japan, 1999.
8. Peoples, M.B., Freney, J.R., and Moiser, A.R. (1995): Minimizing gaseous losses of nitrogen. In "Nitrogen Fertilization in the Environment" (P.E. Bacon, Ed.), 565-601. Marcel Dekeker Inc. New York.
9. Raban, S. (2005): MulticoTechTM: polymer coating technology for responsible plant nutrition. IFA International Workshop on Enhanced-Efficiency Fertilizers, Frankfurt. International Fertilizer Industry Association, Paris, France.
10. Raban, S., Zeidel E., and Shaviv, A. (1997): Release Mechanisms Controlled Release Fertilisers in Practical Use. In "Third Int. Dahlia Greidinger Sym. on Fertilisation and The Environment"(J.J. Mortwedt, and A. Shaviv, Eds.), 287-295. April 1997, Technion, Haifa.
11. Randall, G.W., Wells, K.L. and Hanway, J.J. (1985): Modern techniques in fertilizer application. In"Fertiliser technology and use" (R.D. Hauck, Ed.), 521-560. SSSA, Madison, WI.
12. Shaviv, A. (1996): Plant response and environmental aspects as affected by rate and pattern of nitrogen release from controlled release N fertilisers. Progress in Nitrogen Cycling Studies (Van Clempt Eds.), 285-291. Kluwer Academ Pub. The Netherlands.
13. Shaviv, A. (1993): Controlled supply of fertilisers for increasing use efficiency and reducing pollution. In "VIII International Colloquium on "Optimization of plant nutrition". Lisabon, September, 1992" (Fragoso Eds.), 651-656. Kluwer Academic Pubs. The Nehterlands.
14. Shaviv, A., and Mikkelsen, R.L. (1993): Slow-release fertilisers for a safer environment maintaining high agronomic use efficiency. Fert. Res. 35, 1-12.
15. Shaviv, A., and Hagin, J. (1988): Interaction of ammonium and nitrate nutrition with potassium in wheat. Fert. Res. 17, 137-146.
16. Shoji, S., and Kanno, H. (1994): Use of polyolefin-coated fertilizers for increasing fertilizer efficiency and reducing nitrate leaching and nitrous oxide emissions. Fert. Res. 39, 147-52.
17. Shoji, S. and Gandeza, A.T. (1992): "Controlled Release Fertilizers with Polyolefin Resin Coating". Kanno Printing Co. Ltd. Sendai, Japan.
18. Trenkel, M.E. (1997): Improving Fertilizer Use Efficiency. Controlled-Release and Stabilized Fertilizers in Agriculture. The International Fertilizer Industry Association, Paris.
19. Wang, F., Bear, J., and Shaviv, A. (1998): A N-dynamics model for predicting N-behaviour subject to environmentally friendly fertilization practices: II - Numerical Model and Model Validation. Transport in Porous Media 33, 309-324.
20. Wiedenfeld, R. P. (1986): Evaluation of controlled release nitrogen fertilizers on cantaloupes and bell pepp.ers. J. Rio Grande Val. Hortic. Soc. 33, 29-36.

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Prospects of Crop Modelling in Fruit Crops

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Nutritive Value

This article throws insights on the role and significance of various crop models in fruit crops pertaining to their perennial behaviour. The key models developed in recent years for the management of fruit crops are predominantly based on them. Models are categorized according to their conceptualization of knowledge, education or encouragement for decisions. A special focus is placed on models that account for plant architecture and on the various plant scales considered.

Introduction

Crop models are a conventional method to introduce quantitative information about how a yield develops in association with its current circumstance. Crop modelling can play a momentous role in systematic proposition by furnishing a potential capability for scenario analyses. Over the past three decades, crop modelling has evolved with an encompassing pace, resulting in the availability of a diversity of crop models. It should be taken into consideration that efficient crop modelling must amalgamate pragmatic scientific approach to augment understanding with an applications orientation to retain a focus on prediction and problem-solving. Achieving an acceptable balance between simplicity and sophistication when aggregating biology, physics and prediction for each particular undertaking is the greatest difficulty in productive crop modelling. The guiding principle is to avoid superfluous complexity and retaining transparency.

In the wake of a prolonged negative impact on agricultural land, food insecurity and required adaptation to climate change, there is an increasing demand of an integrated assessment and modeling of future agro-ecosystems development. A number of modeling tools are used to support the decision making and planning in agriculture. One of the most crucial components in this is crop modeling. Based on relevant data on weather and crop environment, these models can simulate crop development, growth, yield as well as the uptake of water and nutrients from the soil. It has the potential to improve various parameters related to crop through quantification of the uncertainty involved in the results and multifarious model uncertainties through model inter-comparison, compilation of data as required to fill knowledge gaps, elimination of model deficiencies and improve methods for scaling and uncertainty analysis. This will require augmented efforts on linking crop and soil modeling that will also enhance opportunities for exploring linkages between adaptation and mitigation of climate change. The key challenge of crop modeling is to promote appropriate assessment of impact of climate change on food security. The work strategy includes both to stimulate outstanding science and to support capacity as well as network building including demonstration of desirable impact assessments with links to and in consultation with decision makers.

Structuring of Crop Modelling into Three Phases

Phase I: Advancement of the implementation of the crop model for risk management capabilities, including upscaling, model linking capabilities, and better understanding and quantification of model uncertainties.

Phase II: showcasing model optimization, advanced upscaling methods and model linking and evaluation of uncertainty and boosting research capability in these aspects

Phase III: establishment of strategies for future crop modelling research for enhanced climate risk Assessment.

Modelling of Fruit Crops

In the current scenario, there is an acute need to give emphasis on carbon-based crop productivity models with a special accent on fruit tree models. The intent and orientation of the model can vary according to the interest of the researcher, including a variety of issues that include:

1. Water use efficiency.
2. Prediction of phenology of fruit ripening.
3. Prediction climate effects, assessment of stress responses and/or pest management.
4. Conceptual understanding of the physiological processes involved.
5. Imaginative, quantitative thinking.
6. Availability of extensive agricultural/biological database.

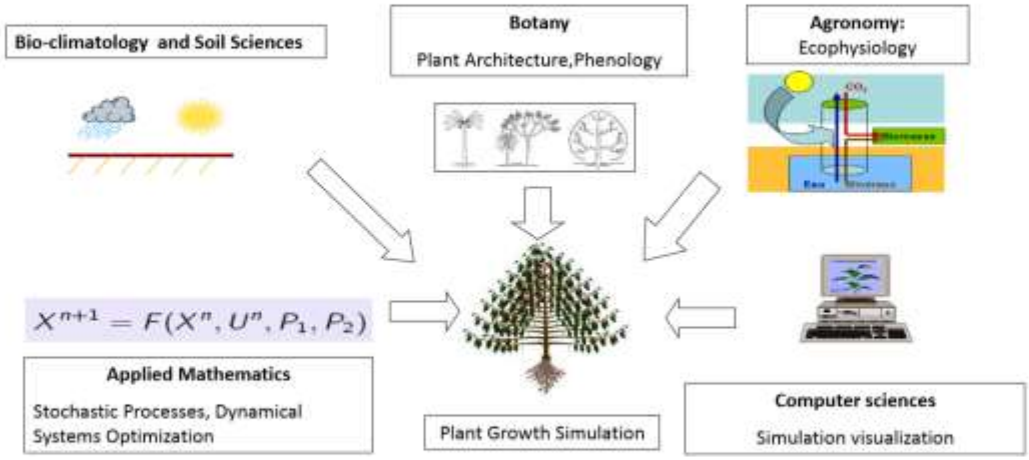

Fig. Fruit tree growth modeling: a multidisciplinary subject

Features of Fruit Tree Models

Modeling of fruit trees is tedious task. They are quite complex organisms for the purpose of crop modeling. Therefore, there is no coincidence that sugar beet was among the first crop plants to be modeled since it bears only two major organs; a rosette type crown of leaves that acts as a source and a storage root that acts as a sink, hence, relatively easy to model. Even, other annual crop plants are more complex, having leaves, shoots, roots and reproductive structures, but the entire lifespan is a few months. Fruit trees are still more diverse and complex bearing perennial trunk, branches and scaffold roots of several ages, along with a vast of current year's vegetative and reproductive organs. Due to numerous variations in pollination compatibility, parthenocarpic potential and hormonal effects, generalizations are nearly impossible. The perennial nature of fruit trees depends on the previous years of life in several aspects. These permanent structures have carbon and nutrient reserves, but they bear effects from year to year as well. The number of flowers and thus crop potential are determined in deciduous fruit trees in the previous season and represent stresses and carryover status of tree physiology from previous years; trends often continue for many years. It is very difficult to build multiple year models as many of the major carryover effects on growth or cropping are not well known. In addition, fruit trees are characterized by discontinuous canopy structures, good management by pruning and preparation, crop level manipulation, and grafting on rootstocks that have growth and cropping effects that differ, but are poorly understood.

One of the preliminary tasks of the modeler is the assessment of the biomass produced by the tree or orchard. This appears to be an unambiguous task with an annual crop plant that starts its development from seed, contains negligible biomass, and the dry matter of all its organs can be determined at harvest, although senescence of leaf and floral organs must be taken into account. Since the perennial nature of fruit trees, the woody skeleton not only grows and develops during the annual cycle, but also accumulation and exports of carbohydrates and other reserve materials also takes place. In this way, the estimation of the net increase in biomass of a fruit tree is perplexed during the annual cycle. As a consequence, it is therefore more difficult to determine the harvest Index of fruit trees. The validation by growth analysis experiments is particularly difficult due to the amount of standing dry matter in the spring, the variations caused by previous years, and the limited number of large plants that can be harvested.

In fruit tree culture, the focus is also very unique from that of most annual crops. The key parameter of success in field and garden crops is yield, which is limited but approximately corresponds to the production of dry matter, [and is usually predetermined by the genetic make-up of the variety]. The discourse of quality aspects plays a limited role. For a variety of factors, models of fruit trees focus on aspects of reproductive growth that are not generally included in field and garden crop models. Typically, only a small percentage of the flowers on a fruit tree will survive for harvest as fruit, so most flowers and young fruits will have to abscise. The optimization of the final size and, in particular, the quality of the crop depends on a fairly precise control of the final number of fruits. Consequentially, with chemical thinning sprays and/or hand thinning, fruit tree growers exploit and try to regulate fruit numbers. This, of course, interferes with natural processes in basically wild-type crops. Eventually, it is an incredibly complex method to model the control of abscission in fruit trees, natural or artificially induced. During the spring bloom and fruit abscission, many current and carryover physiological effects interfere with grower management and highly variable temperature.

Architectural Modelling

Based on the concept of “axis differentiation” in five main morphological criteria all related to the meristem activity they have formed “23 architectural models” and are dedicated to famous botanists.

1. Growth direction: (Plagiotropic or Orthotropic).
2. Growth rhythm: (Continuous or Rhythmic).
3. Branching mode: (Monopodial or Sympodial).
4. Sexual differentiation of meristems: (Terminal or Auxillary).
5. Polymorphism of axes: Short (Brachyblasts), medium (Mesoblasts) and long shoots (auxiblasts).

Existing Models or Modelling Frameworks for Fruit Crops

1. Hi-SAFE and Yield-SAFE: The Hi-SAFE model was designed in response to the need for a process-based model that could simulate tree-crop interaction and management options in a temperate region. The typical agroforestry systems to be simulated by the model are walnut (Juglans spp.), wild cherry (Prunus avium) or Mediterranean oaks (Quercus spp.) with winter and summer annual crops, grass and alfalfa.
2. Holttum’s model: It consists of only one meristem and it is not branched. The meristem will convert into inflorescence and plant eventually dies. This model is adopted in Banana.
3. Corner’s model: Trunk is single, monopoidal and orthotropic in nature. Growth is indeterminate and auxiliary inflorescence is seen. Fruit trees in which this model adopted are papaya and datepalm.
4. Rauh model: Trunk is monopodial, orthotropic in nature. Lateral flowering is seen. It is adopted in apple.
5. Troll’s model: Sympodial and plagiotropic in nature the fruit tree model is Annona squamosa.
6. 3 -D Architectural model: This model consists of two forms:

a. Green- Lab Model.
b. L-System Modeling.

Limitations

The shortcomings of any crop model that is developed and used are essential to consider, since they are inherently gross simplifications of complex systems. For complex systems such as fruit trees, it is necessary to accept the first point, but to aim for utility. For any modeler, a challenging decision is how simple or complicated the model can be made. As models that are too simplistic are easy to understand, but ignore too many significant variables, there is a balance in them. Hence, they are unrealistic and inconsistent in their actions. In further cases, however, models that contain all main processes usually behave realistically, however they become quite hard to grasp and errors are difficult to explain. The objective is to have the model guided by major processes and concepts, but in as basic a form as possible. As Einstein was reported to say "Make it as simple as possible, but no simpler".

The small and insufficient database of good quantitative data for modelling is a specific restriction for fruit tree crop models. The high level of canopy management that can lead to very limited canopy types such as thin vertical walls or Y-shaped hedgerows or mid-summer pruning is a distinctive element of fruit tree orchards that challenge modelling. As previously discussed, where there are abnormal canopy shapes, the estimation of the associations of radiation and tree geometries is not negligible. A hybrid approach is to use a "broad leaf" model of everyday time that measures the photosynthesis of the canopy by a full-canopy light reaction to intercepted radiation. The interception of radiation can be modeled or can be a feedback depending on field radiation interception measurements by the modeled trees. Since, the methods for estimating fractional radiation interception in orchards are reasonably simple, this can prevent a complicated modelling step and allow focus on other parameters.

Finally, the challenge in interpreting the models of other researchers is a significant constraint in the whole field of modelling. The ambiguity of the models themselves, the various assumptions made and the computer programming used always deter those who were not interested with the models from even basic comprehension. In addition, it is difficult to publish crop models since scientific journals typically prohibit the lengthy duration of debate required to thoroughly describe crop model hypotheses, characteristics of limitations. Consequently, in this area, there is much less appreciation of the work of others than in most other areas. Furthermore, challenges in rendering crop models available to a wider audience have contributed to a lack of adoption of models in horticultural management decisions. The shortage of researchers with good mathematical and programming expertise also exacerbates this issue in tree fruit science. Researchers have an intrinsic interest in qualitative modelling and have good familiarity with the structures of the fruit tree, but the presumed necessity of solid math skills and computer programming abilities discourages or discourages them.

Fortunately, some easy-to-use simulation tools can make modelling even more available, such as the STELLA ® tools used in the existing apple model. These restrictions will be solved in near future and that tree fruit crop models can become an essential component of scientific research and the practical application of expertise to further tree fruit farming.

Conclusion

Fruit crop modelling incorporates knowledge of fruit trees' behavior through numerous architectural modifications such as root stock impacts, preparation, pruning, thinning and plant growth regulators, as well as environmental interactions. Such modifications allow fruit growers to maximize the production, efficiency and quality of export-appropriate goods.

References

1. Costes E. (1999). Modeling and architectural analysis as bases for fruit crops management. Acta Hortic. 495: 313-316. DOI: 10.17660/ActaHortic.1999.495.17
2. Eliezer E. G. and Alan N. L. fruit tree models: scope and limitations. Fruit tree models- Environmental Economics and Management. economics.agri.huji.ac.il.
3. Gary C., Jones J. and Tchamitchian M. (1998). Crop modelling in horticulture: State of the art. Scientia Horticulturae. 74: 3-20.

Stevia Farming: The Safest Route to a "Sugar-Free" World

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Stevia is a shrub like perennial plant which is used as sugar substitute and is also known as 'sweet leaf, sugar leaf and honey leaf'. It belongs to family Asteraceae and is native to Paraguay, where it has a long history of use by the Guaraní people. The leaves of Stevia plant are source of zero calorie sweetener and sweetness of this plant is more than sugar. The leaves contain a number of sweet-tasting chemicals known as steviol glycosides, which can be used fresh or dried to sweeten beverages or desserts or can be commercially processed into powdered noncaloric sweeteners. Steviol glycosides, particularly the chemicals stevioside and rebaudioside A, can be more than 300 times sweeter than table sugar and are nonglycemic (i.e., they do not affect blood glucose levels). Scientifically known as Stevia rebaudiana (Bertoni), it is mainly grown in Paraguay, Kenya, China and the United States. As increasing volumes of stevia are in demand by consumers, the stevia plant is also now being grown in Vietnam, Brazil, India, Argentina and Colombia among other countries. Stevia producers use conventional breeding techniques to increase the sweet compounds found in the leaves of the plant. It can be a hardy, sustainable crop for small, independent farming communities. Depending on the region, it may be harvested several times per year and requires little farm acreage. Stevia is grown best in environments with long days of sunshine and is a perennial plant.

Composition

Most important components of the leaves on dry weight basis are protein (6.2%), lipids (5.6%), total carbohydrates (anthrone) (53%) and stevioside (11%), aluminium (0.072%), phosphorus (0.328%), potassium (1.78%) and carotene (0.0075%), the leaves of stevia, stevioside, sweet crystalline diterpene glycosides are extracted. Stevioside is non-caloric, measured to be 200-300 times sweeter than sucrose.

Cultivation Practices

Climate Requirements: Stevia requires a warm and humid climate. It grows best in temperature range of 30-32 degree Celsius with an average annual rainfall of about 1500mm. Temperatures above 45 degree Celsius and below 5 degree Celsius is detrimental to crop.

Soil Requirements: Stevia grows best in well drained, rich, red/sandy loam soils. The plant prefers acidic to neutral soil with fine tilth. Soil pH range should be about 6.0 to 7.5 for best growth and yield. Organic matter and micronutrients may be applied to poor soils.

Land Preparation: The land should be harrowed and well ploughed to break down clods and make the soil weed-free. The site should not be susceptible to flooding and pudding. 1-2 ploughing has to be done after harrowing.

Planting and Spacing: Planting of Stevia is done on raised beds of about 15cm height and 60 cm width. Row to row distance should be 40 cm and plant o plant distance should be maintained at 30cm. This would give a population of about 20,000 to 25,000 plants per acre. There are two popular verities suitable for Indian climates, MDS-13& MDS-14, which have been very successful.

Stevia is propagated by stem cuttings of preferably 15cm. The best season for Stevia propagation is from February to March. The cuttings become ready for transplanting after 4 weeks of rooting.

Manures and Fertilizers: Farm yard manure (FYM), Vermicompost or cow dung manure maybe added to increase soil fertility. Fertilizer dose of 28 kg N:113 kg, P:113kgK per. Hectare is recommended for high yield of Stevia crop.

Irrigation: Irrigation can be carried out either by traditional methods or by drip/sprinkler irrigation. In hot summer months, frequent light irrigations should be given; however excessive moisture in the soil should be avoided.

Inter-culture operations: Regular weeding (manual) at 8 weeks should be carried out. Usually, there are no instances of pests/diseases in Stevia crop. However, if any pest or disease is noticed, spray of diluted neem oil is the best organic remedy. Flowering of plants should be avoided as leaf is the main produce.

Harvesting: Stevia plants become ready for first harvesting 4-5 months after planting when they attain a height of about 40-60cm. After that, harvesting can be carried out every 3 months for 3 years. Plucking of leaves is done either in small batches or the whole plant can be harvested leaving 15cm from the base. The plants should be cut just before the onset of flowering as the sweetener in the leaves is maximum at this time and it is of best quality.

Yield: An average yield of 2500 to2700 kgs per acre of dried Stevia leaves can be obtained with a good variety and proper cultural practices.

Post-Harvest operation: After harvesting, Stevia plant should be dried in shade for 2 days.

Crushing: After drying, leaves are stripped from the stems by hand or a mechanical thresher/separator before transporting to the processing facility. Stems of stevia plants contain little or no sweetness, although it is suggested that they may contain some flavour enhancer, odourisers and other agents of potential use for improving food stuff or alcoholic beverage. Crushing the dried leaves is the final step in releasing stevia's sweetening power. This can be done either by hand or for greater effect, in grinder or in a special blender for herbs.

Process for Extraction and Grades

Stevioside is a complex molecule naturally found in stevia that gives the stevia plant its special properties. The higher percentage of steviosides, the more potent the extract will be. Extracts of stevia leaves can be prepared by a number of methods. One can make liquid stevia extract by adding a cup of warm water to 1/4 cup of fresh, finely-crushed stevia leaves. This mixture should set for 24 h and then refrigerated. It is manufactured the best way possible by utilizing water extraction and citric acid discoloration. Most commercial processes consist of water or alcohol extraction, discoloration by bleach or citric acid, and purification using ion-exchange resins, electrolytic techniques, or precipitating agents (Hassan et al., 2002). However, some companies like Stevia, USA use a natural water process to obtain the stevioside. This method offers a superior stevia product.

Stevia has been able to provide an important role in biodiversity because it requires little land and allows farmers to diversify their crops. Unlike commodity crops, Stevia is generally grown on smaller plots of land and provides supplemental income to the more common place "cash" crops. Stevioside and Rebaudioside A are the most prevalent and generally make up about 75% of the total steviol glycoside content in stevia. Stevia is an age old naturally derived sweetener with a bright future. As far as importance of Stevia crop is concerned, it can be said that as long as diabetic patients exist in the world, this crop can never go down. This evolution of the science and taste of stevia will continuously benefit consumers as well as food and beverage companies seeking to reduce sugar.

References

Hassan, M.I, Zeitoun, A.A, Zietoun, M.A, Moussa, M.A, 2002. Effect of harvesting time, drying, extraction and purification methods on sweeteners extracted from Stevia rebaudiana Bertoni. Journal of Agricultural Sciences: 27:323–339.

"Molecular Mechanism of Autophagy and its Role in Plants"

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Autophagy is a highly evolutionarily-conserved catabolic process facilitating the development and survival of organisms which have undergone favourable and/or stressful conditions, in particular the plant. Accumulating evidence has implicated that autophagy is involved in growth and development, as well as responses to various stresses in plant. Similarly, phytohormones also play a pivotal role in the response to various stresses in addition to the plant growth and development (Wento et al., 2019). Among autophagic (ATG) proteins, ATG8 from the uniquitin-like protein family plays a key role in Autophagosome formation. ATG8 is also involved in selective autophagy and in more processes not associated with autophagy. The identification of the structure and possible functions of plant proteins from ATG8 family is required. The structure of ATG8 proteins from plants and their homologs from yeast and animal cells, interaction of ATG8 protein with functional ligands, and involvement of ATG8 proteins in different metabolic processes in eukaryotes (Ryabovol and Minibayeva, 2016).

Autophagy is a self-digestion mechanism that functions in all of these processes by transferring cell parts to the vacuole for degradation by vacuolar hydrolases, followed by recycling of the breakdown products. How the function of autophagy switches between cell survival and cell death is still unknown. It is activated by a wide variety of stress conditions and developmental cues, and the signalling pathways for activation in plants are just beginning to be elucidated. Molecular mechanism and potential substrates of autophagy, its regulation in response to various signals, its physiological roles during development and stress, and the relationship between autophagy and programmed cell death in plants (Floyd, 2015).

Case Studies

Wento et al., (2019) studied relationship between autophagy and phytohormones which still remains poorly understood. Advances in the crosstalk between them upon various environmental stimuli. they also discuss how autophagy coordinates the phytohormones to regulate plant growth and development. Here propose that unraveling the regulatory role(s) of autophagy in modulating the homeostasis of phytohormones would benefit crop breeding and improvement under variable environments, in particular under suboptimal conditions.

According to Khan and Hemalatha (2015) autophagy is an evolutionary conserved pathway of vacuolar degradation of cytoplasmic constituents. The characteristic feature of the pathway is double membrane bound autophagosome which transfer the damaged and excessive cell components to the lysosome or vacuoles for degradation and recycling. Autophagy allows the cell to survive under nutrient starvation and various biotic and abiotic stresses. The molecular mechanism of autophagy has been studied in yeast to mammals and also in plants. Many Experimental results suggested that the basic molecular mechanism and pathways are conserved in yeast, mammals and plants to a large extent. This review highlights basic molecular autophagy and its role in defense mechanism and programmed cell death in plants.

Wen, X. and Klionsky, D.J., (2013) macroautophagy is an evolutionarily conserved dynamic pathway that functions primarily in a degradative manner. A basal level of macroautophagy occurs constitutively, but this process can be further induced in response to various types of stress including starvation, hypoxia and hormonal stimuli. The general principle behind macroautophagy is that cytoplasmic contents can be sequestered within a transient double-membrane organelle, an autophagosome, which subsequently fuses with a lysosome or vacuole (in mammals, or yeast and plants, respectively), allowing degradation of the cargo followed by recycling of the resulting macromolecules.

Mallikarjun (2012) developed the system which produces modified complexes Atg8-PE and Atg5-Atg12-Atg16 as autophagy regulators. Autophagy is activated in response to diverse stress and physiological conditions. For example, food deprivation, hyperthermia, and hypoxia are mediated by factors like insulin/IGF-1, m-TOR signaling, FOXO transcription factors, and chaperones. The perturbance in autophagy may lead to several types of cancers, myopathies, and neuromuscular disorders. Several autophagy inducers and inhibitors like 3-methyladenine (3-MA), bafilomycin A1, LY294002 (LY), and Velcade have been used to treat disease is an intense field of study.

Future Perspectives of Autophagy in Plants

Autophagy is poorly understood and no suitable molecular markers are available to trace when and where autophagy is induced in plants. Only a few autophagy and related mutants have been identified in plants. Approaches and methods for analysing autophagy reported in the literature are not always appropriate. The succeeding are key topics for future research into plant autophagy viz., crosstalk between autophagy and photosynthesis, transcriptional and post-transcriptional regulation, the lipid composition of autophagosomal membranes, and the way lipids are mobilized, delivered and assembled within them, mechanisms and physiological roles of granulophagy and ribophagy in plants, the potential roles for autophagic receptors of ubiquitinated targets in ubiquitin-dependent endosomal trafficking, mechanisms and directionality of autophagosome trafficking, the selectivity of bulk autophagy, the role of selective autophagy in nutrient acquisition by host-adapted pathogens, the role of autophagy in cell remodelling during cell differentiation, manipulation of autophagy for better nutrient management at the whole-plant level, regulation of autophagy by sink-strength demand, metabolic checkpoints in autophagy regulation in source and sink tissues, non-invasive monitoring of autophagic flux in planta and development of drugs to manipulate plant-specific autophagy.

Conclusion

Autophagy plays important role in defense to limit the pathogen spread and infection: The production of ROS is enhanced by autophagy to prevent death and to increase the survival. Autophagy is a conserved mechanism in yeast, plants, animals and humans. Further research is needed to identify the target of the pathogens and interaction of autophagy genes with the targets. By identifying the targets, inhibitors can be designed to increase immunity and disease resistance in plants. The critical roles played by the genes involved in autophagy can be identified by functional and comparative genomics. Considering its importance in development and stress responses, plant immunity, autophagy is a promising target to manipulate for agricultural benefits like higher crop yield. Expression related autophagy genes may be valuable in agricultural applications, as this can confer a number of benefits to plants, including enhanced crop growth, higher crop yield, increased stress tolerance and defense response against pathogen attack.

References

1. Floyd, B.E., Pu,Y., Soto-Burgos, J. and Bassham, D.C., (2015). To live or die: autophagy in plants. Springer, Switzerland, 269-300, DOI: 10.1007/978-3-319-21033-9-11.
2. Khan M. S. and Hemalatha S., (2015). Autophagy: Molecular Insight and Role in Plant Programmed Cell Death and Defense Mechanism. International Research Journal of Biological Sciences, Vol. 4(2), 78-83.
3. Mallikarjun Badadi (2012). Autophagy Mechanism, Regulation, Functions, and Disorders. International Scholarly Research Network, ISRN Cell Biology, Volume 2012, Article ID 927064, 11 pages doi:10.5402/2012/927064.
4. Ryabovol, V.V. and Minibayeva, F, V, (2016). Molecular mechanism of autophagy in plants: Role of ATG8 proteins in formation and functioning of autophagosomes. Biochemistry, 81(4):348-363.
5. Wentao Gou, Xi Li, Shaoying Guo, Yunfeng Liu, Faqiang Li, and Qingjun Xie, (2019). Autophagy in Plant: A New Orchestrator in the Regulation of the Phytohormones Homeostasis. Int. J. Mol. Sci., (12) 2900; doi: 10.3390/ijms20122900.
6. Wen, X. and Klionsky, D.J., (2016). An overview of macroautophagy in yeast. J. Mol. Biol. ;428 (9 Pt A):1681-99, doi: 10.1016/j.jmb.2016.02.021. Epub 2016 Feb 22.

A Brief History of Grapevine Phylloxera and its Control

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Introduction

Grapevine phylloxera, *Phylloxera vitifoliae* (Phylloxeridae: Hemiptera) is a very small, pale yellow colored sap-sucking insect native to North America, infesting commercial grapevines worldwide. Damage is caused by both nymphs and adults by feeding on the leaves and roots. As a result, the vine becomes prone to secondary fungal infections. In leaves, small galls of about the size of half a pea develop on the leaf surface which in severe form can cover the entire leaf whereas, in roots, numerous knots or galls are formed with rotting of roots. Leaf galls do not cause significant losses in grape production but in severe infestation do cause distortion and dropping of affected leaves late in the season. Whereas, root galls decrease the vigor of the vines and susceptible vines may result within 3-10 years.

Fig. 1 Damage symptoms caused by grapevine phylloxera a) leaf galls, b) root galls

American Vines

American vines namely, *Vitis labrusca*, *aestivalis*, *rupestris* and *riparia* have evolved resistance against phylloxera by several natural defenses such as exudation of sticky sap from roots that repels the nymph by clogging its mouth when it tries to feed on the vine. If the nymph creates a feeding wound on the root, then the vine forms a protective layer of tissue to cover the wound and protect it from secondary infections. In American vines, damage symptoms were more in leaves.

Phylloxera Epidemic in Europe

During the mid-19th century, the pest destroyed most of the vineyards of wine grapes in Europe, especially in France. European experimented with American vines and plants in their soil, for that purpose many varieties were imported from America to Europe without any regulation, disregarding the possibility of pest transfer and related problems. In 1850, some botanists in Victorian England collected specimens of American vines to Europe. Phylloxera was native to America, so varieties there were resistant or partially resistant to its attack but in Europe, wine grapes like Vitis vinifera were susceptible to the insect due to which epidemic devastated vineyards in Britain and spread to different parts of Europe. In 1863, vines began to deteriorate in some southern regions of France. Total wine production also fell due to its attack in France.

Control of Phylloxera

Many growers attempted different methods for its control like the use of live toads under each vine, chemical application, allowed poultry to roam free in the hope that they would eat the insect but none of these methods were successful. Research was carried to find the major solutions for the phylloxera control and two solutions emerged given hereunder:

1. Hybridization: It involved the breeding of European vines with resistant American species. The cross intended to develop a hybrid that was resistant to phylloxera but the produced vine didn't taste like American grapes. However, these hybrids never gained popularity over the traditional ones. In Europe, they were banned and discouraged from use, due to the quality of the vine.

2. Grafting with resistant rootstock: Charles Valentine Riley discovered American grape varieties that were resistant to phylloxera. Gaston Bazille proposed grafting traditional French vines onto American rootstock. Grafting involved the use of *V. vinifera* as scion onto the roots of a resistant rootstock *V. aestivalis* or other species native to America.

Summary

Grapevine phylloxera poses a substantial threat to any vineyard not planted with grafted rootstock. Grafting with resistant rootstock is the most preferred method for the control of phylloxera as rootstock does not interfere with the development of the wine grapes and provides control against this pest.

References

1. https://en.m.wikipedia.org/wiki/Great_French_Wine_Blight.
2. https://en.m.wikipedia.org/wiki/Phylloxera.
3. Jeffrey, G., Walker, M. A., Kocsis, L. and Omer, A. D., (2001). Biology and management of grape phylloxera. Annual review of Entomology, 46:387-412.
4. Riley, C.V., (1870). The grape-leaf gall-louse (Phylloxera vitifoliae Fitch). The American Entomologist and Botanist, 2(12):353-359.

Popularization of Pulse Production for Ensuring Nutritional and Food Security

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Abstract

According to United Nations Report (2004) the population of the world is estimated to reach 8.9 billion by 2050. Therefore, food and nutritional security with changing climatic scenario along with increasing population becomes a challenge. One of the potential solutions of these issues is by diversification of crops in global cropping pattern and by promoting legume crops, commonly called as Pulses. More than ten pulse crops are grown in different parts of India. Among them, chickpea (gram or chana), pigeon pea (tur), mung bean (green gram or moong), urd bean (black gram or mash), lentil (masoor) and field pea (matar) are most common ones. Soybean and groundnut are important oilseed legumes for fulfilling global vegetable oil requirement and are also used as protein supplements. Pulses in general are nutritionally enriched as they have high protein content, as compared to staple cereals. The growth rate of pulse production (2.61%) during last one decade was even higher than the growth rate of cereals like rice (1.59%), wheat (1.89%). This has also had a direct influence on per capita availability of pulses (39.4 g/capita/day from the earlier 36 g/capita/day). Farmers are still reluctant to grow pulse crops despite several benefits, this is due to lack of availability of quality seeds, lack of awareness. Therefore, training and other awareness activities should be organized, for increasing adoption of improved cultivars and technologies by farmers.

Introduction

Protein Calorie Malnutrition (PCM) is a global concern especially in infants, young children and nursing mothers. The protein content of legumes is considerably higher (20-36.0%; Gowda et al., 2014) in comparison to major cereals (6.0-15.0%; Champagne et al., 2004; Shewry 1993). The protein content of important grain legumes is: pigeon pea [21.7g/100g], chickpea [19.3g/100g], lentil [25.8g/100g], bean [23.4g/100g], cowpea [24g/100g] and, soybean [36.5g/100g] (USDA 2013). Pulses are a good source of minerals but in India, these are largely cultivated under energy starved conditions, mostly on marginal and sub-marginal land and more than three-fourth of the area under pulses is still rainfed resulting in poor crop productivity (Choudhary, 2013). Minerals are important in human metabolism and their deficiencies are often associated with some human diseases or disorders such as cardiovascular disease (CVD), diabetes, cancer, and neurodegenerative disorders (Cabrera et al. 2003). Pulses are a good source of vitamin B, folic acid, and tocopherol (Gowda et al., 2014). Additionally, legumes like chickpea and bean also provide β-carotene and Vitamin-K.

In addition to their nutritional content, there are several reasons for adopting legume cultivation. Some of them are:

1. They are suitable for human as well as livestock consumption, ease in adaptability for inter- or mixed cropping, agronomic management of legumes is relatively easy.
2. Legumes can grow profitability even in poor soil condition, nitrogen requirement is lower compared to other crops.

Legume cultivation has several benefits still farmers do not prefer to grow them due to slow adoption of improved cultivars and production technologies by farmers due to unawareness of farmers about improved cultivars and technologies or unavailability of seeds and other required inputs. Various schemes like National Food Security Mission (NFSM), Rashtriya Krishi VikasYojana (RKVY), and accelerated pulses production program (A3P) etc. are launched by the central government to promote pulses cultivation. In order to ensure self-sufficiency, the requirement for pulses in the country is projected at 39 million tonnes by the year 2050; at an annual growth rate of 2.2%, a change in research and developmental strategies, beside good policy support from the government is required.

Future Strategies for Increasing Productivity and Production of Major Pulse Crops

1. Chickpea: Chickpea (*Cicer arietinum*) has always been the most important pulse crop of India and its global importance has increased considerably during the past three decades. During 2013, 89.20% of the chickpea area and 84.47% of production was in Asia, 3.57% and 4.05% in Africa, 4.24% and 6.22% in Oceania, 2.44% and 4.55% in Americas and 0.55% and 0.71% in Europe (FAOSTAT 2015).

The chickpea area has reduced drastically (about 4.0 million ha) in northern India because the existing varieties are not responsive to high input conditions and tend to show excessive vegetative growth and lodging when grown in fertile alluvial and black soil and receive rains or irrigations during crop growth. The chickpea crop can be made more profitable and competitive by developing chickpea varieties which are non-lodging and responsive to high input conditions.

This will require long-term investment in research on restructuring the plant type. There is a need to develop super early chickpea varieties with acceptable seed size, resistance to fusarium wilt, tolerance to cold and heat tolerance at reproductive phase and should harvested in 60-70 days for green pods. The farmers are demanding chickpea cultivars which can be directly harvested by combine harvesters. The current chickpea cultivars are not suited to mechanical harvesting because the plant height is not adequate and the branches are close to ground due to semi-spreading growth habit.

Development of chickpea cultivars with 30 to 40% more height compared to the present cultivars with semi-erect to erect growth habit is essential for mechanical harvesting. Chickpea is the most consumed pulse crop of India and it contains high protein content (20-22%). Though wide variation has been observed for protein content (14 to 30%) in chickpea germplasm, no efforts have been made to breed for high protein varieties.

The high protein germplasm accessions already identified can be exploited for development of high protein varieties. An improvement in the protein content by 20-25% appears feasible. The high protein chickpea cultivars will improve protein availability to the people by 20 to 25% from the same amount of chickpea consumed.

2. Pigeon pea: Pigeon pea is an important grain legume mostly being cultivated in Africa, Asia and Americas. Pigeon pea is mostly consumed as dry split dal besides several other uses of various parts of pigeon pea plant. It is an excellent source of protein (20-22%), supplementing energy rich cereal diets in a mainly vegetarian population. In addition to food, it can be used as fodder, feed, fuel, functional utility (for making baskets, huts, fences, etc.), fertilizer (fixes atmospheric nitrogen and releases phosphorus), forest use (reforestation, lac production), and even for pharmaceutical purposes.


Pigeon pea like most other grain legume crops has lost genetic variability during the process of its domestication. Systematic studies to rebuild the plant type to improve the genetic yield potential of pigeon pea are very limited. In view of above, the following strategies are needed for genetic enhancement in the crop such as development of varieties or hybrids tolerant to wilt, SMD, pod borer and *Phytophthora*, development of extra-short duration genotypes (< 120 days maturity) to different cropping systems in north western plain zone. The existing seed delivery system of pigeon pea constrains the technology adoption.

Incorporation of preferred traits in the pigeon pea crop improvement programs will foster adoption. There is, therefore, no option but to concentrate on increasing the yield potential of pigeon pea by evolving such varieties of pigeon pea that are high yielding and resistant to drought conditions, pests and diseases and are of short duration with bigger sized grains and higher recovery percentage accompanied by less wastage. Incorporation of these preferred traits would not only foster adoption at a faster rate but would also increase their marketability.

3. Lentil: Lentil *(Lens culinaris)* is one of the most nutritious amongst cool season legumes, grown throughout the northern and central India for grains, which are used as dal (whole or dehulled) and in various other preparations. Lentil seeds contain 25% protein, 0.7% fat, 2.1% mineral, 0.7% fiber and 59% carbohydrate. Lentil is mainly grown under harsh environmental conditions, and realization of yield potential depends on the stored moisture from the previous rainy season and rainfall during crop growth. There is an urgent need to develop climate smart varieties for rainfed conditions and suitable for late sown areas.

Table: Pulse cultivars suitable for rainfed agro–ecosystems (Source: Bana et al., 2014):

Crop	Variety
Pigeonpea	Pusa Ageti, Sharda, ICPL 87, Pusa 991, T 21
Mothbean	Maru Moth 1, Jadia, Jwala, AKMO 33, AKMO 35, Moth 880, RMO 40, Maru Bahar
Clusterbean	Durgapura Safed, FS 277, Maru guar, HG 75, Navin, RGC-1017, RGC-936, RGC-1003
Chickpea	Ujjain 21, G 24, G 130, Phule G 5, K 850, Vijay, RSG 4, RSG 936, Pant G 114, Pusa 1053, Pusa 256, Pusa 372, Pusa 362

Promotion of Pulses in Intercropping Systems and Non-Traditional Areas

Pulse crops are grown as intercrops in many parts of the country during all three crop seasons (rabi, kharif and spring/summer) and forms integral part of rainfed agriculture. Vast potential exists for promotion of pulse crops in intercropping system as an intercrop. For example, chickpea/ lentil + autumn planted sugarcane in western Uttar Pradesh, Terai region of Uttar Pradesh, Maharashtra and Karnataka; mungbean + long/medium duration pigeonpea in Uttar Pradesh, Bihar, Jharkhand, Madhya Pradesh, Maharashtra and Gujarat; chickpea/lentil + mustard in Rajasthan, southern Madhya Pradesh and Uttar Pradesh; pigeonpea + soybean; and pigeonpea + sorghum etc. Substitution of upland crops like rice, sorghum, maize, pearl-millet and diverting these areas to short duration pulses in eastern and southern states will be beneficial.

Technological and Extension Yield Gaps in Pulses Production

In order to boost pulse production in India, farm scientists have generated state of art technologies right from varietal development to crop and resource management technologies. Now, main emphasis should be on technology transfer mechanism for adoption of pulse production technologies in India (Badiyala et al., 2012). This sector is being given more and more attention by the Government of India. But, still there are many gaps in the technology generated by the research institutions and what has actually reached on farmers' fields (Paul et al., 2011). Introduction of HYVs' embedded demonstration followed by intensive awareness campaign besides creation of better irrigation infrastructure eventually may also lead to higher technology adoption in pulses among Indian farmers.

Conclusion

Pulses are playing a vital role in ensuring the food and nutritional security in India. However, there is a huge gap in supply and demand of many pulse crops. There is a huge potential for substantially enhancing production of pulses in India, primarily by increasing productivity and to some extent increasing area. A large gap exists between the average yields received by farmers and the yields obtained in research stations and well managed farmers' fields. The adoption of high yielding cultivars/hybrids and improved crop management practices can increase the yield substantially. There is also a scope of enhancing area in the rice-fallows of eastern India (and possibly other rice-fallow areas, and also in the hilly areas where some of the improved extra- short and short-duration varieties.

References

1. Badiyala D, Shekher J, Sharma S K, Singh R and Choudhary A K. 2012. Agronomic research in hills with special reference to Himachal Pradesh – An overview. Indian Journal of Agronomy 57 (3rd IAC Special issue): 168–74.
2. Bana R S, Pooniya V, Choudhary A K and Rana K S. 2014. Agronomic interventions for sustainability of major cropping systems of India. Technical Bulletin (ICN: 137/2014), Indian Agricultural Research Institute, New Delhi, p 34.
3. Cabrera C, Lloris F, Giménez R, Olalla M, López MC (2003) Mineral content in legumes and nuts: contribution to the Spanish dietary intake. The Science of the Total Environment 308:1-14.
4. Champagne ET, Wood DF, Juliano BO, Bechtel DB (2004) The rice grain and its gross composition. In: ET Champagne (ed), Rice:Chemistry and Technology, 3rd (ed.). AACC, St. Paul, MN, pp. 77-107.
5. FAOSTAT (2015) http://faostat.fao.org/site/339/default.aspxChoudhary A K, Thakur S K and Suri V K. 2013. Technology transfer model on integrated nutrient management technology for sustainable crop production in high value cash crops and vegetables in NW Himalayas. Communications in Soil Science and Plant Analysis 44 (11): 1 684–99.
6. Gowda CLL, Jukanti AK, Gaur PM (2014) Contribution of grain legumes in combating food and nutrition in-security in different regions of the world. In: The basics of human civilization - food, agriculture and humanity (Vol- II). PNASF, Bangalore, India, pp. 469-500.
7. Paul J, Suri V K, Sandal S K and Choudhary A K. 2011. Evaluation of targeted yield precision model for soybean and toria crops on farmers' fields under sub-humid sub-tropical North-Western Himalayas. Communications in Soil Science and Plant Analysis 42 (20): 2 452–60.
8. Shewry PR (1993) Barley seed proteins. In: AW MacGregor and Bhatty RS (eds), Barley: Chemistry and Technology. AACC, St. Paul, MN, pp. 131–197.

Baby Corn: A Crop with Immense Importance

Article ID: 10206

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Abstract
In India, yield obtained by cultivation of maize is very poor in comparison to average yield of the world. More than 80% of maize is cultivated under rainfed conditions. These low yields can be due to moisture stress faced by maize crop at its critical stages of growth that are flowering and grain formation. This problem can be solved by adopting cultivation of baby corn. Baby corn are the cobs that are harvested within 3 to 5 days after flowering and are not allowed to fertilize and set seed. Baby corn can be produced from both common sweet corn and field corn. However, field corn varieties are more economical due to their lower seed cost. Higher amount of water is consumed during baby corn cultivation. Indian farmers face a serious issue as they are not able to match water consumption and water availability rate for the production of baby corn. Baby corn cultivation provides avenues for crop diversification, value addition and increases income generation possibilities.

Introduction
Baby corn is dual purpose crop grown round the year in India (Singh et al. 2015). Baby corn cultivation practices or methods are similar to regular commercial maize cultivation practices. The only difference is the harvesting period or duration of the crop. Baby corn crop duration is about 2 months whereas regular corn/maize crop duration is 4 months. Among all other cultural operations, detasseling is a major operation for baby corn production to ensure better quality (Moreira et al. 2010). Detasseling has to be done usually around 40 to 45 days as and when tassels start emerging. In India, Baby corn consumed as fresh vegetable in curries, pickles, pulav, soups, salads and snacks. Baby corn is rich in fibre and phosphorus. This vegetable is low in calories and free cholesterol. It is nutrient-rich and good source of vitamins and minerals having low glycaemic index than regular corn. Hence good for controlling blood sugar levels. Baby corn is free from insect-pests and diseases and its nutritional value is comparable with other vegetables available at high price (Pandey et al. 2000). Farmers can increase their income within a short period of time by cultivating baby corn. Factors affecting optimum production of baby corn are poor germination, scanty rainfall and slow growth in winter season. In order to deal with these, farmers should be made aware about the improved cultivation technologies of baby corn.

Field Preparation and Sowing
The field is ploughed to fine tilth with the help of a tractor by mold board plough, disc plough, a cultivator and a rotavator, and form wide ridges and furrows. Sowing should be done on the side of ridges. Spacing of 60 cm x 15-20 cm row to row and plant to plant should be maintained depending upon the plant type that are spreading or erect. 2-3 seeds should be dibbled in these furrows at each hill. The optimum depth of sowing is 7-8 cm in and 4-5 cm in kharif and rabi respectively. The optimum planting depth for sweet corns is 3-4 cm. The optimum seed rate is 22-25 kg/ha. The optimum plant density for baby corn varies from 1,25,000 to 1,43,000 plants/ha. A total of 83,334 plants can be accommodated in 1-hectare field. One popular variety of baby corn is HM-4.

Time of Sowing
Sowing time varies from February to November in North India. Baby corn can be sown any time round the year under irrigation as there is no necessity for pollination and seed setting. It faces problems like poor germination when temperature is low in December-January, therefore a nursery is raised under protected structure. For raising of raising, cocopeat, vermiculite, perlite and vermicompost are mixed in the ratio of 3:2:1:6 and filled in plastic plug-trays, and sowing is done as single seed per cavity. The seedlings are ready for transplanting after

20-30 days after sowing. Generally, planting of baby corn from August to November gives the best quality baby corn.

Drip Irrigation

Baby corn can be grown year the round that is three crops continuously in a year under drip irrigation system. The drip irrigation system consists of a head work including a hydrocyclone filter, a sand media filter with a back flush mechanism, main lines (PVC pipes of 60 mm diameter with a pressure of 2 6 kg/cm), sub-main lines (PVC pipes of 40 mm diameter with a 2 pressure of 6 kg/cm), laterals, drippers, pressure gauges, pressure release valves and flush valves etc. The system ensures a uniform moisture distribution pattern both under surface and sub-surface.

Manures and Fertilizers

Fertilizer requirement of baby corn are Farm yard manure (FYM) at the rate of 12.5 tonnes, nitrogen 150 kg, phosphorous 60 kg, potassium 60 kg and zinc sulphate 25 kg/ha.

Water Requirement

The water requirement of baby corn ranged from 0.1 to 3.4, 1.2 to 8.2 and 0.6 to 5.5 mm/day from the early stage to the peak demand period during October - February, April - July and August November, respectively.

Weed Management

Broad leaf weeds and most of the grasses can be controlled by pre-emergence herbicide, atrazine @ 1.0- 1.5 kg/ha in 500-600 liters of water. Generally, two hoeing are recommended for aeration and uprooting of the weeds. Farmers doing hoeing should move backward in order to avoid compaction of soil and to facilitate better aeration.

Plant Protection Measures

Stem borer can be controlled by spraying profenophos @ 2 ml/litre at 35 DAS. Stem borer (*Chilo partellus*), Pink borer (*Sesamia inferens*) and Sorghum shoot fly (*Atherigona spp.*) are serious disease problems. Stem borer can be controlled by spraying of carbaryl 1 to 2 times after 10 and 20 days of germination. Spraying should be done in the central whorl of the plant. The first spray consists of 500 gm carbaryl in 500 litres of water applied in the central whorl of the plant. The second spray consisting of 750 g carbaryl in 700-800 litre water should be applied if required. Baby corn ears are tightly wrapped inside the husk, which helps in protecting them from pest attack. Disease problems in baby corn include Stewart's wilt, leaf blight, rust and viruses.

Detasseling

Baby corn is an unfertilized small cob. So, in order to avoid pollination, it is very important to remove male inflorescence soon after its emergence. The crop should be under close observation for the removal of male inflorescence (tassel) as soon as it emerges from the flag leaf. The removal of tassels is commenced from 47 days onwards and continued till all the tassels have emerged. It should be practiced row-wise. It should be removed in such a way that it should not cause any damage to the plant. The male inflorescence can be fed to cattle, as it is rich in nutrients.

Harvesting and Storage

Baby corn is harvested using hand 2 to 3 days after silk emergence, while the ears are still immature. The ideal ear size is 5 to 10 cm in length and 0.8 to 1.7 cm in diameter, and the desired colour is golden yellow. After 8 or 10 days of first harvest, second and third cobs will be ready for harvesting. The harvest period lasts for 2 to 4 weeks. For baby corn as a primary crop, all ears are harvested. A single planting may be harvested 9–12 times over a period of 3–4 weeks (Miles and Shaffner, 1999 and Bar-Zur and Saadi, 1990).

Yield

The yield depends on the potential of genotypes and climatic conditions. In a good crop, on an average, 5.5-11.4 t/ha husked baby corn or 1.1-1.9 t/ha de-husked baby corn can be harvested. Green fodder yield is about 15 - 40 t/ha, which gives additional income to the growers. All the growth parameters and yield of baby corn were recorded highest under biweekly fertigation frequency. The highest yield of cob (13.25 t/ha), baby corn (2.25 t/ha) and fodder (63.33 t/ha) were recorded in biweekly fertigation schedule at a system operating pressure of 1.0 kg /cm.

Economic Analysis of Baby Corn Cultivation

The benefit-cost ratio of baby corn cultivation for the consecutive three crop seasons in a year was estimated. High values of benefit-cost ratio of 3.04, 3.68 and 1.86 were estimated (if the sale price of baby corn is Rs.100/kg and green fodder is Rs.1/kg) under biweekly fertigation for crops grown during October-February, April-July and August-November, respectively. The payback period refers to the recovery period for the amount spent in purchase and installation of drip irrigation system. The minimum payback period (0.58 year) was estimated under biweekly fertigation frequency during April to July. It is recommended that biweekly fertigation will give more yield, good quality produce, higher water use efficiency and good economic return with minimum payback period for baby corn cultivation.

References

1. Bar-Zur, A. and Saadi, H. 1990. Prolific maize hybrids for baby corn. Journal of Horticultural Science, 65(1):97-100.
2. Miles, C. and Shaffner, O. 1999. Baby Corn Research Report. Washington State University Cooperative Extension, Lewis County. pp. 8.
3. Moreira, J.N., Silva, P.S.L., Silva, K.M.B., Dombroski, J.L.D. and Castro, R.S. 2010. Effect of detasseling on baby corn, green ear and grain yield of two maize hybrids. Horticultura Brasileira, 28: 406-411.
4. Pandey, A.K., Parkash, V., Mani, V.P. and Singh, R.D. 2000. Effect of rate of nitrogen and time of application on yield and economics of baby corn (Zea mays). Indian Journal of Agronomy, 45: 338-343.

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Forensic Entomology: Insects in Crime Investigation

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Forensic Entomology

Forensic entomology is the scientific study of the invasion of the succession pattern of arthropods with their developmental stages of different species found on the decomposed cadavers during legal investigations. It is the application and study of insect and other arthropod biology to criminal matters. It also involves the application of the study of arthropods, including insects, arachnids, centipedes, millipedes, and crustaceans to criminal or legal cases. It is primarily associated with death investigations; however, it may also be used to detect drugs and poisons, determine the location of an incident, and find the presence and time of the infliction of wounds.

History

Historically, there have been several accounts of applications for, and experimentation with, forensic entomology. The concept of forensic entomology dates back to at least the 13th century. However, only in the last 30 years has forensic entomology been systematically explored as a feasible source for evidence in criminal investigations.

Hermann Reinhard

The first systematic study in forensic entomology was conducted in 1881 by Hermann Reinhard, a German medical doctor who played a vital role in the history of forensic entomology. He exhumed many bodies and demonstrated that the development of many different types of insect species could be tied to buried bodies. Reinhard conducted his first study in east Germany, and collected many Phorid flies from this initial study. He also concluded that the development of only some of the insects living with corpses underground were associated with them, since there were 15-year-old beetles who had little direct contact with them. Reinhard's works and studies were used extensively in further forensic entomology studies.

Jean Pierre Mégnin

French veterinarian and entomologist Jean Pierre Mégnin (1828–1905), published many articles and books on various subjects including the books *Faune des Tombeaux* and *La Faune des Cadavres*, which are considered to be among the most important forensic entomology books in history. In his second book he did revolutionary work on the theory of predictable waves, or successions of insects onto corpses. By counting numbers of live and dead mites that developed every 15 days and comparing this with his initial count on the infant, he was able to estimate how long that infant was dead.

Different Insects Orders Studied in Forensic Entomology

1. Flies: Flies (order Diptera) are often first on the scene. They prefer a moist corpse for their offspring (maggots) to feed on. The most significant types of fly include:

a. Blow flies – Family Calliphoridae: Flies in this family are often metallic in appearance and between 10 and 14 mm in length. In addition to the name blow-fly, some members of this family are known as blue bottle fly, cluster flies, greenbottles, or black blowfly. A characteristic of the blow-fly is its 3-segmented antennae. Hatching from an egg to the first larval stage takes from eight hours to one day. Larvae have three stages of development (called instars); each stage is separated by a molting event. Worldwide, there are 1100 known species of blowflies, with 228 species in the Neotropics, and a large number of species in Africa and Southern Europe. The most common area to find Calliphoridae species are in the countries of India, Japan, Central America, and in the southern United States. The typical habitat for blow-flies are temperate to tropical areas that provide a layer of loose, damp soil and litter where larvae may thrive and pupate. The forensic importance of this fly is that it is the first insect to come in contact with carrion because they have the ability to smell death from up to ten miles (16 km) away. Some prominent species of Calliphoridae are *Calliphora vomitoria* and *Calliphora vicina.*

b. Flesh flies – Family Sarcophagidae: Most flesh flies breed in carrion, dung, garbage, or decaying material, but a few species lay their eggs in the open wounds of mammals; hence their common name. Characteristics of the flesh-fly is its 3-segmented antennae. Most holarctic Sarcophagidae vary in size from 4 to 18 mm in length (Tropical species can be larger) with black and gray longitudinal stripes on the thorax and checkering on the abdomen. Flesh-flies, being viviparous, frequently give birth to live young on corpses of human and other animals, at any stage of decomposition, from newly dead through to bloated or decaying (though the latter is more common). Sarcophaga barbata are specifically useful since they deposit maggots directly onto the decomposing body, their larger, visible size, and difference in activity during different stages. Their main limitation, however, is due to lack of information surrounding their geographic distribution and taxonomic features.

c. House fly – Family Muscidae: is the most common of all flies found in homes, and indeed one of the most widely distributed insects; it is often considered a pest that can carry serious diseases. The adults are 6–9 mm long. Their thorax is gray, with four longitudinal dark lines on the back. The underside of their abdomen is yellow, and their whole body is covered with hair. Each female fly can lay up to 500 eggs in several batches of about 75 to 150 eggs. Genus *Hydrotaea* are of particular forensic importance.

d. Cheese flies – Family Piophilidae: Most are scavengers in animal products and fungi. The best-known member of the family is *Piophila casei*. It is a small fly, about four mm (1/6 inch) long, found worldwide. This fly's larva infests cured meats, smoked fish, cheeses, and decaying animals and is sometimes called the cheese skipper for its leaping ability. Forensic entomology uses the presence of Piophila casei larvae to help estimate the date of death for human remains. They do not take up residence in a corpse until three to six months after death. The adult fly's body is black, blue-black, or bronze, with some yellow on the head, antennae, and legs. The wings are faintly iridescent and lie flat upon the fly's abdomen when at rest. At four mm (1/6 inch) long, the fly is one-third to one-half as long as the common housefly.

e. Coffin flies – Phoridae.

f. Lesser corpse flies – Sphaeroceridae.

g. Lesser house flies – Fanniidae

h. Black scavenger flies – Sepsidae

i. Sun flies - Heleomyzidae

j. Black soldier fly - Stratiomyidae: have potential for use in forensic entomology. The larvae are common scavengers in compost heaps, are found in association with carrion, can be destructive pests in honey bee hives, and are used in manure management (for both house fly control and reduction in manure volume). The larvae range in size from 1/8 to 3/4 of an inch (3 to 19 millimetres). The adult fly is a mimic, very close in size, color, and appearance to the organ pipe mud dauber wasp and its relatives.

k. Phorida-Humpbacked flies: Larvae feed on decaying bodies. Some species can burrow to a depth of 50 cm over 4 days. Important in buried bodies.

l. Non-biting midges - Chironomidae: These flies have a complex life cycle. While adults are terrestrial and phytophagous, larvae are aquatic and detritivores. Immature instars have been used as forensic markers in several cases where submerged corpses were found.

2. Beetles: Beetles (Order Coleoptera) are generally found on the corpse when it is more decomposed In drier conditions, the beetles can be replaced by moth flies (Psychodidae).

a. Rove beetles – family Staphylinidae: These are elongate beetles with small elytra (wing covers) and large jaws. Like other beetles inhabiting carrion, they have fast larval development with only three larval stages. Creophilus species are common predators of carrion, and since they are large, are a very visible component of the fauna of corpses. Some adult Staphylinidae are early visitors to a corpse, feeding on larvae of all species of fly, including the later predatory fly larvae. They lay their eggs in the corpse, and the emerging larvae are also predators. Some species have a long development time in the egg, and are common only during the later stages of decomposition. Staphylinids can also tear open the pupal cases of flies, to sustain themselves at a corpse for long periods.

b. Hister beetles – family Histeridae: Adult histerids are usually shiny beetles (black or metallic-green) which have an introverted head. The carrion-feeding species only become active at night when they enter the maggot-infested part of the corpse to capture and devour their maggot prey. During daylight they hide under the corpse unless it is sufficiently decayed to enable them to hide inside it. They have fast larval development with only two larval stages. Among the first beetles to arrive at a corpse are Histeridae of the genus *Saprinus*. *Saprinus* adults feed on both the larvae and pupae of blowflies, although some have a preference for fresh pupae. The adults lay their eggs in the corpse, inhabiting it in the later stages of decay.

c. Carrion beetles – family Silphidae: Adult Silphidae have an average size of about 12 mm. They are also referred to as burying beetles because they dig and bury small carcasses underground. Both parents tend to their young and exhibit communal breeding. The male carrion beetle's job in care is to provide protection for the breed and carcass from competitors.

d. Skin/hide beetles – family Dermestidae: Hide beetles are important in the final stages of decomposition of a carcass. The adults and larvae feed on the dried skin, tendons and bone left by fly larvae. Hide beetles are the only beetle with the enzymes necessary for breaking down keratin, a protein component of hair.

e. Scarab beetles – family Scarabaeidae: Scarab beetles may be any one of around 30,000 beetle species worldwide that are compact, heavy-bodied and oval in shape. The flattened plates, which each antenna terminates, are fitted together to form a club. The outer edges of the front legs may also be toothed or scalloped. Scarab beetles range from 0.2 to 4.8 in (5.1 to 121.9 mm) in length. These species are known for being one of the heaviest insect species.

f. Sap beetles – family Nitidulidae.

3. Mites: Many mites (class Acari, not insects) feed on corpses with *Macrocheles* mites common in the early stages of decomposition, while Tyroglyphidae and Oribatidae mites such as Rostrozetes feed on dry skin in the later stages of decomposition.

Nicrophorus beetles often carry on their bodies the mite *Poecilochirus* which feed on fly eggs. If they arrive at the corpse before any fly eggs hatch into maggots, the first eggs are eaten and maggot development is delayed. This may lead to incorrect PMI estimates. *Nicrophorus* beetles find the ammonia excretions of blowfly maggots toxic, and the *Poecilochirus* mites, by keeping the maggot population low, allow *Nicrophorus* to occupy the corpse.

References

1. Catts, E. P. and N. H. Haskell, eds. Entomology & Death: A Procedural Guide. Joyce's Print Shop, Inc. 1990. p5.
2. Whitworth, Terry (2006). "Keys to Genera and Species of Blow Flies of America North of Mexico". Proceedings of the Entomological Society of Washington. 108 (3): 710.
3. Pape, Thomas. Catalog of the Sarcophagidae of the World. Memoirs on Entomology. Gainesville, FL: Associated, 1996. 288-289.

Integrated Nutrient Management: The Desired Pillar of Agriculture

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Agriculture is the skeletal system of India, sharing a big shoulder in the Indian economy. Amid multiple challenges like hunger, malnutrition & food security, the sector continues to feed & provides bread & butter to 65% of the Indian population. The struggle that commenced as a means of survival then has now transformed into a significant economic activity, entrepreneurship, import & export, etc. world-wide. The economic status of Indian farmers is impoverished & this is one of the deadliest blows as farmers' poverty makes soil poor. Despite challenges& the high cost of fertilizers, the approach of Integrated nutrient management is a boon, it is a holistic determined approach that can turn the table, where solo components may prove to be less satisfying. The long-term use of chemical fertilizers is proving disastrous from an environmental point of view consequently causing health hazards to humans, society & N levels polluting underground water & also declining soil productivity. The health of the environment i.e., air, water, the soil is a menacing global concern today. The environmental & agriculture scientists are leaving no stones unturned to maintain the environment safe. To achieve bumper productivity & maintenance of soil fertility status the integrated nutrient concept seems to be the upper hand for a future run. The shift of equilibrium to INM can be the key to success for the world of agriculture.

The benefits of INM are pleasing, but the burgeoning population of the second populated nation already at 1.5 billion, simultaneously the area of land remaining the same has combinedly challenged the burden of feeding. The multiple Pros of INM have caught the attention of scientists, at the same time taking research & study to deeper levels, the combined impact of the parameters of INM provided satisfactory results from soil & crops point of view. The organic manure component of INM is a promise on account of its macro & micronutrient contents & ability to improve the physical, chemical & biological properties of soil. The highest plant nutrient uptake, availability & increase in plant growth parameters were found with combined organic & inorganic application (Babita Mishra et al 2019). Fertilizer is one of the imperative components though it can never be replaced because of its un-eco-friendly nature, other parameters can be used as a substitution for reducing the quantity of its application. The N fertilizer dose can be reduced by the application of biofertilizers like rhizobium on account of their capacity to fix atmospheric Nitrogen, also biofertilizers assist in improving dynamic soil fertility & productivity. The green revolution period had a higher demand for fertilizer as inputs to sustain high-yielding varieties, but taking into consideration the future picture of agriculture the concept of INM is in the lead. Two of the gravest concern of this era are climate change & the rising concentration of CO_2 at present 412 ppm, which was 280 ppm during pre-industrialization.

The agriculture sector to bears the blame on account of releasing greenhouse gases, several mitigation options have been suggested for croplands, as reviewed in Intergovernmental Panel on Climate Change, IPCC (Smith et al. 2007, 2014) e.g., nutrient management, tillage and residue management. The addition of 10% more crop residues increased C input to the soil and so enhanced SOC. The quality & availability of organic source plays a key role in storing carbon by manure. An increase in SOC content was noticed when manure was applied, as observed in the FYM plot (K Begum et al 2017). SOC sequestration and plant growth can be increased with practices amalgamating both organic & inorganic.

Extra attention to the macronutrients especially NPK, has pushed micronutrients to a corner that requires more observation. Micro-nutrients are equally important for human health from infants, pregnant women to adults.

Collaborative application of inorganic micronutrient sources with a combination of organic can give a solution to the micronutrient deficiencies, combined application than the solo application is always a better option. The use of micronutrient-rich organic sources can be a preferable choice in crop production. Nutrient use efficiencies can be increased, the ease of preparing organic sources in-situ has provided an extra benefit since decades in integrating with inorganics. The left-over residues of green manure crops used for a dual-purpose help to provide nutrients & decrease the dose of fertilizer application. Under irrigated conditions & regular application of RDF, productivity declined after an initial increase, the combined application of fertilizer & FYM sustained soil fertility & productivity (Katyal et al 2001). Integrated management of organics and chemical fertilizers in rice was found to be more viable for sustaining productivity and improving the efficiency of inorganic fertilizers (Kumar et al 2017). The INM execution improves physical, chemical & biological properties of soil & also minimizes nutrient losses.

To maintain the rank & status of India as a powerhouse in agriculture, The INM based on fertilizer, organics, legumes & biofertilizer can be the healthy choice for the agriculture community to maintain soil fertility &achieve a quality product, and also managing sustainable agriculture goals. In a nutshell, each & every human being on earth is directly or indirectly roofed under agriculture either to earn or live their life, despite the sector is challenged by multiple factors, so the need lies on the shoulder to manage & maintain the system of production to make all efforts to achieve higher productivity. To make the best use of INM, to protect the environment & earth scientists are leaving no stones unturned. Soil test crop responses approach, soil fertility evaluation, soil testing recommendation must be followed & executed, In the era of 21st century, to meet the increasing demand for food in a short time, to achieve more productivity can be the front runner to uplift the production status of agriculture today & till the end of time.

References

1. Babita Mishra, GS Sahu, P Tripathy, S Mohanty, B Pradhan (2019). Effect of integrated nutrient management (INM) on growth, yield, nutrient uptake & soil fertility in okra. Pusa A-4. J PharmacognPhytochem. 8(5):1011-1014.
2. K. Begum. M. Kuhnert. J. Yeluripati. M. Glendining. P. Smith (2017) Simulating soil carbon sequestration from long term fertilizer and manure additions under continuous wheat using the DailyDayCent model NutrCycl Agroecosystem 109:291–302.
3. Smith J, Smith P (2007) Environmental modeling: an introduction. Oxford University Press, New York.

Total Quality Management (TQM) of Fruit Crops

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In the changing global scenario, the making of horticultural enterprise more economically vibrant through total quality assurance is a resilient concept and approach as the enterprise is emerging as an avenue for nutritional security, poverty alleviation and employment generation. Nowadays, horticulture crop production has moved from rural confines to commercial ventures and has attracted youth since it has proved to be intellectually satisfying and economically rewarding. In such a growth-oriented situation, the horticultural enterprise is starting the journey in the global market with its table products and postharvest products after complying with the need of the domestic market. But the main issue with the export of the horticultural produce lies in the total quality assurance of the marketed surplus.

Quality, the degree of excellence or superiority, is a combination of attributes, properties or characteristics that give each commodity value in terms of its intended use. In the era of globalization and to uplift the status of the horticultural crop growers and exporters, the need of the hour is to manage the total quality during the production and marketing process of the horticultural produce. That can be obtained through introducing the culture of quality management within all the actors present in the production and marketing chain or value chain.

Improving crop quality is a challenge in the context of a global horticultural food supply, since the development of sustainable crop production systems inevitably affects many quality traits. Fruit and vegetable quality include size, visual attractiveness (color, shape), overall flavor (taste and texture), health benefits, shelf life, suitability for processing…etc.

At each step of the production chain, specific criteria prevail depending on the product's final destination, either the fresh market or the processing industry. These criteria are not necessarily the same throughout the chain, and likely interact during the product's life.

Thus, the management and improvement of postharvest quality requires the integration of knowledge from the field until purchase and consumption of the fresh or processed product. This e-collection collates state-of-the-art research outputs on the quality of fruits and vegetables from seed to fork, covering the underlying physiological processes, the genetic and environmental controls during plant and organ development and the postharvest evolution of quality during storage and processing.

What do you Mean by Quality?

1. Quality means a combination of characteristics, attributes and properties that gives the values to human and enjoyments.
2. Consumers consider good quality in relation to colour, flavour and nutrition.
3. The ultimate quality is the final manifestation of inter relation between the commodity and its environment.

Quality Management

Universally accepted definition for quality is many and depending on the industry it may be expressed in terms of its relevance (Sila and Ebrahimpour, 2003). Quality management evolved from a result-orientated quality control to an integrated company-wide approach (Mehra et al., 2001). Total Quality Management (TQM) is a holistic quality management approach that considers the entire value chain and emphasizes human factors (Welikala and Sohal, 2008).

Factor Affecting Total Quality Management of Fruit

1. Pre harvest factor.
2. Post-harvest factor.

Pre-Harvest Factor Affecting Quality of Fruit

1. Environmental aspects.
2. Cultural aspects.

Pre-Harvest Factors

The developing stage of fruits is subjected to many internal and external influences, which may modify its inherent anatomical, chemical, and physical characteristics and physiological behavior to some extent (Ladaniya, 2008). The genetic factors, agro techniques, biological control agents and other cultural practices, pre harvest disease control measures and hygiene and sanitation are some of the factors did affect the composition and quality (Barret, et al, 2005).

Intrinsic and Physical Condition

Quality of fruits can be judged by its edible and other characteristics like nutritional parameters, physico-chemical properties (Augusti, M. et al., 2002; Barret et al.,2005). Physical condition of the fruits without bruises and injury will be most suitable for consumption and packaging (Ladaniya, 2008).

Post-Harvest Pest and Disease Control Measures

Infection and contamination occur at different stages in the field and after harvest during marketing (Ladaniya M.S., 2008; Barret, et.al., 2005; Jiuxu and Timmer, 2007; Susan et al., 2004). Application of essential oil amended coatings to citrus was undertaken by some researchers as a safe botanical preservative against post- harvest fungal infestation of food commodities (Wilma du Plooya, et al., 2009; Ashok Kumar et al., 2008). Integrated pest management strategy and alternative strategies must be used in order to reduce the incidence of fruit fly infestation (Yoav, et al., 2000; Simon, 2008; Sharma, et al., 2009; Aquino et al, 2011). It has been estimated that without use of fungicides, sale of fresh citrus would be reduced by at least 50% (Ismail and Zhang, 2004).

Environmental Factor

Following are the environmental factors affecting quality of fruits:

1. Temperature: It is an important determinant of plant growth. High as well as low temperatures influence growth of plants. Broad leaved, evergreen plants are more susceptible to low temperature. High temperature reduces the quality in citrus like maturity, colour, sugar acidity etc. and increased the quality in grape and melons. Low temperature caused the chilling and freezing injury. Development of red colour in blood orange is governed by low temperature. More severe winter favours discontinuous synthesis of chlorophyll and unmasking of carotenoids pigment which imparts red colour to oranges. Carbohydrate synthesized by plants may be stored as starch , sugar etc. or converted to proteins, fats, organic acids etc. Sweetness determines the quality of many fruits and low temperature helps in accumulation of sugars while high temperature causes its degradation. Temperature at the time of collection of horticultural products greatly influences the quality through adjustment of sweetness lower mean temperature during the period of maturity and harvest ingretard the rate of respiration and also the conversion of sugar to starch.

2. Light: Light is the important factor which influence the organism, more so the autotrophic plants. Tee light is found to affects the quality of the fruits. Fruits exposed to light are found to be better in quality as compared to fruits receiving less light. In mandarin, it has been observed that, the fruits borne on upper halt of the tree and consequently receiving more light were found to be richer in vit. C content. It also essential for anthocynin formation. Exposed fruits to sun light develop lighter weight, thinner peel, lower juice and higher TSS than shaded fruits like citrus, mango etc. High sun light causes sun scald in citrus.

3. Rainfall: Water is the major constituent of protoplasm. Rainfall is the ultimate source of most of the water supply of all life and especially so to plant. Plants have some critical period of water requirements and adequate supply of water during these stages defiantly raises the quality and yield. Rain at the time of flowering washout the pollen grains and greatly reduced the fruit set and quality of fruits. High rainfall causes cracking the grapes, lemons, dates, litchi etc. it also reduces appearance and sweetness.

4. Wind: Heavy wind velocity is detrimental to the plants. It causes damage to fruits tree in several ways high wind blows away the fruit and break the branches. Hot wind at the time of blossoming may cause failure of pollination due to drying of stigmatic fluid and reduced the activity of pollinating insect. It may cause abrasion of fruits. Mild wind velocity produces wind scaring disorder in citrus when the fruits is rubbed against twigs or thorns. Thorns punctures may heal over with corky scar tissue and brushing on the fruit of citrus.

5. Relative Humidity: It is crucial component of climate influencing growth and production of crop. Humidity is essential for growth of the plants and qualitative development of the fruits. The colour, TSS sugar acid blend is better in dry atmosphere having very little humidity. The oranges grow under high humidity have thin rind and have more juice. Low humidity favours better colour development in oranges. High humidity increases the acidity in citrus and grapes etc. but on other hand it is needed for better quality of banana, litchi and pineapple.

6. Soil: Soil is an important for establishing an orchard and maintain the quality of fruit. In general, it may be stated that soil for fruits growing should be porous, deep and well aerated should not be water logged, marshy, saline or acidic and there should be no hard pan at the bottom layers. Fruits ripen a little earlier on tree growing in sandy or gravelly soil than clayey soil in a poor drained soil, the soil interspaces are water-filled and aeration is thus reduced.

Cultural Aspect

Below mentioned factors affecting quality of fruits:

1. Foliar spray: The foliar spraying of organic compounds other than nutrients which in small quantity modify the plant physiological process which ultimately improves the quality. Growth regulators used to improve the quality and foliar spray of fungicide reduces the incidence of disease by pre harvest applications. In foliar application ethylene inhibitor plays an important role in maintaining the quality of fruits. The ripening of fleshy fruits represents the unique coordination of developmental and biochemical pathways leading to changes in colour, texture, aroma, and nutritional quality of mature seed-bearing plant organs. Recent developments in the regulation of fruit ripening with an emphasis on the regulation of ethylene synthesis, perception, and response.

Fruits have classically been categorized based upon their abilities to undergo a program of enhanced ethylene production and an associated increase in respiration rate at the onset of ripening. Fruits that undergo this transition are referred to as climacteric and include tomato, apple, peach, and banana whereas fruits that do not produce elevated levels of ethylene are known as non climacteric and include citrus, grape, and strawberry.

2. Fertilizer application: Nutrition of the plant is by far most extensively studies of the factors affecting the quality of harvested produce. It has been observed that size, weight and ascorbic acid and decrease by high N and P. Fertilization with major elements, such as N,P,K and Ca affect the internal quality of fruits. It will be noted that titratable acidity was increased by application of K. TSS was increased by N and decreased by K nutrition. It indicates excessive fertilizer application decrease fruit firmness and increased the solubility of cell wall constituent. P provides for fast and vigorous growth and speeds maturity. P stimulates flowering and seed development necessary for the enzyme action of many plant processes. K used to form carbohydrates and proteins, formation and transfer of starches, sugars and oils and it increases disease resistance, vigour and hardiness.

3. Irrigation management: Irrigation is very important in fruit crops as sufficient moisture must be maintained in the soil for obtaining the yield of good quality fruits. The irrigation systems have to be properly devised so that the water requirement of the trees is met at the minimum expenditure without any wastage of water. System of irrigation of fruit plants vary with the age of trees. Several methods are employed for the irrigation of fruit trees depending on the age of the tree, soil topography and the availability of irrigation water.

4. Bagging: Bagging is technique which can increase the colour uniformity and can induce earliness in the ripening process of fruits. Uniform colour of the whole fruit is reached because the fruit protected against the direct incidence of the sunlight and also induce earliness in the ripening process by providing favourable microclimate to the fruits.

Advantages and Limitation of Pre-Harvesting of Bagging

Advantages:

1. Pre-harvest bagging of fruits protects from infestation of fruit fly and attack by sooty mould disease.
2. It protects fruits from damage by bruises arising due to strong winds and bird's attack.
3. It ensures uniform fruits ripening with attractive colouration and higher market appeal.
4. It also protects fruits from damage by post-harvest diseases.

Limitation:

1. Bagging cannot improve the colour of some coloured varieties of fruits crop. Eg. In Vanraj Variety of Mango.
2. When using plastic bags, open the bottom or cut a few small holes to allow moisture to dry up. Moisture trapped in the plastic bags damage and/or promotes fungal and bacterial growth that caused diseased-fruits. Plastic also overheats the fruit.
3. Bags made of dried plant leaves are good alternatives to plastic.
4. Remove the bags during harvest and disposed them properly.

Maturity Indices

These ae the measurable points which give notation of harvesting which ensures proper quality of produce. Some commonly used maturity indices are:

S.N	Maturity indices	Fruits
1	Calendar date	All fruits
2	DFFB	All fruits and radish
3	T Stage	Apple
4	Size	All fruits, cherry
5	Surface morphology	Grape (cuticle formation), banana, litchi
6	Specific gravity	Cherries, Mango and Ber.
7	Colour	All fruits, Muskmelon
8	TSS	All fruits, and melons
9	Firmness	Pome and stone fruits
10	Juice content	Citrus
11	Acidity and Sugar	Pomegranate, Citrus, Papaya.
12	TSS/ acid ratio	Grape and Citrus

The maturity index for a commodity is a measurement or measurements that can be used to determine whether a particular commodity is mature.

Importance of Maturity Indices

1. Ensure sensory qualities.
2. Ensure adequate post-harvest shelf-life.
3. Facilitate scheduling at harvest and packaging operation.
4. Facilitate marketing over the phone or through internet.

Harvesting Methods

Harvesting is a deliberate operation to separate the produce from source of its attachment. This is very important operation as far as quality, shelf life, transportation; marketing, processing, value addition and ultimately consumer satisfaction are concerned.

Types of Harvesting

1. Manual harvesting: In India, mostly manual harvesting is adopted human labour is deployed to harvest the produce. Secateurs, sickle, clipper etc. are made use to harvest depending upon nature, kind and extent of farming. Hand harvesting is followed for most of the fruits.

2. Mechanical harvesting: It is used in case of apple, strawberry, cherry, raspberry etc. The harvesting is achieved by shaking the tree by mechanical vibration. The tree is shaken by mechanical vibration and the fallen fruits under tree are collected over a large blanket or in net. The harvested fruit receives injury.

3. Chemical harvesting: Some chemicals are sprayed on the tree before harvesting to loosen the attachment of the fruit to the plant. Following shaking the fruits fall down from tree. Spray of 2 4- D @ 500 ppm and 200 ppm. Resulted in keeping the buttons of kinnow and eureka lemons fruits respectively, intact and green during storage. MH @ 1000 ppm delayed the ripening of hard green mangoes during storage.

Importance of Harvesting

1. Harvest only mature fruits.
2. Pick fruit early in the morning or late in the evening.
3. Harvest fruits with 1.0 cm stalk or above the first node of the stalk. It prevents sap oozing.
4. Harvest fruits with hand or harvester developed by the Institute.
5. Do not harvest fruits with stick or shaking the tree/branch.
6. Keep harvested fruits in plastic crates or on tarpoline / cloth / newspaper under shade. Avoid contact of fruits with soil.
7. Avoid latex flow on fruits during harvesting and handling.
8. Desap the fruits, particularly for export, by inverting them in a desapper for about 25 – 30 minutes.

Post-Harvest Factors for Quality Management

Silaand Ebrahimpour, (2005) and Tari et al. (2005) found that the leadership play a significant role in shaping the quality focus of the companies. Management leadership is necessary for TQM effectiveness because leadership is directly related to quality planning, human resources management, information management, quality assurance, learning, supplier focus and customer focus. Apart from this there are quality management constructs which are exclusively cater to post-harvest quality management of citrus fruit industry.

Post-Harvest Process Control

Harvesting methods may determine uniformity of maturity at harvest, which intern influences quality of the fruit (Barret, et.al.,2005).Packinghouse are meant for applying suitable treatments and grading of fruit in order to facilitate distribution of fresh fruits as per consumer demand. The sanitation in packinghouses and eco-friendly, healthy alternative to post-harvest chemical treatments are needed with changing times. Inspection, quality evaluation with labelling will help in proper post-harvest process control. Previous researchers, Chen and Nussinovitch (2001); Rong Zenga, (2012); Po-Jung Chien, et al.,(2007) studied the effect of coatings on fruit surface for improving post-harvest quality. Tiwari and Cummins, (2011) studied the Factors influencing levels of phytochemicals in selected Fruit and Vegetables during pre- and post-harvest food processing operations.

Transportation and Storage

All the operations like packaging, transportation, temperature and humidity management (Barret, et al., 2005; Ladaniya, 2008; Anung and Chang, 2014) during the operations will influence the storage life. Packaging and transportation CFB box, retains freshness and firmness (Dhall, et al., Ladaniya, 2008, Henriod, 2006, Robert, 1999). Andrea et.al.,(2005) and Angelique (2009) found that commercial conditioning and cold quarantine storage treatments on fruit enhanced the shelf life of fruits. Low-temperature cold shock may induce rind colour development of fruit Graham et al., (2006). Storage temperature and time influences sensory quality of mandarins by altering soluble solids, acidity and aroma volatile composition (David Obenlanda, et al.,(2011). Ahmet et al.,(2009) studied the effects of hot water treatments on chilling injury and cold storage of fuyu persimmons. Taste and aroma of stored mandarins was compared with fresh by Zipora, et al., (2010) in a review paper.

Evaluation, Testing, Documentation and Auditing Factors

The aim of the formal evaluation is to provide a starting point for the understanding of quality issues and the identification of areas to improve (Zhang et al., 2000). José and Carlos, (2010) studied intact orange quality prediction with two portable NIR spectrometers as a non-destructive testing method. Ricoa, et al.,(2007) spelled out the ways to extending and measuring the quality of fresh-cut fruit and vegetables. Instrumental measurements are often preferred to sensory evaluations in research and commercial situations because they reduce variations in judgment among individuals and can provide a common language among researchers, industry and consumers (Judith, 1999). The computers simplify database management and accelerate data analysis such as trend analysis (Frederick, 1994). Statistical methods are used for data reduction as the selection of measurement variables, such as wavelength, for predicting quality and for product classification (Judith, 1999, Leena, 2010, Blasso, 2007).The Audit or check may help the firm to monitor the further progress with continuous improvement (CI) (Sarah Caffyn,1999; Bessant, 1992).

Marketing and Distribution

Technological changes in the handling of fresh commodities are slow to be accepted by shippers, wholesalers and retailers. Researchers need to develop data that involves simulated shipping tests and commercial trials (APCoAB, 2010). Supply chain logistics, post-harvest management and diverse sourcing of fruits and vegetables have brought enhanced concern for food safety. All innovations and application of technology needed to ensure market access for growers and shippers should be integrated and optimized into the handling system. Another case study adopted a Multi criteria Decision Aid (MCDA) method (Danielly and Adiel 2012) to study the market dynamics.

Specific Post-Harvest Techniques to Enhance Quality

Technological developments are taking place with leaps and strides for making availability of quality fruits for a longer period. Proper harvesting and postharvest management, faulty storage techniques, which permit slow gas exchange leading to spoilage (Verma and Tikoo, 2004, Wills et al.,1999, Ladaniya, 2008). The advancements in machine vision, non-destructive techniques for quality determination and real time computer application ensure work efficiency and quality fruit to consumers (Studman ,2001; José and Carlos 2010; Leena, 2010; Blasso, 2007). Fruit coating with fungicide and emulsion, controlled atmospheric storage and modified atmospheric storage are some of the techniques which are used to extend the shelf life of fresh fruits (Ba rret,et.al, 2005; Sandhya,2010; Ron et al., 2004;RongZe nga,(2012),Chen and Nussinovitch 2001). Pre-cooling techniques and applications for horticultural products enhanced the shelf life as confirmed by many researchers (Tadhg and Da-Wen, 2001).

Quality Assurance

An effective quality assurance (QA) system throughout the handling steps between harvest and retail display is essential to provide a consistently good-quality supply of fresh horticultural crops to the consumers and to protect the reputation of a given, marketing label. QA starts with the selection of the genotype and its proper time to harvest for the best appearance, textural, flavour (taste and aroma), and nutritional (including phytonutrients) quality. Careful harvesting and handling are required to minimize physical injuries. Each postharvest handling step has the potential to either maintain or reduce quality and, in a few cases, (such as ripening of climacteric fruits) improve eating quality. Safety assurance can be part of QA and its focus is on minimizing chemical and microbial contamination during production, harvesting, and postharvest handling of intact and fresh-cut fruits and vegetables.

Quality Assurance Procedures During Handling of Horticultural Perishables

Handling Steps	Quality Assurance Procedures

Harvesting	Careful handling and protecting produce from sun exposure.
Packinghouse Operations	Checking product maturity, quality, and temperature upon arrival. Implementing an effective sanitation program to reduce microbial load. Checking packaging materials and shipping containers to ensure they meet specifications. Training workers on proper grading by quality (defects, color, size), packing, and other packinghouse operations. Inspecting a random sample of the packed product to ensure that it meets grade specification. Monitoring product temperature to assure completion of the cooling process. Maintaining effective communications with quality inspectors and receivers to correct any deficiencies as soon as they are identified.
Transportation	Inspecting all transport vehicles before loading for functionality and cleanliness. Training workers on proper loading and placement of temperature-recording devices in each load. Keeping records of all shipments as part of the "trace back" system.
Handling at Destination	Checking product quality upon receipt and moving it quickly to the appropriate storage area. Shipping product from distribution center to retail markets without delay and on a first in/first out basis unless its condition necessitates a different order.

Crop Wise Cultural Aspects

1. Mango:

Fertilizer application: Among many plant mineral nutrients K play important role to improve the fruit quality. Soil applied K fertilizer compare to foliar application resulted in improved fruit quality attributes. There is a high demand for K during fruit development.

Water management: Bearing mango trees are not generally irrigated. However, watering at an interval of 10-15 days during fruit setting and fruit development is advantageous to reduce fruit drop to increase fruit retention, size and fruit quality.

Foliar spray:

i. GA3 150 ppm: Improves fruit size and fruit weight, Fruit volume improves, produced maximum T.S.S., Increases in ascorbic acid and acidity decreases.

ii. 2, 4-D 10 ppm: Increase size of fruit, Increases T.S.S. and ascorbic acid.

iii. 2, 4, 5-T 100 ppm: Increases total sugars, Increases the ascorbic acid, Reduced the acidity.

Bagging: Efficiency of different bagging materials for the control of the mango fruit fly and black spots % occur during Mango season. The experiment is carried out at Kallyanpur by Sarker et al. (2009). Fruit bagged at 30-40 days before crop harvest. T1=Polybag (black), T2=Polybag (transparent), T3=Brown paper bag, T4=Control (no bagging)They found that all three bagging materials gave full protection against the fruit fly infestation and of all evaluated brown paper bag showed maximum reduction in the black spots (4.3to 5.5%) in mango fruits in cv. Langra and Khirshapat, however black spot were higher in polybag.

Maturity indices: Fullness of shoulders, Internal and external colour Starch content, specific gravity.

Harvesting methods: Mangoes generally harvested by Nutanzela in India and in foreign countries mechanical harvester is use.

2. Banana:

Foliar spray: One foliar application of Agromin 4 gm + Urea10gm +MOP 10 gm per lit. water 3 weeks after flowering, give good harvest of attractive fruits. Spraying K2SO4 3% at 3rd and 4th week after bunch emergence increase the bunch weight, finger character and shelf life in banana.

Fertilizer application: A nutrient loving plant requires large quantity of nutrients for its growth and developments. Potassium is much wanted element for banana and its requirement is high during flowering period. It stimulates early shooting, increase number of hands, finger size, improve quality and sweetness.

Water management: It is a moisture loving plant. It requires adequate soil moisture throughout its life. Irrigation requires during early vegetative period, flowering, fruit development up to ripening.

Maturity indices: The edges of fingers become round, Change in color of fruits and TSS.

Bagging: The experiment was carried out by Debnath et al. (2001) with title Effect of bunch cover on size, weight of finger and other finger characters in cv. Giant Governor. *Bunch covered with bags after the opening of last female bract. They observed that the highest finger length (16.03 cm), diameter (3.85 cm), weight of finger (114.0 g), weight of pulp (79.75 g) and peel (34.25 g) with transparent polythene cover and they also recorded that highest pulp content (70.36%), pulp: peel ratio (2.37:1) and lowest peel (29.31%) with blue polythene cover in banana bunch cv. Giant Governor.

3. Grapes:

Fertilizer application: Phosphorous is necessary at flower bud initiation stage nitrogen is mainly required at fruit ripening stage. Potash is required during fruit set and fruit development. 50 % N and P fertilizer were applied after fruit set to veraison 25 % K supply between verasion and before harvest increase the cluster size, no. of fruits per cluster, increase berry size and also increase TSS, sugar and yield.

Water management: Irrigation at an interval of 5-7 days during initial development stage till they become pea size. 10 days interval till maturity is better for good yield watering should be withheld 25-30 days prior to harvesting to ensure quality of produce.

Foliar spray:

i. GA3 75 ppm: Increases in the bunch and berry size Increases yield, to give maximum recovery and produce fairy good quality raisin.
ii. Ethephon500 ppm: Increase TSS, reducing sugars, non reducing sugars and total sugars, Decrease acidity
iii. Chiston 1g/ lit.: Decrease incidence of disease. Inhibit spore germination and mycelia growth of phytopathogen.

Bagging: Signes et al. (2007) Effect of bagging on grape bunch and volatile aroma composition in cv. Perla and reported bagged cv. Perla grape increase volatile aroma composition of limonene (9.6%), Trans-2- Hexenal (2.2%),3-Hexenal (2.4%), 2-Hexen-1-ol (59.4 %) while Ethyl acetate (66.2%) was found maximum in non-bagged grapes.

4. Citrus:

Fertilizer application: Half dose of N + full dose of FYM, P and K be given at the time of release of water stress. Remaining half dose of N be given when fruit attain the pea size.

Foliar spray:

i. GA3 75 ppm: Increase fruit size improve fruit quality. Reduction in seed per cent2, 4-D 10 ppm, Fruit weight increases. Produce maximum number of fruits. Fruit yield increases
ii. CaCl2 4-6%: Increase Vit. C content. Increase juice per cent.

Water management: It is essential at the time of flowering and fruiting period. - Mostly required at maturity period of fruits

Maturity indices: Size of fruit, External colour, Juice content.

Harvesting Method: Plucking with hand or use of knife for cutting with some twing portion.

5. Guava:

Foliar spray:

i. GA3 200 ppm: Increase fruit size, Improves fruit weight, T.S.S. increases

ii. CaNO3 0.5-1.5%: Minimize PLW Increase palatability rate, Increase TSS, Ascorbic Acid

iii. Ethephon 600 ppm: Produce better quality fruits, produce higher ascorbic content, Better ripening, Retained higher content of T.S.S., Acidity decreases.

Water management: In bearing trees irrigation is beneficial to increase fruit size, fruit set and quality. Adult bearing tree requires watering during April to June at fortnightly interval to insure high fruit set and fruit drop.

Bagging: Montoya et al. (2010) reported that the percentage of oviposited fruits were higher in control (92.50%), while it was minimum under Tergal bag (0.52%) in Taiwanese guava cv. Tai-Kuo.

Maturity indices: Size of fruit, - Color of skin, TSS.

Harvesting Method: Plucking with hand or use of knife for cutting with some twing portion.

6. Pomegranate:

Fertilizer application: Addition of NPK fertilizer with the chelate iron cause significant in fruit weight juice per cent, thickness and weight of epicarp and decrease fruit cracking percentage.

Foliar spray:

i. GA3 at 200 mg per lit: Significant increase in total yield weight, increase juice per cent, Increase TSS.

ii. Fe at 200 mg per lit: Increase in TSS total acidity reducing sugar, Increases anthocynin pigment percent.

Water management: Ordinary irrigation practices are quite enough.

Maturity indices: Skin colour change to yellowish red, Fruit gives a metallic sound when tapped, Closing of calyx at distal end of fruits.

Harvesting Method: Plucking with hand or use of knife for cutting with some twigs portion.

Conclusion

1. Pre-harvest spray of PGR and other chemicals plays important role in improving quality of fruit and help in enhancing shelf life of fruit crop.
2. One of the best ways to meet the increasing demand of quality fruit sand reduce the wide gap between demand and supply.
3. It helps in increasing the foreign exchange and also the economic condition of farmers.
4. Maturity indices and proper harvesting method are playing an important role in quality improvement.
5. Bagging is an efficient technique regarding induced uniform maturity followed by ripening with full attractive colour and aroma development.
6. Bagging improved quality in terms of chemical characteristics like, TSS, reducing sugar (%), Non-Reducing Sugar (%), Total sugar (%) along with helpful to reduced pest incidence.
7. Implementation of quality management in pre & post-harvest processing of fruits may take longer time to implement, and requires major changes in cultural aspects as well as stake holder mindset in fruits industry.
8. Leadership, management, finance, organizational culture, skills and expertise are considered as the generic factors critical for the successful implementation within SMEs environment and repeatedly recommended in literatures and research findings.
9. Judgmental process of grouping similar requirements led to the classification of all these requirements into ten separate categories as dependent variables. Items identified for the purpose of measuring the performance of post-harvest processing aspect are clubbed in to four categories.

References

1. Swapnil Dnyaneshwar & Deshmukh, Pre-Harvest Management for Total Quality Improvement in Fruit
2. U.T. Sunil Kumar*, L. Rakesh, Shrivastava and Archana Khadse1 Quality management and post harvest processing in citrus-A review Department of Mechanical Engineering,
3. Yashwantrao Chavan College of Engineering, Nagpur-441 110, Maharashtra, India. Agricultural Reviews, 39(1) 2018 : 22-30
4. A.A. Kader QUALITY ASSURANCE OF HARVESTED HORTICULTURAL PERISHABLESDepartment of Pomology, University of California, Davis, CA 95616, USA
5. Abbott, J.A., 1999. Quality measurement of fruits and vegetables. Postharvest Biol. Technol., 15:207-225.
6. Abbott, J.A., R. Lu, B.L. Upchurch, and R. Stroshine, 1997. Technologies for nondestructive quality evaluation of fruits and vegetables. Hort. Rev., 20:1-120.
7. Cavalieri, R.P. (ed.), 1999. Fresh fruits and vegetable: quality and food safety. Postharvest Biol. Technol. 15:195-340. (Proceedings of Beltsville Symposium XXIII, May 1998).
8. Sunil Kumar, Bholanath Saha & Sushanta Saha. (2017) Integrated nutrient management for enhanced yield, nutrient uptake & use efficiency in the rice-wheat cropping system. Int. J. Curr. Microbiol.App.Sci6(10): 1958-1972.

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Jaggery (Gur) - Health Benefits

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Introduction

Consumption of jaggery is considered very beneficial in Indian culture. There are many types of benefits in health by consuming jaggery. Jaggery is also recognized as a natural dessert.

In our villages, even today, jaggery is eaten in almost every household, but in this race of modernism, mainly in cities, sugar has taken the place of jaggery. Sugar is not beneficial for health in any way, but is harmful. Where sugar damages us, jaggery is beneficial for us.

Although both sugar and jaggery are made from sugarcane, but the sugar, sugar, nutrients like iron, calcium, potassium, phosphorus present in sugarcane juice are destroyed while making jaggery. Along with these elements, vitamin A and vitamin B are also found in jaggery. According to Ayurveda, by consuming jaggery a little daily, a person is free from many diseases.

When the winter season starts, it is seen that people consume jaggery more. But the reality is that we should consume it throughout the year. By taking it, you get rid of many diseases in the body. Including it in your daily diet will give many benefits to your body.

Beneficial to Increase Immunity

Jaggery is rich in antioxidants and nutrients like selenium. This is the reason that jaggery is helpful in increasing the amount of hemoglobin in the blood.

Possible Treatment of Infectious Diseases Like Flu

With the help of jaggery, one gets relief from infectious diseases like cold and cough. It produces heat in the body. For this reason, it is advisable to consume it in winter. You can drink it mixed with hot water. Apart from this, it can also be drunk by replacing sugar with tea.

Blood Pressure Remains Normal

If a person has a problem of high blood pressure, then the consumption of jaggery is considered a boon for him. Such people are advised to eat jaggery on behalf of doctors. Blood pressure remains under control by taking jaggery regularly.

Beneficial in Cleansing Blood

Jaggery has the ability to purify our blood. Consuming it regularly and in limited quantities has many health benefits. Let us tell you that due to the clean blood, many diseases do not wander around. This is especially beneficial for pregnant women. Actually, anemia is a common problem in pregnant women.

Period Pain Relief

It is especially beneficial for women with many essential nutrients. Its regular intake provides relief in the period. During this period, stomach cramps, changes in mood, etc. usually relieve problems. According to experts, a small piece of jaggery should be eaten daily.

It works by releasing endorphins from the body. Due to which the body gets rest. It can prevent premenstrual syndrome (PMS).

Reduce Weight

Our electrolytes balance due to the amount of potassium present in it. It also helps to build muscle and increase metabolism. According to nutritionist experts, it maintains the lack of water in the body. By hydrating it helps us lose weight.

Reduce Iron Deficiency

There are many things whose intake reduces iron deficiency, but jaggery is such that iron is found in a lot. That is, jaggery is a major source of iron. It is very beneficial for patients with anemia. Therefore, people suffering from anemia are advised to eat jaggery instead of sugar. Especially for women, its intake is very important.

Essential for Stomach Cold

Jaggery forms the normal body temperature. It helps in cooling the stomach. According to the expert, in the cold days or in the summer months, one should drink Gur Sharbat.

Reduce Weight

Our electrolytes balance due to the amount of potassium present in it. It also helps to build muscle and increase metabolism. According to nutritionist experts, it maintains the lack of water in the body. By hydrating it helps us lose weight.

It is Better for the Brain

The use of jaggery also helps to freshen the mood of people. If a person has a migraine problem, eating jaggery daily for him is very beneficial. By taking it regularly, the brain remains strong and memory is also very good.

Keep the Body Active

In addition to strengthening the body and bones, the intake of jaggery energizes the body. This keeps your body active. If you have weakness in your body, consuming jaggery with milk will give you strength. If you do not like milk, then you will not feel tired by consuming five grams of jaggery, a little lemon juice and black salt in a cup of water.

Beneficial for the Eyes

If your eyesight is weak or there is any other problem in your eyes, then jaggery will be beneficial for you. Eating jaggery removes the weakness of the eyes. Not only this, jaggery is very helpful in increasing eyesight.

Reduce the Effect of Pollution

If you work in a factory or factory where the pollution level is higher than normal, then you should consume at least 100 grams of jaggery daily. You can consume jaggery with food or even after eating. In this case the effect of pollution on your body will be less.

Get Rid of Sour Belts

Eating jaggery, rock salt and black salt gets rid of sour belts.

Improves Voice

Heat jaggery with ginger and eat it lukewarm, relieves sore throat and burning sensation. This also makes the voice much better.

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Impact Of e-Learning During Covid-19 Pandemic on Writing & Printing Paper Industries

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Introduction

The economy of any country is highly depending on the agriculture, industry and service sectors. What will happen, if all the three sectors didn't work? The CoViD2019 stopped mostly all the functions in Indian economy except some of the occupation. The virus spread over the entire world and made many big economies in trouble. The lockdown was announced during March 2020 and day by day many sectors started its functions slowly with limited numbers of workers. The micro medium and small-scale industries sector also affected highly because of the CoViD19 pandemic. It is estimated that in the first phase of lockdown, the revenue shortfall was over 44 per cent in Tamil Nadu MSME sector. Chalk piece industry is one among the important sector registered under MSME's. This industry is highly related to education sector, whereas due to lockdown the schools and colleges were closed for the past 8 months affect this industry a deep. Thus, it is necessary to study about the status of the chalk piece industries during the lockdown.

Status of Paper Industry

Data says, during the lockdown period, around 40-45% of paper mills are in red zones. The extended lockdown to check the spread of the Covid-19 pandemic has dealt a nasty blow to the highly fragmented paper industry in the country, according to rating agency CRISIL. Around 80 per cent of the nation's paper capacity of 25 million tonnes (mt) (750-800 mills) is clustered around six states that account for half of India's gross domestic product. They are also major consumption hubs. The industry is grappling with weak demand, shortage of raw material and limited availability of labor, which are affecting capacity utilization. CRISIL Research expects demand for paper and card boards to contract 10-15 per cent on-year, affecting all categories of products. The shutdown of schools, colleges and majority of offices has crimped demand for.

Impact of Covid-19 on the Global Paper Products Market, 2020-2030

Data says, the global paper products market is expected to decline from $896.6 billion in 2019 to $868.8 billion in 2020 at a compound annual growth rate (CAGR) of -3.1%. The decline is mainly due to economic slowdown across countries owing to the COVID-19 outbreak and the measures to contain it.

The market is then expected to recover and grow at a CAGR of 7% from 2021 and reach $1030.7 billion in 2023. Asia-Pacific was the largest region in the global paper products market, accounting for 35% of the market in 2019. North America was the second largest region accounting for 26% of the global paper products market. Africa was the smallest region in the global paper products market.

The growing awareness on the impact of deforestation to the environment has led to paper manufacturing companies opting for alternative sources for paper production. Paper manufacturing companies are recycling paper products to save costs on raw material that in turn is helping companies in their environment conservation efforts.

Also, biomass produced as a by-product from paper industry is enabling companies to generate electricity for manufacturing activities. For instance, Austrian based Mondi Container board launched eco-friendly paper grades for packaging that can be recycled for producing wide range of paper products.

Report Scope

The report covers market characteristics, size and growth, segmentation, regional and country breakdowns, competitive landscape, market shares, trends and strategies for this market. It traces the market's historic and forecast market growth by geography. It places the market within the context of the wider paper products market, and compares it with other markets. The market characteristics section of the report declines and explains the market. The market size section gives the market size ($b) covering both the historic growth of the market, the impact of the Covid 19 virus and forecasting its recovery. Market segmentations break down market into sub markets. The regional and country breakdowns section gives an analysis of the market in each geography and the size of the market by geography and compares their historic and forecast growth. It covers the impact and recovery trajectory of Covid 19 for all regions, key developed countries and major emerging markets. Competitive landscape gives a description of the competitive nature of the market, market shares, and a description of the leading companies. Key financial deals which have shaped the market in recent years are identified. The trends and strategies section analyses the shape of the market as it emerges from the crisis and suggests how companies can grow as the market recovers. The paper products market section of the report gives context. It compares the paper products market with other segments of the paper, plastics, rubber, wood and textile market by size and growth, historic and forecast. It analyses GDP proportion, expenditure per capita, paper products indicators comparison.

Conclusion

Many people consider using of papers for exams is outdated especially during the CoViD2019. Some experts claim that teachers have stubbornly resisted new technologies that could improve teaching and eliminate the papers entirely. A study which recently investigated whether studying / writing with paper was more effective than using online system concluded that chalkboards were more interactive, progressive, and fruitful. Thus, the paper playing a major role in the younger students career the chalk paper industries and the paper producers should be protected in the times.

Policy Recommendations

The banks and other financing agencies may provide loans to the paper industries with additional re-payment period also with less interest rate. The government may provide subsidies to attract the paper producers to do production activities after the re-start of economy subsequent to CoViD19 pandemic. The government agencies may give new trainings for the paper producers and turn their production towards other products related to papers. The marketing department should help the paper producers by marketing them to any other uses. The loss during the lockdown period in may supported by the insurance companies. Hence, it is necessary to safeguard the writing and printing paper industries.

Impact Of e-Learning During Covid-19 Pandemic on Writing & Printing Paper Industries

Article ID: 10212

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Introduction

The economy of any country is highly depending on the agriculture, industry and service sectors. What will happen, if all the three sectors didn't work? The CoViD2019 stopped mostly all the functions in Indian economy except some of the occupation. The virus spread over the entire world and made many big economies in trouble. The lockdown was announced during March 2020 and day by day many sectors started its functions slowly with limited numbers of workers. The micro medium and small-scale industries sector also affected highly because of the CoViD19 pandemic. It is estimated that in the first phase of lockdown, the revenue shortfall was over 44 per cent in Tamil Nadu MSME sector. Chalk piece industry is one among the important sector registered under MSME's. This industry is highly related to education sector, whereas due to lockdown the schools and colleges were closed for the past 8 months affect this industry a deep. Thus, it is necessary to study about the status of the chalk piece industries during the lockdown.

Status of Paper Industry

Data says, during the lockdown period, around 40-45% of paper mills are in red zones. The extended lockdown to check the spread of the Covid-19 pandemic has dealt a nasty blow to the highly fragmented paper industry in the country, according to rating agency CRISIL. Around 80 per cent of the nation's paper capacity of 25 million tonnes (mt) (750-800 mills) is clustered around six states that account for half of India's gross domestic product. They are also major consumption hubs. The industry is grappling with weak demand, shortage of raw material and limited availability of labor, which are affecting capacity utilization. CRISIL Research expects demand for paper and card boards to contract 10-15 per cent on-year, affecting all categories of products. The shutdown of schools, colleges and majority of offices has crimped demand for.

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Circadian Clock and Plant Pathogen Interaction

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Introduction

The daily environmental changes were attributed by the rotation of the earth which has its influence on the organisms and they are adapted to the 24-h periodic transition in the environment and react accordingly. This endogenous mechanism in the plant is controlled by “Circadian clock”. It is defined as the endogenous mechanism responsible for adjusting physiology and metabolism to specific times of day (Harmer, 2009).

Circadian Clock

“Circadian” is the Latin word which means “about a day”. It is the internal time keeping mechanism which is operating for the period of 24 hr. Most organisms possess a circadian clock includes organisms such as bacteria and fungi as well as plants and animals (Doherty & Kay, 2010). This circadian regulation occurs in all species but has been extensively studied in mice, *Drosophila* (Ceriani *et al.,* 2002), *Neurospora* (Nowrousian, 2003), *Arabidopsis thaliana* (Salome & McClung, 2004) and rice (Filichkin *et al.,* 2010). Plants undergo endogenous rhythms in the presence or absence of environmental signals in cycle with the 24-hour period. These have been named circadian rhythms (McClung, 2001). The circadian rhythms are the oscillation of metabolic, physiological and behavioral processes (Nakamichi, 2011). The first observation of circadian rhythms was observed by French astronomer De Mairan in 1729. De Mairan noticed leaf movement in heliotrope plants and tested his theory by transferring the plants to dark conditions (McClung, 2006). All circadian rhythms share three basic properties includes they persist even under constant conditions; the system is in continuous interaction with the environment and the system is temperature-compensated.

Circadian System

The circadian system regulates several aspects of plant development such as flowering time, hypocotyl elongation (Schultz & Kay, 2003), seed germination, leaf movement, cellular processes, stomatal opening, photosynthesis, carbon fixation and stress response (Yakir et al., 2007). The circadian system contains three conceptual components: the input (entrainment) pathways (light & temperature), the central oscillator (clock), and the output pathways (Somers, 1999). The input pathways include light and temperature. The input pathways then entrain the central oscillator. Light is mediated through plant photoreceptors phytochromes (PHY) and cryptochromes (CRY). The central oscillator contains a subset of proteins forming multiple feedback loops, controlling each other and generating a period of approximately 24h. The output pathways contain several overt rhythms such as leaf movement, flowering time, stomatal opening, seed germination, nutrient uptake, and defence against pathogens.

Input Pathways: Light and Temperature

The circadian system contains two input pathways: light and temperature. The clock can be reset by changing of these two variables. The input pathways convey environmental information, which entrains the central oscillator (clock). The plant photoreceptors are classified as phytochromes (PHY) and cryptochromes (CRY). Phytochromes absorb the red and far-red region of the spectrum and cryptochromes absorb blue light (Devlin & Kay, 2001). Temperature is another environmental signal that resets the circadian clock, although the mechanism is less well understood (McClung, 2006).

Central Oscillator

The clock (central oscillator) generates a 24-hour rhythm, which regulates certain physiological processes of plants occurring at the optimal phase of the light–dark cycle (Fankhauser & Staiger, 2002). The central oscillator is the core of the circadian system and consists of multiple rhythmic behaviors controlling multiple physiological processes (Más, 2005). The core feedback loop contains three components: two morning-phased Myb-related transcription factors CCA1 and LHY, and the evening-phased and clock-regulated TOC1 (Harmer, 2009). During the day, in the first loop (the core loop), the CCA1 and LHY proteins bind to the TOC1 promoter and inhibit the expression of TOC1. Thus, CCA1 and LHY function as negative regulators (elements) of TOC1. Shortly before the evening, the levels of CCA1 and LHY decrease and TOC1 expression increases. At the end of the night, TOC1 induces the expression of CCA1 and LHY. TOC1 thus functions as a positive regulator (element) of CCA1 and LHY (Alabadí et al., 2001).

Output Pathways

Output pathways such as flowering, photosynthesis, cold, salt and drought tolerance, hypocotyl growth and nutrient uptake and metabolism are controlled by the following genes: CCA1, LHY, TOC1, ELF3/4, LUX, and GI (Pruneda-Paz & Kay, 2010).

Circadian System of Fungus

The central clock proteins Frequency (FRQ) and white-collar complex (WCC), which consists of the transcription factors white collar-1 and -2 (WC-1 and -2, respectively), are the classical elements of the interconnected transcriptional/translational feedback loops in N. crassa (He et al., 2005). Plants are continually subjected to biotic and abiotic stress. Incidence of many of these stresses fluctuates over the 24-h cycle. The stress reaction in the plants based on the circadian oscillation as given by Spoel and Ooijen (2014).

Also, the hormone levels are found to oscillate and the effects of hormone stimulus will be more or less pronounced depending on the time of day. For example, circadian regulation of hormone signaling and has been found for auxin (dawn-phased), abscisic acid (ABA, early morning-phased), jasmonates and ethylene (JA and ET, midday-phased) and salicylates (SA, midnight-phased) (Spoel and Ooijen, 2014).

The direct regulation by the circadian clock on stress signalling, enhances the ability of the plant to prepare for severe conditions and to gate appropriate responses in a timely manner, thereby providing an efficient way to maximize metabolic efficiency and to improve plant fitness. Plants anticipate daily fluctuations of ambient biotic and abiotic stresses, which activate molecular and physiological responses at the corresponding time to ensure adaptive fitness.

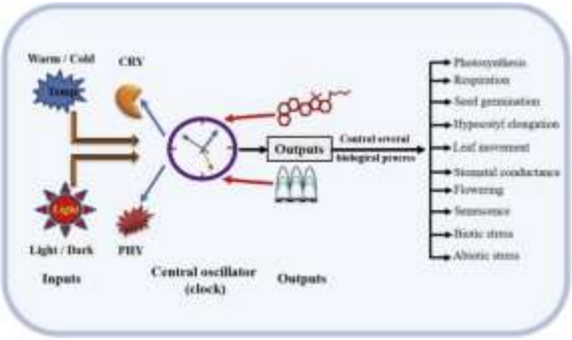
Conclusion

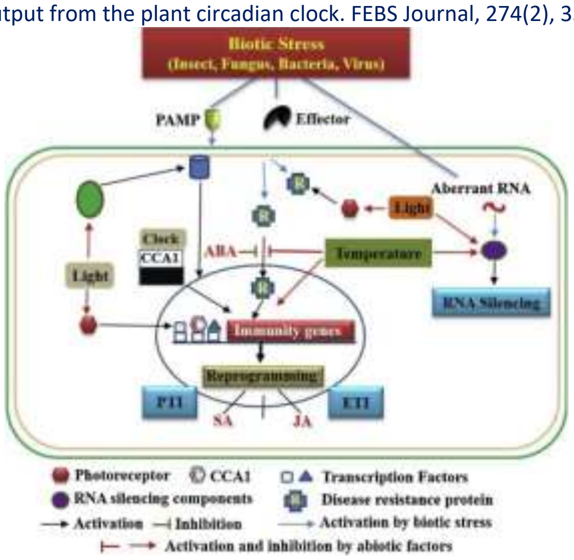
From this it is understood that, every organism has a unique 24 hr cycle to regulate its normal functions. Any deviations in this cycle lead to suffering in the plant which may be due to the biotic factors (pest & pathogens) and abiotc factors (environmental factors). So, detailed study on this circadian cycle will helps to elevate the plant health by managing the factors with affects the plant health.

References

1. Alabadí, D., Oyama, T., Yanovsky, M., Harmon, F. G., Más, P., & Kay, S. (2001). Reciprocal regulation between TOC1 and LHY/CCA1 within the Arabidopsis circadian clock. Science, 293(5531), 880-883.
2. Ceriani, M. F., Hogenesch, J. B., Yanovsky, M., Panda, S., Straume, M., & Kay, S. A. (2002). Genome-wide expression analysis in Drosophila reveals genes controlling circadian behavior. The Journal of Neuroscience, 22(21), 9305-9319.
3. Devlin, P. F., & Kay, S. A. (2001). Circadian photoperception. Annual Review of Physiology,63(1), 677-694.
4. Doherty, C. J., & Kay, S. A. (2010). Circadian control of global gene expression patterns. Annual Review of Genetics, 44, 419-444.
5. Fankhauser, C., & Staiger, D. (2002). Photoreceptors in Arabidopsis thaliana: Light perception, signal transduction and entrainment of the endogenous clock. Planta, 216(1), 1-16.
6. Filichkin, S. A., Priest, H. D., Givan, S. A., Shen, R., Bryant, D. W., Fox, S. E., et al. (2010). Genomewide mapping of alternative splicing in Arabidopsis thaliana. Genome Research, 20(1), 45-58.
7. Harmer, S. L. (2009). The circadian system in higher plants. Annual Review of Plant Biology, 60, 357- 377.

8. He, Q., H. Shu, P. Cheng, S. Chen, L. Wang, and Y. Liu. 2005. Light-independent phosphorylation of WHITE COLLAR-1 regulates its function in the Neurospora circadian negative feedback loop. Journal of Biological Chemistry, 280:17526-17532. Más, P. (2005). Circadian clock signalling in Arabidopsis thaliana: From gene expression to physiology and development. International Journal of Developmental Biology, 49(5-6), 491-500.
9. McClung, C. R. (2001). Circadian rhythms in plants. Annual Review of Plant Physiology and Plant Molecular Biology, 52(1), 139-162.
10. McClung, C. R. (2006). Plant circadian rhythms. The Plant Cell, 18(4), 792-803.
11. Nakamichi, N. (2011). Molecular mechanisms underlying the Arabidopsis circadian lock. Plant & Cell Physiology, 52(10), 1709-1718.
12. Nowrousian, M., Duffield, G., Loros, J. J., & Dunlap, J. C. (2003). The frequency gene is required for temperature-dependent regulation of many clock-controlled genes in Neurospora crassa. Genetics, 164(3), 923-933.
13. Pruneda-Paz, J. L., & Kay, S. A. (2010). An expanding universe of circadian networks in higher plants. Trends in Plant Science, 15(5), 259-265.
14. Salomé, P. A., & McClung, C. R. (2004). The Arabidopsis thaliana clock. Journal of Biological Rhythms, 19(5), 425-435.
15. Schultz, T. F., & Kay, S. A. (2003). Circadian clocks in daily and seasonal control of development. Science, 301(5631), 326-328.
16. Somers, D. E. (1999). The physiology and molecular bases of the plant circadian clock. Plant Physiology, 121(1), 9-20.
17. Spoel, S.H. and van Ooijen, G., 2014. Circadian redox signaling in plant immunity and abiotic stress. Antioxidants & redox signaling, 20(18), pp.3024- 3039.
18. Yakir, E., Hilman, D., Harir, Y., & Green, R. M. (2007). Regulation of output from the plant circadian clock. FEBS Journal, 274(2), 335-345.





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Government Policies for Sustainable Development of Agriculture in India

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The Agricultural Policy of India

Agricultural policy of a country is mostly designed by the Government for raising agricultural production and productivity and also for raising the level of income and standard of living of farmers within a definite time frame. This policy is formulated for all round and comprehensive development of the agricultural sector.

Policies for Sustainable Agriculture

The Indian government's policies have always emphasized food grain self-sufficiency, which has not necessarily coincided with agricultural sustainability. The growth of agricultural production and productivity, which had risen significantly during 1970s and 1980s, declined during 1990s. These slowdowns have worsened since 2000; both overall agricultural production and food grains production have shown negative growth rates in 2000-01 to 2002-03 periods (GoI, 2002). Decline in the growth rates of agricultural production and productivity is a serious issue considering the questions of food security, livelihood, and environment. As such, a critical examination of the approaches for sustainable agricultural development is necessary. This examination must be framed not only by India's ongoing need to ensure food self-sufficiency but also by the consequences of access to international markets.

In India, the main objectives of agricultural policy are to remove the major problems of agricultural sector related to improper and inefficient uses of natural resources, predominance of low-value agriculture, poor cost-benefit ratio of the sectoral activities and insignificant progress of co-operative farming and other self-help institutions.

The Following are Some of the Important Objectives of India's Agricultural Policy

1. Raising the Productivity of Inputs: One of the important objectives of India's agricultural policy is to improve the productivity of inputs so purchased viz., HYV seeds, fertilizers, pesticides, irrigation projects etc.

2. Raising Value-Added per Hectare: Another important objective of country's agricultural policy is to increase per hectare value-added rather than raising physical output by raising the productivity of agriculture in general and productivity of small and marginal holdings in particular.

3. Protecting the Interest of Poor Farmers: One of the important objectives of agricultural policy is to protect the interest of poor and marginal farmers by abolishing intermediaries through land reforms expanding institutional credit support to poor farmers etc.

4. Modernizing Agricultural Sector: Modernizing agricultural sector is another important objective of agricultural policy of the country. Here the policy support includes introduction of modern technology in agricultural operations and application of improved agricultural inputs like HYV seeds, fertilizers etc.

5. Checking Environmental Degradation: Agricultural policy of India has set another objective to check environmental degradation of natural base of Indian agriculture.

6. Agricultural Research and Training: Another important objective of Indian agricultural policy is to promote agricultural research and training facilities and to percolate the fruits of such research among the farmers by establishing a close linkage between research institutions and farmers.

7. Removing Bureaucratic Obstacles: The policy has set another objective to remove bureaucratic obstacles on the farmers' Co-operative societies and self-help institutions so that they can work independently.

Sustainability in Agriculture

The new policy seeks to introduce economically viable, technically sound, environmentally non-degrading and non-hazardous and socially acceptable use of natural resources of the country for promoting the concept of sustainable agriculture.

In Order to Fulfil this Strategy, the Following Measures are Suggested in the New Policy

1. To use unutilized barren wastelands for agriculture and afforestation.
2. To contain biotic pressures on land and to control indiscriminate division of agricultural lands for non-agricultural uses.
3. To enhance cropping intensity through multi-cropping and inter-cropping.
4. To emphasize rational use of ground and surface water so that over-exploitation of ground water resources can be checked. To adopt better technologies such as drip and sprinkler irrigation system so as to arrange more economic and efficient use of water.
5. To adopt vigorously a long-term perspective plan for sustainable rain-fed agriculture by adopting watershed approach and water harvesting method for development of two-thirds of cropped area of the country which is dependent on rainfall.
6. Involvement of farmers and landless labourers will be sought in the development of pastures/ forestry programmes on huge public wasteland by providing adequate financial incentives and entitlement of trees and pastures.

Food and Nutritional Security

In order to meet the growing pressure of population growth and to provide food and nutritional security to such a large population, special efforts will be made for raising the productivity and production of crops and thereby to meet the requirement of raw materials of expanding agro-based industries. Special stress will be made for the development of new crop varieties, especially food crops, with higher nutritional value.

The policy has paid due emphasis for the development of rain-fed irrigation, horticulture, floriculture, roots and tubers plantation crops, aromatic and medicinal plants, bee-keeping and sericulture for augmenting food supply and boosting exports along with generation of employment in rural areas.

High priority has also been given on the development of animal husbandry, dairy, poultry and aquaculture so as to diversify agriculture, increasing animal protein availability in food basket and also for generating exportable surpluses.

The policy also encouraged the cultivation of fodder crops and fodder trees so as to meet the growing need for feed and fodder requirements. The policy has encouraged the involvement of co-operatives and the private sector for the promotion and development of animal husbandry, dairy and poultry farming.

Development and Transfer of Technology

The policy suggested that the Government should encourage application of biotechnology, remote sensing technologies, energy saving technologies, pre- and post-harvest technologies, and technology for environmental protection. Moreover, the Government will make a fresh attempt to move towards a regime financial sustainability of extension services in a pleased manner. The Government will also undertake special measures for empowering women and also to build their capabilities for improving their access to inputs, technology process and other farming resources.

Incentives and Investment in Agriculture

The policy suggested that the Government should make adequate efforts for improving the terms of trade for agriculture along with associated manufacturing sector. Accordingly, attempts will be made to review and rationalize the structure of taxes on food grains, other commercial crops and also excise duty on farm machinery and implements. The Government has committed to keep agriculture outside purview of taxes and decided to continue the present regime of agricultural subsidies.

The, new policy statement accepted the problem of fall in public sector investment in agricultural sector and decided to step up public investment for narrowing regional imbalances and also for accelerating development of supportive infrastructure.

In addition to this, private sector investment in agriculture will be encouraged in some sophisticated areas like agricultural research, post-harvest management, marketing and human resource development. Moreover, attempts would be made for setting up agro-processing units in collaboration between the producer co-operatives and the corporate sector.

Policy on Institutional Structure

The policy gave due emphasis for reforming the Institutional structure where the approach on rural development and land reforms will give stress on the following issues:

1. Consolidation of holdings throughout the country following the pattern of north western states.
2. Steps for redistribution of ceiling surplus lands and waste-lands among the landless farmers and unemployed persons.
3. Adopting tenancy reforms for recognizing the rights of tenants and sharecroppers.
4. Promotion and development of lease markets for raising the size of holdings by making legal provisions so as to give private land on lease for cultivation and agro-business purposes.
5. Recognizing the rights of women on land.
6. Making provision for updating and improvement of land records through computerization and also by issuing land pass books to all the farmers.

The policy has made arrangement for promotion through contract farming and land leasing arrangements for allowing accelerated technology transfer, capital inflow and assured marketing arrangements for some crops, especially of oilseeds, cotton and horticultural crops.

Risk Management

The National Agricultural Policy (2000) gave due importance for the promotion of National Agriculture Insurance Scheme (NAIS) so as to cover all crops and all farmers over the country by giving package insurance policy ensuring protection from all risks in pre- and post-harvest operations, including marketing fluctuations in agricultural prices.

The policy document observed that private sector participation would be promoted through contract farming and land leasing arrangement, to allow accelerated technology transfer, capital inflow, assured markets for crop production, especially of oilseeds, cotton and horticultural crops. Moreover, private sector investment in agriculture would be encouraged, particularly in areas like agricultural research, human resource development, post harvest management and marketing.

In view of dismantling of quantitative restrictions (QRs) on imports as per WTO agreement on agriculture, the policy has recommended formulation of commodity wise strategies and arrangements to protect farmers from adverse impact of undue price fluctuations in the world market and promote exports.

The policy also observed that the Government would enlarge coverage of future markets to minimize the wide fluctuations in commodity prices as also for hedging their risks. The policy hoped to achieve sustainable development of agriculture, create gainful employment and raise standards of living.

The policy has also envisaged evolving a “National Livestock Breeding Strategy” to meet the requirement of milk, meat, egg and livestock products and to enhance the role of draught animals as a source of energy for farming operations and transport.

The policy document mentioned that plant varieties would be protected through a legislation to encourage research and breeding of new varieties, particularly in the private sector, in line with India’s obligations under the “Trade-related Intellectual Property Rights” (TRIPs) agreement.

The farmers would, however, be allowed to save, use, exchange, share and sell their 'farm saved seeds', except branded seeds of protected varieties for commercial purpose. The policy document observed that the development of animal husbandry, poultry, dairy and aquaculture would receive high priority to diversify agriculture, increasing availability of animal protein in the food basket and for generating exportable surpluses.

A high priority would be accorded to evolve new location specific and economically viable improved varieties of agriculture and horticulture crops, livestock species and aquaculture as also conservation and judicious use of germplasm and other bio-diversity resources. Moreover, the domestic agriculture market would be liberalized.

The policy further mentioned that the restrictions on the movement of agricultural commodities throughout the country would be progressively dismantled. The structure of taxes on food grains and other commercial crops would be reviewed and rationalized.

The excise duty on materials such as farm machinery and implements and fertilizers used as inputs in agricultural tax collection system. Appropriate measures would be adopted to ensure that agriculturists, by and large, remained outside the regulatory and tax collection system.

The policy also observed that in order to protect the interest of farmers in the context of quantitative restrictions, continuous monitoring of international prices would be undertaken and appropriate tariff protection would also be provided.

The policy document further mentioned that rural electrification would be given high priority as a prime mover for agricultural development. The use of new and renewable sources of energy for irrigation and other agricultural purposes would be encouraged.

Finally, the policy document observed that the progressive institutionalization of rural and farm credit would be continued for providing timely and adequate credit to farmers. Moreover, endeavour would also be made to provide a package insurance policy for the farmers, right from sowing of crops to post-harvest operations, including market fluctuations in the prices of agricultural produce.

Way Forward

The trajectory of Indian agriculture and its associated environmental problems has brought about recognition that future agricultural growth and productivity will have to occur simultaneously with environmental sustainability. The environmental challenges, especially in terms of land degradation and groundwater depletion, water logging and excessive use of chemical inputs are posing problems for the future of Indian agriculture. To address the problems, policies have laid emphasis on promoting sustainable agriculture including organic farming. Differential approaches and policy instruments, however, will be required to address these problems. The shift from input-intensive to sustainable, particularly organic farming is a difficult task as it involves a number of policy measures dealing with a variety of issues ranging from the transfer of information and technology to the development of markets. Another difficult task, and perhaps more difficult, relates to marginal and small farmers – which comprise a substantial part of Indian agriculture. Although these marginal and small farmers have been considered organic by `default', severe resource constraints make a shift to the modern sense of organic farming prohibitive.

References

1. Government of India (2000), National Agriculture Policy – 2000, Ministry of Agriculture, New Delhi.
2. Government of India (2001), India: Nation Action Programme to Combat Desertification, Volume – I. Ministry of Environment and Forests, New Delhi.
3. Government of India (2002), Tenth Five Year Plan 2002-2007, Volume – II, Planning Commission, New Delhi.
4. Vyas V. S. (2003), India's Agrarian Structure, Economic Policies and Sustainable Development, Academic Foundation Publishers, New Delhi.

Integrated Nutrient Management: The Desired Pillar of Agriculture

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Agriculture is the skeletal system of India, sharing a big shoulder in the Indian economy. Amid multiple challenges like hunger, malnutrition & food security, the sector continues to feed & provides bread & butter to 65% of the Indian population. The struggle that commenced as a means of survival then has now transformed into a significant economic activity, entrepreneurship, import & export, etc world-wide. The economic status of Indian farmers is impoverished & this is one of the deadliest blows as farmers' poverty makes soil poor. Despite challenges& the high cost of fertilizers, the approach of Integrated nutrient management is a boon, it is a holistic determined approach that can turn the table, where solo components may prove to be less satisfying. The long-term use of chemical fertilizers is proving disastrous from an environmental point of view consequently causing health hazards to humans, society & N levels polluting underground water & also declining soil productivity. The health of the environment i.e., air, water, the soil is a menacing global concern today. The environmental & agriculture scientists are leaving no stones unturned to maintain the environment safe. To achieve bumper productivity & maintenance of soil fertility status the integrated nutrient concept seems to be the upper hand for a future run. The shift of equilibrium to INM can be the key to success for the world of agriculture.

The benefits of INM are pleasing, but the burgeoning population of the second populated nation already at 1.5 billion, simultaneously the area of land remaining the same has combinedly challenged the burden of feeding. The multiple Pros of INM have caught the attention of scientists, at the same time taking research & study to deeper levels, the combined impact of the parameters of INM provided satisfactory results from soil & crops point of view. The organic manure component of INM is a promise on account of its macro & micronutrient contents & ability to improve the physical, chemical & biological properties of soil. The highest plant nutrient uptake, availability & increase in plant growth parameters were found with combined organic & inorganic application (Babita Mishra et al 2019). Fertilizer is one of the imperative components though it can never be replaced because of its un-eco-friendly nature, other parameters can be used as a substitution for reducing the quantity of its application. The N fertilizer dose can be reduced by the application of biofertilizers like rhizobium on account of their capacity to fix atmospheric Nitrogen, also biofertilizers assist in improving dynamic soil fertility & productivity. The green revolution period had a higher demand for fertilizer as inputs to sustain high-yielding varieties, but taking into consideration the future picture of agriculture the concept of INM is in the lead. Two of the gravest concern of this era are climate change & the rising concentration of CO2 at present 412 ppm, which was 280 ppm during pre-industrialization.

The agriculture sector to bears the blame on account of releasing greenhouse gases, several mitigation options have been suggested for croplands, as reviewed in Intergovernmental Panel on Climate Change, IPCC (Smith et al. 2007, 2014) e.g., nutrient management, tillage and residue management. The addition of 10% more crop residues increased C input to the soil and so enhanced SOC. The quality & availability of organic source plays a key role in storing carbon by manure. An increase in SOC content was noticed when manure was applied, as observed in the FYM plot (K Begum et al 2017). SOC sequestration and plant growth can be increased with practices amalgamating both organic & inorganic.

Extra attention to the macronutrients especially NPK, has pushed micronutrients to a corner that requires more observation. Micro-nutrients are equally important for human health from infants, pregnant women to adults. Collaborative application of inorganic micronutrient sources with a combination of organic can give a solution to the micronutrient deficiencies, combined application than the solo application is always a better option. The use of micronutrient-rich organic sources can be a preferable choice in crop production. Nutrient use efficiencies can be increased, the ease of preparing organic sources in-situ has provided an extra benefit since decades in integrating with inorganics. The left-over residues of green manure crops used for a dual-purpose help to provide nutrients & decrease the dose of fertilizer application. Under irrigated conditions & regular application of RDF, productivity declined after an initial increase, the combined application of fertilizer & FYM sustained soil fertility & productivity (Katyal et al 2001). Integrated management of organics and chemical fertilizers in rice was found to be more viable for sustaining productivity and improving the efficiency of inorganic fertilizers (Kumar et al 2017). The INM execution improves physical, chemical & biological properties of soil & also minimizes nutrient losses.

To maintain the rank & status of India as a powerhouse in agriculture, The INM based on fertilizer, organics, legumes & biofertilizer can be the healthy choice for the agriculture community to maintain soil fertility &achieve a quality product, and also managing sustainable agriculture goals. In a nutshell, each & every human being on earth is directly or indirectly roofed under agriculture either to earn or live their life, despite the sector is challenged by multiple factors, so the need lies on the shoulder to manage & maintain the system of production to make all efforts to achieve higher productivity. To make the best use of INM, to protect the environment & earth scientists are leaving no stones unturned. Soil test crop responses approach, soil fertility evaluation, soil testing recommendation must be followed & executed, In the era of 21st century, to meet the increasing demand for food in a short time, to achieve more productivity can be the front runner to uplift the production status of agriculture today & till the end of time.

References

1. Babita Mishra, GS Sahu, P Tripathy, S Mohanty, B Pradhan (2019). Effect of integrated nutrient management (INM) on growth, yield, nutrient uptake & soil fertility in okra. Pusa A-4. J PharmacognPhytochem. 8(5):1011-1014.
2. K. Begum. M. Kuhnert. J. Yeluripati. M. Glendining. P. Smith (2017) Simulating soil carbon sequestration from long term fertilizer and manure additions under continuous wheat using the DailyDayCent model NutrCycl Agroecosystem 109:291–302.
3. Smith J, Smith P (2007) Environmental modeling: an introduction. Oxford University Press, New York.
4. Sunil Kumar, Bholanath Saha & Sushanta Saha. (2017) Integrated nutrient management for enhanced yield, nutrient uptake & use efficiency in the rice-wheat cropping system. Int. J. Curr. Microbiol.App.Sci6(10): 1958-1972.

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Climate Resilient Horticulture

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Introduction

For the country like India, diverse climate (tropical, subtropical and temperate) and different soil type creates ample opportunity to grow a variety of horticultural crops comprising of fruits, vegetables, flowers, spices, medicinal and aromatic crops. Horticulture sector contribute 30% on India's agriculture GDP. Due to the labour-intensive cultivation, they also play an important role in employment generation for rural areas. Presently, we are producing over 314 million tons of fruits and vegetables. Fruits and vegetables are rich source of vitamins, minerals, proteins, carbohydrates etc. which plays an essential role in human nutrition. Hence, these are referred to as protective foods and important for nutritional security of the people. Thus, cultivation of horticultural crops plays a crucial role in the prosperity of a nation and in a straight line linked with the health and happiness of the people. India with more than 98.3 million tonnes of fruits and 187 million tonnes of vegetables is the second largest producer of fruits and vegetables in the world after China. However, per capita consumption of fruits and vegetables in India is only around 46kg and 130g against a minimum of about 150g and 400g respectively recommended by Indian Council of Medical Research and National Institute of Nutrition, Hyderabad.

The knowledge about the impact of climate change on horticultural crops is limited. The issues of climate change and solution to the problems requires thorough analysis, advance planning and improved management. The present challenges like global climate change, water and soil pollution, less water availability, more and erratic rainfall urbanization etc adds up to the situation. In combination with increase temperatures, decreased rainfall could cause reduction in availability of irrigation water and increase in evapo-transpiration, leading to severe crop losses. Vegetable production is in danger by increasing soil salinity particularly in irrigated lands which provide 40% of the world's food. Fruits, vegetables, flowers, medicinal plants and tubers are grown from tropical to temperate, some horticultural crops like spices and plantation crops are location specific. In order to sustain our horticultural production with present day challenges we have to have to manage these stresses. Horticultural crops play a unique role in India's economy. Therefore, the development of horticultural crops that can withstand stress will be the single most important step we may take to adapt the changes we have faced today and will face in the future.

A large variety of fruits are grown in India, of which mango, banana, citrus, guava, grape, pineapple and apple are the major ones. The climate change increases the temperature and change of rainfall pattern, as a result banana cultivation may suffer from high temperature, soil moisture stress or flooding / water logging. Due to rise in temperature, crops will develop more rapidly and mature earlier. For example, Citrus, grapes, melons etc. will mature earlier by about 15 days. Strawberries will produce more runners and less fruits. High temperature and moisture stress also increase sunburn and cracking in apples, apricot and cherries also increase in temperature at maturity will lead to fruit cracking and burning in litchi and pomegranate. Delay in monsoon, dry spells of rains, and untimely rains during water stress period, supra-optimal temperatures during flowering and fruit growth, hailstorms are some of the most commonly encountered climatic conditions experienced by the citrus growers over the past decade or so. Specific chilling requirements of pome and stone fruits will be affected hence flowering will be earlier. Air pollution significantly reduced the yield of several horticultural crops and affect the quality of fruit by increase the intensity of certain physiological disorders like black tip of mango which is induced by coal fume gases, sulphur dioxide, ethylene, carbon monooxide and fluoride.

Repercussion of Climate Change in Horticulture

Two major factors of climate change that are more erratic rainfall patterns and unpredictable high temperature spells will consequently reduce crop productivity of horticulture as well as agriculture sector. Latitudinal and altitudinal shifts in ecological and agro-economic zones, land degradation, extreme geophysical events, reduced water availability, rise in sea level and salinization are some major parameters that are adversely affecting the horticulture as well as agriculture sector (FAO 2004). The climate change will have many impacts on horticulture and some are stated below:

1. Many areas presently suitable for horticulture crops would become unsuitable in another 25. There would be new areas which are presently unsuitable, become highly suitable for cultivation.
2. Higher temperatures will reduce the growth and development of different horticultural crops by affecting different maturity process and pollination. In case of potato tuberization process, anthocynin or other pigment development in different fruit and vegetable crops, different physiological disorders will increase, germination in nursery also adversely affected.
3. The winter regime and chilling duration will reduce in temperate regions affecting the temperate crops and results shifting the temperate fruit areas to the upper regions of mountain.
4. Due to increase in temperature the bee activity will be affected ultimately pollination. Flower and fruit drop and floral abortions will also increase, which results the poor fruit set and the yield.
5. The requirement of annual irrigation will increase and heat unit requirement will be achieved in much lesser time.
6. Production timing will change due to change in climatic condition. Due to rise in temperature, photoperiods may not show much variation. As a result, photosensitive crop will mature faster.
7. Coastal regions can expect much faster percolation of sea water in inland water tables causing more salinity.

Conclusion

Impacts of climate variability have invariably, profound influence on production and quality. An understanding of the impacts and relevant adaptation strategies is of foremost importance to sustain the productivity and profitability of horticulture crops in the climate change scenario, which necessitates building up of current knowledge to develop strategies for adaptation and mitigation to achieve climate-resilient horticulture.

References

1. Awasthi RP, Verma HS, Sharma RD, Bhardwaj SP and Bhardwaj SV (2001). Causes of low productivity in apple orchards and suggested remedial measures: Productivity of temperate fruits. Jindal, K.K. and Gautam, D.R. (Eds), 1-8.
2. FAO (2004). Impact of climate change on agriculture in Asia and the Pacific. Twenty seventh FAO Regional Conference for Asia and the Pacific. Beijing, China, 17-21 May 2004.
3. Houghton J, Ding Y, Griggs D, Noguer M and Van der Linden P (2001). Climate Change 2001: The Scientific Basis. Published for the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK and New York. 881p.

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Application of Drones in Pest Management

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Introduction

Drones or Unmanned Aerial Vehicles (UAV) are becoming increasingly adopted as part of precision agriculture and IPM. Drones with remote sensing equipment (sensors) are used to detect the pest outbreak, monitor crop health, crop loss assessment and many more. They could serve as decision support tools, as early detection and response to suboptimal abiotic conditions may prevent large pest outbreaks. When outbreaks do occur, drones could be deployed to deliver swift solutions to identified pest hotspots.

Types

1. Drones with electric drives, where electric batteries constitute the source of energy. Here, the drone will be able to control itself, but it will use GPs or another sensor to determine the area it will cover.
2. Drones that are driven with the use of internal combustion engines. They are controlled by the operator using remotes with the use of a transmitter or independently according to the programmed route.

How to Detect the Insect?

The insect detection system comprises of two primary components:
1. Aerial data acquisition.
2. Insect detection and segmentation algorithm.

Data acquisition consists of flying the drones over the area under study with the camera and UV light source facing down, illuminating and capturing any coated insects on the ground (Stumph et al., 2019). Drone captures the high-resolution images using a camera or sensor attached. These images are captured in different bands from visible to infrared spectrum based on measured parameters. After the data acquisition step, these images are then downloaded onto a workstation translated with algorithms into useful information.

Application in Pest Management

1. Early detection of pest and their hot spots: Pests are small in size and difficult to find under field conditions. Drones indirectly detect the changes in how plants reflect light, has the potential to find the pest and their hotspots earlier. For effective pest management, early detection of pest outbreak is a crucial step as it allows us to take management decisions before pests are well-established and crop losses avoided.

2. Pest surveying or monitoring: Pests monitoring can be done by both direct as well as indirect methods. Direct method examines the crop images through the reflection spectrum of plants, whereas indirect method utilizes the data based on favourable weather conditions and based on that information, the occurrence of crop pests is monitored. Weather factors such as temperature, rain and humidity are the key factors responsible for pest's survival, number, migration, reproduction, and longevity.

3. Pest forecast: Data obtained by drones equipped with sensors can be utilized for early warning systems and pest forecasts. It provides an insight into the specific relationship between the occurrence of pests and the crop environment. The incidence of pests and diseases can be studied by analysing the climate changes, and precautionary actions can be taken against pests in advance.

4. Tracking insect dispersal pattern: Invasive pest have high dispersal capacity due to which they move from one habitat to new and can adversely affect the invaded habitat. Tracking pest migration patterns are helpful in mitigating their damage to both natural environments and agricultural production. Flight patterns of invasive pests can be tracked using drones fitted with global positioning system (GPS). Based on the dispersal capacity of newly identified invasive pest species, strategy to eliminate or manage can be initiated. Drones can be used to track populations of locusts.

5. Insect damage assessment: Drones uses different kinds of sensors between wavelength visible, NIR and thermal infrared, different multispectral indices can be computed based on the reflection pattern at different wavelengths. These indices can be used to assess the insect-pest attack on crops.

6. Mating disruption and Sterile Insect Technique (SIT): Drones are being used in different countries for mating disruption by releasing sterile insects for the control of codling moth, *Cydia pomonella* and pink bollworm *Pectinophora gossypiella* in USA (Femando et al., 2020). Drone release of the sterile insects may be cheaper and faster than ground release, which occurs for instance by means of all-terrain vehicles or release by manned aircraft.

7. Pesticide spraying: Sprayer system mounted on UAV can be used for site-specific application of pesticides over large crop fields. It provides potential platform for pest management and vector control and also reduces the wastage of chemicals. Drones deliver very fine spray applications that can be easily targeted to specific areas, maximizes the efficiency and ultimately reduce the chemical cost.

8. Release of biological control agents: Drones are used in different integrated pest management (IPM) programs to release bioagents such as predators, parasitoids and pathogens, when the target area is large. They are more flexible and cheaper to operate in comparison to planes and helicopters used in conventional aerial pest-control operations.

Advantages

1. More efficient distribution than traditional application techniques.
2. Reduce labour costs.
3. More evenly distributed application over larger areas.
4. It can kill the pests in such places where chemicals can't reach.
5. Reduce the use of pesticides.
6. Safer application as compared to manual, backpack and tractor sprayers, as the risk of poisoning is reduced.

Limitations

1. Trained personnel are required to operate and process the images captured.
2. High initial cost.
3. Drones are weather dependent, can't fly during rainy or windy days.

Summary

Pest outbreak is increasing day by day and it has become very difficult to manage them. Drones have a high potential in pest management as they provide quick and accurate information regarding insect's attack. As a result, necessarily actions can be taken in advance which will save the crop and ultimately increase the agricultural productivity and livelihoods of farmers without causing any adverse effect on the environment.

References

1. Fernando, H. I. F., Wieke, B. H., Zhaodan, K. and Elvira, S. L., (2020). Drones: innovative technology for use in precision pest management. Journal of Economic Entomology, 113(1):1-25.
2. Stumph, B., Virto, M., Medeiros, H., Tabb, A., Wolford, S., Rice, K. and Leskey, T., (2019). Detecting invasive insects with unmanned aerial vehicles. https://arxiv.org/pdf/1903.00815.pdf.

Soil Health - Don't Hurt the Dirt

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Introduction

Soil health is a hot topic these days, one that is justifiably receiving considerable attention from farmers and their farm advisors. Whereas in the past, soil testing and evaluation focused more on chemical and physical measures, new research has shown that the biology of the soil is very important to its overall health and productivity. An incredible diversity of bacteria, protozoa, arthropods, nematodes, fungi and earthworms create a hidden food web in the soil that affects how crops grow, how soil nutrients are cycled and whether rainfall is quickly absorbed into the soil and stays where crop roots can access that moisture.

sustainable soil management has the potential to produce up to 58% more food - and with world populations increase, it's important to get as much crop out of our land as possible. Farmers understand that productive soils mean productive farms, and tools like soil amendments, cover crops, no-till, and others are becoming more popular in farming circles. Further, farmers see soil health as a way to preserve their land for future generations of farmers in their families. Healthy soils help protect the planet from climate change.

"Soil remove about 25% of the world's fossil fuel emissions each year." Governments and private enterprises are creating systems that provide the financial assistance needed to improve soil health on farms by providing grants, and sometimes paying farmers directly for the carbon their soils take from the atmosphere.

Basic Principles of Maintaining Soil Health

1. Keep the soil covered as much as possible.
2. Disturb the soil as little as possible.
3. Keep plants growing throughout the year to feed the soil.
4. Diversify crop rotations as much as possible, including cover crops.

Three Core Practices for Maintaining the Soil Health

1. Cover crops.
2. Crop rotation.
3. Conservation tillage: Have the ability to add three times more organic matter to the soil, ultimately providing healthier soil that can provide economic and environmental benefits.
4. Cover Crops: these can build organic nitrogen, and/or sequester residual nitrogen in the soil. A legume or legume mix planted in early summer can help fix nitrogen for the next cash crop. ... Additionally, this results in a more rapid gain in total soil biomass and a higher total nutrient availability for subsequent crops.

Benefits of Cover Crops

1. Reducing soil compaction which encourages root development in the corn or soybeans planted next, and allows for greater aeration for better soil microbial growth.

2. Reducing surface evaporation which helps retain moisture for primary crops.

3. Increasing the nutrient holding capacity of the soil.
    a. Crop rotation: it helps return nutrients to the soil without synthetic inputs. The practice also works to interrupt pest and disease cycles, improve soil health by increasing biomass from different crops' root structures, and increase biodiversity on the farm.

b. Conservation tillage: The Food and Agriculture Organization of the United Nations (FAO) promotes conservation tillage as a way to protect soils from erosion leading to desertification. “The current rate of soil degradation threatens the capacity of future generations to meet their needs,” states the agency, which adopted 2015 as the International Year of Soils.

4. Reducing soil erosion by as much as 60 percent, depending on the tillage method and amount of residue left to shield soil from rain and wind.

5. Adding organic matter to soil.

6. Decreasing farmers’ expenditures on fuel and planting because fewer tractor trips across the field are needed.

7. Reducing potential air pollution from dust and diesel emissions.

8. Reducing soil compaction that can interfere with plant growth.

Organic Agriculture

Improves water infiltration and retention capacity through high levels of organic matter and permanent soil cover, such as cover crops or mulch, which substantially reduce the amount of water needed for irrigation.

Conclusion

1. Cover crops helps to increase the organic matter in the soil, less erosion, fewer weeds, and even more beneficial insects.
2. Crop rotation helps to improve the soil structure, nutrient availability and uptake, a more active and larger soil microbial biomass which combine to improve soil health, and enable future crops to be more productive and use inputs more efficiently.
3. Farmers’ illiteracy, lack of knowledge, unavailability of the implementation of conservation technology, and limited research on conservation tillage are the major obstacles to adoption of conservation agriculture.
4. long-term impact of conservation tillage and residue management practices suggest that soil properties and availability of nutrients (viz. N, P, K, Cu, Mn, and Zn) are improved in the surface soil layer in comparison with that of conventional farmers’ practice.

References

1. Das, A.; Layek, J.; Idapuganti, R.G.; Basavaraj, S.; Lal, R.; Rangappa, K.; Yadav, G.S.; Babu, S.; Ngachan, S. Conservation tillage and residue management improves soil properties under a upland rice–rapeseed system in the subtropical eastern Himalayas. Land Degrad. Dev. 2020, 1–17.
2. Dikgwatlhe, S.B.; Du-Chen, Z.; Lal, R.; Zhang, H.L.; Chen, F. Changes in soil organic carbon and nitrogen as affected by tillage and residue management under wheat-maize cropping system in the North China Plain. Soil Tillage Res. 2014, 144, 110–118.
3. Eilers, R. G., W. D. Eilers, W. W. Pettapiece, and G. Lelyk. p. 77-86 in D. F. Action and L. J. Gregorich (eds.) (1995): The Health of Our Soils Toward Sustainable Agriculture in Canada.
4. Gathala, M.K.; Ladha, J.K.; Saharawat, Y.S.; Kumar, V.; Kumar, V.; Sharma, P.K. Effect of tillage and crop establishment methods on physical properties of a medium-textured soil under a seven-year rice−wheat rotation. Soil Sci. Soc. Am. J. 2011, 75, 1851–1862.
5. Khan, S.; Shah, A.; Nawaz, M.; Khan, M. Impact of different tillage practices on soil physical properties, nitrate leaching and yield attributes of maize (Zea mays L.). J. Soil Sci. Plant Nutr. 2017, 17, 240–252.
6. Rochester I.J., Peoples M.B., Hulugalle N.R., Gault R.R. and Constable G.A. 2001. Using legumes to enhance nitrogen fertility and improve soil condition in cotton cropping systems. Field Crops Research 70: 27-41.
7. Ramos, E.; Robles, A.B.; Sa, A.; Gonza, L. Soil responses to different management practices in rainfed orchards in semiarid environments. Soil Tillage Res. 2011, 112, 85–91.
8. Sparling G.P. 1997. Soil microbial biomass, activity and nutrient cycling as indicators of soil health. In: Biological indicators of soil health. C.E. Pankhurst, B.M. Doube and V.V.S.R. Gupta (eds.). pp. 97-120.
9. Thierfelder, C.; Wall, P.C. Effects of conservation agriculture techniques on infiltration and soil water content in Zambia and Zimbabwe. Soil Tillage Res. 2009, 105, 217–227.

Wheat Grass: Wonder Grass

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Introduction

Wheatgrass is the freshly germinated first leaves of the common wheat plant (Triticum aestivum) used as a drink or dietary supplement. It grows in temperate regions throughout Europe and the United states and can subsist indoors or outdoors (1). Many people grow their own wheatgrass by putting wheat seeds in water and then harvesting the leaves.

Nutritional Content of Wheat Grass

Wheatgrass is a rich source of vitamins such as vitamin A, vitamin C, Vitamin E (alpha tocopherol), vitamin K and vitamin B6. It also provides essential nutrients such as iron, zinc, copper, manganese, and selenium. Besides, it also consists of protein (less than one gram per 28 grams). The nutrient content of wheat grass juice is almost equal to that of dark leafy vegetables (2).

Ways of Using Wheatgrass

The leaves of the wheatgrass are usually crushed and squeezed to produce juice as they are difficult to digest. Wheatgrass leaves may also be dried and rendered into tablets or capsules. Some people mix wheatgrass with water and use it as an enema to cleanse the digestive tract (2).

Health Claims Related to Wheat Grass

Some people use wheatgrass to combat regular health issues, including cold, cough, fever, stomach issues, and skin conditions, etc. Wheatgrass has also been used for the prevention and treatment of more severe illnesses, from cancer to AIDS. Chlorophyll, a pigment that gives plants their green colour, is the strong ingredient in wheatgrass, according to some researchers.

They claim that chlorophyll works like haemoglobin (the protein carrying oxygen in red blood cells) and raises the oxygen levels of the body. Supporters of wheat grass have put forward numerous arguments for its health benefits, ranging from the betterment of general well-being to the cancer prevention.

According to the American Cancer Society, however, "the scientific data available does not support the belief that wheatgrass will cure or prevent illness (3). Despite all the health claims, there is very little, if any, evidence that wheatgrass actually acts to detoxify or prevent or cure illness. Here's what a few studies have found the wheatgrass can do.

Wheatgrass and Cancer

Wheatgrass may be a powerful addition to cancer treatment plans. A review of the studies conducted in 2015 found that wheatgrass has an anticancer potential (3). This may be how certain kinds of cells are destroyed by wheatgrass.

This could be because wheatgrass kills off certain kinds of cells. When used in combination with traditional cancer therapy, wheat grass can improve the immune system and allow the body to detoxify. To validate these results, broader studies are required.

Chemotherapy

A study was carried out in 2007 which showed that women with breast cancer undergoing chemotherapy reduced their toxicity levels by taking wheatgrass juice. Wheatgrass can also improve chemotherapy-induced myelotoxicity. Myelotoxicity decreases the activity of the bone marrow and can increase the risk of infection (4). A 2011 study reveals that wheatgrass has antioxidant properties that can help prevent cancer. The high nutritional value of wheatgrass helps to build a strong immune system, which is thought to keep the body healthy and free of disease. Some of the health benefits associated with wheat grass are as under:

Elimination of Toxins

Nutrients in wheatgrass help the body get rid of impurities and toxins stored. Chlorophyll for instance helps detoxify the body and helps to promote healthy liver function (1).

Aids Digestion

Wheatgrass has high levels of enzymes that help your body break down food and absorb nutrients to aid digestion. Detox effects of wheat grass cleanses the intestines and helps to relieve various types of digestive disorders such as gastritis, bloating, abdominal discomfort, constipation, irritable bowel syndrome etc (1).

Enhancing Metabolism

Drinking wheatgrass can improve metabolism and helps in weight loss (1).

Reduces Cholesterol Level

Wheatgrass is also known to reduce the level of cholesterol which lowers the risk for developing heart diseases (1).

Improves Immunity

Wheatgrass improves the activity of immune system which helps in preventing infection and disease (1).

Lowers Blood Pressure

Wheatgrass helps in lowering blood pressure in people suffering from hypertension (1).

As Energy Booster

Wheat grass helps to boost up the energy level in the body (1).

Improving Cognitive Performance

Wheatgrass can enhance general mental function and reduce anxiety. It helps to reduce loss of memory and can be used to enhance coordination between hand and eye. Its neuroprotective effects make it possible to improve cognitive function and can help prevent and treat Alzheimer's disease (1).

Help with Diabetes

Wheatgrass has been found to improve blood sugar levels in people with diabetes (1).

Help in Arthritis

The anti-inflammatory properties of wheatgrass may relieve symptoms such as stiffness, pain, and swelling (1).

Improving the Signs of Ulcerative Colitis

A study conducted in 2002 by researchers in Israel found that treatment with wheatgrass juice relieved the symptoms of ulcerative colitis-colon inflammation. More analysis needs to be done, but this shows the potential benefits of wheat grass (1).

Reduce Side Effects of Chemotherapy

Although there is no definitive evidence that wheatgrass can suppress tumours in cancer patients or improve survival, a preliminary study of 60 women with breast cancer found that wheatgrass decreased some of the adverse effects of chemotherapy without altering the efficacy of treatment (1).

Risks Related to Wheatgrass Consumption

While wheat grass is considered to be safe, its side effects have been documented in some cases, especially at high doses. Some common side effects include mild to more severe allergic reactions (hives and swelling of the throat), headaches and nausea. Since most people consume raw wheatgrass, there is also a rare chance that it may be infected by bacteria or other soil species.

Is it Safe to Use Wheatgrass?

People can consume a small quantity of wheat grass procured from a reliable company. However, individuals with weakened immunity, pregnant or nursing women and children should avoid using wheat grass due to the possibility of bacterial infection.

References

1. https://www.webmd.com/food-recipes/wheatgrass#1.
2. "Wheatgrass". WebMD.
3. "Wheatgrass". American Cancer Society. November 2008. Archived from the originalon May 2, 2015. Retrieved February 10, 2017.
4. Bar-Sela G, et al. (2007). Wheat grass juice may improve hematological toxicity related to chemotherapy in breast cancer patients: a pilot study [Abstract]. DOI: dx.doi.org/10.1080/01635580701308083.

Nutritional Genomics

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Introduction

Nutritional genomics helps to examine dietary signatures in cells, tissues and organisms and to understand how nutrition influences homeostasis. It is the interface between the nutritional environment and cellular / genetic processes. There is an interacting two-way relationship between nutrition and the human genome. Nutritional genomics defines and marks the gene expression and metabolic response. Nutritional genomics helps in visualizing the individual's health condition and their level of susceptibility to disease. Firstly, the genetic background of the individual can be pictured with the nutrient state, metabolic response, and susceptibility to diet-dependent or related health disorders. Secondly, the role of nutrients in regulating the transcription factors that modify the gene expression, up or down, consequently, adjust the metabolic responses can be identified at the molecular level.

Basic Tenets of Nutrigenomics

1. Improper diets are risk factors for disease.
2. Dietary chemicals alter gene expression and or change genome structure.
3. The degree to which diet influences the balance between healthy and disease states may depend on an individual's genetic makeup.
4. Some diet – regulated genes are likely to play a role in the onset, incidence, progression and or severity of chronic diseases.

Identification of Difference Among Individuals DNA

Most of the genes have small sequence differences – polymorphisms – that vary among individuals. Single Nucleotide Polymorphism (SNP) are the most common type of variation. Specific genetic polymorphisms in human populations change their metabolic response to diet and influence the risk patterns of disease. Some SNPs change the recipe for the gene so that either a different quantity of the protein is produced or the structure of the protein molecule is altered.

Diet – Disease Interactions

Nutrient deficiency or excess, oxidative stress and calorie excess causes DNA strand breaks, DNA hypomethylation and also telomere shortening all these leads to unstability of the genome. For example, in case of phenylketonuria – high protein food such as fish, chicken, egg, milk, cheese can be avoided. Phenylketonuria (PKU) was the first genetic disease in which a gene-diet interaction was described. People with PKU lack the enzyme required to metabolize phenylalanine, an essential amino acid found in dairy, meat, fish, nuts and pulses, with the result that dangerous levels of phenylpyruvic acid may build up which are toxic to the brain Thus, individuals with PKU need to stick to a low phenylalanine diet for life to avoid PKU symptoms.

1. Direct interactions: Nutrients after interacting with a receptor, behave as transcription factors that can bind to DNA and induce gene expression.

2. Epigenetic interactions: Nutrients can alter the structure of DNA so that gene expression is altered.

3. Genetic variation: Common genetic variations such as Single Nucleotide Polymorphisms (SNPs) can alter the expression or functionality of genes.

Conclusion

Nutritional genomics helps in focusing on a healthy diet and lifestyle with increased awareness of risk of certain conditions. It helps in better understanding of the mechanisms involved in disease susceptibility through which disease morbidity and premature mortality can be avoided.

References

1. Kaput, J. and Rodriguez, R.L. (2004). Nutritional genomics: the next frontier in the postgenomic era. Physiological genomics, 16(2): 166-177.
2. Mead, M.N. (2007). Nutrigenomics: the genome–food interface. Environmental Health Perspectives, 115 (12): A582-A589.
3. Neeha, V.S. and Kinth, P. (2013). Nutrigenomics research: a review. Journal of Food Science and Technology, 50(3): 415-428.
4. Singh, R. and Sharma, L. (2019). Nutrigenomics: A combination of nutrition and genomics: A new concept. International Journal of Physiology, Nutrition and Physical Education, 4(1): 417-421.

Farmer Producer Organizations: Status and Factors Affecting its Performance

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Introduction

Agriculture plays a pivotal role in Indian economies. About more than 85 per cent of population of India are small and marginal with average land-holding of 1.16 ha (B.H. et.al, 2018). In developing countries smallholder agriculture is important for economic development and poverty reduction but due to low bargaining power of small farmers a huge gap exist between farmer and consumer as a result farmer tends to depend on monoculture, so institutional support is needed for overcoming the market failure (B.H. et al., 2018). Hence govt. of India felt the need of formation of producer organization which acts as vehicle for improving the agricultural performance of smallholder farmer through active market participation thereby enhancing living condition of resource poor farmer and diversifying the farm income (Ramappa and Yashashwini, 2018). In India, the Companies Act, 1956, was amended in 2002 to allow for the incorporation of producer organizations, on the basis of the recommendations of Y. K. Alagh committee. SFAC is the nodal agency to coordinate between the states and act as single window for the technical advice and investment needs. Producer Organization Development Fund (PODF) has been created by NABARD to promote the FPOs. The aim of FPO is to enhance farmers' competitiveness and to increase their advantage in the emerging market opportunities by helping them in the entire cultivation practices from production to marketing of the produce thereby increasing the bargaining power of smallholder farmer. FPO offers its beneficiaries with technical advice, consultancy services, improve their production efficiency, reduce the transaction costs, training, education, research and development. So, keeping this in view the topic has been selected with the objective to know the status of Farmer Producer Organization and the factors affecting its performance.

Status of FPOs

Table 1, indicates that in all India level total number of FPOs promoted by SFAC is 876 and a total of 872297 numbers of farmers were linked to FPOs as against the target of 892409 numbers of farmers. Among the states the number of farmers mobilised towards FPOs by SFAC are highest in Madhya Pradesh with 138844 farmer members followed by Karnataka and Maharastra. SFAC promoted the largest number of FPOs in Madhya Pradesh followed by Karnataka with 149 and 121 FPOs respectively. As shown in table2, NABARD has promoted 2096 numbers of FPOs and a total of 888706 farmers were linked to FPOs. Tamilnadu has mobilized 122783 numbers of shareholders towards FPOs and a total of 170 FPOs were promoted in Tamilnadu by NABARD which is highest among the states. On the whole, the number of farmers linked to FPOs are highest in Madhya Pradesh which is promoted by SFAC. However, in case of total number of FPOs, Tamilnadu has largest number of FPOs and is promoted by NABARD. So largest number of FPOs is promoted by NABARD but SFAC linked larger number to FPOs. On an average the SFAC promoted FPOs have larger number of farmers being linked with 995.77 farmers per FPO than that of NABARD promoted FPO with 424 farmers per FPO. However, Table 3, provides information regarding State-wise number of promoting institutions involved in formation of FPOs. Promoting institutions play a crucial role in the formation and functioning of FPOs by providing technical and financial help to them. Promoting institutions gain fund from NABARD and SFAC for mobilizing the farmers. NABARD has 818 number of promoting institutions which is more than SFAC as it has promoted only 127 number of promoting institution. Among the states Karnataka (85) has highest number of promoting institutions constituting about

8.9 % of the total promoting institutions in Karnataka (78) followed by Uttar Pradesh (77) and in case of SFAC highest number of promoting institution is found in Madhya Pradesh (21) followed by Assam (12).

Table 1: State-wise progress of FPOs promoted by SFAC (As on 31.10.2020):

States	Total Targeted Farmer	No. of Farmers	No. of FPOs	Farmers/FPO
Andhra Pradesh	15300	12557	12	1046.41
Arunachal Pradesh	4750	4270	4	1067.5
Assam	10500	10831	1	722
Bihar	35600	36423	38	958.5
Chhattisgarh	29000	29436	26	1132.15
Delhi	3500	3535	4	883.75
Goa	1750	1810	2	905
Gujarat	24000	22438	25	897.52
Haryana	12750	14081	23	612.21
Himachal Pradesh	7150	7703	8	962.87
Jammu & Kashmir Jammu (Division) Srinagar (Division)	 5481 4080	 5854 4090	 1 1	 5854 4090
Jharkhand	12000	12009	10	1200.9
Karnataka	128500	125662	121	1038.52
Madhya Pradesh	150000	138844	149	932
Maharastra	104500	105093	105	1000.88
Manipur	6950	6450	8	806.25
Meghalaya	3750	2990	3	996.66
Mizoram	2700	1700	1	1700
Nagaland	3750	3000	2	1500
Odisha	38900	38605	41	941.58
Punjab	6000	6288	7	898.28
Rajasthan	60500	59662	50	1193.24
Sikkim	15750	16265	30	542.16
Tamil Nadu	17000	15070	13	1159.23
Telangana	29998	29268	22	1330.36
Tripura	5750	3142	4	785.5
Uttarakhand	6000	6004	7	857.71
Uttar Pradesh	56000	56962	56	1017.17
West Bengal	90500	92255	88	1048.35
Total	**892409**	**872297**	**876**	**995.77**

Source: Small Farmers' Agri-Business Consortium

Table 2: State-wise progress of FPOs promoted by NABARD:

State	No. of Districts	No. of shareholders	No. of FPOs	Farmers/FPO
Andaman and Nicobar	2	307	3	102.33
Andhra Pradesh	13	46692	95	491.49
Arunachal Pradesh	5	969	6	161.5
Assam	17	14280	40	357
Bihar	32	39855	118	337.75
Chhattisgarh	15	24773	57	434.61
Delhi	1	10	1	10
Goa	1	104	2	52

Gujarat	22	36725	117	313.88
Haryana	17	25740	50	514.8
Himachal Pradesh	9	10731	51	210.41
Jammu and Kashmir	10	1548	13	119.07
Jharkhand	21	30805	63	488.96
Karnataka	27	76035	159	478.20
Kerala	14	53519	132	405.44
Lakshadweep	1	50	1	50
Madhya Pradesh	36	69750	160	435.93
Maharastra	21	39698	119	333.59
Manipur	5	2956	8	369.5
Meghalaya	6	1459	9	162.11
Mizoram	7	3266	16	204.12
Nagaland	1	1379	5	275.8
Odisha	28	54285	100	542.85
Punjab	20	8435	70	120.5
Rajasthan	28	56927	143	398.09
Sikkim	1	856	4	214
Tamil Nadu	31	122783	170	722.25
Telangana	19	23157	68	340.54
Uttar Pradesh	43	46459	116	400.50
Uttarakhand	13	17628	50	352.56
West Bengal	18	77525	150	516.83
Total	**484**	**888706**	**2096**	**424**

Source: NABARD Portal on Farmer Producers' Organisations (Promoted under PRODUCE Fund)

Table 3: State-wise number of promoting institutions involved in formation of FPOs:

State/Union Territory	NABARD	SFAC	Total	Percentage
Andaman and Nicobar	1	0	1	0.11
Andhra Pradesh	57	3	60	6.35
Arunachal Pradesh	1	2	3	0.32
Assam	29	12	41	4.34
Bihar	52	4	56	5.93
Chhattisgarh	31	6	37	3.92
Delhi	0	4	4	0.42
Goa	1	2	3	0.32
Gujarat	32	5	37	3.92
Haryana	17	5	22	2.33
Himachal Pradesh	18	2	20	2.12
Jammu and Kashmir	6	1	7	0.74
Jharkhand	36	3	39	4.13
Karnataka	78	7	85	8.99
Kerala	73	0	73	7.72
Madhya Pradesh	38	21	59	6.24
Maharashtra	19	10	29	3.07
Manipur	4	1	5	0.53
Nagaland	0	1	1	0.11
Meghalaya	4	1	5	0.53

Mizoram	7	1	8	0.85
Odisha	34	4	38	4.02
Punjab	9	2	11	1.16
Rajasthan	57	5	62	6.56
Sikkim	4	2	6	0.63
Tamil Nadu	25	4	29	3.07
Telangana	42	5	47	4.97
Tripura	1	2	3	0.32
Uttar Pradesh	77	6	83	8.78
Uttarakhand	36	2	38	4.02
West Bengal	29	4	33	3.49
All India	**818**	**127**	**945**	**100**

Source: Progress and Performance of States in Promotion of Farmer Producer Organisations in India

Factors Affecting Performance of FPOs

1. Growth and development of FPOs have faced various issues and challenges such as funding, capacity building, value chain investments, lack of appropriate structure for FPOs etc.
2. Viability of FPOs depends on number of farmers but tends of large and influential farmers to join cooperatives, poor skills of professionals of the Producer Companies, poor marketing and value addition capacity may affect their viability (Ramappa and Yashashwini, 2018).
3. For proper handling of FPOs, it may require financial support from the government so govt. should focus on this aspect.
4. The small and marginal farmers have no idea about how to run a registered company and even some of FPOs lack skill for preparation of feasible business Plans, so managerial support is needed from the side of the government.

Conclusion

Most of the marginal and small farmers faced suppression daily by the middle men for remunerative price, so formation of FPO is the best solution for enhancing the income of farmers. FPO plays a major role in integrating both forward and backward linkages in the agricultural sector with the objective to enhance their livelihoods through reduced cultivation and transaction costs. In the process of development, FPOs faces many problems so it is important to equip farmers with the capacity to respond to the changing agricultural environment through extension support, necessary training and providing proper knowledge and information.

References

1. Anonymous. NABARD Portal on Farmer Producers' Organisations (Promoted under PRODUCE Fund). Retrieved from, https://nabfpo.in/images/staticFPO.html
2. Anonymous. Small Farmers’ Agri-Business Consortium. Retrieved from, http://sfacindia.com/UploadFile/Statistics/State%20wise%20summary%20of%20registered%20and%20the%20process%20of%20registration%20FPOs%20promoted%20by%20SFAC%20(as%20on%2030%20September%202020).pdf?var=9958908.25855
3. B.H. M., Kumar P., P P., Anbukkani P., Kar A., Jha G.K. and Rao D.U.M., (2018). Progress and Performance of States in Promotion of Farmer Producer Organisations in India. Indian Journal of Extension Education. 54(2):108-113.
4. Ramappa K. B. and Yashashwini M. A., (2018). Evolution of Farmer Producer Organizations: Challenges and Opportunities. Research Journal of Agricultural Sciences. 9(4): 709-715.

Organic Cultivation of Medicinal and Aromatic Plants

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Introduction

Medicinal plants have been used by humans since many years back for getting rid of several suffering and ailments. The practices of indigenous systems of medicine in India are based mainly on the use of these plants. These systems include Ayurveda, Siddha, Unani, and many other indigenous practices. Charaka Samhita (1000 BC-100 AD) records the use of 2000 plants for cure different diseases. In present, about 80 per cent of the population of developing countries relies on traditional plant-based medicines for their health requirements. The people are still relying and more focusing on traditional system of medicine for solving health care problems. Due to significant use of medicinal plants in health care sector, it is important to increase production. The use of organic farming methods, found to be improving the yield and quality of produce. The organically grown medicinal and aromatic crop plants produce high plant yield as well as the physical and chemical quality of compound extracted was found more as compared to traditional method. Organic farming is an alternative to chemical agriculture. As, organic method of production avoid the use of artificial fertilizers, pesticides, growth accelerators and rely on crop rotation, farm yard manure, compost, vermin-compost, beneficial micro-organisms and biological control of diseases and pest. Organic farming provides the social benefits like, potential effects on the public health system, natural resources, livestock, water and improvement of soil fertility. Organic farming is economically more feasible in areas where resources are available within the farm and least dependent on external resources. The areas like North Eastern region of India and other hilly areas, where a lot of biomass is available from forest, weeds, crops etc. organic farming would be more economical. The main objective of organic farming is to feed the soil rather than the crops to maintain optimum soil health.

Organic Inputs and their Effects

In organic cultivation compost act as a soil conditioner and organic fertilizer; and provide biological control against various plant pathogens. Aqueous extracts of compost have also been suggested to replace synthetic fungicides. Many previous and ongoing researches concluded that application of compost improves soil structure, fertility and consequently development and productivity and essential oil content of medicinal plants.

Vermicompost has been found beneficial for growth and development of medicinal plants, as it contains most nutrients in plant-available forms such as nitrates, phosphates, and exchangeable calcium and soluble potassium. It has been reported that it is rich in microbial population and diversity, particularly fungi, bacteria and actinomycetes these microorganisms produce plant growth regulators which also contribute in better health of the plant.

Mycorrhizal fungi are beneficial microorganisms which promote the plant growth and health and hence, have been considered as bio-fertilizer. It enhances the uptake of immobile nutrients such as Phosphorus, Zinc and Copper. Resistance against biotic and abiotic stresses has been argued to be due to the effects of arbuscular mycorrhizal fungi on inducing plant hormones production. Mycorrhizal inoculation increases the percentage of essence and essence yield by improving the mineral nutrition in plant.

Phosphate solubilizing microorganisms are another kind of bio-fertilizers which have the ability to solubilize organic and inorganic phosphorus compounds by producing organic acid or phosphatase enzyme to make them available for plants. Many studies showed that these bacteria have a synergistic effect with mycorrhizal fungi and co-inoculation of them leads to more absorption of water and soil minerals and increases growth of host plant. It is believed that, inoculation of soil with bacterial mixtures caused a more balance nutrition for plants and improved the root uptake of nitrogen and phosphorus in a main mechanism of interaction between phosphate solubilizing and bacteria nitrogen fixing.

Merits of Organic Farming

1. Organic farming is economically feasible in areas where farm and forest resources availability is high like North Eastern region of India and other hilly areas.
2. Input used in organic farming is easily available and most of the recourses are from farmer field itself.
3. Cost of cultivation of organic farming is low as compare to the traditional method.
4. In organic farming a lot of emphasis is given on ecosystem conservation and maintenance.
5. Organic matter improves physico-chemical and biological properties of soil.
6. Production is of more quality; in case of medicinal plant the essential oil content is higher than the traditional system of farming.
7. Effective utilization of plant biomass, manure, animal excreta that has the potential to create pollution are composted and recycled in organic crop production.
8. Organic produce are known to be richer in health benefits and also have high micronutrients, vitamins and other quality parameters.
9. All the essential macro and micro nutrients are present in soil as plant available form.
10. Organic matter recycling is renewable and thus energy resources can be made available for organic production.
11. Organically grown crops are preferred most by people as it is believed to be more nutritious compared to the conventional ones.
12. Organic produce fetches more prices in the national and international market. Thus, increase the farmer income.

Conclusion

Medicinal and aromatic plants perform better in terms of yield and quality under organic farming system. At present excessive application of the chemical fertilizer caused decreases in quality of the products but also in residual effect leads to enter the food chain and threat to human health. But the organic manures along with improvement in the yield and also provide the organic matter and nutrients to the soil, ultimately improve the soil health. This system is economically more feasible in areas especially North Eastern region of India and other hilly areas, where resources are available within the farm are in abundance.

References

1. Hoitink HAJ, Grebus ME. 1994. Status of biological control of plant disease with composts. Compost Science Utilization 2, 5–12.
2. Rashid M, Khalil S Ayub N, Alam S, Latif F. 2004. Organic Acid Production and Phosphate Solubilization by Phosphate Solubilizing Microorganism (PSM) under in vitro Conditions. Pakistan Journal of Biology Science 7, 187- 196.
3. Sharma AK. 2002. Bio-fertilizers for sustainable agriculture. Agrobios Indian Pub, 407 p.

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Influence of Different Sources of Nutrients on Yield of Lettuce (*Lactuca sativa* L.)

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Introduction

Lettuce (*Lactuca sativa* L.) is an important leafy vegetable grown throughout temperate regions of the world. It does the best in cool environment and not takes kindly to extreme heat or cold. It is popular for its delicate, crispy texture and slightly bitter taste with milky juice as fresh condition. It is the most popular amongst the salad vegetables (Squire et al. 1987). The plant had a root system that includes a main tap root and smaller secondary roots. It generally has a height and spread of 15 to 30 cm and have short stem. The leaves are simple and alternately arranged and are colourful mainly in green and red colour spectrum. Its inflorescence also known as flower heads or capitula are composed of multiple florets, each with a modified calyx called a pappus. The pappus remains at the top of each fruit as a dispersal structure. The fruit contains one seed, which can be white, yellow, Gray or brown depending on the variety of lettuce.

Lettuce is a good source of Vitamin A and minerals like calcium, iron and folic acid. High content of magnesium in its juice is good for muscular tissues, nerves and brain. Lettuce leaves contain 95.1% moisture per 100g, 1.2g protein, 0.2g fat, 2.5g carbohydrate, 900 IU Vitamin A, 0.06mg Thiamin (B1), 0.06mg Riboflavin (B2), 0.4mg Niacin (B3), 8mg Ascorbic acid (Vitamin C), 35mg calcium, 26mg phosphorus, 2mg iron. The plant had been used in traditional medicines since many decades for many ailments including inflammation, pain, stomach problems including indigestion, lack of appetite, bronchitis, urinary tract infections (Ismail et al. 2015).

It mainly originated in the Mediterranean region. Lettuce was first brought to the Americas from Europe by Christopher Columbus in the late 15th century. It was cultivated at the first time in ancient Egypt. China is the largest producer and consumer of lettuce. In 2017, world production of lettuce was 27 million tonnes, with China alone producing 15.2 million tonnes i.e., 56% of the world total. India ranks 3rd in commercial production of lettuce occupying 4% of world's total production after China and USA. Total production of India was 1.1 million tonnes. The important lettuce growing countries include China, USA, India, Spain, Italy, Iran, Japan, Turkey, Mexico and Germany.

Recently, it has been largely cultivated in greenhouses. Cultivating lettuce without soil may lead to greater quantity and quality (Silber et al. 2003). It was best cultivated in sandy loam or silt loam soil, well supplied with organic matter. Plant spacing for lettuce cultivation is an important criterion for attaining maximum vegetative growth and an important aspect of crop production for maximizing the yield. Optimum plant spacing ensures judicious use of natural resources and makes the intercultural operations easier. It helps to increase the number of leaves, branches and healthy foliage. Densely planted crop obstructs the proper growth and development. On the other hand, wider spacing ensures the basic nutritional requirements but decrease the total number of plants as well as total yield. Yield may be increased for any crop up to 25% by using optimum spacing in leafy vegetable (Bansal et al. 1995).

Nutrient Management in Lettuce

Organic manures played a vital role in the maximum profitable production of lettuce with sustaining soil fertility. The experiment was performed to absorb the growth and the yield of lettuce under different organic fertilizer application, to find out the suitable organic fertilizer for higher production, and to investigate the proper dose for the maximum production of lettuce. Organic fertilizer was used to reduce the number of toxic compounds (such as nitrates) produced by conventional fertilizers in vegetables like lettuce and hence, improved the quality of leafy vegetable as well as human health (Masarirambi et al. 2010). The application of organic fertilizers in lettuce increased the yield and the nutrient content in plants. Knowing that leafy vegetables respond well to organic manure obtained from an experiment with lettuce had concluded that organic matter mineralization contributed for nutrients to plants supplying their needs during development, because the area was managed with organic practices (Oliveira et al. 2010).

The application of biological or organic fertilizers alone cannot provide required N and P completely, but application of both organic sources of nutrients with the chemical fertilizer will be effective in increasing yield of lettuce. In combination of fertilizers, essential nutrient elements for plants have been provided, thus dry matter and yield will be increased. Application of organic nutrient sources combined with chemical fertilizer played an important role to maintain and improve the soil fertility and increased the fertilizer use efficiency and improved crop yield (Xu et al. 2008). Considering the positive effects mentioned for organic and bio fertilizers, integrated use biological fertilizer with chemical and organic fertilizers increased yield of lettuce. Application of organic fertilizer alone decreased the most vegetative growth characteristics as compared to application of chemical fertilizer alone.

Organic farming is appreciated by vegetable consumers as it enhances the quality of the produce. Lettuce being a salad crop, organic cultivation of this crop is preferable, which increases its quality with minimum residual effect. Organic manure plays a direct role in plant growth as a source of all necessary macro and micronutrients in available forms during mineralization and improves physical and chemical properties of soils (Chaterjee et al 2005).

Benefits of Lettuce

1. Lettuce good for insomnia: Cutting or breaking lettuce leaves reveal a white liquid called lactucarium that helps to deal with insomnia.
2. Lettuce protects against diseases: Lettuce possesses antioxidants that act against the free radicals in our bodies which are formed due to cellular metabolism.
3. Lettuce good for cancer patients: Lettuce leaf extracts can prevent the spread of leukaemia cells and breast cancer cells and protect the body from lung and oral cavity cancers.

4. Lettuce helps in improving body metabolism: Due to the presence of iron, magnesium and potassium, lettuce intake helps to improve the metabolic processes in our body. Lettuce also contains Vitamin B-complex which aids our metabolism.
5. Lettuce good for heart patients: Lettuce prevents the oxidation of cholesterol and thus protects our heart against diseases.
6. Lettuce prevents harm to neuronal cells: Extracts from lettuce, due to its significant role in glucose or serum deprivation, help to prevent death of neuron cells.
7. Lettuce has antimicrobial properties: Lettuce has antimicrobial properties and helps to fight the harmful microbes that may cause various diseases.
8. Lettuce leaves for anxiety: Lettuce has anxiolytic properties that help to control anxiety. Lettuce has a role in neurological health process and so helps to deal with mental problems such as depression.
9. Lettuce helps to remove toxins: Minerals present in lettuce help to remove the toxins from our body. This helps to maintain the acid balance.
10. Lettuce has anti-inflammatory properties: Lettuce extracts have anti-inflammatory properties due to the presence of biocatalysts like lipoxygenase and carrageenan.

References

1. Bansal GL, Rana MC and Upadhyay RG. 1995. Response of grain amaranth (Amaranthus hypochondriacus) to plant density. Indian Journal of Agricultural Science. 65 (11): 818-820.
2. Chaterjee B, Ghanti P, Thapa U, Tripathy P. 2005. Effect of organic nutrition in sprouting broccoli (Brassica oleraceae var. Italic Plenck). Vegetable Science. 33(1): 51-54.
3. Ismail H and Mirza B. 2015. Evaluation of analgesic, anti-inflammatory, anti-depressent and anti-coagulant properties of Lactuca sativa (cv. Grand Rapids) plant tissues. Complementary and Alternative Medicine. 15:199.
4. Masarirambi MT, Hlawe MM, Oseni OT and Sibiya TE. 2010. Effects of organic fertilizers on growth, yield, quality and sensory evaluation of red lettuce (Lactuca sativa L.) 'Veneza Roxa'. Agriculture and Biology Journal of North America. 1(6):1319-1324.
5. Oliveira EQ, Souza RJ, Cruz MCM, Marques VB and Franca AC. 2010. Lettuce and arugula yield in consorted systems under organic and mineral fertilization. Horticultura Brasileria. 28: 36-40.
6. Silber A, Levkovitch G, Soriano, Xu.I, Bilu S, Wallach AR. 2003. High fertigation frequency- the effects on uptake of nutrients, water and plant growth. Plant and soil. 253:467-477.
7. Squire GR, Ong CK, Monteith, JL. 1987. Crop growth in semi-arid environment. International Crops Research Institute for Semi-Arid Tropics, Patancheru, Hyderabad. Pp 219-231.
8. Xu M, Li D, Li J, D Q, Kazuyuki Y, Hosen Y 2008. Effect of organic manure application with chemical fertilizers on nutrient absorption and yield of rice in Hunan southern China. Agricultural Sciences in China. 7(10):1245-1252.

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Genetic Gain and Ways to Enhance it

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Summary

For modern technology-driven plant biology, where biologists presented challenges and computational scientists offered solutions, an integrated plant breeding platform involves a multidisciplinary collaboration. A fully functional breeding pipeline should also include a robust, user-friendly, well supported information and breeding management system, regional biometric support, and a mechanized, semi- or fully automatic field and breeding operation Experience from multinational corporations shows that their breeding focus to increase genetic gain and protect productivity for many major crops has been built on a base of extensive genetic diversity that can be harnessed with new genomic and data technologies.

Advances in biological science and technology, which involve genomics, informatics, modelling, communication technologies, satellite imaging, remote sensing, and precision farming and agriculture, have contributed significantly to increasing crop productivity. Omics approaches, high-throughput genotyping, and transgene and genome editing will play an important role in unlocking and creating genetic variation.

Introduction

The current breeding tools followed in food crops are inadequate to meet future demand of 60-80% more food for growing population by 2050. An enhancement of genetic gain at higher rates is a challenge for breeder and it is not realized as same in breeder's experimental station and farmer's field.

Further, the changes in climatic patterns, arable land, and water availability are providing additional challenges for ensuring yield stability across diverse environments and for closing the yield gap1. Genetic improvement has been described by the concept of genetic gain which can be defined as the amount of increase in the performance that is achieved through artificial selection.

Genetic Gain

Genetic improvement or breeding progress has been described by the concept of genetic gain, and measured by the difference between a selected population and its offspring population, Genetic contributions, first formalized by James and McBride (1958), have underpinned the development of methods for maximizing genetic gain while managing inbreeding and loss of genetic diversity (Woolliams et al., 2015).

In the molecular breeding era, the expected genetic gain per year can be defined as: $\Delta G = i\ r\ \sigma A/t$, where ΔG is the response to selection, i is the intensity of selection (mean deviation of selected individuals in units of phenotypic standard deviation), r is the selection accuracy, σA is the standard deviation of breeding values (Falconer and Mackay, 1996) or genetic standard deviation (the square root of the additive genetic variance), and t is the breeding cycle time.

In the context of genomic selection (GS), r is the correlation between true breeding values (TBVs) and genomic-estimated breeding values (GEBVs), while in the context of phenotypic selection, r is equal to the square root of the narrow-sense heritability (h), and thus $\Delta G = i\ h\ \sigma A/t$.

How to Enhance the Genetic Gain

The factors responsible for genetic gain are genetic variation, heritability (Selection intensity), selection accuracy and accelerating the breeding cycle.

Unlocking and Creating Favourable Genetic Variation

Genetic variation provides the foundations for selection response in plant breeding. Selection results in the change of allele and gene frequencies in the target population due to differential reproduction of genotypes results in change genotypic and phenotypic values for the trait.

Genetic variation affected by Size of the population gene flow, mutation, it is due genes, their interaction, action masked by environment Germplasm, landraces, wild relatives' ecotypes, subspecies, elite types are hub of genes these have to be exploited by QTLS, haplotyping. Creation of variation by gene pyramiding, cisgeneic approaches, transgenics and genome editing.

Full Coverage of Genetic Variation

Whole genome sequencing through broad and deep re-sequencing, the number of single nucleotide polymorphisms (SNPs) discovered increases as a function of sample size (Fig. 3B). For most crop species, however, sequencing has been largely based on single reference genomes.

The first step in the sequencing effort has left huge gaps in detection of genetic variation (Fig. 4). First, single genomes are usually sequenced with ~80–90% coverage due to the limitation of sequencing technology, and, in most cases, only one genotype, usually representing a domesticated elite variety, has been sequenced with relatively high resolution and precision.

Functional Diversity

Traditional molecular markers such as restriction fragment length polymorphisms (RFLPs) and many PCR-based markers are developed from sequence polymorphisms which do not have any relationship to functional genes or alleles. New generation markers, such as SNPs, CNVs, PAVs, and their alleles and haplotypes provide high resolution of genetic diversity so that they can be easily associated with genes and their functions. Recent developments in genome sequencing make it possible to construct haplotype maps to cover an entire genome.

Creation of Genetic Variation

Mutagenesis: EcoTILLING examines an accession (variety or inbred line) against a reference genome in a one-on-one comparison with a reference genome. It can define unique patterns for individual accessions, identify a wide range of haplotype diversity in target genes and patterns of SNPs shared among accessions in natural populations, and reveal selection in different gene regions (e.g., decreased diversity within exons versus introns) as well as among genes.

Both TILLING and EcoTILLING reveal point mutations and naturally occurring SNPs that influence amino acid sequence. TILLING screening can identify individuals with heterozygous recessive mutations, which are usually missed in phenotyping, and the polymorphism of the target gene can be used in MAS.

Genome editing: By inactivating genes, generating functional alleles, replacing mutant alleles, or creating site-specific transgene integration, genome editing is used to make predicted changes in the DNA sequence or precisely insert exogenous DNA (Petolino et al., 2016).

Several engineered endonucleases can precisely target a specific DNA sequence to create double-stranded DNA breaks (DSBs), including zinc-finger nucleases (ZFNs) (Carroll, 2011), transcription activator-like effector nucleases (TALENs) (Mahfouz et al., 2011; Li et al., 2012), and clustered regularly interspaced short palindromic repeats (CRIPSR)-associated systems (CRISPR/Cas).

Opportunities for Enhancing Genetic Gain

Genetic gain depends largely on selection of desirable recombinants that can be expected based on crossover events. Crossover events have been largely characterized through analyses of crossover-associated DNA sequence motifs, open chromatin signature, crossover landscape variation between male and female meiocytes and between species, preferential occurrence in promoter region, biased mismatch repair during meiotic recombination, and GC content gradient Gene stacking is relevant to enhancing genetic gain.

As many agriculturally important crops are recalcitrant to transformation with currently available protocols, development of high-efficiency gene stacking systems is crucial. Site-specific integration in plants is a necessary step towards serial DNA stacking through transgene additions or genome editing. MAS has been successfully used for gene stacking, and in a recent report, high-yield and superior (Xu et al. 2015) quality rice was developed through pyramiding major genes from three parents (Zeng et al., 2017).

To take all the opportunities for enhancing genetic gain, more transdisciplinary approaches, will be required. Synthetic biology will become increasingly important, by which plant breeders could design and engineer biologically based parts, novel devices, and systems that have never been seen in nature before as well as redesigning existing, natural biological systems (Kitney and Freemont, 2012).

High-Efficiency Breeding Pipeline

The key metrics by which breeding programs and seed systems in developing countries need to be assessed are:
1. The rate of genetic gain they deliver in farmers' fields.
2. The average age of varieties in farmers' fields.

As a part of these efforts, the project Genomic and Open-source Breeding Informatics Initiative (GOBII), supported by the Bill and Melinda Gates Foundation (BMGF), has been launched to put in place the systems, databases, analytical pipelines, and decision support tools that will allow plant breeders serving smallholders in the developing world to apply genomic information in variety development to increase genetic gain (Robbins et al., 2016; Varshney et al., 2016).

Conclusion

High-throughput precision phenotyping can be explored for improving heritability estimation, while envirotyping can be implemented for controlling environmental errors and improving phenotyping; The G–P–E typing strategies can be integrated and used for enhancing genetic gain, when combined with population management, a modern breeding pipeline, and standardization of breeding procedures.

Among currently available technologies, sequencing, genome editing, GS, and DH production are game changers that will significantly impact on genetic gain in plant breeding. High throughput and low-cost sequencing will result in a full genome capture of genetic variation that will facilitate marker development, gene discovery, and GS.

A high and sustained rate of genetic gain is a key component of agriculture transformation; the genetic gain delivered in farmers' fields is the key measure of effectiveness of a crop improvement system.

Research leaders, scientists, and the donor community must take responsibility for enhancing genetic gain, particularly in developing countries, which has been backed up by big donors, such as BMGF, that are committed to helping modernize and improve the international crop improvement system largely through establishment of public–private partnerships.

References

1. Abe A, Kosugi S, Yoshida K, et al. 2012. Genome sequencing reveals agronomically important loci in rice using MutMap. Nature Biotechnology 30, 174–178.
2. Abudayyeh OO, Gootenberg JS, Konermann S, et al. 2016. C2c2 is a single-component programmable RNA-guided RNA-targeting CRISPR effector. Science 353, aaf5573.
3. Akbari M, Wenzl P, Caig V, et al. 2006. Diversity arrays technology (DArT) for high-throughput profiling of the hexaploid wheat genome. Theoretical and Applied Genetics 113, 1409–1420.
4. Bernardo R. 2008. Molecular markers and selection for complex traits in plants: learning from the last 20 years. Crop Science 48, 1649–1664.
5. Chen L, Hao L, Parry MA, Phillips AL, Hu YG. 2014. Progress in TILLING as a tool for functional genomics and improvement of crops. Journal of Integrative Plant Biology 56, 425–443.
6. Golicz AA, Batley J, Edwards D. 2016. Towards plant pangenomics. Plant Biotechnology Journal 14, 1099–1105.

7. Heffner EL, Lorenz AJ, Jannink JL, Sorrells ME. 2010. Plant breeding with genomic selection: gain per unit time and cost. Crop Science 50, 1681–1690.
8. Poland J, Endelman J, Dawson J, et al. 2012a. Genomic selection in wheat breeding using genotyping-by-sequencing. Plant Genome 5, 103–113.
9. Springer NM, Ying K, Fu Y, et al. 2009. Maize inbreds exhibit high levels of copy number variation (CNV) and presence/absence variation (PAV) in genome content. PLoS Genetics 5, e1000734.
10. Varshney RK, Singh VK, Hickey JM, Xu X, Marshall DF, Wang J, Edwards D, Ribaut JM. 2016. Analytical and decision support tools for genomics-assisted breeding. Trends in Plant Science 21, 354–363.
11. Wang TL, Uauy C, Robson F, Till B. 2012. TILLING in extremis. Plant Biotechnology Journal 10, 761–772.
12. Zhao Y, Zhang C, Liu W, et al. 2016. An alternative strategy for targeted gene replacement in plants using a dual-sgRNA/Cas9 design. Scientific Reports 6, 23890.
13. Zuo W, Chao Q, Zhang N, et al. 2015. A maize wall-associated kinase confers quantitative resistance to head smut. Nature Genetics 47, 151–157.

Non-Conventional Feed Resources in Poultry

Article ID: 10225

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Most of areas in India are characterized by irregular rainfall and thus livestock and poultry have to survive on persistent shortage of feed resources of low nutritional value for most part of the year. The limited feed supply and poor-quality feeds which available are the main problem for optimal livestock and poultry productivity in our country. There is need to improve the scientific knowledge about utilizing low cost locally available agro-industrial by-products in poultry feed in order to reduce the feed cost. As feed constitutes 60-70 % of the total cost of production, any attempt to reduce the feed cost may lead to a significant reduction in the total cost of production. A major gap exists between the demand and supply of conventional feed resources for feeding livestock in the world. In order to manage this problem of demand and supply, it is essential to increase the availability of conventional feed resources for the different livestock production and management systems. But mostly poultry feeds have very low amount of fibre and essentially cereal based, as such often comprise between 50 and 75% of the diet. Cereal grains such as maize, grain sorghum, wheat, and barley contribute most of the carbohydrates to poultry diets. It is therefore clear that feeding of poultry presents a challenge to farmers. So, its need to improve the scientific knowledge for utilizing low cost locally available agro-industrial by-products in poultry feed in order to reduce the feed cost. There is need to improve the scientific knowledge for utilizing low cost locally available agro-industrial by-products in poultry feed in order to reduce the feed cost.

Increase in livestock and human population and decrease in land under cultivation have resulted in acute shortage of feeds and fodder for livestock which further increases due to natural calamities like droughts and flood. The feeds which are traditionally not used for feeding animals are called unconventional feeds. The non-conventional feed resources (NCFR) refer to all those feeds that have not been traditionally used in animal feeding and or are not normally used in commercially produced rations for livestock. NCFR include commonly, a variety of feeds from perennial crops and feeds of animal and industrial origin. The term NCFR has been frequently used to describe such new sources of feedstuffs as pallet oil mill effluent and palm press fibre (oil palm by-products), single cell proteins, and feed material derived from agro industrial by-products of plant and animal origin. Poor-quality cellulosic roughages from farm residues such as stubbles, haulms, vines and from other agro-industrial by-products such as slaughter-house by-products and those from the processing of sugar, cereal grains, citrus fruits and vegetables from the processing of food for human consumption also comes under category of NCFR.

With an increasing demand for livestock products as a result of rapid growth in the world economies and shrinking land area, future hopes of feeding the animals and safeguarding their food security will depend on the better utilization of unconventional feed resources which do not compete with human food.

Most of NCFR feed resources are low in energy, protein, minerals and contain high amounts of anti-nutritional components. The major constraints to the use of NCFR are a collection, storage, dehydration (due to high moisture content) and detoxification processes. Processing technologies that are economic and practical are urgently required. Some of the materials like sal seed meal, neem seed cake, mahua seed cake, and galas seed cake are available in large quantities but due to the presence of potentially toxic substances, have limited value in animal feeds. Many of the forest tree seeds contain 15-35 percent oil and are used for the extraction of oil, after which the cake is valuable as animal feeds. Animal organic wastes such as dung and poultry excreta are also available as a part of animal feeds.

Several other known examples of feed sources such as oil palm by-products, single-cell proteins and feed materials derived from agro-industrial by-products of plant and animal origin, poor-quality cellulosic roughages from farm residues and other agro-industrial by-products such as slaughter-house by-products and those from the processing of sugar, cereal grains, citrus fruits, palm leaf meals, palm press fibre, cassava foliage, spent brewer's grains, sugar cane bagasse, rubber seed meal and some aquatic plants

NCFR are mainly organic and can be in a solid, slurry or liquid form. NCFR economic value is less than that the cost of collection and transportation for use thus referred to as wastes. Some NCFR contain toxic factors and have some deleterious effect on animals such as castor bean meal and neem seed cake. NCFR are by-products of food production systems that have not been used, recycled or salvaged. NCFR have considerable potential as feed materials. In the case of feeds, their value can be greatly increased if processing techniques are employed.

Non-Conventional Poultry Feeds

The energy sources are deoiled salseed-meal, tapioca-meal, dried poultry waste, molasses, and small millets. The vegetable protein sources are mustard-cake, soybean-meal, cluster bean, sunflower seed-meal, safflower-mea, lramtil-cake, cotton-cake, maize gluten-meal and linseed-meal. Animal protein sources are blood-meal, liver residue-meal, silkworm pupae-meal, hatchery by-product-meal, feather-meal, poultry by-product-meal, meat and meat-cum-bone-meal

Limiting factors for the use of non-conventional feed are presence of naturally occurring anti-nutritional and/or toxic factors (alkaloids, non-starch polysaccharides, glycosides, tartrates, heavy metals) and presence of pathogenic micro-organisms (Salmonellae; present if waste is not processed/ sterilized properly), non-conventional feed resources need for supplementation of minerals and most limiting essential amino acids and also Processing requirements (drying, detoxification) (availability of machinery; knowledge of processing; energy source).

Shortage of feedstuffs in the future is an alarming issue at present trends in the poultry industry. A distinctive gap exists between the requirements and supplies of nutrients, the non-conventional feeds could partly fill this gap. Presently these by-products are not exploited to the full extent for inclusion in the poultry feed. Seasonal availability, high cost of handling and transportation from the production site to the farm, presence of antinutritional factors. It is essential to increase feeds by growing more fodders, propagating agro and social forestry, improving the nutritive value of crop residues and utilizing other NCFRs. Crop residues, AIBPs and browse foliage are certain an increasingly important role as feeds in the future, as human and livestock populations expand. The maximum and minimum level of incorporation of feed could be suggested. Biotechnology innovations & processing techniques could be done. Adoption of alternative feed resources in poultry nutrition will be a sure way to achieve the strategic plans on suitable animal production for national food security and poverty alleviation.

Herbal Feed Additive in Poultry

Article ID: 10226

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India has ranked third and fourth in production of egg and meat or poultry, respectively in the world. The whole poultry population in the nation was 851.81 million in the year 2019 (20th Livestock Census, DAHD, 2019), increased by 16.8% over 19th census. The poultry industry has become an important economic activity in many countries for the production of high-quality eggs and meat to balance the human diet. The economic and nutritional demand of our modern society for food from poultry has necessitated the raising of poultry under intensive production system. The poultry production has a very important position because of its low cost and huge potential in bringing fast economic growth in India, mainly for weaker sections of population.

Poultry feed represents approximate 70% of overall production cost, indicating the need of improving feed utilization. Efficient broiler production mostly depends on increase feed efficiency, enhanced body weight, heritable potential, environmental conditions, and disease resistance to lower the morbidity rate and death rate. The production of safer poultry products without any chemical and microbial residues in an economic manner is the order of the day.

The use of feed additives has been an important part of achieving this success. Recent trend in broiler production is to provide feed containing the feed additives to improve efficiency and get maximum returns in shortest possible time.

The term 'feed additive' is applied to all products other than feedstuffs, which could be added to the ration with the purpose of obtaining some special effects. Various types of feed additives such as antibiotics, coccidiostats, enzymes, antioxidants, probiotics, herbal products, buffers, hormones, organic acids, mould inhibitors, synthetic micronutrients etc., are being used as growth stimulants in poultry production and have well established their role in improving feed conversion ratio (FCR).

In 2006, European Union prohibited antibiotics utilization in the feed like feed additives because of its residual effects in animal tissues with gradual antimicrobial resistance in people. Therefore, nowadays herbs and phytobiotics are incorporated into poultry feed as natural growth promoters feed additives in broiler production in current years. The use of medicinal plants or herbs as feed additives to promote growth and health is gaining popularity worldwide due to their suitability and preference, low cost of production, reduced risk of toxicity, minimum health hazards and environment friendliness

Various herbs and plant extracts, and their essential oils have anti-microbial activities and antioxidant properties, which make them useful for quality safe meat production. In commercial broiler production, mainly powder forms or essential oils of Asafoetida (Ferula asafoetida), Cloves (Syzygiumaromaticum), Coriander (Coriandrumsativum), Fennel seed (Foeniculumvulgare), Fenugreek (Trigonellafoenum-graecum), Ginger (Zingiberofficinale), Turmeric (Curcuma longa), Ashwagandha (Withaniasomnifera), Tulsi (Ocimum sanctum) Oregano (Oreganumvulgare), Thyme (Thymus vulgare), Horseradish (Armoraciarusticana), Chilli (*Capsicum annum*), Peppermint (Menthapiperita), Cinnamon (Cinnamomum cassia), Anise (Pimpinellaansium), Black pepper (*Piper nigrum*), Rosemary (*Rosmarinusofficinalis*), Sage (*Salviaofficinalis*), and Garlic (*Allium sativum*) wereused singly or in combination as feed additives.

Valuable impacts of these substances may incorporate the stimulation of appetite and feed intake, the enhancement of endogenous digestive enzyme secretion, better immune response due to antioxidant, antimicrobial activities, hypocholesteremic, hypolipidaemic, anticoccidial,antidiabetic, anticoagulant, antiulcer, anti-inflammatory, nematocidal, antiseptic, hepatoprotective and immunomodulatory property. Recent research works on herbal formulations as feed additives have shown encouraging results as regards weight gain, feed efficiency, lowered mortality, enhanced egg production, reduced medicinal costs and better meat quality.

Thus, herbal feed additives supplementation can improve poultry production and can be used at optimum level to ensure safe meat for human consumption.

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Pineapple-Health Benefits

Article ID: 10227

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Scientific name: *Ananas comosus.*
Family: Bromeliaceae.
Origin: South America.

Botany of Pineapple

Pineapples grow as a small shrub, herbaceous perennial. Spike type of inflorescence is present in pineapple. The individual flowers of the unpollinated plant fuse to form a multiple fruit. The plant is normally propagated from the offset produced at the top of the fruit or from a side shoot (Sucker).

Species of Pineapple

1. Ananas comosus var. *ananassoides*
2. Ananas comosus var. *bracteatus*
3. Ananas comosus var. *comosus*
4. Ananas comosus var. *erectifolius*
5. Ananas comosus var. *parguazensis*

Benefits of Pineapple

Nutritional facts of pineapple:

a. Calories: 82.5.
b. Fat: 1.7 grams.
c. Protein: 1 gram.
d. Fiber: 2.3 grams.
e. Vitamin C: 131% of the RDI.
f. Manganese: 76% of the RDI.
g. Vitamin B6: 9% of the RDI.
h. Copper: 9% of the RDI.
i. Thiamin: 9% of the RDI.
j. Folate: 7% of the RDI.

k. Potassium: 5% of the RDI.
l. Magnesium: 5% of the RDI.
m. Niacin: 4% of the RDI.
n. Pantothenic acid: 4% of the RDI.
o. Riboflavin: 3% of the RDI.
p. Iron: 3% of the RDI.

*RDI –Recommended Daily Intake
Mostly Vitamin C and Manganese (131% and76%) were more in pineapple fruit.

Health Benefits

1. Reduces risk of heart disease and diabetics.
2. Aids good digestion.
3. It cures cancer.
4. Used to relieve an arthritis symptom.
5. Reduces swelling and inflammation.

Conclusion

Pineapple attains many nutritional facts for human beings. So eat a pineapple and get a fine life.

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Enzymatic Activities in Plant Parasitic Nematodes

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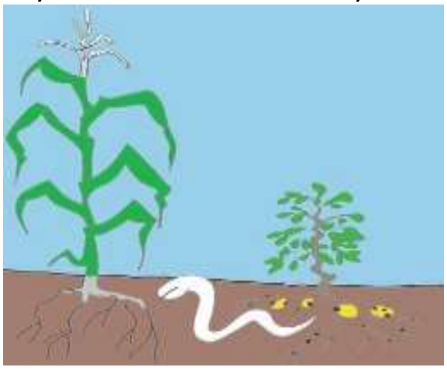
Nematodes parasitizing plant tissues cause mechanical damage with their stylets. Presumably, they also secrete hydrolytic enzymes from their esophageal glands which dissolve cell walls, enabling intracellular and intercellular movement of endoparasites which act as "digestive enzymes," digesting solid components of cells that can be imbibed by the parasite.

Examples

Strong lysis of cell walls in stems invaded by *Ditylenchus dipsaci* and in roots invaded by *Meloidogyne* spp. and *Heterodera* spp. does not seem to be only the result of the activity of enzymes secreted by nematodes.



What Happens to Plants?

1. The result of host metabolism disturbance some additional plant endohydrolases are activated or cellulose biosynthesis is disturbed. Such a high hydrolytic activity favours the rapid destruction of cell walls and protoplasts of the host plant.

2. Many hydrolases have been found in nematodes .The most common are cellulase, protease, and amylase. These hydrolases are the primary reason for metabolic changes caused by nematodes. Enzyme activities in nematodes are probably influenced by parasitic activities.

3. The hydrolytic nematode enzymes that destroy host cells may activate plant endohydrolases.

4. In this manner the total hydrolytic activity at the feeding site can increase. Treatment of plant tissues with pectolytic and cellulolytic enzymes involves the activity of oxidoreductases.

5. The area invaded by *M incognita* and *G. rostochiensis* hydrolase, oxidase and dehydrogenase activity was found to increase.

6. The oxidoreductases seem to be connected with susceptible-resistant response of plant tissues, as they are able to modify many physiologically active host cell components such as phenols, auxins and amino acids. In general, oxidation leads to maturation, differentiation, and senescence of cells.

7. On the other hand, reduction leads to cell division. Young and active cells are characterized by high "reducing power". It is possible to assume that redox potential in cells may determine the plant tissue response to nematode infection.

Enzymes	Nematode species
Pectinmethyl esterase	*Ditylenchus triformis, D. myceliophagus* and *D. dipsaci alfalfa race*
Nonspecific esterase	*Meloidogyne javanica* and *M. hapla*

Alkaline phosphatase	*Meloidogyne spp.*
Acid phosphatase	*D. triformis, Meloidogyne spp* and *Tylenchulus semipenetrans*
Amylase	*Aphelenchoides sacchari, T. semipenetrans, D. dipsaci, D. destructor, D. triformis, Heterodera schachtii, Globodera rostoechiensis* and *M. javanica*
Chitinase	*D. dipsaci, D. myceliophagus and D. destructor*
Cellulase	*A. avenae, A. sacchari, D. dipsaci, D. myceliophagus, D. triformis, Radopholus, similis, Helicotylenchus nannus, Pratylenchus penetrans, P. zeae, M. incognita and T. semipenetrans*
Polygalacturonase	*A. avenae, P. zeae, D. dipsaci, D. myceliophagus* and *D. destructor*
Invertase	*A. sacchari, M. arenaria, R. similis* and *P. penetrans*
β-Glucosidase	*P. penetrans, Aphelenchoides fragariae* and *G. rostochiensis*

Conclusion

Several enzymes play's a major role in parasitism of plants. These enzymes were regulated by artificially and reduces the parasitism behaviour of nematodes.

Properties of *Chironji* and their Use in Product Development to Increase Nutritional Value of Product

Article ID: 10229

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Chironji (Buchanania lanzan) is an important non-wood tree species found in deciduous forests throughout the greater part of India. Demand of *chironji* kernel is very high in national and international market. Whole kernel which is extracted from *chironji* nut has high market value.

The plant grows on yellow sandy-loam soil and is commonly found in the dry forests of Jharkhand, Madhya Pradesh, Chhattisgarh, Varanasi and Uttar Pradesh. *Chironji* is an almost evergreen, moderate sized tree, with straight, cylindrical trunk, up to 10-15 m height and tormentors branches. Bark is rough, dark grey or black, fissured into prominent squares, 1.25-1.75 cm thick, and is reddish inside. The fruits of *chironji* mature in 4 to 5 months and are harvested manually in the month of May and June.

Chironji is an active source of phytochemical, antioxidant and the nutritional properties such as protein content, carbohydrate crude fibre, fat and also high calorie value and minerals like Iron, Phosphorous, Magnesium, Calcium, Manganese, Copper, Barium, Aluminium and Boron in trace amounts. Chironji kernels has almond like flavour, eaten raw or roasted form, used as cooking spice and dry fruit in sweets, kheer, meaty korma in India.

Develop ready-to-eat nutritious sweeteners by using *chironji* kernel and increase nutritional value of product. *Chironji* are used in preparation of many sweet preparations such as *hlwa, laddu, barfi* etc. They are also used as dry fruit in preparation of sweets and shelf-life studies of ready to eat food products will be evaluated at regular interval with respect to physical, chemical, sensory and microbiological quality will be evaluated.

Watershed Management Approach for Soil and Water Conservation

Article ID: 10230

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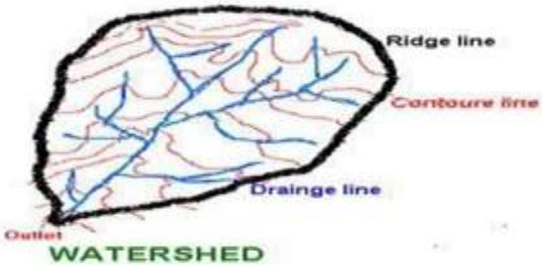
Introduction

Watershed is a topographically delineated area that is drained by stream system, i.e., the total land area that is drained to some point on a stream or river. A watershed is a hydrological unit that has been described and used as physical-biological unit and also, on many occasions, as a socio-economic- political unit for planning and management natural resources (Sheng,1990).

Generally, a watershed can be defined as an area from which runoff resulting from precipitation flows past a single point into a stream, river, lake or an ocean. The term watershed catchment areas or drainage basins are used synonymously. The watershed boundary is called drainage divide. Technically, a watershed is the divide separating one drainage area from another (Chow, 1964).



Watershed Management and Multiple Use Concept

The management of watershed resources to produce more than one product refers as the multiple use concepts. A multiple use perspective is required to achieve sustained and integrated watershed management. particularly in those areas, whether large rural population depends upon a variety of resources produced in upland watershed. It may be noted that much of the intensive farming, grazing and timber harvesting that take place in most of the areas is leading to watershed degradation, loss of bio-diversity and adverse downstream impacts. Watershed management is the rational utilization of land and water resources for optimum production with minimum hazard to natural resources.(Anon., 2002)

It essentially relates to soil and water conservation in watershed which means proper land use, protecting land against all forms of deterioration, building and maintaining soil fertility, conserving water for farm use, proper management of local water for drainage, flood protection and sediment reduction and increasing productivity from all land use.

Watershed inhabitants in many areas practice multiple use, which involves the production of goods that they require such as food, fibre, fuel and fodder. Most of the development activities are closely associated to the development and use of water resources. Thus, multiple use is being practiced on various watersheds, but whether multiple use is being properly managed for upland and downstream inhabitants is a matter of concern.

Objectives of Watershed

1. To establish a watershed as a basis to conserve and upgrade crop and degraded lands.
2. To develop and demonstrate location-specific technologies for soil and water conservation and crop production stabilization.
3. To augment the fodder, fruit and fuel resources through alternate land use systems.

For steep hill slopes, the following aspects are to be considered (Sarma,1997)
1. Ensuring adequate protection of land against soil erosion with the use of local resources and skill- based soil conservation measures.
2. Maximum retention of rainfall within the area without affecting crops.
3. Storage of runoff water, its use for pisci-culture and irrigation

Based on the micro-watershed approach, different land uses such as agriculture, horticulture, agri-horti, agri-horti-silvi-pastoral and livestock-based systems etc., may be adopted for a judicious resource conservation. In the watershed approach, proper land-use systems may be adopted to minimize runoff and soil losses. (Gurmel et al., 2000).

Causes of Watershed Deterioration

Deterioration of watershed takes place due to faulty and bad management through the activity of man and his animals. These activities are:
1. Faulty agriculture, forestry and pasture management leading to degradation of land.
2. Unscientific mining and quarrying.
3. Faulty road alignment and construction.
4. Industrialization
5. Fire.
6. Apathy of the people.

Results of Watershed Deterioration

1. Less production from agriculture, forests, grass lands etc.
2. Erosion increases and decreases biomass production
3. Rapid siltation of reservoirs, lakes and river beds.
4. Less storage of water and lowering of water table.
5. Poverty as a result of less food production.

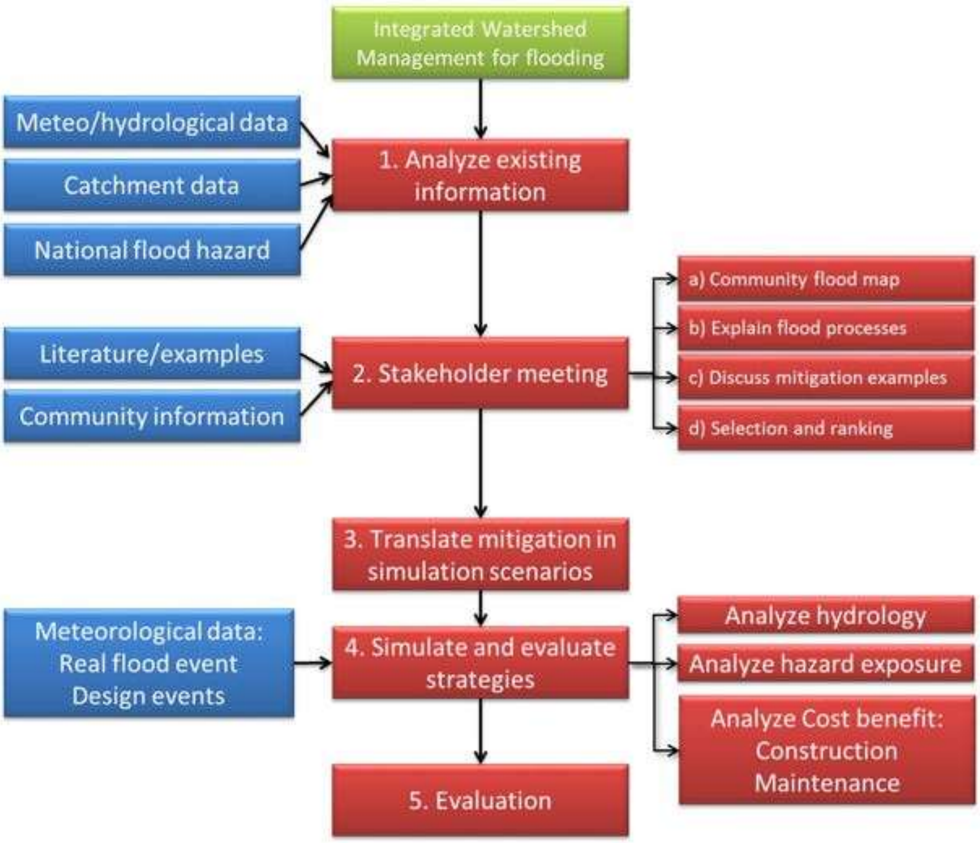


Fig: Integrated watershed modelling as a part of watershed management

Principles of Watershed Management

1. Watershed as natural system that we can work with: A system can be defined as complex whole formed from related parts or a combination of related parts organized into a complex whole. Similarly, watershed can be regarded as a complete system and it entails several components. Entities that define the system may include products or outputs leaving the system, inputs coming to the system and interaction (+, -) between its components.

The various parts of the watershed are physically and operationally linked i.e., the various resources are linked not only spatially but also functionally, and the potential benefit from integrated use can be large.

2. Watershed management must be participatory: Participatory means involving method where the community is motivated to function and contributes as a group to perform various tasks. The management must involve local farmers and other land users and wide community who depend on the land.

The adequacy of planning depends on the human element and not only on physical or technical aspects. Therefore, planning must start from people living on the land. The watersheds communities must involve in all stages of implementation of watershed development activities.

3. Should follow multi-disciplinary approach and it is a continuous process: Watershed management is inter-disciplinary approach. Watershed planning is a coordinated analysis by a team of technicians representing various disciplines like hydrology, geology, engineering, soil science, forestry, agronomy, and economists. Each disciple is inter-related with each other.

4. Watershed management must be gender sensitive: Women's are the most affected by environmental hardship; for example, they need to walk long hours to fetch increasingly scarce water, firewood and animal dung in addition to attending livestock, to name a few. Their involvement in watershed development planning, implementation and management is the key to ensure that they equally benefit from the various measures

5. Watershed management must be built up on local experience, strength: Local knowledge is essential to improve the existing technologies, to adopt new ones and to manage natural measures once they are introduced and established.

6. Watershed management must be realistic, integrated, productive and manageable: It must be realistic based up on local capacity, available resources and of government and partner support. Integrated conservation and development base are the guiding principles of watershed management. The watershed activities must be tangible and quick benefits the households. The measures must accommodate both production and conservation. Management is not only for the sake of conservation it must include both conservation and production.

7. Watershed management must be complementary to food security and rural development mainstream (like HIV, health, education and others): Watershed deployment planning should incorporate additional elements related to basic services and social infrastructure.

8. Flexible approach is always need: One should never look for a rigid, step-by-step ‘’cookbook recipe’’ for watershed management. Different regions have watershed that function in very different way, and even neighbouring watersheds can have major differences in geology, land use, or vegetation that imply the need for different management strategies.

Different communities vary in benefits they want from their watersheds. Therefore, watershed management is a dynamic and continually readjusting process that is built to accommodate these kinds of changes.

9. Watershed management framework support partnering, using sound science, taking well-planned action, and achieving results: When you are designing a house, you first think about all the functions you want it to serve. The same is true for designing a watershed management framework. A strong watershed framework uses sound science, facilitates communications and partnership, fosters actions that are well planned and cost effective.

Among the three common elements of successful watershed management framework:

a. Geographic management units (the watershed itself) is the first one, which agreed up on by partners to provide a functional, practical basis for integrating efforts.

b. Secondly, stakeholders (anyone who can impact or is impacted by decisions in the watershed are involved through the processes, with clearly defined roles and responsibilities.

c. Thirdly, partners agree on a management cycle, including activities they will work on together and a fixed time schedule for sequencing these activities. importantly, the cycle signals that watershed management is a never-ending job. remember, these steps can be initiated by a local watershed association, basin group, or regional or federal agency.

References

1. Anonymous., 2002, Fundamentals of Soil Science, Indian Society of Soil Science, New Delhi.
2. Chow, J. S. ., 1964, Quality of irrigation water. Translation.19th Int. Cong. Soil Sci., 1: 391-404.
3. Gurmel, Singh., Venkataramanan,, C., Sastry, G., Joshi., B.P., 2000, Manual of Soil & Water Conservation Practices.
4. Sarma, M.N., 1997, Watershed Management, Guidelines for Indian Conditions.
5. Sheng, P. P., 1990, Soil erosion assessment in a hilly catchment of north eastern India using USLE. Water Res. Manage., 22: 1783-1798.

Hydroponic Fodder Production: Productivity at its Peak

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Introduction

1. The word "hydroponics" means growing plants in water (from two Greek words hydro means 'water' and ponic means 'working'.

2. Hydroponics is a type of horticulture and a subset of hydroculture, which is a method of growing plants, usually crops, without soil, by using mineral nutrient solutions in an aqueous solvent.

3. Plants grow through a process called photosynthesis, in which they use sunlight and a chemical inside their leaves called chlorophyll to convert carbon dioxide (a gas in the air) and water into glucose (a type of sugar) and oxygen. Write that out chemically and you get this equation:

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

Basic Principle of Hydroponics

Water and nutrients, both easily obtained from soil. But if they can get these things somewhere else-say, by standing with their roots in a nutrient-rich solution—they can do without soil altogether.

Plants commonly grown hydroponically on inert media: maize, barley, oats, sorghum.

When Compared to Traditional Soil-Grown Crop Production, Hydroponics has the Following Advantages

1. Up to 90% more efficient use of water.
2. Production increases 3 to 10 times in the same amount of space.
3. Many crops can be produced twice as fast in a well-managed hydroponic system.
4. Decreasing the time between harvest and consumption increases the nutritional value of the end product.
5. Indoor farming in a climate-controlled environment means farms can exist in places where weather and soil conditions are not favourable for traditional food production.
6. No chemical weed or pest control products are needed when operating a hydroponic system.

Production of Hydroponic Fodder

Fodder produced by growing plants in water or nutrient rich solution but without using any soil is known as hydroponics fodder or sprouted grains or sprouted fodder (Dung et al., 2010a). The greenhouse for the production of hydroponics fodder can be of two types as per the financial status of the farmer and availability of building material.

1. Hi-tech greenhouse type hydroponics fodder cultivation unit.
2. Low-cost greenhouse type hydroponics fodder cultivation unit.

Which Fodder Crops can be Grown by Hydroponics?

Different types of fodder crops viz. barley and maize (Naiket al., 2011) can be produced by hydroponics technology. However, the choice of the hydroponics fodder to be produced depends on the geographical and agro-climatic conditions and easy availability of seeds. In India, maize grain should be the choice as the grain for production of hydroponics fodder due to its easy availability, lower cost, good biomass production and quick growing habit.

Seed Preparation

1. Soaking of seeds and the rapid uptake of water for facilitating the metabolism and utilization of reserve materials of the seeds for growth and development of the plants is a very important step for production of hydroponics forage.

2. Example: In case of barley (Morgan et al.,1992) and maize (Naik, 2012b) seeds, 4 hours soaking in water is beneficial.

3. Under field conditions, farmers producing hydroponics maize forage have the practice of putting the seeds in a gunny bag tightly and then make it wet and keep for 1-2 days.

Seed Rate

It affects the yield and hydroponics fodder which varies with the type of seeds. Most of the commercial units recommend seed rate of 6-8 kg/m (Morganet al., 1992), however, seed rate of7.6 kg/m has been suggested by Naik (2013a) for hydroponics maize fodder for higher output. If seed density is high, there are more chances of microbial contamination in the root mat which affects the growth of the sprouts.

Nutrient Solution and Water

The use of nutrient solution for production of hydroponics forage is not mandatory as it can also be produced by tap water. The nutrient solution (Dung et al., 2010a) for hydroponics fodder production contained Ca, K, N, Fe, Mg, S, P, Zn, Mn, Cu, Bo and Na at a level of 89.20,81.90, 75.10, 1.80, 20.80, 43.20, 3.20, 0.40, 0.50, 0.01,0.10 and 0.10 ppm, respectively. It is quite interesting to note that the hydroponics forage production requires only about 3-5% of water needed to produce same amount of forage produced under field condition (AI-Karakiet al., 2012).

Germination and Growth Period

The starting of germination and visibility of roots varies with the type of seeds. In case of maize and cowpea seeds, germination starts after 1 or 2 days and the roots were clearly visible after 2 or 3 days, respectively.

Photosynthesis is not important for the metabolism of the seedlings until the end of day-5 when the chloroplasts are activated (Sneath and Mclntosh,2003). Therefore, light is not required for sprouting of cereal grains however, a little light in the second half of the sprouting period encourages photosynthesis and greening of the sprouts.

Yield of Hydroponics Fodder

For successful hydroponics fodder production, fresh yield and dry matter (DM) content of the crops are important. Farmers producing hydroponics maize fodder under low-cost devices or greenhouses revealed fresh yield of 8-10 kg from one kg locally grown maize seeds in 7-10 days (Naiket al., 2013b).

The fresh yield and DM content of the hydroponics fodder are mainly influenced by the type of crops, days of harvesting, degree of drainage of free water prior to weighing, type and quality of seed, seed rate, seed treatment, water quality, pH, irrigation frequencies, nutrient solution used, light, growing period, temperature, humidity, clean and hygienic condition of the greenhouse etc. (Trubey and Otros, 1969).

Feeding Value of Hydroponic Fodder

Hydroponics fodder is palatable and the germinated seeds embedded in the root system are also consumed along with shoots of the plants without any nutrient wasting (pandey and Pathak 1991). Sometimes, animals take the leafy parts of the hydroponics fodder and the root portion are not consumed which can be avoided by mixing the hydroponics fodder with the other roughage components of the ration (Reddy et al., 1988, Naiket al., 2014).

Potential Health Benefits of Hydroponics Fodder

1. Dry grains contain abundant enzymes which are mostly inactive due to the enzyme inhibitors.
2. During sprouting, the activities of the inactive enzymes of the grains are increased due to the neutralization of the enzyme inhibitors and these enzymes ultimately breakdown the reserve chemical constituents such as starch, protein and lipids into various metabolites viz. sugars, amino acids and free fatty acids.
3. Sprouts are rich source of anti-oxidants in the form of β-carotene, vitamin-C, E and related trace minerals such as Se and Zn.
4. Sprouted grains (hydroponics fodder) are rich in enzymes and enzyme-rich feeds are generally alkaline in nature, therefore, feeding of the hydroponics fodder improves the animals' productivity by developing a stronger immune system due to neutralization of the acidic conditions.
5. Helping in the elimination of the anti-nutritional factors such as phytic acid of the grains, hydroponics fodders are good source of chlorophyll and contain a grass juice factor that improves the performance of the livestock.

Conclusion

Hydroponics fodder can be produced and fed in situations where cultivated fodder cannot be grown successfully. The technology can also be adopted by progressive modern dairy farmers with elite dairy herd and produce hydroponics fodder for feeding their dairy animals.

References

1. Al-Karaki, G.N. and Al-Hashimi, M. 2012. Green fodder production and water use efficiency of some forage crops under hydroponic condition. Internl. Schol. Res.Network.
2. Anonymous. 2013. Hydroponics technology benefiting dairy farmers. The Gomantak Times, Dec. 19, 2013.
3. Morgan, J., Hunter, R.R. and O'Haire, R. 1992. Limiting factors in hydroponic barley grass production. In: Proc.8th International Congress on Soilless Culture. Hunter's Rest, South Africa, pp: 241-261.
4. Naik, P.K., Dhuri, R.B. and Singh, N.P. 2011. Technology for production and feeding of hydroponics green fodder. Extension Folder No. 45/ 2011, ICAR Research Complex for Goa, Goa.
5. Naik, P.K., Dhuri, R.B., Swain, B.K. and Singh, N.P. 2012a. Nutrient changes with the growth of hydroponics fodder maize. Indian J. Anim. Nutr. 29: 161-163.
6. Naik, P.K., Dhuri, R.B., Swain, B.K. and Singh, N.P. 2012b. Cost of production of hydroponics fodder maize. In: Proc. of 8th Biennial Animal Nutrition AssociationConference on 'Animal Nutrition Research Strategiesfor Food Security', November 28-30, 2012, Bikaner, Rajasthan, India.
7. Naik, P.K., Gaikwad, S.P., Gupta, M.J., Dhuri, R.B., Dhumal, G.M. and Singh, N.P. 2013b. Low cost devices for hydroponics fodder production. Indian Dairyman. 65: 68-72.
8. Pandey, H.N. and Pathak, N.N. 1991. Nutritional evaluation of artificially grown barley fodder in lactating crossbred cows. Indian J. Anim. Nutr. 8 (1): 77-78.
9. Reddy, G.V.N., Reddy, M.R. and Reddy, K.K. 1988. Nutrient utilization by milch cattle fed on rationscontaining artificially grown fodder. Indian J. Anim. Nutr. 5 (1): 19-22.
10. Sneath, R. and Mclntosh, F. 2003. Review of hydroponic fodder production for beef cattle. Queensland Government, Department of Primary Industries, Dalby, Queensland.
11. Trubey, C.R. and Otros, Y. 1969. Effect of light, culture solution, and growth period on growth and chemical composition of hydroponically produced oat seedlings. Agron. J. 61: 663-665.

Seed Plot Technique in Potato

Article ID: 10232

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Introduction

Seed Plot Technique is a raising healthy seed crop during low aphid period available in Northern Plains during Oct- Jan and cutting haulms and harvesting of crop. This technique and effective viral diagnostics have sustained the National Potato Seed Production Programme by producing about 2600 tons of breeder's seed annually. This breeder's seed is further multiplied to about 4,32,000 tons of certified seed by the State Departments of Agriculture/ Horticulture. Thus, the country saves about 484 million US dollars because most Asian countries like Pakistan, Bangladesh and even China continue to import seed potatoes from Europe. The decentralization of potato breeding from hills to plains in India through the seed plot technique enabled the development of varieties suited to different agro climatic regions of the country. The area under seed potato production also increased by 12 times and enabled the availability of seed potato throughout the country in proper physiological state.

Principle and Need

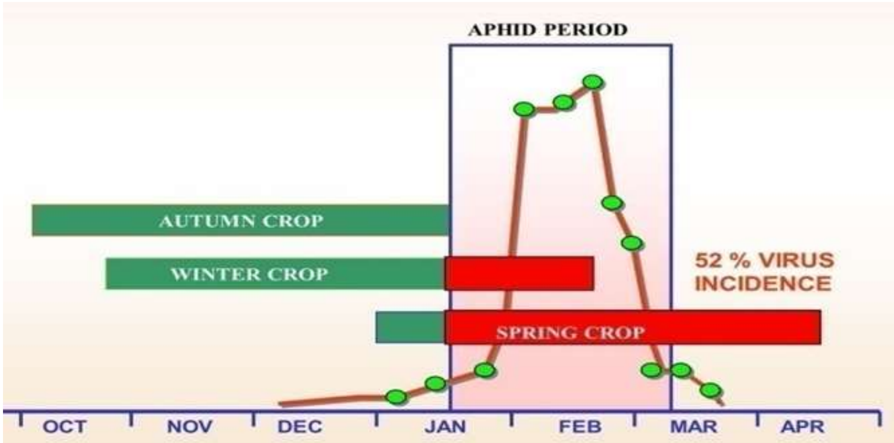
Principle: selection of time having less incidence of Aphid (major vector).

Need:

a. Hills account only 6% of the area under potato cultivation and not enough to meet the seed requirement of plains.

b. The tubers harvested in Sept- Oct in the hills cannot be used for planting the commercial crop in Sept- Oct in the plains because of dormancy.

Central Potato Research Institute developed seed plot technique during 1959 which has revolutionized the seed potato production in sub-tropical plains of India. The principle of seed plot technique is growing seed potato crop using healthy seed during low aphid period from October to first week of January coupled with integrated pest management, rouging and dehaulming the seed crop during the last week of January before aphids reach the critical limit.



Seed Source: The seed should be obtained from a reliable source preferably from a Government seed producing agencies, National Seed Corporation (NSC) and State Farm Corporation of India (SFCI). It is better to replace the seed in every 3 years with certified seed.

Field Preparation: Select the field where three years crop rotations have been adopted during seed potato production. Sandy loam soil with pH 6.0-7.0 is most suitable for seed potato production. Fallowing and summer ploughing of field is necessary for seed potato crop. After green manuring, prepare the field for planting. The field should be levelled to provide good drainage. Plough the field with a mould board plough or disc harrow followed by one or two tilling with tiller or desi plough. Planking and tilling can be combined.

Seed Size and Seed Rate: The seed size tubers should be having diameter of 30 to 55 mm and its corresponding weight of 25 to 125 gram. Hill seed tubers are slightly bigger than the plain seeds. Use whole seed tubers having multiple sprouts of about 2-3 cm. The seed rate may vary from 20-25 q/ha. Planting of the whole tuber is recommended for disease free quality seed production.

Seed Preparation: Take out the seed potato from the cold store at least 10 days before the planting. Do not bring out the seed bags in direct sun as it may result in rottage due to sudden exposure to high temperature. Spread the tubers in thin layer under shade in diffused light for sprouting and allow sprouts to become 0.5-1.0 cm long, thick and green. Carry the sprouted tubers to the fields in seed trays or baskets for planting to avoid sprout damage. Remove white, pale, thin sprouted, diseased and rotten tubers.

Planting Time: Potato planting varies with agro-climatic conditions of the region. The optimum time for planting is that when temperature is below 320C and remain below 200C for about 20-25 days after planting and available growing period should be more than 70 days so that a reasonable and economic yield could be obtained. Indo-Gangetic plain of North India is most suitable for seed potato production. Maximum seed potato is being produced from the alluvial soil spreading from Punjab to Bihar. Planting of seed potato tuber in Punjab, Haryana and North-western plain should be completed in first fortnight of October. Planting in Rajasthan, Western Uttar Pradesh and Central plains should be carried out in second fortnight of October. The planting for seed crop in Eastern Uttar Pradesh, Bihar, West Bengal and Orissa should be in first week of November. The above-mentioned location specific planting and dehaulming schedule is very essential for virus free seed potato production.

Planting Method: In most of the places, planting is done manually after opening the shallow furrows, broadcasting or placement of fertilizer mixture, placing seed tubers followed by ridging with spade or bullock drawn or tractor drawn ridger. Another method is that, first ridges are formed after application of fertilizers and their tubers are dibbled with Khurpi (a narrow blade tool), 5-7 cm deep on the ridges manually. The distance between ridge to ridge should be 60 cm and tuber to tuber should be maintained 20 cm while planting. Care has to be taken that tubers do not come in direct contact with fertilizers and should remain 4-5 cm above the fertilizer zone. The crop is also planted with tractor drawn semi-automatic or automatic potato planters which combine few or all the operations i.e., opening of furrows, application of fertilizers, placement of seed tubers and ridging etc.

Manures & Fertilizer Application

In green manured field, apply 10-15 t/ha well rotten FYM in furrows at the time of planting. FYM application at 30t/ha can take care of phosphorus and potassium requirement of potato crop. If FYM is applied at 15t/ha, then half the dose of phosphorus and potassium is to be applied through fertilizers.

For Plains

Generally, 75 kg nitrogen, 60-80 kg phosphorous and 100-120 kg potash per hectare at the time of planting and 75 kg nitrogen per hectare at the time of earthing-up is recommended.

For Hills

The basal application of 80 kg nitrogen (3.2 q CAN), 100 kg phosphorus (6.25 q SSP) and 100 kg potash (1.7 q MOP) per hectare at the time of planting and 40 kg nitrogen (1.6 q CAN) per hectare at the time of earthing-up is recommended. Fertilizers should be applied in furrows and should be partially covered with soil and then tubers should be planted, so that they may not come in direct contact with the fertilizers.

Mulching

Apply plant material such as paddy straw or farm refuse on ridges as mulch. Remove the mulch 20-25 days after planting for inter-cultural and earthing-up operations. Mulch reduces the soil temperature by 3-4^{0}C and also helps to conserve soil moisture and controls the weeds.

Inter-Cultural Practices

After 25 days of planting in plains and 40-45 days in hills when the crop is of 8-10 cm in height, the weeds are removed. Apply the remaining dose of nitrogen and cover it with soil to make a thick ridge with the help of narrow spade or tractor driven potato ridger. Herbicides can also be used to control the weeds. Pre-planting application of fluchloralin at 0.70-1.0 kg/ha or pre-emergence application of metribuzin at 0.75-1.00 kg/ha or post-emergence application of paraquat at 0.40-0.50 kg/ha at about 5 per cent emergence of potato plants as directed spray on weeds effectively check the annual grasses and broad leaf weeds in potato crop. The use of these herbicides in the potato crop requires effective skill for their efficient and safe use. Soil application of thimet 10 G at10kg/ha is essential during earthing-up in seed potato crop.

Irrigation

Potato being an herbaceous crop with sparse and shallow root system, requires readily available water throughout the crop growth period. Give one irrigation before planting to ensure uniform emergence. If pre-irrigation is not given then the first irrigation should be given the day after planting. The post planting irrigation should be very light. Give subsequent irrigation at 7-10 days interval in sandy loam soil and 10-12 days in heavy soil. Do not let the ridges submerge under water in any case. Stop irrigation 10-12 days before harvesting.

Roguing

During the crop season, examine the crop thrice to remove off-type and diseased plants showing mosaics, crinckling, rolling of leaves, marginal flavescence and purple top roll symptoms. First rouging should be done at 25-30 days after planting immediately before earthing-up. Do the last rouging 3-4 days before haulm cutting. Ensure that all the tubers of diseased and off-type plants are removed.

Plant Protection

1. Management of Late Blight: Prophylactic spray (just at the time of canopy closure) with mancozeb or propineb at 0.2 per cent (2 gm/lit of water) followed by need based application of cymoxanil + mancozeb or dimethomorph + mancozeb or fenamidone + mancozeb at 0.3% (3 gm/lit of water) for effective management of late blight.

2. Integrated Management of Bacterial Wilt:

a. Soil solarization by covering the plot with linear low-density polyethylene of 25 mm thick (LLDPE) sheet during summer for at least 15 days.
b. Use healthy seed tubers obtained from bacterial wilt-free regions.
c. Dip well chitted tubers in 0.25% (106CFU/ml) suspension of Bacillus subtilis (Bio B-5) and dry under shade before planting.
d. Crop rotation with finger millet or ragi.
e. Soil application with stable bleaching powder @12 kg/ha.
f. Deep summer and winter ploughing twice at 15 days interval in plains and hills respectively.

3. Management of White flies and Aphid Vectors:

a. Place yellow sticky traps (15x30 cm2 sizes) just above the canopy height @60 traps per hectare at equidistance from each other for mass trapping of white flies/aphids.
b. Seed treatment with imidacloprid (200 SL) @0.04% (4 ml/10 lit) for 10 minutes before planting.
c. First spray with imidacloprid (200 SL) @0.03% (3 ml/10 lit of water) at the time of emergence of crop, if needed.

d. Second spray with thiamethoxam (25 WG) @0.05% (5 gm/10 lit of water) after 15 days of crop emergence.

4. Management of other Insect and Pests:

a. In early planted crop, against leaf hoppers and mites, foliar spray of monocrotophos 40EC @1.2 lit/ha and dicofol 18.5 EC @2 lit/ha, respectively at 30-35 days after planting should be given. To control leaf eating beetles and semi-loopers/caterpillars, spray with carbaryl 50% WP @2.0 kg/ha.

b. For the management of soil insect pests like cutworms and white grubs, apply phorate 10G @10 kg/ha during earthing-up. When damage is noticed, drench the ridges with 20EC chloropyrifos @ 2.5 lit/ha.

Dehaulming

The recommended dehaulming schedule is based on region specific aphid population and must be adopted to get virus free seed potato production. Dehaulming in Punjab, Haryana and North-Western plains should be carried out in last week of December. The dehaulming in Rajasthan, western Uttar Pradesh and Central plains must be completed in first week of January while in eastern Uttar Pradesh, Bihar, West Bengal and Orissa the seed crop must be dehaulmed in second week of January. The seed potato grows can adjust dehaulming time on the appearance of critical aphid population i.e., 20 aphid/100 compound leaves subject to availability of 70-75 days crop growth period to get seed size tubers.

Harvesting and Marketing

The seed crop which is meant for storage should be harvested at full maturity. Generally, the seed crop should be harvested at 15-20 days after haulm cutting and at proper soil moisture. The harvesting in plains must be completed on time to avoid charcoal rot and damage by high temperature. The harvesting can be done by tractor drawn one or two row potato digger or by the bullock drawn-one row digger or with the help of spade or khurpi. In the hills, the harvesting should be done after the off set of rains. After harvest, air dry the produce and keep the tubers in heaps for 10-15 days in shade for curing of skin. Remove all damaged and rotten tubers. To get the good returns, the seed tubers should be graded and packed in gunny bags. Do not expose the tubers to sun light as far as possible, otherwise they will become green and the inner core will be spoiled.

Seed Treatment

Wash the seed tubers in water and then 1% bleaching solution and again in water. Tuber treatment (spray) with three per cent Boric acid before storage is effective in management of black scurf and common scab. Treatment of Boric acid at three per cent can be done by dipping of tubers for 30 minutes also and the solution once prepared can be used for 20 times dipping.

Seed Storage

Pack the seed tubers in clean Hessian bags and label them as per standard. Store them immediately in cold storage. If the ambient temperature is high, the seed bags should be kept in pre-cooling chamber or in a cool place and then stored in cold store at temperature at 2-3^{0}C and relative humidity (RH) 75-80 per cent. The stored bags should be inspected periodically. Seed treated with chemicals should not be used for table purposes. In hills, the treated tubers should be kept in wooden or plastic trays or in baskets or spread in a well-ventilated room.

Breeding Approaches for Climate Change on Vegetable Production

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Introduction

Vegetables play a crucial role in ensuring food and nutritional security, but they are highly perishable and their prices rise fast under situations like droughts or floods, putting them out of reach of the poor. Climate change may have more effect on small and marginal farmers, particularly who are mainly dependent on vegetables. Moreover, the winter season vegetables are more sensitive to harsh weather than the summer season vegetables. Abiotic stresses like extreme temperatures (low/high), soil salinity, droughts and floods are detrimental to vegetable production. Thus, high temperature and limited soil moisture are the major causes of low yields in vegetables. The different development phases like vegetative growth, flowering and fruiting are significantly influenced by the vagaries of climate. The effects of elevated temperature and unpredictable and irregular precipitation can disrupt the normal growth and development of plants which ultimately affect crop productivity. Environmental stresses severely affect the soil organic matter decomposition, nutrient recycling and nutrient and water availability to the plant. However, the intensity and duration of environmental extremes determine the magnitude of impact on crop growth cycle, biomass accumulation and ultimately, the economic return. Crop yields in Asia are expected to decline by 2.5 10% from 2020 onwards and by 5 30% after 2050, with worst declines in South and Central Asia.

To mitigate the possible impact of climatic change on vegetable production as well as on national economy, several initiatives have been undertaken. These include selection of better adaptable genotypes, genetic manipulation to overcome extreme climatic stresses, measures to improve water and nutrient-use efficiency and biological nitrogen fixation as well as exploiting the beneficial effects of CO_2 enhancement on crop growth. In this chapter, the impact of global climate change on vegetable crop growth and yield is discussed and strategies to overcome the harmful consequences are outlined. The effect of climate on different quality aspects of vegetable crops that may occur under the changed climate is reviewed.

Breeding Approaches

1. Tolerance to high and low temperature.
2. Drought tolerant crop varieties.
3. Tolerance to water logging and saline soils.
4. Use of biotechnological tools in stress management.

Use of Heat - and Cold-Tolerant Genotypes

Several heat-tolerant genotypes have been developed in vegetables, particularly in tomato. AVRDC, Taiwan, has made significant contributions to the development of heat-tolerant tomato and Chinese cabbage lines (*Brassica rapa* subsp. *Pekinensis* and *chinenesis*) adapted to hot and humid climate. The key to achieving high yields with heat-tolerant cultivars is the broadening of their genetic base through crosses between heat-tolerant tropical lines and disease-resistant temperate or winter varieties. The heat tolerant tomato lines were developed using heat-tolerant breeding lines and landraces from the Philippines (*viz*., VC11-3-1-8, VC 11-2-5, Divisoria-2) and the United States (*viz*., Tamu Chico III, PI289309). However, lower yields in the heat-tolerant lines are still a concern. A CL5915 line is considered best combiners for percentage fruit set and total yield in hybrids developed for heat-tolerance. Similarly, for cold tolerance, several genotypes have shown very good tolerance like, PI-120256, a primitive tomato from Turkey; LA-1777 (*Solanum habrochaites*) from AVRDC, Taiwan, and *Lycopersicon hirsutum* LA3921 and LA3925, both *Solanum habrochaites* from AVRDC, Taiwan, have also shown chilling tolerance. Similarly, EC-520061 (*Solanum habrochaites*) can set fruits under both high (40±2°C) and low (10±2°C) temperatures. These lines can be used for the development of cold tolerance in various backgrounds.

Drought Tolerant Crop Varieties

Most of the vegetables are sensitive to drought; however, brinjal, cowpea, amaranthus, and tomato can tolerate drought to a certain extent. Genetic variability for drought tolerance found in the cultivated tomato (*S. lycopersicum*) is limited and inadequate. The best source of resistance is from other species in the genus Solanum. Wild accessions of tomato, *viz. S. cheesmanii, S. chilense, S. lycopersicum, S. lycopersicum* var. cerasiforme, *S. pennellii*, *S. peruvianum* and *S. pimpinellifolium* possess stress tolerance. *S. chilense* and *S. pennellii* produce small green fruit and have an indeterminate growth habit. *S chilense* is adapted to desert areas and often found in areas where no other vegetation grows.

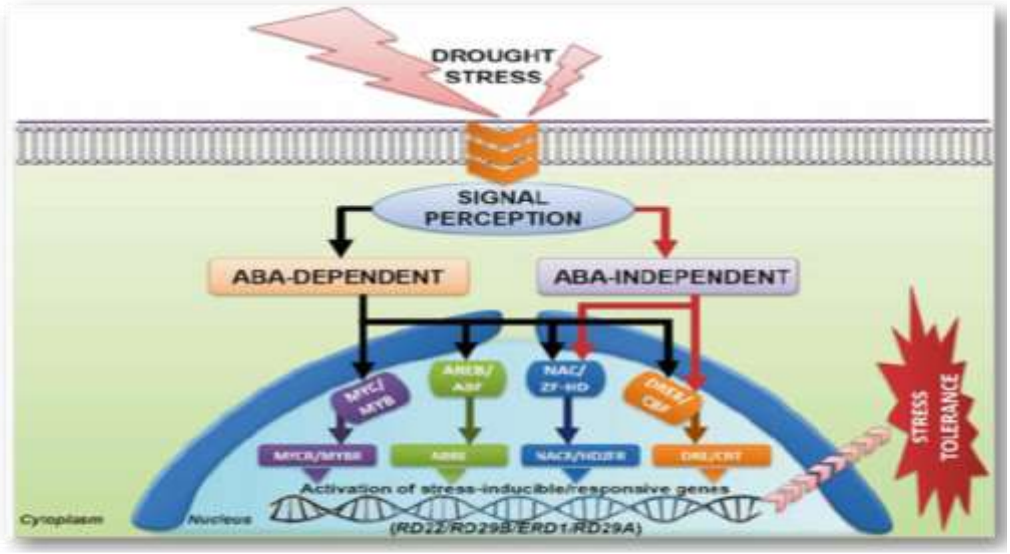
Table 1. Drought tolerant species and genotypes of vegetables:

Vegetable Crops	Drought tolerant genotypes/species	References
Tomato	*S. habrochaites (EC- 520061), S. pennelli, S. pimpinellifoloium (PI-205009, EC- 65992), S. esculentumvar. cerasiforme, S. hirsutum, S. cheesmanii, S. chilense, S. sitiens,* Arka Vikas	Rai et al. (2011)
Brinjal	*S. microcarpon, S. gilo, S. macrosperma, S. integrifolium, Bundelkhand Deshi, S. sodomaeum*	Rai et al. (2011)
Chilli	*C. chinense, C. baccatum var. pendulum, C. eximium Arka Lohit*	Kumar and Singh (2006)
Potato	*S. acaule, S. demissum and S. stenotonum, Alpha, Bintje S.ajanhuiri, S. curtilobum, S. xjuzepczukii .*	Arvin and Donnelly (2008)
Okra	*A. caillei, A. rugosus, A. Tuberosus, A. crinitus*	Charrler (1984).
Onion	*Allium fistulosum, A. munzii, Arka Kalyan*	Singh (2010)
French bean	*P. acutifolius*	Kavar et al. (2011)
Water melon	*Citrullus colocynthis*	Dane et al. (2007)
Cucumis Spp.	*Cucumis melo var. momordica ,VRSM- 58, INGR-98015 (AHS-10), Cucumis melo, SC-15, Cucumis melo var. callosus, Cucumis pubescens,*	Rai et al. (2008)
Winter Squash	*Cucurbita maxima*	Rai et al. (2008)

Use of Biotechnological Tools in Stress Management

Use of molecular technologies has revolutionized the process of traditional plant breeding. Combining of new knowledge from genomic research with traditional breeding methods has enhanced our ability to improve crop plants. The use of molecular markers as a selection tool provides the potential for increasing the efficiency of breeding programmes by reducing environmental variability, facilitating earlier selection, and reducing subsequent population sizes for field testing. Molecular markers facilitate efficient introgression of superior alleles from wild species into the breeding programmes and enable the pyramiding of genes controlling quantitative traits; thus, enhancing and accelerating the development of stress tolerant and higher-yielding cultivars for farmers in developing countries.

Several QTLs have been identified to stress tolerance in tomato, i.e., for water-use efficiency in *S. pennellii* and *S. pimpinellifolium* as source of salt tolerance. Only a few major QTLs account for the majority of phenotypic variation, indicating the potential for marker-assisted selection (MAS) for salt tolerance. Integration of QTL analysis with gene discovery and modeling of genetic networks will facilitate a comprehensive understanding of stress tolerance, permit the development of useful and effective markers for marker-assisted selection, and identify candidate genes for genetic engineering.



Drought is one of the most severe abiotic factors restricting plant growth and yield. Numerous genes functioning in drought response are regulated by abscisic acid (ABA) dependent and independent pathways. In this pathway external signal like drought, stress or any abiotic factors are sensed by the receptors which are present on the outer cell membrane of the plants. This induces various signaling cascades where there will auto phosphorylation of the sensor kinase and various response regulators. Then response regulators or transcription factors go and bind to the specific DNA binding domain. This led to the activation of various stress responsive genes.

Bacterial Cytoskeletal Elements

Article ID: 10234

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The cytoskeleton is an intracellular matrix that supports cell shape and function. The matrix is a dynamic structure composed of three main proteins, which are capable of rapid assembly or disassembly dependent on the cell's requirements. Cytoskeletal elements perform vital tasks in many aspects of the physiology of the cell. Bacterial tubulin (FtsZ), actin (MreB), and intermediate filament (IF) proteins are key elements in cell division, chromosome, plasmid segregation and maintenance of proper cell shape, as well as in maintenance of cell polarity and assembly of intracellular organelle-like structures. The individual functions of FtsZ, MreBs, and IFs are different from those performed by their eukaryotic cells (Graumann, 2007).

FtsZ was the first protein described to form a cytoskeletal structure in prokaryotic cells (Lutkenhaus *et al.,* 1980). Researchers have identified many genes involved in cell division, using immune electron microscopy and showed that FtsZ is present primarily at the invaginating edge of the septum.

The use of immune fluorescence microscopy revealed that FtsZ forms a ring at the middle of the cell. Depletion of FtsZ leads to the formation of long aseptate cells, in which chromosomes are normally segregated and ultimately lyse.

Ben-Yehuda and Losick, (2002) revealed that when *Bacillus subtilis* cells are starved, cells can be differentiating into a spore that is dormant for a long period and highly resistant to high temperature or a variety of chemicals. The hallmark of sporulation is the generation of a septum close to one cell pole, rather than at mid cell. This asymmetric division generates a small cell that differentiates into the spore and a large cell that lyses.

Tubulin assembly is regulated by a large array of proteins, several proteins that interact with FtsZ influence the stability of the Zring. MinC inhibits polymerization of FtsZ close to the cell poles, whereas FtsA and ZipA appear to stabilize Z rings in *E. coli* cells. Both FtsA and ZipA are essential for cell division but not for the formation of Z rings and they interact with FtsZ independently (Pichoff and Lutkenhaus 2002).

FtsA belongs to the family of actin-fold proteins which are interacts directly with the extreme C terminus of FtsZ and localizes to the FtsZ ring invariably dependent on FtsZ whereas most division proteins other than FtsZ are recruited to the FtsZ ring dependent on FtsA (Errington *et al.,* 2003)

In the late 1960s, screens designed to find genes whose product affects cell morphology in rod-shaped cells identified several loci in which mutations led to the formation of osmotically stable, round cells. One of these loci was the Mre (murein cluster E) operon, which contains three genes in *E. coli*, and in many other bacteria, called *mreB, mreC,* and *mreD* . Mutations in all three genes lead to formation of irregularly bulged or oval to round cells.

Intermediate filaments (IF) proteins assemble into 8 to 10 nm thick reversible filamentous structures and covalently cross-linked mesh works, wherein they can frequently provide mechanical strength. The first bacterial IF-type protein was identified in *Caulobacter crescentus* cells (Ausmees *et al*., 2003).

Bacteria possess a dynamic cytoskeleton that achieves a variety of essential tasks, and that appears to have been present in the ancestor of all cells, the cytoskeleton was a prokaryotic invention and the investigation of these elements will give fundamental information for all types of cells.

References

1. AUSMEES, N., KUHN, J. R. AND JACOBS-WAGNER, C., 2003, The bacterial cytoskeleton: an intermediate filament-like function in cell shape. Cell, 115:705–13.

2. BEN-YEHUDA, S. AND LOSICK, R., 2002, Asymmetric cell division in B. subtilis involves a spiral-like intermediate of the cytokinetic protein FtsZ. Cell, 109:257–66.
3. ERRINGTON, J., DANIEL, R. A. AND SCHEFFERS, D. J., 2003, Cytokinesis in bacteria. Microbiol. Mol. Biol. Rev., 67:52–65.
4. GRAUMANN, P. L., 2007, Cytoskeletal Elements in Bacteria. Ann. Rev. Microbiol., 61:589–618.
5. LUTKENHAUS, J. F., WOLF-WATZ, H. AND DONACHIE, W. D., 1980, Organization of genes in the ftsA envA region of the Escherichia coli genetic map and identification of a new fts locus. J. Bacteriol., 142:615–20.
6. PICHOFF, S. AND LUTKENHAUS, J., 2002, Unique and overlapping roles for ZipA and FtsA in septal ring assembly in Escherichia coli. EMDO. J., 21:685–93.

Essential Oils for the Control of Pulse Beetle in Storage Grains

Article ID: 10235

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Cereals and pulses have great biological and nutritional value in human diet. The losses during post-harvest handling, processing, storage and distributions systems vary between 20-60 per cent (Singh et al.,2012). Pulse beetle (Callosobruchus chinensis) is widely distributed and is known as a major destructive insect of stored chickpea (Aslam et al.,2002). After harvesting approximately 1660 insect species attack the agricultural produce during different phases losses caused by these insect pests may reach upto 30 per cent during storage (Haubruge et al.,1997).

C. chinensis to cause enormous losses to almost all kind of pulses in storage condition (Alam,1971). 12.5 per cent loss due to pulse beetle's infestation in pulse stored in warehouses (Rahman,1971). Pulse beetles are a major problem in stored legumes in all tropical countries. Pulse beetles breed rapidly in storage and the infested grains are unmarketable (Disna et al.,2004). 60 per cent of whole production that produced is destroyed by insect pests in which storage insect-pest play an important role. The insect causing damage in storage [pulse beetle, khapra beetle, lesser grain borer. Among the pulse beetle is most important damaging insect which cause infestation to pulse both in field as well as ambient storage (Singh et al.,2017). Losses during storage accounts for around 6 per cent of the total losses as proper storage facilities are not available (Prakash et al.,2016).

Materials & Methods

The experimental procedure adopted for the studies is briefed below on effects of different plant oils on pulse beetle (*Callosobruchus chinensis*) in black gram. The investigations were carried out at the Department of Agricultural Entomology, Imayam Institute of Agriculture and Technology, Thuraiyur during 2018-2019. The materials used and methods adopted in the study are detailed below.

1. Crop variety used for the study: Freshly harvested local variety blackgram seeds were obtained from farmers of Thuraiyur region. Obtained blackgram seeds were used in storage experiments.

2. Mass culturing of pulse beetle (*C.chinensis*): Mass culturing of pulse beetle (*C.chinensis)* was done at the entomology laboratory, Imayam Institute of Agriculture and Technology, Thuraiyur. Mass culturing was done using these samples. **Udo (2011)** method was followed for rearing of pulse beetles on black gram seeds.

Experimental Methods

1. Design: The experiments were laid out in Complete Randomized Design (CRD) with 6 treatments and 3 replications.

2. Treatment: A total of 6 treatments were used for the study.

Which are: T1 – 0.5 ml of Neem oil, T2 – 1 ml of Neem oil, T3 – 0.5 ml of Eucalyptus oil, T4 – 1 ml of Eucalyptus oil, T9 – 1ml of Malathion , T10 – control.

Insecticidal Action of Plant Oils

0.5 gram of black gram seeds were taken and kept in plastic containers for 10 treatments and 3 replications. Plant oils of 0.5 and 1ml concentrations were taken and kept. In this experiment we also used one insecticide, Malathion for comparison with the oils. They were treated with the black gram seeds kept in the containers. Followed by sun drying for 24 hrs. Next day 10 pairs of newly emerged adult beetles were released into each container. Then the containers were covered using kada cloth and kept at room temperature inside the laboratory. Untreated seeds served as control. Mortality count based on lack of movement (locomotion) and response to repeated probing, was observed after 24 hrs for 6-7 days until the death of all the released beetles. The experiment was conducted according to CRD with 10 treatments and 3 replications.

Mortality (%) = Number of insects dead / Total number of insects released ×100.

Ovipositional Deterrent Effect of Plant Oils

Ovipositional deterrence = 100×(NET/NEC).
NET - the number of eggs in treatment, NEC - the number of eggs in control.

Anti-Feedant Effect of Plant Oils

After data collection grains were kept in plastic container of the respective treatments. The extent of damage caused by pulse beetle on black gram was determined on the basis of the weight loss from the total weight was calculated. After 100 per cent mortality of the beetles, grains were taken from the treated sample of each treatment and total weight loss in each replication for 10 treatments were measured using weighing balance. The data was recorded for each computing infested /unhealthy grain after 48 and 72 hours.

Statistical Analysis

The data were subjected to statistical analysis. The data on percent values were transformed into arc sine values and analysis of variance was done with AGRESS and AGDATA packages, means were compared by using LSD (Least Significant Deviation Test).

Results and Discussion

The results of the experiments were conducted to study the effect of two different Essential oils on pulse beetle, *Callosobruchus chinensis* infesting pulses and attraction of pulse beetle, *C. chinensis* to black gram is presented below.

Effect of Essential Oils of *C. chinensis* in Black gram

The results of insecticidal activity of two different Essential oils viz., Eucalyptus oil, Neem oil on pulse beetle, *C. chinensis* in Black gram are furnished in Table 2. On 24 HATS, the highest mortality was recorded in Eucalyptus oil with 40.0, 56.6 per cent, Neem oil with 13.3, 10.0 per cent. On 2 DAT , the highest mortality was recorded in Eucalyptus with 76.6, 96.6 per cent and lowest mortality was recorded in neem oil with 33.3, 23.3 per cent which was on par with control .The process was repeated until 6th day. On 6 DAT, the highest mortality was recorded in Eucalyptus oil with 99.5 per cent, Neem oil with 97.5 per cent and control with 70 per cent. Mean per cent mortality recorded in the Eucalyptus oil was higher with 99.5 per cent, followed by Neem oil 86.5 per cent and the least mean percent mortality rate was recorded in control with 15 per cent.

Oviposition Deterrent Action of Essential Oil on *C. chinensis* in Black gram

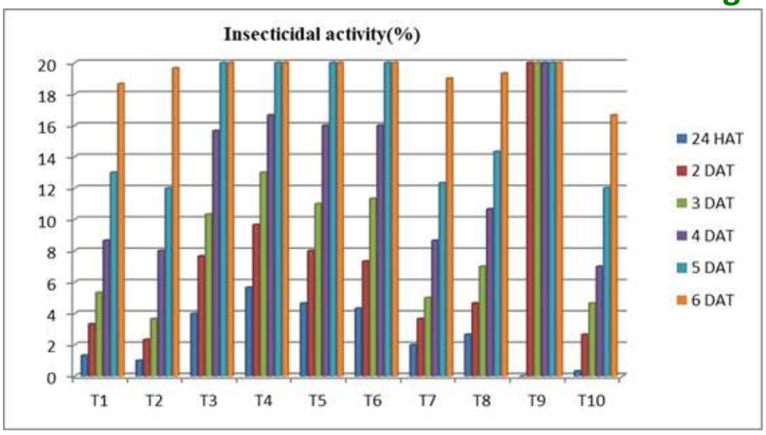

Fig.1. Insecticidal activity of essential oil and edible oils (T5,T6,T7,78) on *C.chinensis* in Black gram

The oviposition of pulse beetle, C. chinensis when treated with different Essential and edible oils viz., Vegetable oil, .Eucalyptus oil, Neem oil and Sesame oil furnished in Table 3. On 24 HATS, the minimum oviposition was observed in Vegetable oil with 7.5 per cent, Eucalyptus with 37.75.

Table 1- Insecticidal activity of Essential oils on Callosobruchus chinensis in black gram:

Treatment	Cumulative mortality per cent						
	24 HAT	2DAT	3DAT	4DAT	5DAT	6DAT	MEAN
T1 : neem oil(0.5ml)	1.33 (6.536)cd	3.33 (10.495)def	5.33 (13.298)de	8.66 (17.078)cd	13 (21.125)c	18.66 (25.586)a	8.39
T2 :neem oil(1ml)	1 (4.797)de	2.33 (8.745)f	3.66 (11.016)f	8 (16.430)d	12 (20.257)c	19.66 (26.324)a	7.78
T3 : eucalyptus(0.5ml)	4 (11.477)ab	7.66 (16.047)bc	10.33 (18.720)c	15.66 (23.300)b	20 (26.565)a	20 (26.565)a	12.94
T4 : eucalyptus(1ml)	5.66 (13.760)a	9.66 (18.095)b	13 (21.125)b	16.66 (24.093)b	20 (26.565)a	20 (26.565)a	14.16
T9:malathion	0 (0.523)f	20 (26.565)a	20 (26.565)a7	20 (26.565)a	20 (26.565)a	20 (26.565)a	16.67
T10:control	0.33 (2.262)ef	2.66 (9.360)ef	4.66 (12.358)ef	7 (15.240)d	12 (20.257)c	16.66 (24.080)b	7.22
CD (5%)	3.219	2.105	2.210	2.233	1.014	1.016	

Table 2- Oviposition deterrent activity of essential oil oils on C. chinensis in black gram:

Treatments	Oviposition deterrent activity
T1 : Neem oil(0.5ml)	8.67 (17.098)[b]
T2 : Neem oil(1ml)	8 (16.410)[b]
T3 : Eucalyptus(0.5ml)	5 (12.879)[cd]
T4 : Eucalyptus(1ml)	5.67 (13.686)[c]
T9:malathion	0 (0.523)[e]
T10:control	14.67 (22.500)[a]
CD (5%)	2.075

Values are mean of three replications.
Figures in parentheses are arcsine transformed values.

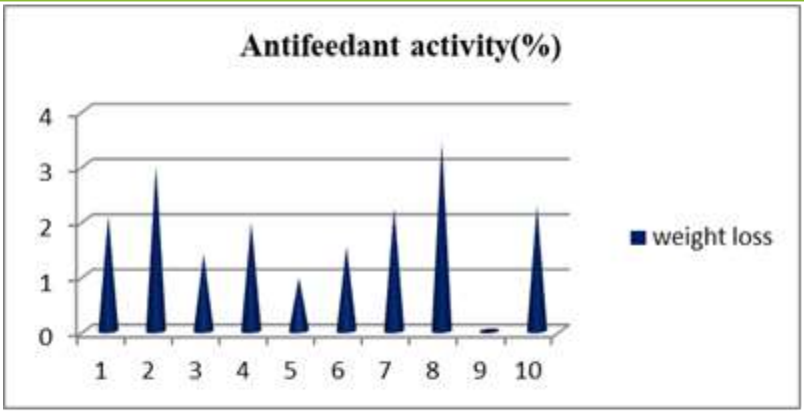

Fig.2. Anti-feedant activity of essential oil and edible oils (T5,T6,T7,78) on *C. chinensis* in Black gram

Conclusion

Comparing both the tables (1,2) and figures(1,2) it has been analysed and concluded that Eucalyptus oil shows effective insecticidal property and neem oil shows higher ovi positional and anti-feedant property with limited usage on black gram seeds during storage. Since, neem oil is cheaper and easily accessible that can be preferred more when compared to the Eucalyptus oil.

References

1. Aslam M, Potency of some spices against C. Chinensis Linnaeus. Journal of Biological Science. 2002;2(7):449-452.
2. Disna Ratnasekara and Rajapakse (2009). Repellent Properties of Plant oil vapours on Pulse Beetle (Callosobruchus maculatus) in Stored Black gram
3. Haubruge, E.,(1997). The impact of sperm precedence in malathion resistance transmission in populations of the flour beetle Tribolium castaneum. Stored product.Res., Pn:143-146.
4. Rahman, M.H.,Ali,M.A. and Ahmed, Bio efficacy of some plant derivatives that protect grain against the pulse beetle, Callasobruchus maculatus. Journal of insect Sciences.6(3):1536-2442(2004).
5. Singh. A, Khare. A, Singh AP (2012). Use of vegetable oils as Biopesticide in Grain Protection-A Review.J Biopesticide 3:114.doi:10.4172/2155-6202.1000114
6. Singh,D (2017). Reproduction retardent and fumigant properties of essential oils against rice weevil in stored products.82(3):727-733.
7. Udo I.O.2011.Potentials of Zanthoxylum xanthoxyloides(Lam.) for the control of stored product insect pests.Res.2(3):40-44.

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Easy and Quick for Multiplication of Planting Material in Horticultural Crops through Sexual and Specialized Organs Propagation Methods

Article ID: 10236

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Abstract

Nursery is an area where the plants are propagated and maintained in the initial years. Most of the horticultural crops are raised in nurseries and then transplanted in the field. The nursery ensures better germination and establishment and also ensures saving of time, area and labour and makes easy maintenance. The establishment of nursery requires knowledge of propagation methods and resources such as land, mother plants and plant propagation structures, growing media, containers, and mixture for containers, propagation equipment.

Keywords: Nursery, Runners , Suckers Sexual Propagation, etc.

Introduction

The method of production of more than one plant from the mother plant or seeds over a specific time period is termed as plant propagation. The production of true to type progeny from the mother plant is the prime objective of propagation. The multiplication of plants depends on the plant species, variety, method of propagation, climatic and growth conditions. There are three aspects of plant propagation:

1. Art of propagation.
2. Growth and plant growth and structure.
3. Knowledge of methods of propagation.

Plant propagation is primarily done by conventional methods, which include sexual and asexual methods. However, in the recent past plant propagation through biotechnological applications have made great contributions towards mass scale production of plants.

The progress in plant improvement would have been of little significance, without methods whereby improved forms could have been maintained in cultivation. Most cultivated plants either would have lost or reverted to less desirable forms unless they are propagated under controlled conditions that perceive the unique characteristic which make them useful. Plant propagation means multiplication of plants with the aim to achieve increase in number and preserve the essential characteristics of the mother plant. It is essentially of two types:

1. Sexual Reproduction.
2. Asexual Reproduction.

Sexual Reproduction

1. Sexual reproduction refers to multiplication of plants by seeds. Seeds are formed after successful pollination and fertilization by the union of male and female gametes.
2. Meiosis division takes place in the course of fusion and the chromosome numbers are reduced to half, which after fertilization becomes normal.
3. The plants raised through seed are called seedling plants.

4. Propagation of plants by seeds offers many advantages however several have disadvantages too.
5. Sexual propagation involves careful management of germination conditions and facilities and knowledge of the requirements of individual kind of seeds.

Stages of Sexual Reproduction

Success of seed propagation depends upon fulfilling the following conditions:
1. Using seed of proper genetic characteristics to produce the cultivar or species, of provenance desired. This can be accomplished by obtaining seed from a reliable source or dealer.
2. Using good quality seeds which germinate rapidly and vigorously to withstand possible adverse environmental conditions in the seed bed and provide a high percentage of usable seedlings.
3. Manipulating the seed dormancy by applying pre-germination treatments or proper timing of planting.
4. Providing proper environment for seed germination i.e., supplying sufficient water, proper temperature, adequate oxygen and either light or darkness (depending upon kind of seed) to the seeds and resulting seedlings until they are well established.

Advantages

Sexual method of propagation has several advantages, like:
1. Propagation by seeds is simple and easy.
2. Seed propagation is only mean of diversity particularly in the selection of chance seedlings.
3. Seedling plants are long lived, productive and have greater tolerance to adverse soil and climatic conditions and diseases.
4. Seed propagation makes feasible to propagate plants like papaya and coconut in which asexual means of propagation is not common.
5. Hybrids can only be developed by sexual means.
6. Sexual propagation offers opportunities of Polyemryony (citrus, mango or jamun) and apomixis *(Malus sikkimensis, Malus hupehensis, Malus sargentii)*, which produces true- to - type plants.
7. Seed is the source for production of rootstocks for asexual propagation.
8. Seeds, if stored properly can be kept for longer duration /period for future use.

Disadvantages

Sexual method of propagation has some disadvantages, like:
1. Seedling plants are not true to type to the mother plants due to heterozygous nature of fruit plants.
2. Seedling plants have long juvenile phase (6-10 years) and hence flowering and fruiting commences very late.
3. Sexually raised plants are generally tall and spreading type and thus are cumbersome for carrying out various management practices like pruning, spraying, harvesting etc.
4. Seeds of many fruits are to be sown immediately after extraction from the fruits as they lose their viability very soon e.g., cashew nut, jamun, jackfruit, citrus, mango and papaya.
5. The beneficial influences of rootstocks on scion variety cannot be exploited in sexual propagation.
6. Seedling plants usually produce fruits of inferior quality.

Propagation through Specialized Organs

1. Runners: A runner is a specialized stem that develops from the axil of a leaf at the crown of a plant. It grows horizontally along the ground and forms a new plant at one of the nodes e.g., strawberry. The runner production is favoured by long day and high temperature. The daughter plants are separated and used as new planting material.

2. Suckers: A shoot arising on an old stem or underground part of the stem is known as suckers. In other words, a sucker is a shoot, which arises on a plant below the ground. These shoots, when separated from the mother plant and transplanted produce adventitious roots. The capacity of a plant to form suckers varies from plant to plant, variety to variety and is even climate dependent. The sucker formation is common in fruit plants like pear and banana. In banana, sword suckers are commonly used for propagation of plants.

3. Separation: The bulbous crops such as garlic, corms etc are propagated by breaking the bulbs and cloves are used for multiplication of plants.

4. Divisions: the rhizome crops such as turmeric, ginger is multiplied by dividing the rhizomes

5. Offsets: The side shoots of plants such as pine apple, date palm is used for multiplication of new plants.

6. Tubers: The tubers are used for multiplying the new plants. Potato is multiplied through tubers.

Source of Planting Material

The second important factor for nursery is the source of planting material such seed of scion wood. The seed of horticultural crops are available with the agencies developing the varieties. But the source of scion wood is limited as the transportation and storage of scion wood is difficult .The best option is the nursery man should develop his own mother plant blocks or he may select the elite plants from the existing orchard.

Selection of Elite Mother Trees:

1. It should be of known identity.
2. It should have production potential.
3. It should have commercial acceptance.
4. It should be free from pests and pathogens.

Conclusion

It is concluded that the aim of good nursery is to provide quality planting material for increasing new areas even by sexual method. The nursery should be maintained at the highest level to ensure only healthy, vigorous and uniform plans planted in the field. Small-scale plant nurseries and their managers have an important role in ensuring the sustainable development of rural communities. It is essential that they obtain access to the knowledge, skills and resources necessary to maintain and enhance their capacity to produce the seedlings through a sexual method and multiplication of specialized organs of plant easily which form an integral part of the local agro forestry systems.

References

1. Banerjee, A.K. 1987. Nursery manual for species commonly used in social forestry in India, Rep: National Wasteland Development Board/00I /007/1987, Kapoor press, New Delhi, p 64.
2. Bhimraj Bhujbal (ed.). 2012. Resource book on horticulture nursery management, YCMOU, NAIP, ICAR, p 264.
3. Landis, T.D., Tinus, R.W. and Barnett, J.P. 1999. The container tree nursery manual: seedling propagation. Agriculture Handbook, 674.Washington, DC: U.S. Department of Agriculture, Forest Service, p 167.
4. Marry L. Duryea and Thomas D. Landis, 1984. Forest Nursery Manual: Production ofbare-root seedlings, Dr. W. Junk Publishers for Forest Research Laboratory, Corvallis, p 385.
5. Ratha Krishnan, P. 2008. Nursery management and quality plant propagation. In: Training manual on “Advances in agroforestry research and development”, 24th Nov - 5th Dec, 2008, NRCAF, Jhansi, pp 85-91.
6. Roshetko, J.M., Tolentino, E.L., Carandang, W.M., Bertomeu, M., Tabbada, A., Manurung, G.E.S. and Yao, C.E. 2010. Tree nursery sourcebook - options in support of sustainable development. World Agroforestry Center-ICRAF and Winrock International. Bogor, Indonesia. p 52.

Evolution of Unified Market Platform (UMP) - A Way Forward in Marketing Reforms of Karnataka

Article ID: 10237

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Introduction

India is predominantly an agrarian economy, with agricultural sector engaging about half of the work force (GOI 2016). It is said that, every culture is bound to fail tomorrow if agriculture fails today. According to a survey conducted by NABARD in 2016-17, about 48% households in India were agricultural house-holds, whose monthly income was `3140 from crop cultivation alone (NABARD 2018). However, one in every five individuals in the country is poor and about 80 percent of the poor belonging to rural area, who primarily depend on agriculture for their livelihood. Indian agriculture achieved the magnificent growth over the last few decades. The food grain production has increased to 284 million tonnes.

The growth and development of agriculture and allied sector directly affect well- being of people at large, rural prosperity and employment, and it forms an important resource base for a number of agro-based industries and agro-services.

While the total production and productivity is being constantly augmented, it is essential to provide the farming community with better marketing facilities with suitable infrastructures in order to enable them in getting remunerative prices for their produce. Agricultural marketing comprises all operations in-volved in the movement of farm produce from the producer to the ultimate con-summer. It includes the operations like collecting, grading, processing, preserving, transportation and financing.

Evolution of UMP

Agricultural markets in India are under developed and imperfect. They are characterized by various problems such as sale of agricultural commodities immediately after the harvest at village level, lack of knowledge on grading of produce, poor marketing infrastructure, existence of marketing malpractices in marketing of agro produce, non-transparency in price discovery mechanism, denied of market information, low marketable surplus, dominating intermediaries etc. the Government recognised the importance of efficient marketing of agricultural produce for overall development of agricultural sector and initiated a number of pro-grammes from time to time to overcome these problems and to strengthen the marketing system.

Bailhong al market is the first regulated market of the former Bombay Karnataka area which was constituted in 1936 under the provisions of the Bombay Cotton Market Act,1927 and later in 1942 it was reconstituted and brought under the purview of the Bombay APMC Act, 1939 with the area of operation covering the entire Bailhongal taluk.

Further, in order to improve efficiency of marketing and to strengthen the trans-parency, the Government of India amended the Agricultural Produce Market Committee Act (Model APMC Act 2003) to provide the direct sale of produce from farmers to consumers and contractors, establishment of minor private markets, infrastructure development, collection of market fee and freedom for market functionaries to operate in different markets through single registration. Karnataka has been the leading state in implementing the Model Act, 2003 further the state introduced e-tendering system, as an innovative approach for price discovery and to encourage fair marketing practices and to ensure competitive prices to farmers for their produce.

E-Tendering in Karnataka

Under the Mandi Modernisation Programme (May2009), The Government of Karnataka in association with the National Commodity and Derivative Exchange (the largest agricultural commodity exchange E-tendering was initiated by) introduced the E-tendering for agricultural commodities.

E tendering system of marketing has advantage over other methods (open auction, manual tender and direct sale) i.e., because of transparent price discovery mechanism. Open auction system provides some scope for mutual negotiation between traders in the process of price discovery, manual tendering system could allow for market malpractices such as alteration in quotes, errors in their entry and compilation.

In case of direct sale, farmer is a price taker because of the absence of competitive mechanisms of price discovery. The time required to declare bids in e tendering system was much lower. Thus, e platform offers advantages of competitive price discovery, transparency, and reduced transaction time.

Unified Market Platform

Karnataka has been a first state to implement e-trading for agricultural commodity which has become a lesson for other states to implement the model e-NAM Looking to the new intervention in marketing through UMP and its potential im-pact on price discovery, trade and marketing of agricultural produce in the select-ed APMCs.

The e tendering acted as a basement for integration and unification of agricultural markets in the state through an online platform. The Government of Karnataka in association with the National Commodity Derivative Exchange (NCDEX) implemented the concept of Unified Market Platform (UMP) in 2014, and a separate institution named Rashtriya e-Market Service Private Limited (ReMS) was created for providing e-marketing services.

The Karnataka state being a fore runner in implementing marketing reforms, has replaced its manual tender system by electronic trading system for price bidding in selected regulated markets in the state. The plan aimed at vertical as well as horizontal integration of all regulated agricultural markets (APMCs) with sup-porting infrastructure for seam less flow of produce, finance and information across different stake holders in the trading environment.

A total of 105 markets spread across 27 districts have been brought under the Unified Market Platform (UMP) as of March 2016 (Chand2016).This initiative provides a unique identification number to every lot brought by the farmers to the APMC market. The farmer can use the option of using either common plat-form or the platform of commission agent to auction his produce. The lots ready for auction are assayed for their quality and the information about quality and quantity is put on the portal of ReMS.

The registered buyers or traders on ReMS who are interested in purchase of produce are required to get the unified market license. Any prospective buyer can bid for the produce on line from anywhere using her/his credentials with ReMS.

A trader can revise the bid upward any number of times before closure of the bidding time. After closure of auction peri-od, the bids are flashed on television screen spur up in the mandies and on the portal of ReMS. Thereafter, the producer/seller is required to give his acceptance for the bid. A seller has the autonomy to reject the bid, in which case a second round of bidding takes place on the same day and in the same way. A bidder is required to keep a pre-bid margin of 5 percent of value of the lot marked for sale with ReMS before opening of the tender. ReMS charges 0.2 percent of the value of the transacted produce for providing various online services.

Conclusion

The important feature of the model is that the participation in UMP is not restricted to Karnataka. Traders from other states and bulk institutional buyers (Cargill, ITC, Reliance, Metro Cash & Carry) are also registered with ReMS. The UMP received over whelming response from farmers in the state and its how's impressive results in a short period. Auction and sale of farm produce is not restricted to traders within the market. Thus, the possibility of tacit understanding to suppress prices received by farmers or cartelization has been eliminated.

References

1. CHAND,R., 2016, E-platform for national agricultural market. Economic and Political Weekly, 51(28):15-18.
2. ANONYMOUS, 2016, Agricultural statistics at a glance .Government of India, New Delhi, p.15
3. ANONYMOUS 2018, All India rural financial inclusion survey (2016-17). National Bank for Agriculture and Rural Development, Mumbai, p.27.

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Coconut Shell-Based Activated Carbon Trade – Current Trend in India

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Activated Carbon

Activated carbon is a carbonaceous, highly porous adsorptive medium that has a complex structure composed primarily of carbon atoms. The networks of pores in activated carbons are channels created within a rigid skeleton of disordered layers of carbon atoms, linked together by chemical bonds, stacked unevenly, creating a highly porous structure of nooks, crannies, cracks and crevices between the carbon layers.

Activated carbon has been known since ancient India and Egypt for its powerful purification abilities. Introduced to the Western world through the European sugar refineries of the 19th century, activated carbon today is used in applications as diverse as air filtration, pharmaceutical processing, and even medical cloths. It can be made from any raw material that is naturally high in carbon, including coconut shells, peat, hard and soft wood, lignite coal, bituminous coal, olive pits and various carbonaceous specialty materials. Chemical activation or High Temperature Steam Activation mechanisms are used in the production of activated carbons from these raw materials. The intrinsic pore network in the lattice structure of activated carbons allows the removal of impurities from gaseous and liquid media through a mechanism referred to as adsorption. This is the key to the performance of activated carbon. Activated carbon is mainly available in three forms or shapes: powder, granular and extruded. And each form is available in many sizes. Based upon the application and requirements, a specific form and size is recommended.

Coconut Shell Activated Carbon

Activated carbon is made from various raw materials and each raw material creates a porous network with uniquely sized pores. Activated carbon made from coconut shell is ideal for water filtration, as its tiny micropores match the size of most water-based contaminants.

In addition, coconuts are a renewable resource. A coconut tree can live for 100 years, and it will continue to produce coconuts until approximately 70 years of age. A mature coconut tree can produce up to 200 coconuts per year, and it is possible to get three or even four harvests per year from each tree.

Figure 1 Coconut shell based activated carbon

Role of India in Activated Carbon Trade

India being first in production and third in area of coconut in the world has wide scope in the production and export of coconut-based products especially coconut shell activated carbon. The country has experienced remarkable growth and currently it is one of the major producers and exporters of coconut-based value-added products.

Table 1 Export of coconut shell based activated carbon from India:

Year	Quantity (in MT)	Value (in Rs. Crores)
2009-10	36855.21	212.63
2010-11	38712.12	255.50
2011-12	38500.00	347.60
2012-13	67720.19	561.23
2013-14	96561.20	607.86
2014-15	54345.07	557.80
2015-16	71672.71	747.56
2016-17	85396.10	811.17
2017-18	93392.08	951.27
2018-19	97050.21	1344.11

Source: Coconut Development Board (2020)

Activated carbon holds a major part in India's export of coconut-based products in terms of both value and volume. In the past decade, the quantity and value of activated carbon export from India exhibited an increasing trend (Table 1).

In-spite of India being the largest producer of coconut and coconut-based products, it lags far behind other Asian countries like Philippines, Indonesia and Sri Lanka in the export.

Competitiveness analysis of coconut and coconut products by Jeyasekhar et. al., (2016) revealed that comparative advantage of India is lower than major coconut exporting countries (Table 2).

It can be seen from Table 2 that in the case of activated carbon, Philippines clearly dominates the list followed by Indonesia, Thailand and Malaysia.

Table 2 India's comparative advantage in coconut products export:

Country	Activated carbon	Coconut oil	Desiccated coconut	Virgin coconut oil	Coconut milk
India	6.9	2.1	1.8	1.1	NA
Indonesia	26.2	21.2	4.9	16.1	NA
Malaysia	10.6	12.0	4.2	5.2	5.2
Philippines	28.1	32.3	29.1	38.0	NA
Thailand	12.6	1.6	5.6	8.1	39.2

Note: Figures are RCA (Revealed Comparative Advantage) indices; NA - not available.
Source: Jeyasekhar et. al. (2016).

Conclusion

Major proportion of coconut products produced in India are consumed in the domestic market itself, which is true for activated carbon too. Wide production and consumption of coconut in India paves way for the production of activated carbon from coconut shell in large quantity in the country.

The country has to formulate plausible strategies to reach the overseas market and capture the optimal share in market segments. Though India is having a strong domestic market base for its own product, in the near future due to the evolving trade agreements even in the domestic sector we may confront fierce price competition from the overseas export.

Hence, policy and other strategic measures need to be taken to improve the export competitiveness of coconut shell based activated carbon from India.

References

1. Coconut Development Board. 2020. Import/export. https://coconutboard.in/images/import-export.pdf
2. Jayasekhar, S., Chandran, K.P., Thamban, C., Jaganathan, D. and Muralidharan, K. 2016. Analyzing the trade competitiveness of Indian coconut sector in the liberalization regime. Journal of Plantation Crops 44(3): 147-152.

Silage – An Alternate Feed for Cattle

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Introduction

Silage is the conserved green fodder having moisture content in the range of 65 to 70 per cent. Fodder crops rich in soluble carbohydrates are incubated after chaffing for 45 – 50 days under anaerobic conditions. Sugars present in the fodder are converted to lactic acid, which acts as a preservative and a good source of readily fermentable sugars for the rumen microbes. Under proper storage condition, silage can be stored even up to two years. Good quality silage should not have any butyric acid, which gives off flavour to silage. If proper anaerobic conditions are not maintained, silage produced would have butyric acid content in it.

Crops Suitable for Silage Making

The fodder crops such as maize, sorghum, oats, pearl millet and hybrid Napier rich in soluble carbohydrates are most suitable for fodder ensiling. Quality of silage can be improved with the use of suitable additives such as molasses, urea, salt, formic acid etc.

The chopped material with mixed with 3 to 5 % molasses just prior to ensiling to provide fermentable sugar to favour the development of the correct bacteria and speed up the fermentation process. Molasses can also be used to improve the tastiness and smell of the silage, which will increase the amount of silage eaten.

The Four Phases of Silage Making

Once the fresh material has been harvested, chopped, compacted and well-sealed, the ensiling process then begins and undergoes four phases

Phase 1 Aerobic phase: Any oxygen trapped between the forage particles is eliminated as a result of the respiration of the plant material and the aerobic activities of yeasts and bacteria. The plant enzymes are also active during this phase, provided the pH is still within the normal range for fresh material (pH 6.0 – 6.5). This phase may take a few hours only, provided the forage is well compacted and sealed as soon as possible after harvest.

Practical aspects of the aerobic phase:

a. Fill the storage site quickly (1-2 days).
b. Chop the material as short as possible (1-3 cm).
c. Compact the storage container as well as possible, as fingers should not be able to be inserted into the compacted forage.
d. Seal the storage container air tight.
e. Weight the top of the stack to maintain an airtight seal between the cover and compacted forage.
f. Seal as soon as possible after harvesting is completed.

Phase 2 Fermentation phase: This stage begins once the oxygen is gone and the storage becomes anaerobic. Depending on the properties of the ensiled crop and the ensiling conditions, this phase may last several days to weeks. A successful fermentation will see the number of lactic acids producing bacteria dominate, reducing the pH to 3.5 to 4.5. The lower pH level may be achieved in unwilted material whereas the higher levels are from wilted forages.

a. Mix molasses (at 3-5 % on wet basis), a substrate source for the bacteria, to encourage lactic acid fermentation.

b. If possible, wilt forage to preferably about 30 % Dry Matter (DM).

Phase 3 Stable phase: Once the pH level has dropped, and air and water are not permitted to enter the storage site, most microorganism of phase 2 slowly decrease in numbers, resulting in a silage which is relatively stable. However, some acid tolerant microorganisms survive this period in an almost inactive state, along with others such as Clostridia and Bacilli which survive as spores.

a. Maintain an airtight seal around the silage.
b. Repair holes as soon as they are noticed.

Phase 4 Feed out phase or aerobic spoilage phase: This phase begins when holes are made in the storage site by mice, birds or other agents or it becomes uncovered for feeding out. The aerobic spoilage phase occurs in two stages. Deterioration begins through degradation of the preserving organic acids by yeasts and occasionally acetic acid bacteria. This results in a rise in the pH and then the second stage of spoilage begins. This is associated with increasing temperature in the silage and activity by spoilage microorganisms such as bacilli, moulds and enterobacteria.

Practical aspects of the aerobic spoilage phase:

a. Maintain an airtight seal.
b. Feed out to ensure about 20 to 30 cm removal from the entire silage face each day.
c. If the silage gets hot, feed it out at a faster rate.
d. If silage heating occurs, consider a smaller stack next harvest.

Procedure of Silage Making

1. Construct a surface/ trench silo (silage storage structure). One cubic meter space / silo can store 500-600 kg of green fodder.
2. Harvest the crop at 30-35 per cent dry matter stage.
3. Wilt the harvested fodder to bring down DM to 30-35 per cent.
4. Chop the fodder into small pieces of 2-3 cm size.
5. Fill the chopped fodder in the silo.
6. Press the chopped fodder in the silo layer by layer of 30-45 cm.
7. Filling and pressing should be completed as fast as possible.
8. Use additives during filling of fodder in the silo, if required.
9. After filling and pressing, seal the silo with thick polyethylene sheet.
10. Put weight through mud layer/ sand bags/ tyres on the sheet to prevent air slow beneath the sheet.
11. Open the silo for feeding, minimum after 45 days, as per need.

Feeding of Silage

Chopping of green fodder — Manual filling and pressing of fodder

Silo sealing — Silage feeding

1. Silo can be opened from one side as per need after 45 days and closed properly after taking out the silage.
2. Silage can be taken out as per requirement. Initially, silage can be fed @ 5 kg/animal to adjust the animals on silage feeding.
3. Silage is a substitute of green fodder and can be fed like green fodder.

Characteristics of Good Quality Silage

1. Bright, light green yellow or green brown in colour.
2. Lactic acid odour with no butyric acid and ammonia odour.
3. Firm texture with softer material.
4. Moisture should be in range of 65-70 per cent.
5. Lactic acid 3-14 per cent.
6. Butyric acid less than 0.2 per cent.
7. pH in the range of 4.0 – 4.2.

Critical Factors Effecting Production of Good Quality Silage

1. Type of silo – surface silo is best due to ease of ensiling.
2. Dry matter of fodder – Ideal 30-35 per cent.
3. Chop length of fodder – Ideal 2-3 cm, easy to get compacted.
4. Pressing/compaction of fodder – As quick as possible to minimise aerobic fermentation.
5. Sealing of silo – To check inflow of air and water into silo.

Advantages of Silage Making

1. Ensures regular supply of fodder to the dairy animals.
2. Ensures uniform quality fodder to animals during different seasons.
3. Silage can be made under almost all-weather conditions.
4. Surplus green fodder can be conserved, minimising wastage.
5. Feeding silage is an effective tool for the control of parasitic diseases, as the parasites present in different stages in green fodder are destroyed during ensiling.
6. Enhances green fodder productivity by improving harvesting intensity.
7. Enhances livestock productivity by ensuring fodder supply, especially during the lean period.

Conclusion

Silage is an alternative feed for cattle especially during the lean period. Under proper storage condition, silage can be stored even up to two years. Quality of silage can be improved with the use of suitable additives. It ensures regular fodder supply, minimum wastage of green fodder, controls parasitic diseases, enhances green fodder productivity and enhances livestock productivity.

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Stingless Bee: An Important Pollinator Under Protected Cultivation

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Stingless bees are the smallest of the honey producing bees. It is highly social insect like honey bees, living in permanent colonies, nesting in old walls, logs, crevices and such other concealed places. The stings of these bees are greatly reduced hence, the name given stingless bees. They are hardy and easy to handle. Stingless bees are hymenopterous insects belong to the super family Apoidea, family Apidae and sub family *Meliponinae*. *Meliponinae* consist of two genera Melipona and Trigona which belong to the tribe *Meliponinae* and *Trigonini*, respectively (Wile, 1983). The *Meliponiculture* has great potentialities viz., rural employment, nutrition and supplementary income generation, especially to women who can easily handle. Ecologically too, the stingless bees are important because of their role in pollination of tropical flora. Modern studies revealed that stingless bees are also an effective substitute to honeybees for the pollination of many crops grown under protected cultivation such as, cucumber, tomatoes, green peppers, hot peppers, seedless watermelons, strawberries, and melons where regular honeybees are avoided for fear of stinging.



Nesting Behaviour

They active all around the year. Less active in cooler weather, with some species presenting diapauses (Ribeiro, 2002). Unlike other eusocial bees, they do not sting but will defend by biting, if their nest is disturbed. In the genus Oxytrigona have mandibular secretions that cause painful blisters (Roubik et al., 1987). The nesting habits of different Trigona species was studied by *Devanesan* et al., (2009) and found that *Trigona iridipennis* build nest inside compound wall, hallow blocks etc.



Floral Choice and Foraging Activity



They prefer small flowers, dense inflorescence, flowers with long corolla tubes that are wide enough for the bees to enter and white- or yellow-coloured flowers. The workers of honey bees can forage over 2- 3 km, while those of the stingless bee can forage over 1 km at the most (Amano et al., 2000).

Pollination of Different Crops Under Protected Cultivation

Cucumber: Santos *et al.* (2008) reported that the highest cucumber yield (with the highest number of perfect fruits) was found in those greenhouses which housed the stingless bees as pollinators (GH I, GH II) over non bee colony greenhouses as well as open field cultivated cucumbers. Azmi *et al.* (2017) showed that the cucumbers pollinated by stingless bees and hand-cross pollination produced heavier, longer and larger cucumbers compared to those produced from pollination without stingless bees. Kishan *et al.* (2017) observed that stingless bee pollinated plots in TNAU and Srivilliputhur had significantly higher yield attributes such as fruit length, fruit girth, fruit weight, number of fruits per plant and yield/plant over control plots.

Chillies: Cruz *et al.* (2005) revealed significantly heavier and wider fruits, containing a greater number of seeds and of better quality (lower percentage of malformed fruits) in stingless bee pollination than self-pollinated greenhouse sweet pepper. Among the Australian stingless bees (*Austroplebeia australis* Friese and *Trigona carbonaria* Smith), *T. Carbonaria* were found to potentially improve fruit yield and quality within the greenhouse capcicum (Greco *et al*., 2011). Pollination by *Hypotrigona gribodoi* in a net cage produced the heaviest fruits with the highest seed numbers followed by feral pollinators and lastly self-pollinated flowers in green pepper (Kiatoko *et al.,* 2014). Azmi *et al.* (2016) found that chilies produced from pollination by the stingless bees, *Heterotrigona itama* and hand-cross pollination were significantly heavier, longer and containing greater number of seeds per fruit than self-pollinated chilies. Both *T. laeviceps* and *Trigona minangkabau* had the same effectiveness as pollinators on chili pepper plantations as compared to other modes of pollination (Putra *et al.*, 2016).

Tomato: Bispo dos Santos *et al.* (2009) found that stingless bees, *Melipona quadrifasciata*, were significantly more efficient than honey bees in pollinating greenhouse tomatoes. Tomatoes originating from flowers visited by stingless bee, *M. quadrifasciata* workers produced about 47 per cent more seeds and their concentration of sugar was approximately 14 per cent higher (Bartelli and Nogueira-Ferreira, 2014). Fruits produced in greenhouses also presented 15 per cent more fresh mass and 41.1 per cent more seeds, than the fruit produced in an open environment (Silva-Neto *et al*., 2019).

Melon: Fahimee and Jajuli (2014) found that TSS (brix) of rock melon fruits were higher in stingless bee pollination compared to manual pollination and it will be grade as a premier fruit. Azmi *et al*. (2019) observed that stingless bee, *H. itama* pollination produced higher rockmelon fruit yield compared to the other pollination in greenhouse.

Straw berry: Slaa *et al*. (2006) reported that *Tetragonisca angustula* pollination in strawberry had reduced significantly the percentage of misshapen fruits (by 86%) and yielding a significant increase in strawberry weight (by 14%) compared to the control. Similar results were found by Roselino *et al.* (2009) by using *Nannotrigona testaceicornis* bees in pollinating strawberries in greenhouses.

Ash gourd: Chauhan *et al.* (2019) Colonies of *T. iridipennis* and *A.cerana* were introduced at 5% blooming stage in separate cages. The observations on relative abundance, foraging rate, foraging speed and loose pollen grains were made ascertain the pollination efficiency. Fruit production and quality parameters (fruit yield, fruit length, fruit diameter, fruit weight, seed number, seed weight *etc*.) were observed for each treatment. In control experiment, no pollinator was allowed to visit the crop. The evaluation of pollination potential revealed their effects on crop production and productivity. Data revealed many folds increase in fruit set (27.96%) and quality with *T. iridipennis* as compared to open and A. cerana pollination. Significantly the least fruit set (54.60%) was observed in without pollination. Thus, an increase of 634% was observed in increase in income of farmers.

Eggplant: Silva *et al*. (2013) observed that colony foraging pattern of *M. fasciculata* in greenhouses, the behaviour of bees during the visits to flowers, and fruit set and fruit quality after different pollination treatments (hand pollination: autogamy, geitonogamy, xenogamy; bee pollination). Our results show that *M. fasciculata* is an efficient pollinator of eggplants and, consequently, may be a viable alternative to bumblebees in Brazil.

Conclusion

Stingless bees are suitable to provide pollination services in greenhouses and thereby increase quantitative (fruit weight, fruit set, seed number, seed weight) as well as qualitative attribute (TSS) of produced under protected cultivation. Characteristics of their social life (perenniality, polylecty, floral constancy, recruitment and harmlessness) suit them for pollination. They play a prominent role in pollination of different crops such as cucumber, chilli, tomato, melons, straw berry, ash guard and egg plant.

References

1. Amano, K., Nemoto, T. & Heard, T. (2000). What are stingless bees, and why and how to use them as crop pollinators? Japan Agricultural Research Quarterly, 34(3), 183-190.
2. Azmi, W. A., Samsuri, N., Hatta, M. F. M., Ghazi, R. & Seng, C. T. (2017). Effects of stingless bee (Heterotrigona itama) pollination on greenhouse cucumber (Cucumis sativus). Malaysian Applied Biology, 46(1), 51-55.
3. Azmi, W. A., Seng, C. T. & Solihin, N. S. (2016). Pollination efficiency of the stingless bee, heterotrigona itama (hymenoptera: apidae) on chili (capsicum annuum) in greenhouse. Journal of Tropical Plant Physiology, 8, 1-11.
4. Azmi, W. A., Wan S. W. Z., Yusuf, N., Hatta, M. F., Salleh, A. F., Hamzah, M. A. H. & Ramli, S. N. (2019). Effects of pollination by the indo-malaya stingless bee (hymenoptera: apidae) on the quality of greenhouse-produced rockmelon. Journal of economic entomology, 112(1), 20-24.
5. Bartelli, B. F. & Nogueira-Ferreira, F. H. (2014). Pollination services provided by Melipona quadrifasciata lepeletier (hymenoptera: meliponini) in greenhouses with Solanum lycopersicum l.(solanaceae). Sociobiology, 61(4), 510-516.
6. Bispo dos Santos, S. A., Roselino, A. C., Hrncir, M. & Bego, L. R. (2009). Pollination of tomatoes by the stingless bee Melipona quadrifasciata and the honey bee Apis mellifera (Hymenoptera, Apidae). Genetics and Molecular Research, 8(2), 751.
7. Chauhan, A., Singh, H. K. & Kumaranag, K. M. (2019). Pollination potential of stingless bee Tetragonula iridipennis smith in ash gourd. Indian Journal of Entomology, 81(4), 854-859.
8. Cruz, D. O., Breno, M. F., Silva, L. A., Silva, E. M. & Isac, A. B. (2005). Pollination efficiency of the stingless bee Melipona subnitida on greenhouse sweet pepper. Pesquisa Agropecuária Brasileira, 40(12), 1197-1201.
9. Devanesan, S., Shailaja, K.K. & Premila, K.S. (2009). Status paper on stingless bee Trigona iridipennis Smith,Kerala, India.1-80pp.
10. Fahimee, M. and Jajuli, R. (2014). https://www.researchgate.net/publication/317013021_Stingless_bees Utilization
11. Greco, M. K., Spooner, H. R. N., Beattie, A. G., Barchia, I. & Holford, P. (2011). Australian stingless bees improve greenhouse Capsicum production. Journal of Apicultural Research, 50(1), 102-115.
12. Kiatoko, N, Raina, S. K., Muli, E. & Mueke, J. (2014). Enhancement of fruit quality in Capsicum annum through pollination by Hypotrigona gribodoi in Kakamega, Western Kenya. Entomological Science, 17(1), 106-110.
13. Kishan, T. M., Srinivasan, M. R., Rajashree, V. & Thakur, R. K. (2017). Stingless bee Tetragonula iridipennis Smith for pollination of greenhouse cucumber. Journal of Entomology and Zoology Studies, 5(4), 1729-1733.
14. Putra, D. P., Dahelmi, D, Salmah, S. & Swati, E. (2016). Pollination in chili pepper (Capsicum annuum L.) by Trigona laeviceps and T. minangkabau (Hymenoptera, Meliponini). Journal of Entomology and Zoology, 4(4), 191-194.
15. Ribeiro, M F. (2002). Does the queen of Plebeia remota (Hymenoptera , Apidae , Meliponini) stimulate her workers to start brood cell construction after winter? Insectes Sociaux, 49, 38–40.
16. Roselino, A. C., Santos, S. B., Hrncir, M. & Bego, L. R. (2009). Differences between the quality of strawberries (Fragaria x ananassa) pollinated by the stingless bees Scaptotrigona aff. depilis and Nannotrigona testaceicornis.Genetics and Molecular Research, 8(2), 539-545.
17. Roubik, D. W., Smith, B. H. & Carlson, R. G. (1987). Formic acid in caustic cephalic secretions of stingless bee, Oxytrigona (Hymenoptera: Apidae). Journal of Chemical Ecology, 13(5), 1079–86.
18. Santos, S. A., Roselino, A. C. & Bego, L. R. (2008). Pollination of cucumber, Cucumis sativus L.(Cucurbitales: Cucurbitaceae), by the stingless bees Scaptotrigona aff. depilis moure and Nannotrigona testaceicornis Lepeletier (Hymenoptera: Meliponini) in greenhouses. Neotropical entomology, 37(5), 506-512.
19. Silva, N.P., Hrncir, M., Silva, D.I., Roldao, C. I. & Imperatriz V. L. (2013). Stingless bees, Melipona fasciculata, as efficient pollinators of eggplant (Solanum melongena) in greenhouses. Apidologie, 44(5), 537-546.
20. Silva-Neto, C. D., Ribeiro, A. C., Gomes, F. L., Melo, A. P., Oliveira, G. M., Faquinello, P. & Nascimento, A. D. (2019). The stingless bee mandacaia (Melipona quadrifasciata Lepeletier) increases the quality of greenhouse tomatoes. Journal of Apicultural Research, 58(1), 9-15.
21. Slaa, E. J., Luis, A. S., Malagodi-Braga, K. S. & Hofstede, E. F., (2006). Springer 37 (2), pp.293-315.
22. Wille, A. (1983). Biology of the stingless bees. Annual Review of Entomology, 28, 41-64.

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Silica Chitosan Nano-Fertilizers for Crop Protection

Article ID: 10241

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Introduction

Silica is found mainly in the crystalline state and hardly in an amorphous stat. In plants it acts as nonessential nutrient but it provides benefits to plant against biotic and abiotic stresses. In Gramineae family, it accumulates in plants and increase crop production by improving physiological and biochemical properties of plants. On the other hand, chitosan is carbohydrate which is polymer of linear polysaccharide that is byproduct in the fishing industry so its raw material can be available in large amount. In plants, chitin- and chitosan-based molecules are widely used as safe and environmental-friendly fertilizer to improve productivity of crop (Maluin and Hussein, 2020). Nano-enabled agrochemicals, also termed as agronanochemicals, plays a key role in the development of integrated management of pests and diseases, as they offer controlled release of active ingredients and site-specific delivery, thus, enhancing their efficacy and efficiency.

Silica Chistosan Agronanochemicals

Controlled Release Fertilizer (CRF) was synthesized that bear NPK and SiO_2 Nanoparticles inside the core and Chitosan was present in outer coating and Sodium Alginate and Kaolin as an outer most superabsorbent coating. CRF beads can absorb large amounts of water and double their weight which can helps to plant to survive under drought and saline conditions without harming the environment. Due to the small size silica chitosan fertilizer deeply penetrate into the plant cell wall and cuticle, which helps to increases the argochemical uptake. Due to encapsulation of agrochemicals in chitosan nanocarriers protects the toxic effect of the free agrochemicals on the plant, cells and DNA, thus, minimizing the negative impacts of agrochemical active ingredients on human health and environmentally friendly (Kusumastuti *et. al.,* 2019).

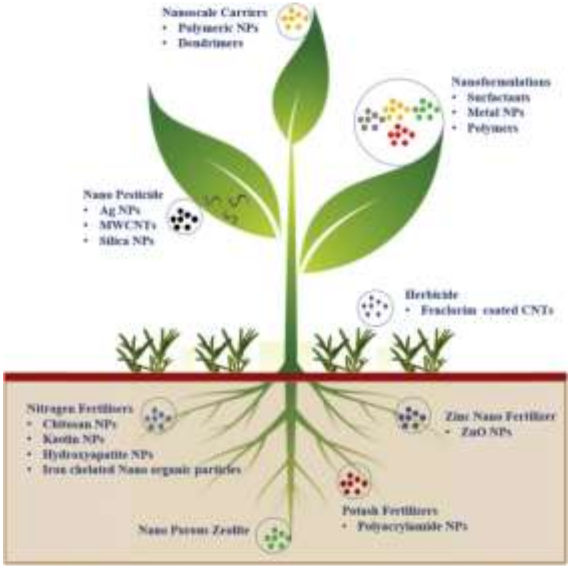

Fig 1 : Nano fertilizers and their formulations (adapted from Vishwakarma et. al., 2018)

Most of the clay mineral absorb water from surrounding environment and greatly increase its volume. Kaolin clay, as the polymer (sodium alginate and kaolin) enhanced the water withholding capacity by several folds. Chitosan, sodium alginate and kaolin are used in CRF used are completely degradable so this CRF is novel, biocompatible and environment friendly. Chitosan nanoparticles increase the growth of plant and act as antimicrobial agents against pathogenic fungi and bacteria (Friedman *et. al.,* 2013). Silica Chitosan-based agronanochemicals can be prepared by ionic gelation, emulsion cross-linking, spray drying, precipitation, reverse micellar and sieving methods. Out of these methods, the sieving method is the simplest and direct method. Foliar and seeds treatment with zinc-loaded CHTNP enhanced gluten content in durum wheat and promoted crop yield in maize while Cu- and Zn-CHTNP suppressed cotton seedling disease caused by *Rhizoctonia solani* . Ag-CHTNP application-controlled leaf fall disease caused by *Corynespora cassiicola* on rubber trees and significantly affected *Phytophthora capsici* growth on pepper plants while lanthanum-CHTNP effectively promoted growth and improved disease resistance of rice (Liang *et. al.,* 2018).

Conclusion

CRFs exhibit superior characteristics due to copolymerization of chitosan and acrylamide were a key step toward its commercialization as well as enhanced fertilizer use efficiency. Amendments of urea CCFs into the urea CRF formulations using excipients emanating from chitosan-acrylamide coencapsulation along with silicone doping are a feasible process. Till now many unattempted questions including thermokinetic properties of the prepared CRFs formulations, release profiles under actual soil conditions with varying pH, formation of linear and deformed sigmoid release pattern following silicone doping are there for further scientific research.

References

1. Friedman, A.J., Phan, J., Schairer, D.O., Champer, J., Qin, M., Pirouz, A. and Kim, J. 2013. Antimicrobial and Anti-Inflammatory Activity of Chitosan–Alginate Nanoparticles: A Targeted Therapy for Cutaneous Pathogens. J Invest Dermat, 133(5): 1231–1239.
2. Kusumastuti, Y., Istiani, A., Rochmadi, and Purnomo, C.W. 2019. Chitosan-Based Polyion Multilayer Coating on NPK Fertilizer as Controlled Released Fertilizer. Ad Mat Sci Engin, 1–8.
3. Liang, W., Yu, A., Wang, G., Zheng, F., Hu, P., Jia, J. and Xu, H. 2018. A novel water-based chitosan-La pesticide nanocarrier enhancing defense responses in rice (Oryza sativa L) growth. Carbohydr Polym, 199: 437– 444.
4. Maluin, F.N. and Hussein, M.Z. 2020. Chitosan-Based Agronanochemicals as a Sustainable Alternative in Crop Protection. Mol, 25(7): 1611.
5. Vishwakarma, K., Upadhyay, N., Kumar, N., Tripathi, D.K., Kumar, D., Sharma, C.S. and Sahi, S. 2018. Potential Applications and Avenues of Nanotechnology in Sustainable Agriculture. Nanomaterials in Plants, Algae, and Microorganisms Vol 1, pp 473-500.

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Genetically Modified Crops for Insect Resistance - A Solution or Problem

Article ID: 10242

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Introduction

The crop losses due to pest damage account for about 13% of world crop yield. The easiest way is the use of chemical insecticides to control the pest at the field level. However excessive use of pesticides created the problem of pesticide resistance. Therefore, genetically modified crops resistant to insects can be a solution to reduce the reliance on chemical insecticides.

Approaches for Developing Genetically Modified Crops for Insect Resistance

1. Use of bacterial insecticidal genes.
2. Using the endogenous plant protection mechanism.

a. Use of bacterial insecticidal genes:

i. Cry gene from Bacillus thuringiensis produces cry endotoxin which is also known as Bt protein, insecticidal crystal protein (ICP), or δ-endotoxins. The cry proteins made of three domains: domain I, domain II and domain III. Domain I is responsible for pore formation, domain II involves in receptor recognition and domain III involve in receptor binding in the midgut of insect. The Bt proteins are expressed in field crops such as maize, cotton, and potato.

ii. Toxin A, (tcd A) gene of *Photorhabdus luminescens* bacterium which lives symbiotically within nematode. Nematode uses this toxin produced by the bacteria to kill the insect host. Arabidopsis transformed with tcd A gene showed resistance to tobacco hornworm.

iii. Vegetative insecticidal protein (Vip): This protein is secreted during the vegetative growth of Bacillus thuringiensis, unlike the cry protein which is secreted only during sporulation. Vip family showed the insecticidal property.

b. Using the endogenous plant protection mechanism: Plant resistance genes that encode for insecticidal proteins such as trypsin inhibitor, α-amylase inhibitor, and lectins, act as a natural defense against the pest. These genes have been identified and used to produce transgenic crops. Eg- Cowpea trypsin inhibitor (CpTI) gene transformed to tobacco showed resistance against lepidopteran pests.

Insect Resistance to Bt Became a Problem

The development of insect resistance to Bt protein can be understood by the mechanism through which this protein is recognized in the insect midgut. This protein binds the receptor present in the insect gut and pores are created. Subsequently, the insect gets killed. However, resistance against Bt protein occurs due to the mutation in the receptor protein of the insect; as a result, Bt protein is not able to bind with the receptor and the insect did not get killed and the insect becomes resistant to Bt protein.

Some of the Strategies for Countering Insect Resistance to Bt are Listed here

1. Gene pyramiding: Using more than one transgene through the conventional crossing between different transgenic lines. Eg Bollgard II is developed by stacking cry2Ab with cry1Ac to prevent the development of resistant cotton bollworm (Bravo, A., and Soberon, M. 2008).

2. Domain engineering: It involves fusing of different domains present in cry protein to get a fusion protein with enhanced effectiveness and activities.

3. Use of other insecticidal proteins: Eg- Vip family proteins or toxin A.

4. Integrated pest management: E.g., High –dose/refuge approach. Trangenic Bt crops are grown surrounded by non-Bt refuges crop. A high dose of Bt protein-expressing transgenic crop is required to ensure feeding of only homozygous resistant insects. Refuges ensure the feeding of a large population of susceptible insects. Therefore, most of the mating between two groups of insects (homozygous resistant and susceptible insects) will produce heterozygous resistant offspring which are unable to survive on the Bt crop. Thus, it cannot lead to the development of insect resistance to Bt.

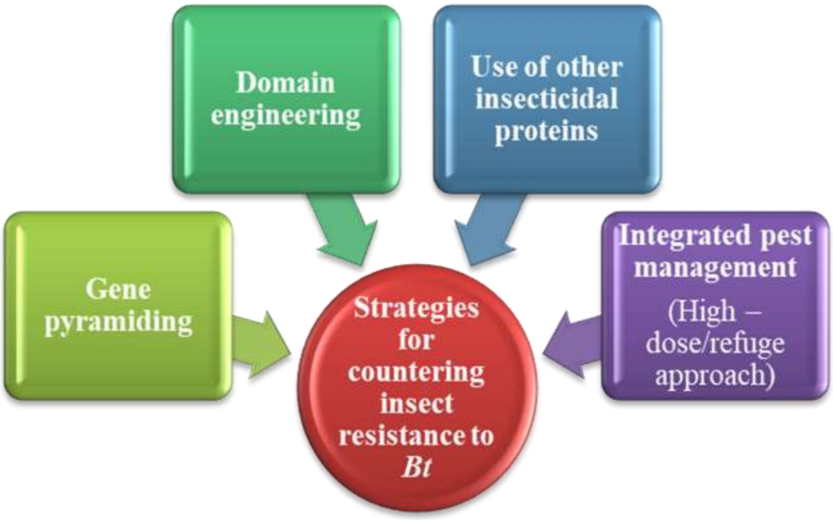

Figure 1 – Strategies to counter insect resistance to Bt

Conclusion

Apart from the problem of insect resistance, the related concerns such as the threat to biodiversity and food safety-related issues are major hurdles in the field of GM crops approval. Therefore, scientific evidence is required to prove these claims. The world population is growing day by day so we need more food to feed the increasing mouth. The conventional breeding approaches cannot achieve it; therefore, GM crops can be a solution.

References

1. Adrian Slater, Nigel W. Scott, and Mark R. Fowler. (2008). Plant Biotechnology: The Genetic Manipulation of Plants. Oxford University.
2. Bravo, A., and Soberon, M. (2008). How to cope with insect resistance to Bt toxins?. Trends in biotechnology, 26(10), 573-579.

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Artificial Intelligence: A Modern Approach in Agricultural Entomology

Article ID: 10243

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Introduction

Machine being able to think and act like human beings was a far-fetched idea when Mc Carthy et.al., (1995) coined the term Artificial intelligence (AI), but in 21st century our whole society is running on AI from a tiny mobile phone in our pocket to solving how our universe originated. Agriculture is not far behind in adopting this evolving technology. AI can be described as a machine or a system being able to achieve human-like performance in all cognitive tasks such as speech recognition, natural language understanding and translation, image analysis, decision making etc. using purely logical reasoning. AI requires algorithms to function. Algorithms are mathematical instructions for computers.

History on Development of AI

The era of AI began when Alan Turing built a code breaking machine called The Bombe for British government to decipher the Enigma code used by the German army during the Second World War. Initial developments of AI focused on solving the problems through “if-then” approach (Kaplan and Haenlein, 2019) and tree search method (Campbell, 2002) (deep blue program for playing chess). Example for “if-then” approach: if a solution for a problem is “true” then the alternate result will be false. Hebbian Learning theory developed by Donald Hebb paved way for conception of Artificial Neural Networks (ANN) and in the past decade its hybrid approaches like Deep Learning techniques like Convolutional NN, Generative NN forms the basis of all AI applications.

Structure of AI

The core part of AI is Machine learning (ML). Motta et.al., (2019) defined it as a subarea of artificial intelligence that is able to learn from previous experience. ML algorithms are design to solve problems, extracting features from existing data, learn from these features and predict the outcomes. It includes Artificial Neural networks (ANN), Fuzzy systems, Genetic Algorithms and Deep Learning techniques like Convolutional NN, Generative NN etc.

ANN is an information processing paradigm that is inspired by the way the biological nervous system such as brain process information (Kumar et.al., 2002). It is composed of large number of highly interconnected processing elements (neurons) working in unison to solve a specific problem.

Deep Learning, an advanced form of ANN is essential for general object recognition. It maps an input to output when sufficiently large models and dataset of labelled training examples are given.

Motta et.al., (2019) describes an intelligent mosquito’s trap which classifies harmful from beneficial insects. This is done by feeding the machine with wingbeat frequency data of different kinds of insects. The machine finds pattern in this data and creates its own function which helps the machine to take decision to either release or kill the insect that approaches the trap.

Application of AI in Agricultural Entomology

The most popular applications of AI in agricultural entomology falls under 3 categories. They are as follow:

1. Taxonomic studies (identification and classification of insects, phenotype quantification, understanding evolutionary variations in traits)
2. Ecological studies (Spatial and temporal distribution of insects, understanding changes in insect biomass, abundance and diversity, analysing nutritional ecology of insects, estimating microhabitat characters)
3. Pest management (pest identification, classification, monitoring, control, developing pest warning and prediction systems and biosecurity).

Digital automated identification system (DAISY) is an automated species identification system optimised for the rapid screening of invertebrates and was installed at Natural History Museum in London. It was capable of providing identification of species in less than a second. Automatic Bee Identification System (ABIS) is a software created for monitoring and identification of live bees in field and mounted specimens without removal of any body parts. LeafByte is a mobile app which measures leaf area and levels of herbivory. DrawWing software, SHAPE, Insect identifier app, entomologas and SPIDA are some of the other examples. In India, a project undertaken by Wadhwani AI in collobration with google aims to alert farmers on level of pest infestation and identification in cotton crop, similarly NITI Aayog along with IBM targets to develop a crop yield prediction model using AI. In Switzerland, Maxime bohnenblust is working on AI that monitors the Varroa mite in beehives and alerts the beekeepers in surrounding communities when infestation begins. AI machines are of great tool in Precision agriculture, using this grower can pinpoint a particular area in field that needs attention regarding various factors like control of weed, nutrients and water requirement, pest and disease infestation. They can also record weather factors that affect plant growth and development, pest and disease incident and development and analyse concurrently.

Limitations

1. When compared to humans, machines cannot assess different realities and adopt to it. Every problem is unique and requires constant development and training of new algorithms , just like how each day new kind of smart phones are being developed.
2. Requires huge historical data for algorithm training.
3. When dataset is small, more error can be noticed because of less training cycle. When dataset is large but has less variability, this leads to low accuracy because real-time scenarios are complex with high variations.
4. Requires high quality images to train the algorithm.
5. Developmental cost is high.
6. Lack of sufficient research in the application of robotics in agricultural entomology.

Advantages

The benefits of AI overweigh its limitation. These intelligent systems work with higher accuracy and speed than humans and be responsive like humans. Simple mobile based AI systems are easy and affordable and plays a major role in disseminating new technologies to large crowds in less time and increases the adoption rate of these technologies among farmers. Farmers can get personalized and very specific advice from subject matter specialist. AI based adaptive e-learning can also help students towards learning new concepts. Taxonomists can benefit immensely from these AI systems for identifying underlying evolutionary traits and identifying difference in closely related species and mimicking species. These systems can actually generate better material and more comprehensive testing than traditional methods. Research in entomology can be advanced by adopting AI. With integration of various science fields like entomology, engineering, statistics and computer science, new innovative research can be implemented.

Conclusion

AI has two sides, one logical and other human aspect which augments the jobs of growers instead of replacing them. It helps save time and reduces the burden of famers of scouting and walking through field to check crops for various anomalies. Hence AI should be seen as more of augmenter rather than replacer. The fluidity of AI, makes it fit in all arenas thus bringing new innovations in research and development of agriculture. There is a need for conducting workshop for training entomologist in cognitive science. At national level, biggest agricultural data lies with the government and hence government support is equally needed for India to revolutionize in agriculture by adoption of AI.

References

1. Campbell, M., Hoane, J. A. & Hsu, F. (2002). “Deep Blue,” Artificial Intelligence, 134(1-2): 57-83.
2. Haenlein, M. and Andreas K. (2019). "A brief history of artificial intelligence: On the past, present, and future of artificial intelligence." California Management Review 61:4.
3. Kumar, M., Raghuwanshi, N. S., Singh, R., Wallender, W. W., & Pruitt, W.O. (2002).Estimating Evapotranspiration using Artificial Neural Network. Journal of Irrigation and Drainage Engineering, 128(4), 224233.doi:10.1061/ (asce) 07339437(2002)128:4 (224).
4. Motta, D. S., Badaro, R., Santos, A. and Kirchner, F. (2019).’Use of Artificial Intelligence on the Control of Vector-Borne Diseases’, in Savic, S. (ed) Vectors and Vector-Borne Zoonotic Diseases. IntechOpen,pp 439.

Management of Mite and Nematode in Mushroom Production

Article ID: 10244

N. K. Gajre[1], N. B. Gohil[1]

Like the field crops, mushrooms are attacked by several pests, sciarids flies, phorid flies, cecids, springtails, mites and nematodes are important pests of cultivated mushrooms throughout the world. These pests damage the crop right from spawning to harvesting of the crop. Mushrooms being the indoor crop provide a very suitable habitat for the insect pests due to which pest remains protected from the vagaries of the weather. Therefore, measures should be taken to prevent the entry of mite and nematode into the cropping rooms.

Mites

Cultivated mushrooms are infested by several groups of mites. Fifty-four species of mites have been reported from various parts of world of which 16 species have been found economically important. Cultivated mushrooms are generally infested with mites belonging to Acaridae, Pyemotidae, Ascidae, Digamasellidae, Tydeidae and Macrochelidae.

The initial infestation of mites in mushroom houses comes through raw material used for the preparation of mushroom beds. *T. dimidiatus*, a major pest of mushroom throughout the world is often present in large numbers in hay, straw, grains and similar materials used for preparation of mushroom beds. Occasionally phorid flies also transport mushroom mites.

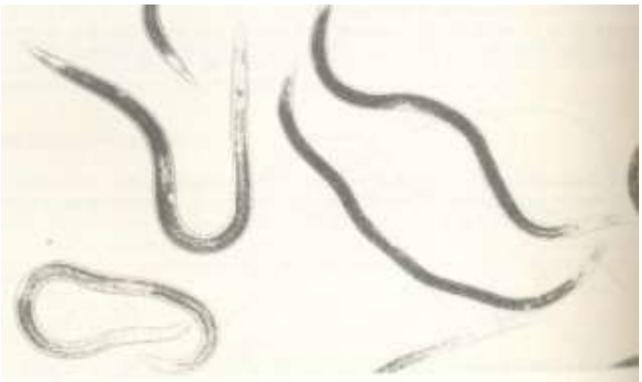
Symptoms/damage caused by the mites varies with the species. *T. dimidiatus* hollows out tiny buttons while in large mushrooms it makes cavities of various sizes on stalk and caps. *T. berlesei*, *T. mycophagus* and *T. longior* make holes on caps. *Tyrophagus putrescentiae* feeds on mycelium and sporophore resulting in small irregular pits on stalk and caps. *Pygmephorus* sp. feeds on mycelium below the casing layer.

Mite infested mushroom

Management of Mites

1. Proper pasteurization of compost and casing material.
2. Proper hygien and sanitation.
3. Disinfection of mushroom house by spraying 0.1 % dicofol.
4. Burning sulphur in the empty rooms @ 2-3 lb/1000 cu.ft.
5. Sterilization of empty tray
6. Applying Propargite (Omite 590 EC) at 0.888 and 0.66 g a.i./m^2 at spawning.
7. Spraying beds with chlorfenvinphos, fenitrothion, fenthion or metasystox (1.0 g a.i/m^2) immediately after spawning and before casing give satisfactory control of mites without crop reduction.

Nematode



During different phases of button mushroom production, a large number of nematodes are encountered along with insect-pests and mites. Mycelium of the fungi favourable source of food for nematodes. Nematodes are one of the most dangerous pests of button mushroom which once enter the beds cannot be eradicated completely, until and unless crop beds are destroyed and disposed of completely. A number of instances of crop failure due to nematodes have been reported during the last two decades. Lack of pasteurization facility, growing crop seasonally under unhygienic conditions and lack of awareness about cultivation practices are some of the factors responsible for easy access of nematodes in cropping beds. Generally, three types of nematodes viz. myceliophagous, saprophytic and predatory are encountered in mushroom.

Nature of Damage

Myceliophagous nematodes have needle like structure (stylet) in their mouth parts. The stylet is hollow inside and can be moved forward and backward by the contraction and relaxation of the muscles. The nematode secretes strong enzymes. These enzymes act immediately after ejection and help in penetration of stipe and to convert the cell contents in assumable forms. This nematode has very fast multiplication rate (50-100-fold/week). It has been found that initial infestation with 3 nematodes of *D. myceliophagous*/100 g of compost can entirely destroy the mycelium within period of 70 days.

Source of Infestation

Button mushroom is highly susceptible to nematode attack during entire cultivation process. The common source of nematode contamination is damp wheat straw, manure, FYM, garden oil, spent compost, platform soil, irrigation water and contaminated implements. Sometimes flies, particularly sciarids, carry the nematodes from one bed to another.

Symptoms

Following symptoms of nematode attack appear in infected beds in succession.
1. Mycelial growth is sparse, patchy and mycelium turns stingy.
2. The compost surface sinks
3. Whiteness of spawn-run slowly changes to brown.
4. Sporophore flushes are poor and delayed.
5. Browning pin head.
6. Declined yield.
7. Complete crop failure.

Management of Nematodes

1. Prophylactic measures:

a. Cropping should be done in purposely built mushroom houses with proper ventilation.
b. Strict hygienic and sanitation measures should be followed throughout the cropping period.
c. Composting yard must be cemented to prevent the direct contact of compost with the soil.

d. All the instruments, walls, floors and galleries should be disinfected with 4% formalin.

e. Composting ingredients should always be stored in clean area.

f. Cleanliness should be maintained inside and in surrounding of mushroom farms.

g. Casing mixture should be properly pasteurized.

h. Manures used for composting should be thoroughly broken and its layers allowed to decay properly.

i. In long method of composting , covering compost with double PVC sheet for 24 hours after third turning gives effective control of nematodes.

j. Foot dips must be installed in front of each cropping room.

2. Chemical control: Mushrooms, being indoor crop, provide little scope for pesticidal usage. Short life of the crop and deleterious effect of pesticides on mycelium and residue problems further limits the scope of pesticide application.

3. Physical control: Use of heat is the most successful method of nematode control in mushroom cultivation. It is recommended that that for making compost free of nematodes, air and bed temperature in the pasteurization room must be maintained 600C at least for two hours and cook out of mushroom house at 700C for 5-6 hours is necessary. Dips of the appliances in boiling water for 1-2 minutes are sufficient for complete destruction of nematodes.

Strategies for Generating Marker Free Transgenic Plants

Article ID: 10245

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Introduction

To produce transgenic plants, selection systems are used that lead to the selective growth of transformed cells. Genes encoding for resistance to specific antibiotics or herbicides have been found to be particularly effective for selection and provide a means for rapidly identifying transformed cells, tissues, and regenerated shoots. Selectable marker genes (SMGs) are integrated into the plant genome; there are concerns about widespread occurrence of transgenes in novel ecosystems (e.g., antibiotic resistance in crops and their agroecosystems). Production of marker-free transgenic crops eliminates risk of horizontal gene transfer and could mitigate vertical gene transfer. There were strategies to achieve these goal: one approach uses markers not based on antibiotic or herbicide resistance genes, and the second is to excise or segregate marker genes from the host genome after regeneration of transgenic plants, which includes co-transformation (i.e., separate transformation of marker and transgene), site-specific recombinase-mediated marker deletion (e.g., Cre/loxP, FLP/FRT and R/RS site-specific recombination systems), transposon-based expelling systems (e.g., Ac transposon), homologous recombination based excision, and transformation by marker genes not based on herbicide or antibiotic selection (Darbani et al., 2007).

Co-Transformation

Co-transformation is a method for production of marker free transformants based on Agrobacterium- or biolistic mediated transformation in which a SMG and gene of interest are on separate constructs. Three approaches are used for co-transformation: (i-a) introduction of two TDNAs, in separate Agrobacterium strains or (i-b) biolistics introduction of two plasmids in the same tissue; (ii) introduction of two T-DNAs carried by different replicons within the same Agrobacterium strain; and (iii) introduction of two T-DNAs located on the same replicon within an Agrobacterium (Darbani et al., 2007).

Site-Specific Recombination-Mediated Marker Deletion

The ability of microbial site-specific recombinases to cleave DNA at specific sites and ligate it to the cleaved DNA at a second target sequence has led to their widespread use in manipulating DNA in higher eukaroytes. The selectable marker gene is inserted into the transformation vector between two directly repeated recombination (R) sites that are recognized by a site-specific recombinase and used for the selection of transgenic plant cells. After expression of the respective recombinase, the marker gene is excised from the plant genome and the trait gene is left behind. some examples are Cre/loxP system from bacteriophage P1, where the Cre enzyme recognizes its specific target sites, FLP/FRT recombination system from *Saccharomyces cerevisiae*, where the FLP recombinase acts on the FRT sites and R/RS recombination system from *Zygo saccharomyces rouxii*, where R and RS are the recombinase and recombination site, respectively (Tuteja *et al*., 2012).

Transposon-Based Marker Methods

Transposable elements which are the DNA sequences able to change their position within the genome can be used to generate marker free transgenics. The strategy is to connect either the transgene or the selectable marker with transposable sequences in such a way that the two entities can be separated from each other in a controlled reaction after transformation and selection. However, as segregation of transgene and marker are required and transposons tend to jump, this approach is very time consuming (Pucth, 2003).

Homologous Recombination System

This method is based on the principle of double stranded DNA break repair mechanism. double stranded DNA break can be repaired by homologous recombination(HR) or Non-homologous End joining (NHEJ).Frequency of HR is higher when homologous sequences near the break is available. Genes in between homologous repeat sequence can be deleted during homologous recombination. Recovery of a high frequency of Kanamycin resistant gene free tobacco plants was reported when Kanamycin gene was inserted between two direct repeat attp regions. Induction of double stranded break for higher homologous recombination can be achieved by transient expression of I-Scel restriction enzyme in vivo. Major disadvantage of this system is uncontrolled recombination, excision of non-target genes and low efficiency (Pucth, 2003).

Alternatives to Herbicides or Antibiotic Resistant Genes

In parallel to or in combination with marker elimination, a new set of markers is being developed. The rationale behind this system is that non transformed cells are not killed as in the procedures using antibiotic or herbicide resistance genes; rather, the transformed cells experience a metabolic or developmental advantage. This might even increase the efficiency of regeneration of transformed plants. Genes that permit identification of transgenic plants in the absence of a selective agent are known as screenable markers. Non-toxic selective chemicals as opposed to antibiotics and herbicides have been used successfully. e.g., the bacterial *β-glucuronidase, Xylose isomerase* (Tuteja et al., 2012).

Conclusion and Future Prospects

The removal of marker gene from the transgenic plants supports multiple transformation cycles for transgene pyramiding. It is clear that several viable methods for the removal of unwanted marker genes already exist. It seems highly likely that continued work in this area will soon remove the question of publicly unacceptable marker genes. At present there is no commercialization of marker free transgenic crop. But development of marker free transgenics would further increase the crop improvement programme.

References

1. Tuteja, N., Verma, S., Sahoo, R. K., Raveendar, S., and Reddy, I. B. L. (2012). Recent advances in development of marker-free transgenic plants: Regulation and biosafety concern. Journal of Biosciences. 37(1): 167–197.
2. Puctha, H. (2003).Marker- Free transgenic plants. Plant Cell, Tissue and Organ Culture 74: 123–134.
3. Darbani, B., Eimanifar, A., Stewart, C. N., and Camargo, W. N. (2007). Methods to produce marker-free transgenic plants. Biotechnology Journal, 2(1): 83–90.

Arsenic Poisoning in Animals

Article ID: 10246

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Introduction

Arsenic poisoning one of the most important toxicological hazard to farm animal. Arsenic poisoning caused by different types of organic & inorganic arsenical compound. Poisoning characterized by colic, weakness, depression, weak pulse, dehydration, cardiovascular collapse partial paralysis of hind limb, trembling, stupor, and cold extremities in animals.

Source

Inorganic arsenical poisoning occurs due to arsenic trioxide, arsenic penta oxide, sodium & potassium arsenate. Arsenic trioxide more soluble & more toxic(5-10 times) arsenic pentaoxide. Through drinking water containing more than 0.25% arsenic. Herbivores animal are poisoned by eat contaminated forage. In sheep poisoned by dipping in arsenical preparation as lead arsenite used as taenicidal in sheep. Cats are poisoned by syrup bait intended for insect. Dog are poisoned by malilciously or accidental. Overdose of arsenic-containing drugs to treat heartworm parasites in dogs.

Organic arsenical it includes Monosodium methanarsonate (MSMA), Disodium methanarsonate (DMSA), Phenylarsonic compound. Phenylarsonic compound are less toxic than inorganic & inorganic & another organic compound. Poisoning result from excess of arsenic containing additive in pig & poultry diet. Persistence of MSMA & DSMA in soil & their tendency to accumulate in plant is a potential source for arsenic poisoning for grazing animal. In calve large dose of arsenic acid. Phenylarsonic used in swine & poultry as feed additive major source for poisoning.

Clinical Sign

Inorganic type: It affects gastrointestinal tract & cardiovascular system. In acute case profuse watery diarrhoea (rice water) sometimes tinged with blood along with colic, weakness, depression, weak pulse, dehydration, cardiovascular collapse. In peracute case animal death. In subacute case animal live for several days, colic, anorexia, depression, staggering, weakness, polyuria & then anuria, dehydration, partial paralysis of hind limb, trembling, stupor, cold extremities. In chronic case it is rare & characterized by poor condition, thirst, wasting, brick red mucous membrane, normal temperature, irregular pulse.

Organic type: In pig loss of weight followed by incoordination, posterior paralysis & eventually quadriplegia. The affected animals remain alert & good appetite, blindness is characteristic of arsenilic acid & not for another arsenical compound.

Lesion: Inorganic

In peracute case no lesion significantly. Inflammation & reddening of gastrointestinal mucosa may occur followed by oedema, rupture of blood vessel & necrosis of epithelial cell. Necrosis may progress to perforation of gastric or intestinal wall. GI content often fluid with foul smelling & blood tinged. There is diffuse inflammation of liver, kidney & other viscera. Liver may have fatty degeneration & necrosis. Kidney has tubular damage of lung & oedematous changes also.

Organic

No special lesion present. Demyelination & gliosis of peripheral nerve.

Remedial Measure

Emesis should be induced followed by activated charcoal with cathetic. GI protectant given as fluid therapy. BAL (dimercarpol) 4- 5 mg/kgbwt deep i/m tid for small animal. For large animal thioctic acid along 50mg/kg 20% solution i/m tid or combination with BAL. Sodium thiosulphate given as orally and i/v 8-10gm in form of 10-20% solution i/v & 20-30 gm orally in about 300ml of water. D- Pencillamine effective with wide margin of safety at 10-5mg/kgbwt orally tid for 3-4 days. Use of demulcent to reduce irritation. In herbivore large dose of saline purgative is desirable by demulcent. Freshly prepared ferric hydroxide solution it contains ferric chloride 3 parts and magnesia 1 part water 17 parts. Dose 500 gm repeat after 24 hours.

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Molecular Basis of Legume-Rhizobium Symbiosis

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Introduction

Biological Nitrogen Fixation is the fixation of elemental dinitrogen (N_2), from the atmosphere, by soil microorganisms through a reductive process into ammonia. The microorganisms that fix nitrogen are called diazotrophs. They belong to the kingdom's bacteria or archae. They may be heterotrophic or photoautotrophic. They may be symbiotic, associative, or free living. Diazotrophs encode nitrogenase, the enzyme complex that catalyses the conversion of N_2 gas to ammonia.

Diazotrophs include bacteria like *Rhizobium* sp. that associate with legumes and the non-legume *Parasponia* sp.; actinomycete like *Frankia* sp. that associate with actinorhizal plants; cyanobacteria like *Nostoc sp.* can establish symbiotic relations with gunnera, (Santi *et al.*, 2013). The plant provides nutrients to the diazotrophs in the form of malate while the diazotroph provides fixed nitrogen to the plants in the form of ammonia, glutamine and asparagine, the process mediated through a cascade of signalling molecules.

Legumes are ecologically and agriculturally significant as they are responsible for a substantial part of the global flux of nitrogen from atmospheric N_2 to fixed forms such as ammonia, nitrate, and organic nitrogen. Legume symbioses contribute at least 60% of the total biologically fixed nitrogen, approximately half deriving from the cool and warm temperature zones and the remainder deriving from the tropics. The present article presents an overview of the molecular cascade of signalling molecules that is responsible for root nodule symbiosis.

Mechanism of Symbiosis

1. Rhizobial Symbiosis:

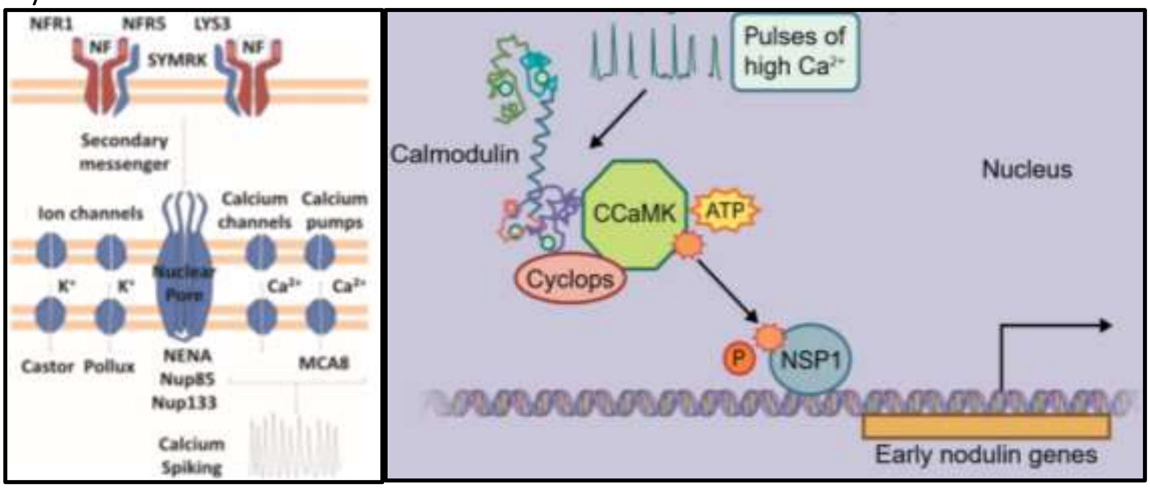

Fig 1 (A) Perception of Nod Factors by plant membrane receptors (Source : Rogers et al., 2016) (B) Regulation by CCaMk (Source : Buchanan et al., 2015).

Plant and bacteria exchange molecular signals. Plants produce root-derived flavonoids, namely, flavone, isoflavone, and chalcone, which is recognized by bacterial NodD receptors which in turn triggers responses in the plant. In the bacterium, the transcriptional activator NodD interacts with a plant inducer (flavonoids) and the transcriptional machinery of the bacterium to induce expression of bacterial *nod* genes. The circuits for nod gene activation may also respond to environmental cues and nutritional status of the bacteria.

Nod factors (encoded by *nodABC* genes) have oligomeric chitin backbones and vary between rhizobia and are determinants of rhizobia-host specificity. These factors are perceived by distinct plant "entry" and "signalling" receptors. A severe nodulation defect where the plants do not form nodules, and they exhibit little or no response to bacteria or Nod factors is noticed if either receptor gene mutates. The entry receptors (LjNFR1 and MtLYK3) have extra cytoplasmic *Lys*M motifs that have chitin binding domains (also function as a part of fungal detection program). The cytoplasmic domain of these receptors includes kinase domains that have phosphorylation and activation loops. Another entry receptor, symbiosis receptor kinase, SymRK, has leucine rich repeats and an intracellular kinase in its cytoplasmic domain, signalling receptors (MtNFP and LjNRF5) have the *Lys*M domains but lack kinase domains. Therefore, signalling receptors mediate host response to nod factors while entry receptors are necessary for infection. Entry receptors interact with E3-ubiquitin-ligase and membrane-associated proteins like flotilins and remorins.

These receptor complexes in turn activate a secondary messenger which initiates calcium spiking, in the nuclear and perinuclear regions within the root hair, driven by proteins in the nuclear envelope. Calcium spiking is dependent on three nuclear pore proteins, NENA, Nup85, and Nup133, the cation channels Castor and Pollux, as well as the calcium pump MCA8 and other calcium channels which have yet to be identified, all present on the nuclear membrane.

This calcium spiking activates a calcium-calmodulin-activated protein (CCaMK) within the nucleus which in turn phosphorylates the transcription factor NSP1. Activated NSP1 and a similar NSP2 bind to and activate the promoters of early *nodulin* genes (like ENOD11) and the downstream regulators ERN and NIN. ERN1 initiates bacterial infection and is necessary for 'Nod factor box' expression while NIN activates additional transcription factors, NF-YA and NF-YB, that are associated with nodule meristem. (Oldroyd and Dixon, 2014; Buchanan *et al.,* 2015).

The influx of Ca^+ ions in the root tip leads to curling of the tip and formation of shepherd's crook. Rhizobia are trapped inside these hooks and proliferate into the root hair forming an infection thread. Simultaneously, increased mitotic activity of the cortical cells give rise to nodule primordium which will grow into a developing nodule. The infection thread grown towards the nodule primordium and enters inside where they reach the target host cells. The bacteria enter the host cells where they are encompassed by the plasma membrane giving rise to symbiosome compartments. This membrane undergoes remodelling and plays a major role in exchange of nutrients and nitrogen between the plant and rhizobia. This membrane is termed peri-bacteroid membrane. Here, the bacteria differentiate into nitrogen-fixing bacteroids (Haag *et al.*, 2013).

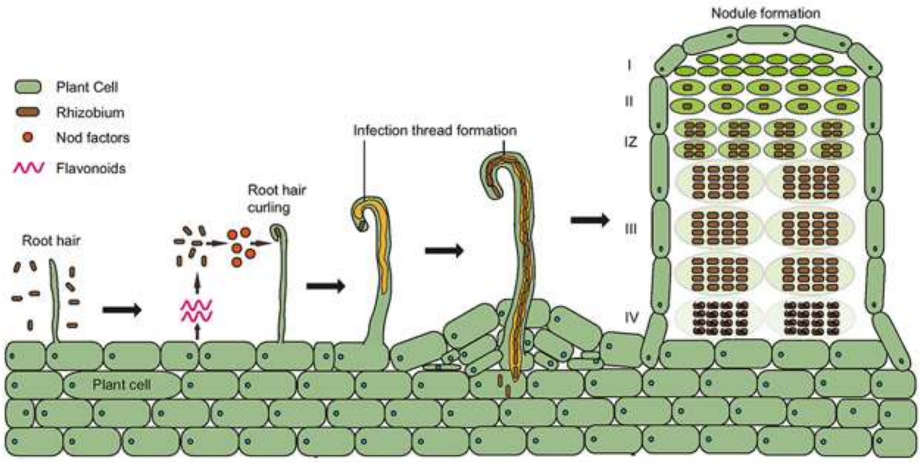

Fig. 1 Plant-microbe interaction in the soil (Source : Wang et al., 2018)

Mechanism of Nitrogen Fixation

Bacteroides in nodules and heterocysts in cyanobacteria are the sites of nitrogen fixation. Nitrogen is reduced to ammonia by an enzyme called nitrogenase which is a complex consisting of the MoFe protein (dinitrogenase or component I) a heterotetramer, and the Fe protein (dinitrogenase reductase or component II) a homodimer through the reaction :

$$N_2 + 16ATP + 8e^- + 8H^+ \longrightarrow 2NH_3 + 16ADP + 16P_i + H_2$$

The Fe protein (encoded by nifH) accepts electrons from a carrier, such as ferredoxin or flavodoxin, depending on the biological system involved. The Fe protein transfers single electrons at very negative potential to P-clusters in the MoFe protein using energy from ATP hydrolysis. The MoFe protein (encoded by nifD and nifK) accepts electrons at the FeMo cofactor and binds H^+ ions and N_2 molecules in a stepwise cycle, ultimately leading to the production of H_2 and ammonia.

Effect of Oxygen

Oxygen competes for electrons with nitrogenase and oxidises the iron in the [Fe-S] metalloclusters of components I and II which ultimately inactivates nitrogenase. In nitrogen-fixing nodules, a high-affinity cytochrome oxidase, oxygen-binding protein leghaemoglobin, and a variable-permeability barrier controlling gas exchange at the nodule periphery maintains ATP production in low O_2 conditions. Other diazotrophs have either spatial (eg. *Nostoc*) and/or temporal (eg. *Cyanothece*) separation of oxygen-evolving photosynthetic and nitrogen fixing cells. In *Cyanothece,* photosynthesis occurs during the day and nitrogen fixation occurs at night. The low O_2 environment leads to the expression of the bacterial genes FixL or FixJ required for nitrogen fixation.

Nutrient Exchange Between Diazotroph and Host

In mature nodules experiencing lower oxygen concentrations, the bacteria differentiate into bacteroids that produce nitrogenase enzyme complex. NH_3 produced by nitrogenase from the bacteria can be incorporated into amino acids via the glutamine synthetase glutamate synthase (GS-GOGAT) pathway. Ammonia transporters (eg. AmtB) allow diffusion of NH_3 into the plant cytoplasm where it is assimilated into nitrogen compounds (amino acids, proteins, and alkaloids) in exchange for food molecules, eg. glucose, amino acids, and other saccharides. The plant provides amino acids to the bacterial cell and in return the bacterial cell cycles amino acids back to the plant for asparagine synthesis. Other nutrients like phosphorus, sulphur, molybdenum, and cobalt are made available to the microbe by the plant (Mus et al., 2013).

References

1. Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). Biochemistry and Molecular Biology of Plants. New York : John Wiley & Sons.
2. Haag, A. F., Arnold, M. F., Myka, K. K., Kerscher, B., Dall'Angelo, S., Zanda, M., ... & Ferguson, G. P. (2013). Molecular insights into bacteroid development during Rhizobium–legume symbiosis. FEMS microbiology reviews, 37(3):364-383.
3. Mus, F., Crook, M. B., Garcia, K., Costas, A. G., Geddes, B. A., Kouri, E. D., & Udvardi, M. K. (2016). Symbiotic nitrogen fixation and the challenges to its extension to nonlegumes. Applied and Environmental Microbiology, 82(13):3698-3710.
4. Oldroyd, G. E., & Dixon, R. (2014). Biotechnological solutions to the nitrogen problem. Current opinion in biotechnology, 26:19-24.
5. Santi, C., Bogusz, D., & Franche, C. (2013). Biological nitrogen fixation in non-legume plants. Annals of Botany, 111(5):743-767.
6. Wang, Q., Liu, J., & Zhu, H. (2018). Genetic and molecular mechanisms underlying symbiotic specificity in legume-rhizobium interactions. Frontiers in plant science, 9:313.

The Rainbow Diet

Article ID: 10248

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Introduction

The Rainbow Diet is a comprehensive holistic health guide that helps you to understand the physical and energetic properties of foods through their colours. It's a simple way of reminding you that a variety of fruits and vegetables in your diet will get you the vitamins and minerals you need. It also calls out the fact that you can learn a lot about your food just by looking at it. When someone says "eat the rainbow," they're trying to explain, in a simplified way, that the colour of your food can tell you a lot about its nutritional value, and eating a variety of colours is one sure method to get as many of those vitamins and minerals as possible (and eat a broad, diverse amount of food in the process.) The phrase is actually an oversimplification of a real issue. It's not difficult to get the vitamins and nutrients you need from a solid, balanced diet, but it can be difficult if you're a picky eater, or have children who don't exactly like to expand their horizons. In fact, much of the documentation we found that uses the phrase is aimed at parents helping children adopt a more healthful diet.

A “Rainbow Diet” is one that includes foods of different colours by adding different kinds of fruits and vegetables into your diet. Most of us know that including generous servings of fruits and vegetables in the diet is the cornerstone of good health, but we lack the motivation to do so.

Besides, the effort that goes into the processing and preparation of vegetables and the ever-spiralling cost are huge deterrents towards ensuring a salad, one or two vegetables and an after-meal fruit. But everyone must include more fruits and vegetables in their diet because they have special ingredients that not only prevent but also delay the onset of many diseases.

Red

The red colour in apples, apricots, watermelons, strawberries and pomegranate is given to it by lycopene, a phytochemical with tremendous antioxidant properties. Lycopene is known for its properties to fight heart diseases, certain types of cancers and even sun burns. The powerful antioxidant present in beetroot has anti-inflammatory and vascular-protective effects.

Green

They have some of the most essential nutrients such as calcium, potassium, iron, magnesium, vitamins B, C, E and K, along with minerals all packed into one. Chlorophyll, a pigment found in the greens of the plants also helps neutralize the free radicals and clears out the toxins. Greens are also a natural deodorizer.

Yellow

This is done through the presence of Vitamin C and collagen, a protein made of amino acids, which have anti-ageing properties. Yellows are also replete with bioflavonoids and carotenoids that help fight cancer. Bite into a banana, mango, pineapple, peach or a musk to have strength, glowing skin and healthy hair.

Blue-Purple

blue-coloured foods such as blueberries, grapes, eggplants and purple cabbage are rich in health boosting phytochemicals called anthocyanins and resveratrol, which are loaded with antioxidants. Resveratrol has anti-ageing and disease-fighting properties and anthocyanins have anti-inflammatory and anti- carcinogenic properties that primarily help in fighting cholesterol, heart related diseases and Alzheimer's.

Orange

Orange foods get their vibrant hue from beta-carotene, a form of vitamin A that acts as an antioxidant. We all are aware that nothing improves your eyesight and regulates your immune system better than Vitamin A. Opt for oranges, kinnows, carrots and pumpkin to get your dose of potassium, vitamin C, vitamin B6, fibre, lycopene and flavonoids.

White

The foods belonging to this category might lack colour, but not nutrients. Be it providing calcium, proteins and healthy bacteria called probiotics in Greek Yogurt or Vitamin C, vitamin K, folate, and fibre in cauliflower, white foods like mushrooms, turnips, tofu, chickpeas and potatoes are packed with nutrients. They contain health promoting chemicals such as allicin and allinin, which help improve blood pressure, and lower total and LDL cholesterol levels.

References

1. https://timesofindia.indiatimes.com/life-style/food-news/what-is-rainbow-diet-and-the-role-each-colour-plays-in-your-body/photostory/78028914.cms
2. https://lifehacker.com/what-it-means-to-eat-the-rainbow-1594799068.
3. https://timesofindia.indiatimes.com/life-style/food-news/what-is-rainbow-diet-and-the-role-each-colour-plays-in-your-body/photostory/78028914.cms

Strategies to Improve the Maternal and Child Health, their Morbidity and Mortality Cases

Article ID: 10249

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Abstract

Maternal Health is an important aspect for the development of any country in terms of increasing equity & reducing poverty. The survival and well-being of mothers is not only important in their own right but are also central to solving large broader, economic, social and developmental challenges. an estimated 47,000 mothers continue to die every year due to causes related to pregnancy, childbirth and the post-partum period. The major medical causes of these deaths are hemorrhage, sepsis, abortion, hypertensive disorders, obstructed labour and 'other' causes including anemia. The Enlarged Program of Immunizations (EPI) Cluster works with the MCH and Disease Prevention and Control Clusters. It provides support to Mozambique for the improvement of the health of children through the eradication of polio and the control of other vaccine preventable diseases in the context of health system strengthening. Immunization strengthening support, including epidemiological surveillance, accelerating disease control, and introducing new vaccines and relevant technologies and tools are the current main areas of work within this Cluster.

Keywords: maternal and child health, Immunization, Disease prevention, post-partum period, poverty.

Introduction

Maternal and child health (MCH) refers to the health of mothers, infants, children, and adolescents. It also refers to a profession within public health committed to promoting the health status and future challenges of this vulnerable population. Maternal Health is an important aspect for the development of any country in terms of increasing equity & reducing poverty. The survival and well-being of mothers is not only important in their own right but are also central to solving large broader, economic, social and developmental challenges. Mothers and children in any country comprise a large, vulnerable population subgroup. Women have special risks related to child bearing, while children face perils during the course of their overall development.

Prevalence

Maternal Mortality Ratio is one of the important indicators of the quality of health services in the country. India has made remarkable progress in reducing maternal deaths in the last two decades. In 1990, Maternal Mortality Ratio (MMR) in India was very high with 600 women dying during child birth per hundred thousand live births, which meant approximately one and a half lakh women dying every year. Globally MMR at that time was 400, which translated into about 5.4 lakh women dying every year, India at that time contributing to 27 percent of the global maternal deaths. In the year 2010 global MMR was 210. Against this, MMR in India has declined to 178 per hundred thousand live births in 2011 as per latest SRS estimates. India now contributing to only 16 percent of the global maternal deaths. However, still an estimated 47,000 mothers continue to die every year due to causes related to pregnancy, childbirth and the post-partum period. The major medical causes of these deaths are hemorrhage, sepsis, abortion, hypertensive disorders, obstructed labour and 'other' causes including anemia. A host of socio-economic cultural determinants like illiteracy, low socio-economic status, early age of marriage, low women's empowerment, traditional preference for home deliveries & other factors contribute to the delays leading to these deaths.

Major health problems affecting mothers and children in India are:
1. Malnutrition.
2. Infection.
3. Unregulated fertility.

Malnutrition

Malnutrition is widely prevalent in the developing countries. Pregnant and lactating women and children are particularly vulnerable to malnutrition. Malnutrition during pregnancy can result in complications like: Maternal depletion, Anaemia, Post-partum haemorrhage, Toxaemia of pregnancy and low birth weight in baby.

Infection

1. Infections lead to increased morbidity and mortality among both, mother and the baby. The risk of infections is low in developed countries; but they continue to be a major problem in developing countries including India.
2. Infection during pregnancy can result in IUGR and low birth weight, Congenital malformations in the foetus e.g., Rubella, abortions and puerperal sepsis.
3. In addition, 25 percent of pregnant women in rural areas have at least one bout of urinary tract infection.

Unregulated Fertility (Uncontrolled Reproduction)

1. Unregulated fertility adversely affects the health of both, the mother and the child.
2. Adverse effects on the mother: Severe anaemia, Abortion, Antepartum haemorrhage and High maternal mortality, the risk increasing significantly after the 4th pregnancy.
3. Adverse effects on the child: Low birth weight, Anaemia, High perinatal mortality and the risk increasing greatly after the 4th pregnancy.
4. Family planning services form an important part of MCH services as it has been shown to have a striking impact on the health of the mother and the child.
5. Moreover, convenient methods of family planning like new and safer Intrauterine contraceptive devices, oral contraceptive pills, long acting injectable medroxy progesterone acetate, female sterilisation and barrier methods are now available.
6. The services can be rendered by the peripheral health workers also.
7. In fact, some countries plan to include family life education at the school level itself.

Different Strategies to Improve the Mother and Child Health (WHO)

The Mother and Child Health Cluster (MCH) includes:
1. Making pregnancy safer.
2. Child and adolescent health / nutrition.
3. Expanded program of immunization.
4. Prevention of mother-to-child transmission.

The MCH Cluster’s work aims at supporting the country to reduce the maternal, neonatal and under-five mortality and morbidity, so as to enhance the quality of life, by promoting the reproductive health of families and individual women, men, adolescents and children as well as by improving access to skills development, knowledge and information and services.

The Enlarged Program of Immunizations (EPI) Cluster works with the MCH and Disease Prevention and Control Clusters. It provides support to Mozambique for the improvement of the health of children through the eradication of polio and the control of other vaccine preventable diseases in the context of health system strengthening. Immunization strengthening support, including epidemiological surveillance, accelerating disease control, and introducing new vaccines and relevant technologies and tools are the current main areas of work within this Cluster.

Janani Suraksha Yojana (JSY)

A demand promotion scheme was launched in April 2005 with the objective of reducing Maternal and Infant Mortality. This is a conditional cash transfer scheme for pregnant women coming into the institutional fold for delivery. It has been lauded as a successful scheme bringing about a surge in institutional deliveries since its launch. The expenditure under JSY has risen from 38.29 crores in 2005-06 to Rs. 1640.00 crores in 2012-13. The number of JSY beneficiaries has also risen from 7.39 lakhs in 2005-06 to more than 106.00 lakhs in 2012-13. In 2013-14 (uptil Dec.) more than 78.27 lakhs beneficiaries have availed JSY benefits and expenditure under JSY is Rs. 1220.40 crores.

Free Service Guarantees at Public Health Facilities: Janani Shishu Suraksha Karyakram (JSSK)

To complement JSY, Government of India launched Janani Shishu Suraksha Karyakram (JSSK) on 1st June, 2011 to eliminate out of pocket expenditure for pregnant women and sick new- borns and infants on drugs, diet, diagnostics, user charges, referral transport, etc. The scheme entitles all pregnant women delivering in public health institutions to absolutely free and no expense delivery including Caesarean section. This initiative also provides for free transport from home to institution, between facilities in case of a referral and drop back home. Similar entitlements have been put in place for all sick new-borns & infants accessing public health facilities. More than Rs. 2000 crores have been allocated to the States for the year 2013-14 for providing the free entitlements under JSSK while Rs. 2107 crores were allocated during 2012-13 under Reproductive Child Health (RCH) & National Rural Health Mission (NRHM) Flexipool.

Essential and Emergency Obstetric Care

Skilled Attendance at birth (domiciliary & health facilities) - Nearly 69,760 ANMs, LHVs and Staff Nurses have been trained in SBA, as per State reports. Multi-skilling of doctors to overcome shortage of skilled manpower in critical specialities-training on Life Saving Anaesthesia Skills (LSAS) and Comprehensive Emergency Obstetric Care (including C-Section). 1,862 Medical Officers have been trained in LSAS and 1,352 Medical Officers in Comprehensive Emergency Obstetric Care (EmOC).

Comprehensive Abortion Care Services (CAC)

Eight percent of maternal deaths in India are attributed to unsafe abortions. Besides this, women who survive unsafe abortion are likely to suffer long-term reproductive morbidity. Comprehensive abortion care is an important element in the reproductive health component of the RMNCH+A strategy. Provision of comprehensive safe abortion services at public health facilities including 24x7 PHCs/ FRUs (DHs/SDHs/CHCs) with a focus on "Delivery Points" (about 16000 health facilities performing deliveries/ C- sections above certain benchmark). Funds are being provided to States/UTs for operationalisation of safe abortion services at health facilities including procurement of equipment and drugs for medical abortion.

Management of Sexually Transmitted and Reproductive Tract Infections (RTI and STI)

Sexually Transmitted Infections (STIs) and Reproductive Tract Infections (RTIs) constitute an important public health problem in India. Studies suggest that 6% of the adult population in India is infected with one or more RTI/STI. These services are to be provided at all CHCs, and at 24x7 PHCs with priority on delivery points. Convergence with the National AIDS Control Programme (NACP) is essential for the provision of services for case management, laboratory services, HIV counselling services, anti-retroviral drugs, equipment and blood safety and skilled and trained manpower.

Mother and Child Protection (MCP) Card

A joint Mother and Child Protection (MCP) Card of Ministry of Health & Family Welfare and Ministry of Women and Child Development (MoWCD) is being used by all States as a tool for monitoring and improving the quality of MCH and Nutrition interventions.

Maternal Death Review (MDR)

The process of Maternal Death Review (MDR) has been institutionalized across the country both at facilities and in the community to identify not only the medical causes but also some of the socio-economic cultural determinants as well as the gaps in the system which contribute to the delays causing such deaths. This is with 55 Annual Report 2013-14 the objective of taking corrective action at appropriate levels and improving the quality of obstetric care. The States are being monitored closely on the progress made in the implementation of MDR. Capacity Building.

Maternal and Child Health (MCH) Wing Under NRHM

100/50/30 bedded state of the art MCH Wings are being established in District Hospitals/District Women's Hospitals/Sub-District Hospitals/CHC-FRUs to overcome the constraints of increasing caseloads and institutional deliveries at these facilities. 470 dedicated Maternal and Child Health Wings (MCH Wings) with more than 28,500 additional beds have been sanctioned in 18 States. Skill Labs to strengthen the quality of capacity building of different cadres of service providers training, Skill Labs are being established in the States. Quality Assurance Guidelines Quality Assurance Guidelines are on the anvil with the objective of providing standard guidelines to be uniformly adopted by all States.

Mother and Child Tracking System (MCTS)

To catch every pregnant woman and every neonates and infants for quality ANC, INC, PNC, FP, Immunization services, the pregnant women and neonates are being tracked by name. Web Enabled Mother and Child Tracking System (MCTS) is being implemented to register and track every pregnant woman, neonate, infant and child by name for quality ANC, INC, PNC, FP, Immunization services. As on March, 2014 more than 6.20 crores women and 5.17 crores children have been registered under MCTS. A new initiative of prevention of PPH through Community Based Advanced distribution of Misoprostol by ASHAs/ANMs has been launched in the districts with high home delivery rates.

Adolescent Health Programme Adolescents (10-19 Years)

Constitute about one-fifth of India's population and represent a huge opportunity that can transform the social and economic fortunes of the country. The large and increasingly relative share and absolute numbers of adolescent population in India make it necessary that the nation ensures they become a vibrant, constructive force that can contribute to sustainable and inclusive growth. Investments in adolescent health will have an immediate, direct and positive impact on India's health goals and on the achievements of the Millennium Development Goals (MDGs). Under Adolescent Health following three programmes are currently being implemented:

Adolescent Reproductive and Sexual Health Programme (ARSH) Adolescent Reproductive and Sexual Health Programme (ARSH): Focuses on reorganizing the existing public health system in order to meet service needs of adolescents. Steps are being taken to ensure improved service delivery for adolescents during routine subcentre clinics and also to ensure service availability on fixed days and timings at the Primary Health Centre and Community Health Centre & District Hospital levels. Core package of services includes promotive, preventive, curative and counselling services being made available for all adolescents - married and unmarried, girls and boys through Adolescent Friendly Health Clinics.

Adolescent Friendly Health Clinics (AFHC): Through Adolescent Friendly Health Clinics, routine check-up at primary, secondary and tertiary levels of care is provided on fixed day clinics. At present 6,302 AFHCs are functional across the country providing services, information and commodities to more than 2.5 million adolescents for varied health related needs such as contraceptives provision, management of menstrual problems, RTI/STI management, antenatal care and anaemia.

Menstrual Hygiene Scheme: The Ministry of Health and Family Welfare has launched Scheme for Promotion of Menstrual Hygiene among adolescent girls in the age group of 10-19 years in rural areas. This programme aims at ensuring that girls have adequate knowledge and information about menstrual hygiene and have access to high quality sanitary napkins along with safe disposal mechanisms. Safe disposal of sanitary napkins. In the first phase, the scheme is covering 25% of the population i.e., 1.5 crore girls in the age group of 10-19 years in 115 districts of 17 States. The scheme has envisaged providing a pack of 6 sanitary napkins under the NRHM's brand 'Freedays'. These napkins are sold to the adolescents' girls at Rs. 6 for a pack of 6 napkins in the village by the Accredited Social Health Activist (ASHA). On sale of each pack, the ASHA gets an incentive of Rs. 1 per pack besides a free pack of sanitary napkins per month.

References

1. Sachdev TR., (1995) Indian J Matern Child Health., Jan-Mar; 6(1):1-2.
2. M.C.H. -- challenges and issues.
3. Maternal health programme - Ministry of Health and Family Welfare Stratigies to improve maternal and child health in india, SALUD, new delhi, india, nov 14.

Famous and Splendid Rosaria of the World

Article ID: 10250

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Rose garden refers to garden or park primarily meant for growing roses. In western countries, it is more commonly known as Rosarium. It is the platform for growing and exhibiting roses and most often open to general public. It is one of the means to provide recreation and bring human beings close to the lap of nature especially for urban areas where they feel the need of fresh air around themselves. Hence, most often, the gardens have been referred as "Lungs of Cities". Some of the famous rose gardens are described as follows.

Zakir Hussain Rose Garden

Location: Chandigarh, India.

Features: Rose garden of Chandigarh is one of the largest rose gardens in Asia. It is named after India's former President, Zakir Hussain. This beautiful garden was set up in 1967 with the support of Chandigarh's first Chief Commissioner, late Dr M. S. Randhawa. It contains more than 32,500 plants belonging to nearly 1,600 varieties of rose. It is a spacious garden covering an area of 27 acres. The garden is situated in a valley and a natural stream runs through it. The area adjoining the stream has been planted with a large number of scented cultivars which fill the whole area with exquisite fragrance. The best time to visit this garden is during February-March when the garden is at its full bloom. There is also a festival dedicated to this Garden which is celebrated in end of February or beginning of March, which is one of the major attractions.

The National Rose Garden

Location: Chanakyapuri, Delhi, India.

Features: The Rose Society of India has been credited with lay out of this garden. It is an exclusive garden for roses. The garden is famous for the large variety of roses from all over the world. It has the collection of the rarest of rare and imported varieties of roses. The best season to visit the rose garden is between December and January when the flowers are in full bloom. It is probably the best park for an evening or morning walk due to the intoxicating fragrance of the gorgeous roses. The Rose Garden is a perfect choice for a good picnic spot due to the amazing surroundings. The main attraction of the garden is the rose show that is held annually during winters.

Cranford Rose Garden

Location: New York, USA.

Features: This garden was established in 1928 and today it is one of the largest and finest rose gardens in the country. It is a part of the Brooklyn Botanic Garden and home of 1200 rose varieties which covers an area of 1.5 acres. All the classes of roses have been represented in the garden. It was designed by Harold Caparn, a landscape architect for the Brooklyn Botanic Garden and Montague Free, the garden's horticulturist. Caparn had drawn the plans several years earlier at the request of Stuart Gager, the first director of the Brooklyn Botanic Garden. Upon Cranford's death in 1935, his widow donated another $5,000 to build the Rose Arc, an addition to the southern end of the garden.

San Jose Heritage Rose Garden

Location: California, USA.

Features: The world-famous Heritage Rose Garden in a 4.5-acre land is a home of about 4,500 roses. It has the largest number of varieties in the Western Hemisphere (3,500) and is completely maintained by volunteers. It is arranged in the form of a bowl, with six sections that contain related classes of roses. It is open to all visitors during daylight hours, and admission is free. In 1995, more than 550 volunteers planted the original 4,200 roses of 2,500 varieties. Hundreds of varieties have been added since, and 240 climbers have been added to the 1/2-mile-long Santa Clara University fence. One of the Heritage Rose Gardens' goals has been to share rare roses with other gardens, nurseries, and collectors, to enhance the probability of their survival.

The Gardens of the American Rose Center

Location: Shreveport, Louisiana, USA

Features: The Gardens of the American Rose Center is the headquarters of the American Rose Society and opened in 1974. It contains more than 65 individual rose gardens and 20,000 roses. Other features include sculptures, fountains, etc.

Elizabeth Park Rose Garden

Location: West Hartford, Connecticut, USA.

Features: It was established in 1894 and named after the Elizabeth, late wife of statesmen Charles Pond. It is regarded as the oldest rose garden which is registered as National Historic Place in the United States. It covers an area of 2.25 acres. The garden has collection of 15,000 roses of 800 different varieties in an elegant setting of Victorian arches, pathways and greenhouses. The garden exhibits old rambling and climbing roses as well as modern roses. Recently, an addition has been made of Elizabeth Park Centennial Rose, a pale pink hybrid tea hybridized by John Mattia, a top rose exhibitor. The Elizabeth Park Rose Garden is an All-America Test Garden, where evaluations of new roses take place. The park is open daily from dawn to dusk.

Jackson and Perkins of Newark

Location: New York, USA.

Features: The garden occupies the top most position among the rose gardens of the world. It occupies an area of 10 hectares and contains more than 36,000 roses of all types including hybrid tea, floribunda, polyanthas, miniatures, climbers and standards. Over 600,000 people visit the Jackson & Perkins Rose Garden annually. These gardens are open to the public from June to September.

Rose Garden in Parque Del Oeste

Location: Madrid, Spain.

Features: The Parque del Oeste is popularly known as Parque de Rosales. It was developed at the request of King Felipe II. Today, the main attraction in this park is the large rose garden where hundreds of roses blossom every year. It has collection of about 30,000 roses. Rose show is being organized every year during spring. This park is an ideal playground for children and also houses the Templo de Debod and the Jardines de Ferraz which is added recently to enlarge the park.

Rose Garden in Parc La Grange

Location: Geneva.

Features: It is Geneva's largest park encompassing 12000 square meters along the lake. The park contains the largest rose garden in the city and also acts as a horticultural centre. The 'Verdure Theatre' on site hosts free concerts every Wednesday and Friday during summer months.

Rose Garden in Parc De Bagatelle

Location: Paris.

Features: It is one of Paris' botanical gardens and is a world-famous rose garden. It is located in the Bois de Boulogne, a huge forest area and has been referred as the "lungs" of Paris. It was created by Jean-Claude

Nicolas Forestier, the Commissioner of Gardens for Paris. Today it has the collection of about 10,000 roses of 1,200 varieties, and hosts an annual international competition for new roses.

Royal National Rose Society Gardens

Location: Hertfordshire, United Kingdom.

Features: It is the official garden of the Royal National Rose Society. The main features of garden include a collection showing the history of the rose, roses with companion plantings and designs to provide inspiration for growing roses in small gardens. The gardens contain 2,500 rose varieties. The main aim of the garden is to create a "living dictionary" of roses. They are generally open to the public during summer.

Queen Mary Gardens in Regent's Park

Location: London.

Features: It is one of the largest and most famous rose gardens in London. This magnificent rose garden was named after the consort of King George V in 1930, however, it was established in 1828. It is the greatest formal rose garden made in circular manner that is surrounded by a ring of pillars where climbers and ramblers are displayed. The garden exhibits formal display and informal display of rose in beds. The most fascinating view of the garden is exhibited by 40,000 roses that bloom during the summers.

The City of Belfast International Rose Garden

Location: Northern Ireland.

Features: This is one of the internationally acclaimed rose gardens. It has been credited with the collection of over 30,000 rose bushes. The garden highlights roses, especially those belonging to Northern Ireland. The Historical Garden sets out the rose history from 1200 B.C. The main attraction of rose garden is Annual Rose Week in July which attracts visitors from all over the world. The park opens daily where the admission fee is exempted.

Rose Garden of the Montreal Botanical Garden

Location: Quebec, Canada.

Features: It was established in the Jardin botanique de Montréal, one of the largest botanical gardens in the world. The rose garden was designed in 1976 and became one of the first rose gardens outside Europe to receive the WFRS Award of Garden Excellence in 2003. The rose garden occupies an area of about 6 acres. The garden inhabited 10,000 plants with over 1,000 rose varieties in one hundred beds. The varietal collection comprised of nearly 160 species, 180 old roses, 500 modern hybrid shrub roses, and almost 220 cold-tender roses including Teas. One of the interesting facts is that the rose beds must be covered with huge thermal blankets for protection from the harsh winter conditions. Agriculture Canada’s cold-hardy, disease-resistant roses, including their Explorer and Parkland series are well represented.

Centennial Rose Garden of Royal Botanical Gardens

Location: Ontario, Canada.

Features: This garden was laid out in 1967. It contains modern hybrid roses which are suitable and hardy for growing in local conditions. The collection displays breeding trends within the genus in particular showcasing the range of colour and form of the flowers. The colour ranges from pure white, cream, buff, yellows, apricots, oranges, pinks and corals and reds. The centre of the garden is devoted to modern roses – hybrid teas, floribundas and grandifloras. It is also having collection of modern shrub roses which bloom repeatedly, fragrant in nature and are winter hardy. A new feature of the rose garden is the pair of infinity edged reflecting pools with a mix of hardy and tropical water plants.

Europa-Rosarium

Location: Sangerhausen, Germany.

Features: It was stablished in 1903 and has the largest collection of roses in the world. It covers an area of 30 acres. The rosarium comprises 7,000 cultivars of different roses. The German rose breeder, Peter Lambert is credited of envisioning the park before its establishment. The park has got collection of rare roses such as 'Sterling,' 'Sunkist' and hybrid perpetual varieties.

Roseto Botanico di Cavriglia “Carla Fineschi”

Location: Tuscany, Italy.

Features: The Roseto contains more than 6,300 varieties of roses. It was established by Professor Gianfranco Fineschi. It was started from a small collection and further expansion is continuously increasing. The garden is well organized in a taxonomical manner and includes representatives of each of the subgenera, sections and classes of the genus Rosa.

Wohl Rose Garden

Location: Jerusalem.

Features: It is a public garden located at the foot of the Israeli Supreme Court over an area of 19 acre. It has collection of 15,000 rose bushes belonging to 400 varieties that are planted in sections representing their countries of origin. The garden also has an experimental section where new varieties of roses are tested. The garden won an award for excellence in an international competition for rose gardens in 2003 and was named one of the 11 most beautiful rose gardens in the world. Other features of the garden include lawns, hills, quarries, an ornamental fishpond, waterfall, sculptures, etc.

Coloma Rose Garden

Location: Sint-Pieters-Leeuw, Belgium

Features: Coloma Rose Garden is one of the largest and most expensive rose gardens in Europe. It has a collection of more than 60,000 rose plants of some 3,000 different varieties. These include a complete collection of Belgian-raised roses. The main features of the garden are pergolas and trellises for climbing roses, statues and well-placed benches. The garden has collection of antique roses, hybrids, climbing roses, rambling roses and bush roses. The Coloma rose garden is divided into five areas. The first incorporates a traditional geometric structure with garden pergolas and glazed or wooden verandas. The second garden occupies a slightly higher position and hence gives good views over Coloma as a whole and main emphasis is given to roses cultivated by Flemish horticulturists. The third rose garden traces the evolution of rose across the ages i.e., from 18th century varieties to the most recently cultivated varieties. The fourth area is set out in landscape style, while the fifth is devoted to 400 long-stemmed rose bushes.

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Fragrant Roses: Adding Aroma in Gardens

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Fragrance plays an important role in many social functions in everyday life. Flowers have been known for a long time to be source of sweet fragrance. For centuries, roses have played an important role in spreading fragrance in human society. Their ornamental value is not only for their size and shape however, abundance of flowering and their fragrance have attracted attention. In case of roses, breeding has led to the development of many beautiful roses in the sense of flower colour and shape with an enhanced vase life but with only a portion of the fragrance of earlier cultivars and wild species. More than 400 volatile compounds have been identified by GC-MS belonging to the three major biosynthetic pathways: phenyl propanoids, fatty acid derivatives and terpenoids. However, most modern rose cultivars lack a distinct scent due to major emphasis on selection for disease resistance, long vase life as well as appearance of the blossom. About 20% of all rose varieties known today are classified as fragrant. The three species *Rosa damascena*, *R. centifolia* and *R alba* are predominantly used in the production of rose oils. The seven basic scents that are most often found in hybrid tea roses include rose, nasturtium, orris, violet, apple, lemon, and clover. Some of the other scents are fern or moss, hyacinth, orange, bay anise, lily-of-the-valley, linseed oil, hone, wine, marigold, quince, geranium, peppers, parsley, and raspberry. Some of the famous rose varieties known for their fragrance are:

Pusa Mahak: It is a Hybrid Tea variety of rose. The plants are tall and vigorous with a height of 100 - 120 cm. The Flowers are dark pinkish in colour and have outstanding fragrance. The flowering starts in 40-45 days after pruning. Flowers are large and semi-double with 22-23 petals. It is a recurrent flowering and floriferous variety and each plant produces on an average 50-60 flowering shoots in a season. The variety is ideal for garden display and the fragrant flowers can be used for floral arrangements.

Double Delight: It is a hybrid tea rose with a long season of the buds are long, pointed to urn shaped. The double blossoms (35 petals) have a rich, creamy white to pale pink centre with deep, ruby edging. They have a bushy habit, growing to about 4-5 feet with a 2-3 foot spread. The blossoms have a strong fruity fragrance.

Elle: This is a 2005 winner hybrid tea rose. She displays above average disease resistance, especially to black spot and mildew. The blossoms are a soft, shell pink set off by glossy, dark green foliage. All of that plus a spicy, citrusy scent. Elle promises to make an excellent cut flower, with 4-5-inch-wide blooms held on 10–14-inch stems.

4th of July: In 1999, it was the first climbing rose to win the AARS award in 23 years. The blossoms are everything you'd expect from a rose named 4th of July, clusters of large 4-inch flowers in vibrant red with white stripes, on 10–14-foot arching canes. As with all the roses listed here, the scent is exceptional. 4th of July has the added bonus of being a repeat bloomer.

Memorial Day: This is arguably the front runner for fragrance. As AARS puts it, "experts say one bloom perfumes almost an entire room." This is another of the popular hybrid teas and was an AARS winner in 2004. Memorial Day has 5-inch, clear pink blossoms with a lavender glow about them. The fragrance is described as similar to the old-fashioned damask roses. Cutting stems are nice and long and the bushes are an especially good choice for hot climates.

Midas Touch: This belongs to HT group of rose. Buds are urn shaped, flowers bright, non-fading yellow, double, 3.5-4-inch, exhibition form, borne mostly singly. Midas Touch is yet another hybrid tea beauty with a warm, musky scent. Foliage large, medium green, tall upright bushy growth.

Mr. Lincoln: The velvety, deep red hybrid tea is still one of the most popularly grown garden roses. Beautiful as well as strongly scented, Mr. Lincoln's blossoms are held are stiff, upright stems. The bushes can be expected to grow 4-5 feet tall and about 2 feet across.

Sentimental: This spicy scented floribunda was the first striped rose was evolved in 1999. With burgundy and creamy white stripes, it hardly needs its wonderful fragrance to attract attention, but that's what made it an award winner in 1997. Flowers double, 25-30 petals, 4-4.5-inch, exhibition form, borne in large clusters, prickles moderate, foliage large quilted medium green , matt, compact medium growth.

Sheer Bliss: It is a delicate, pale pink hybrid tea developed in 1985. Flowers white pink centre, large double, 35 petals, exhibition form, borne singly, spicy fragrance, medium brown prickles, foliage medium green, bushy growth.

Sun Sprinkles: This is a miniature rose, won its award in 2001. Brilliant yellow blooms open early and repeat all summer. With excellent disease resistance, Sun Sprinkles is a great choice even in a garden with limited space. Growing in low and mounded to about 18 - 24 inches, Sun Sprinkles can be used as an edger, in containers or as a specimen. The spicy, musky fragrance and vivid colour will make people stop for a closer look.

Papa Mielland : This HT variety evolved by Alain Mielland in 1963 is a winner of James Alexander Gamble Fragrance Medal. The buds are pointed, flowers dark velvety crimson, large double with 35 petals, exhibition form, intense fragrance, foliage leathery, glossy, olive green, vigorous with upright growth.

Lady Hillingdon: The buds are long pointed, flowers deep apricot yellow, semi-double with tea fragrance, foliage bronze with bushy growth.

Blue Moon: This hybrid tea was developed in 1965. The buds are long pointed, flowers lilac, double, 40 petals, 4 inches, intense fragrance and vigorous growth

Blue Perfume: This HT variety was developed in 1978. The buds are ovoid, flowers mauve bluish, large, double, intense fragrance, foliage glossy with upright growth.

General MacArthur: This Hybrid Tea variety was developed way back in 1905. The flowers are rose red, double, 20 petals with intense damask fragrance, foliage leathery.

Oklahoma: This HT was developed in 1964. The buds are ovoid, flowers dark red, double, 48 petals, 4-5.5-inch, exhibition form, intense fragrance, foliage leathery, dark matt, vigorous bushy growth.

Pusa Mahak

Raktima

Oklahoma

Jawahar

Figure.1: Fragrant rose cultivars

Fragrant Delight: This floribunda variety was evolved in 1978. Flower light orange salmon; reverse deeper, double, 22 petals, 3-inch, intense fragrance, foliage glossy, reddish.

Sugandha: A HT variety developed by Bhattacharji in 1964. Long and bold buds, ranging from pure red to scarlet open into large, loose flowers. Gloriously scented.

Jawahar: A HT variety developed at IARI in 1980. Greenish white buds developing into creamy white, very large, high centred and well-formed blooms. The flowers are borne singly and in bunch of two or three on a strong shoot. Upright tall growing bush with light green foliage. Very good exhibition rose, vigorous with strong fragrance.

Nurjehan : A HT variety developed at IARI in 1980. Rose Bengal-coloured well-formed blooms of very large size and high centre are borne singly on medium and strong shoots. Highly fragrant. Medium spreading bush.

Raktima : A HT variety evolved at IARI in 1991. Shining red, high centred double blooms are produced in singles on strong and straight stems. Sweet fragrance. Recurrent blooming habit tending to produce quality blooms even in off season.

Charles Mallerin: This Ht was evolved in 1951. The flowers are blackish crimson, double 38 petals, 6-inch flat, intense fragrance, foliage leathery, dark, vigorous irregular growth.

Chrysler Imperial: This HT was developed in 1952. The buds are long pointed, flowers deep red, velvety, very double 45-50 petals, 4.5-5-inch, exhibition form , borne singly intense fragrance, foliage dark, semi glossy, vigorous compact growth.

Seasonal Flowers for Landscaping

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Seasonal or annual flowers refer to the group of plants which complete their life cycle i.e., both vegetative and reproductive phase within one year and one season. They are most popular among garden lovers and amateur as they are easy to culture and moreover, they also provide a beautiful and immediate display of colours in the garden.

Seasonal flowers are mostly preferred for growing in pots, beds, borders, window boxes, hanging baskets or as cut flower for interior decoration or as loose flowers. They enhance the aesthetic value of a place within a short span of time and create the instant landscape.

Some of the seasonal are valued for their naturally dried flowers like straw flower, paper flower etc. Some of the annuals also provide sweet fragrance to the garden.

Classification

Seasonable as term indicates are divided in to three groups -Summer, Rainy and Winter season. Summer and Rainy seasonal in India are available in limited number whereas Winter annuals are rich in kinds and available in large range of colours and height and bring riot of colours in the garden and, hence, very popular amongst gardener.

Summer Season Annuals

The summer season annuals grow under higher temperature. The seeds are sown in last week of February to first week of March and seedlings are transplanted in end of March to April in beds or pots. The common summer season annuals are Kochia, Zinnia, Gaillardia, Tithonia, Marigold, Coreopsis, Sunflower etc.

Rainy Season Annuals

These annuals are grown in rainy season with high rains and high humidity in environment. The seeds of rainy season annuals are sown in May-June and transplanted in June-July. All summer season annuals and Amranthus, Celosia, Torenia, Gomphrena and Balsam are grown in rainy season.

Winter Season Annuals

Winter annuals are able to tolerate comparatively low temperature and these are comfortably grown in winter season. Majority of annual flowers are cultivated in winter months in the plains. Most of these annuals have been introduced by Britishers in India.

The nursery of winter season annuals is raised in September and transplanted in beds or pots in October in plains/low hills and in temperate hills, these are sown in February-March and transplanted in March-April. Winter season annuals provide a beautiful display of colours in the garden and this group includes a large number of seasonal flowers.

The most important winter season annuals are Pansy, Phlox, Ice plant, Candytuft, Gomphrena, Sweet William, Sweet Pea, Annual Carnation, Annual Chrysanthemum, Calendula, China Aster, Dimorphotheca, Sweet Sultan, Marigold, Dahlia, Stock, Helichrysum, Salvia, Petunia, Calendula, Antirrhinum, Hollyhock, Gypsophila, Limonium, Lupin, Poppy, Sweet Alyssum, Viola, Amranthus etc.

According to Usage of Seasonal, they are Categorized into Various Groups which are as Follows

Bedding Purpose: Pansy, Phlox, Ice plant, Candytuft, Balsam, Zinnia Gomphrena Sweet William, Carnation, Sweet Sultan, Gaillardia, Marigold, Dahlia, Portulaca, Stock, Cosmos, Helichrysum, Salvia, Petunia, Calendula, Antirrhinum etc.

Loose Flower Purpose: Annual flowers like marigold, chrysanthemum, china aster, zinnia, gaillardia, gomphrena, sunflower, calendula, paper flower, etc. can be utilized for loose flower purpose.

Hanging Baskets: Nasturtium, Phlox, Portulaca, Daisy, Pansy, Petunia, Verbena, Sweet Alyssum, Dwarf Marigold, Zinnia, Ageratum (dwarf) etc.

Pot Purpose: Pansy, Phlox, Ice plant, Candytuft, Balsam, Zinnia Gomphrena Sweet William, Carnation, Gaillardia, Marigold, Dahlia, Portulaca, Stock, Salvia, Petunia, Calendula, Antirrhinum etc.

Dry Flowers: Helichrysum, Statice, Molucella, Carnation, Acroclinum etc.

Shady Situation: Salvia, Cineraria, Ageratum, Alyssum, Phlox, Verbena, Clarkia, Iberis, Impatiens etc.

Cut Flower: Many annual flowers can also be utilized for cut flower purpose like antirrhinum, corn flowers, lupine, carnation, sweet william, sweet sultan, china aster, larkspur, lisianthus, paper flower, etc.

Screening Purpose: Sweet Pea, Holly hock, Helichrysum etc.

Fragrant Annuals: Some of the annual flower also possesses sweet fragrance like sweet pea, sweet sultan, sweet William, sweet alyssum, mignonette, carnation, stock, etc.

Climbing Annuals: Sweet Pea, Nasturtium, Morning Glory etc.

Green Filler: Mollucella, Gypsophilla, Kochia etc.

Garland Preparation: Marigold, Gillardia, Chrysanthemum, Zinnia etc.

Rock garden purpose: Annuals best suited for rock garden are ice plant, nemesia, gamelopsis, phlox, verbena, nasturtium, ageratum, etc.

Propagation

These flowers generally are started from seed or purchased as small plants. Some annual seeds can be sown directly in the garden depending upon location. These include annual Morning Glory, Sweet Pea, Lupin and Nasturtium. Many other annuals do best if raised seedlings and then transplanted. Start seedlings indoors 4 to 6 weeks or more before they will be planted in the garden.

Raising of Nursery

In general, annual flower seed are small. These are sown with high density in controlled space for better care in raised bed/pots/shallow seed pan depending upon the quantity of seeds. The nursery beds should be prepared 60-80 cm wide with 15-20 cm raised above the ground surface and length should be 3-4 metre. The growing media should consist of 1 part each of soil, sand and sieved dry leaf mould or vermicompost and slightly moist before sowing the seeds. To check the infection of soil borne diseases in nursery, soil should be drenched with 0.2% Captan solution.

Before sowing, the seeds are treated with fungicide such as Bavistin or Captan to prevent the seedlings from fungal diseases. Seeds are sown in lines which should be 3-4 cm apart and depth should be about 0.4-0.6 cm. Small seeds such as Petunia may be mixed with a little quantity of fine sand to get uniform sowing. After sowing, the seeds should be covered with sieved mixture of vermicompost, sand and soil. Immediately after sowing the seeds watering should be required twice a day and also keeping in mind that over-watering is harmful for annual seedlings. The beds should be covered with light cloth or newspaper to create darkness which required for better germination. After germination, covering should be removed and the seedling should be required exposed to sunlight. Other-wise, they may become lanky. It takes about one month to grow the seedlings sufficient strong and ready to transplant.

Soil and Bed Preparation

Soil should be fertile, not acidic in nature and well drained with good water holding capacity for proper growth of annual plants. If soil is acidic, addition of lime will be must to make it neutral nature. The sandy loam soil with 6.0-7.0 pH range should be better for successful annual cultivation.

In clay and stiff soil an application of organic matter and sand will make the soil porous. In sandy soil also, a lot of FYM should be added to improve the texture of such soil. The bed should be dig up to 30 cm depth but the digging work should not be undertaken in a very wet soil.

The digging should be repeated 2-3 times to obtain the best result. Beds should be 1.0 m wide with convenient length and made in well pulverized soil. Before planting, mix the well decomposed organic manure @ 5.0 - 8.0 kg per sqm.

The maximum seasonal flower performed well in full sun. Salvia, Cineraria, Ageratum, Alyssum, Phlox, Verbena, Clarkia, Iberis and Impatiens can be grown in partial-shade conditions.

Transplanting

One month old annual flowers seedlings sufficient strong and ready to transplant. The transplanting should be done either on a cloudy day or in the afternoon. Generally, they are planted in bed at 15x15 cm or 15x10 cm or 30x30 cm or 45x30 cm or 45x45 cm. Irrigate the beds soon after transplanting.

Irrigation

Annuals are sensitive to salt. It is, therefore, of great importance that good quality water is used for the better growth of plants. Rain water is highly suitable for its cultivation. The salt content in the irrigation water should be less than10 micro mol per litre. Most annuals need regular water because they don’t develop deep root systems.

Containers and baskets require the most frequent watering and dry out quickly. Watering needs vary widely from area to area. Careful checking, even during periods of rainfall, is important. Top 20-25 cm of soil should be continuously kept moist because the development of root takes place up to this depth. If sufficient water is not given to the plant, the flower production declines.

Fertilization

Well-prepared soil and organic mulch help make nutrients available to plants, but annuals grow so rapidly that supplemental fertilizer is needed to help maintain vigour. Rotten Farm Yard Manure (FYM) @ 5-8 kg/sqm. should be incorporated in the soil at the time of soil preparation. In addition to farmyard manure, it is advisable to apply 10-15 g/sqm. nitrogen and 8-10 g/sqm. each of phosphorus and potash for getting good vegetative growth and flowering. Whole quantity of phosphorus and potash should be applied at the time of land preparation. Nitrogen is to be applied in two split doses. The first dose should be applied 20-25 days after planting and the second dose 40-45 days after transplanting.

Pinching and Disbudding

Many annuals, because of apical dominance the plants grow tall and lanky with very less branches. Such plants are susceptible to lodging and the flower production will be less. Pinching is done to break apical dominance and to encourage axillary branching and thereby increasing flower production. Pinching slightly delays flowering but improves flower production. Pinching 20-25 days after transplanting has been found to be optimal. In case large flower is needed for exhibition then axillary buds should be removed when they are at “Pea Size” stage.

Weeding

Keep annuals free of weeds. A combination of hand weeding and mulch is effective. Weed regularly to prevent seeds from becoming established. If weeds are not controlled in time, growth, flowering and productivity are drastically affected. At least 3-4 manual weeding are required for the entire cropping period. Pre-emergent products, which prevent seeds from germinating, have limited use in flower gardens.

Mulching

Mulching is beneficial to the annual flower plants in many ways. It retains the soil moisture, reduces the soil erosion, controls the weed population and reduces the leaching of nutrients etc. Organic mulch is useful in annual flower beds with weed-free materials like rice straw for winter protection once the ground has frozen.

Staking

Many tall annual flowering plants must be staked or provided with another support system, especially in windy and exposed areas. Wind, rain or the weight of foliage and blossoms will bend or break plants' stems and ruin the display. Dahlias and hollyhocks may reach 6-7 feet with heavy stalks of bloom, need support or staking for which split bamboo sticks may be used.

Insects

Aphids: The aphids are usually found on young leaves and flower buds. It sucks the sap of foliage and bud and cause retarded growth of the plant with poor quality flowers. Two spray of Rogor @ 1.0-1.5 ml per liter of water at 15-20 days interval can control it.

Caterpillar: The caterpillars are particularly active in summer. It damages the foliage and flower buds. It can be controlled by spray of Malathian @ 1.0-1.5 ml per liter of water.

Thrips: The thrips suck sap from the undersurface of the leaves and also the flower buds. Thrips prefer dry hot summer season. Spraying of Rogor or Monocrotophos @0.1% controls the thrips.

Mites: Mites infect the annual flower plants. The infected plants give dusty appearance. The plants show webbed appearance. These can be controlled by spraying Dicofol @ 0.1%.

Leaf hopper: The hoppers suck sap from the leaves and stem. The infected plants show cupped or rolled leaves and give wilted appearance. Spraying of Rogor (0.2 %) controls the hoppers.

Diseases

The plants are affected by a number of fungal diseases which attack the plants and flowers. The most destructive diseases are botrytis, root rot and foot rot.

Botrytis: In a *Botrytis* infected plant, brown colour spot is developed and visible on the flower petals during the period of high humidity. It can be controlled by spray of Mancozeb @ 2.0 g per litre of water.

Damping off: Root rot is caused by the fungus *Pythium* and it prefers moist conditions. Infected plants lose the root parts and suffer heavy loss to the flower production. It generally attacks the plants grown in heavy and compact soil. Root rot can be controlled by sterilization of soil before planting, better air circulation and decreasing the moisture content of growing media. The disease can be controlled by prophylactic drenching of nursery beds with Captaf (0.1%) and Bavistin (0.1%). Seed treatment with Captaf 0.1% will also reduce the incidence of the disease.

Leaf spot and blight: Various pathogens cause leaf spot and blight in annual flowers. The symptoms appear as small brownish spots on leaves. These leaf spot diseases can be controlled by Dithane M-45 @ 0.2% spray.

Inflorescence blight: Inflorescence gives a burnt appearance in severe cases. This disease can be controlled by spray of Dithane M-45 @ 0.2%.

Powdery mildew: Whitish tiny spots appear on leaves initially. The entire plant shows white powdery appearance in severe cases. The disease can be controlled by Karathane (0.1%) or Claxin (0.03%) sprays.

Seed Collection

For most of families such as Leguminosae, Liliaceae, Cruciferae and Papavaraceae, seed/pod collection should be started when the ovary wall starts to change from green to yellow. With the other families such as Compositae, Labiatae and Umbelliferae, each flower head should be harvested individually when seed is turning brown. At the time of picking, flowers in which seed setting has not taken place should be avoided. The dried flowers are threshed and winnowed to obtain the seed. The seed can be stored in muslin cloth bags or paper bags in a well-ventilated place.

Some of the annual flowers along with their families are listed in the following table.

Botanical Name	Common Name	Family
Amaranthus caudatus	Love- Lies-Bleeding	Amaranthaceae
Celosia sp	Cock, s comb	Amaranthaceae
Gaillardia pulchella	Blanket flower	Asteraceae
Gomphrena globosa	Globe amaranth	Amaranthaceae
Zinnia elegans	Zinnia	Asteraceae
Althea rosea	Hollyhock	Malvaceae
Antirrhinum majus	Snapdragon	Scrophulariaceae
Brachycome iberidifolia	Swan river daisy	Asteraceae
Calendula	Pot marigold	Asteraceae
Callistephus chinensis	China aster	Asteraceae
Chrysanthemum coronarium	Annual Chrysanthemum	Asteraceae
Cosmos bipinnatus	Cosmos	Asteraceae
Dahlia variabilis	Dahlia	Asteraceae
Delphinum hybridum	Larkspur	Ranunculaceae
Dianthus barbatus	Sweet william	Caryophyllaceae
Dimorphotheca aurantica	African daisy	Asteraceae
Gypsophila elegans	Baby's breath	Caryophyllaceae
Petunia hybrida	Petunia	Solanaceae
Phlox drummondii	Star flower	Polemoniaceae
Tagetes erecta	African Marigold	Asteraceae

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DNA Barcoding in Insects

Article ID: 10253

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Introduction

Barcoding is an automatic identification technology that allows us to collect the data rapidly and accurately. The information is stored in the form of black lines with variations in different numbers. This information is decoded with the help of a certain database. Based on similar principal barcoding can be done in plants and animals for their easy and rapid identification and data collection. Just as species differ in morphology, ecology, and behaviour, they also differ in their DNA sequences. Hence, a particular gene or gene fragment can be used to identify a given species in much the same way that retail barcodes uniquely identify each consumer product. This is known as DNA barcoding. It is a technique in which species identification is performed by taking DNA sequences from a small fragment of the genome from taxonomically unknown species, commonly referred to as DNA barcodes and compare it with the reference library of barcodes of known species (Wilson JJ, 2012). It aims at recognizing organisms by assessing the degree of similarity in their DNA sequence to a set of reference taxa. So, the first step for successful species identification by using DNA barcoding is to create a massive online digital library of barcodes that will serve as a standard to which the DNA barcode sequence of an unidentified sample of any plant or animal could be matched.

DNA Barcoding in Insects

Insects constitute the most dominant and diverse groups of animals on the planet. Research of insects has added immensely to our understanding of evolution, ecology, and the genetic control of development. Earlier, the species identification was carried out based on their morphological characters which could be done only by experts such as taxonomists. However, post-genomic research offers new approaches that use molecular instead of morphological data for identification of taxa. DNA barcoding is one such approach used for rapid species identification with precision. It has been utilized to study the taxonomy and systematics of insects particularly in the following orders: Hemiptera, Diptera, Hymenoptera, Coleoptera, and Trichoptera. The first insect order to be utilized for DNA barcoding, and to have their sequences incorporated into the CBOL's database was Lepidoptera (Ratnasingham and Hebert, 2007). The CBOL-Consortium for the Barcode of Life (www.barcodeoflife.org) is currently working on DNA barcode data for insects such as bees, mosquitoes, fruit flies, Trichoptera, and Lepidoptera.

The first step in DNA barcoding is to standardize a particular gene region. For animals, the standard is the ~650 base-pair region near the 5′ ends of the mitochondrial cytochrome c oxidase subunit I (COI) gene. The choice of a particular genomic region that is to be used as a barcode is important. The particular genomic region used as a barcode is an important choice. It must be homologous or conserved between the organisms compared and have a rate of evolution fast enough to show variation between closely related species. It also must have sufficient regions of sequence conservation to allow a limited set of PCR primers to amplify the target gene region from broad sections of the tree of life.

What Makes the CO1 Gene an Ideal Gene for Barcoding?

The CO1 gene codes for an important protein involved in cellular respiration and hence are present in most of the eukaryotic organisms. It is involved in the electron transport phase of respiration. This makes it a highly conserved gene across species. Also, since it is present in the mitochondria, it has a higher sequence evolution rate than the nuclear genome which is fast enough to be different between species but slow enough to be identical in the same species. It also lacks recombination because it is only maternally inherited and is present in large copy number per cell because of multiple copies of mitochondria. A large copy number helps in its easy amplification. All these properties make it a suitable marker for molecular diversity.

Steps Involved in DNA Barcoding

1. Sample collection and DNA isolation: A whole insect or a muscle can be used as a suitable source. The DNA is extracted from the sample tissue.

2. Amplification: Only the desired portion from the DNA isolated has to be amplified. In case of insects, it is the specific region of CO1 DNA barcode gene. This is done with the help of specific primers that amplify only a specific region using PCR.

3. Gel electrophoresis: After amplification, multiple copies of the CO1 gene will be produced. The size of these amplicons is checked using gel electrophoresis. Make sure good quantity and quality of DNA is obtained.

4. DNA sequencing and comparison: The amplified sequence is then submitted for sequencing and the sequenced gene is then compared with barcodes of known species. This is done by using databases like GeneBank or BOLD. The sequence may identify with a species already known and represented in the database. However, some barcodes can be entirely novel.

Application of DNA Barcoding in Entomology

1. Identification of new, endangered and threatened species.
2. It can be used for the detection of invasive species.
3. Important research tool for improving species-level taxonomy.
4. For identification and recognition of cryptic species.
5. Recognition of insect species from any developing stage.

References

1. Wilson JJ. 2012. DNA barcodes for insects. In: Methods in molecular biology (Clifton NJ, eds) Humana Press. P 17-46
2. Ratnasingham, S. and Hebert, P. D. N. (2007). Bold: the barcode of life data system. Molecular Ecology Notes. 7(3): 355–364.

Plant Pharmacogenomics

Article ID: 10254

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Introduction

Plants have been an integral part of ethno medicine and are being exploited for their therapeutic benefits for centuries. Their contribution is not only up to the drug discovery and development process but support the conventional therapeutic strategies by providing effective curative alternatives. The qualitative and quantitative properties of a phytochemical which is affected by genetic makeup of the botanical source. These plant products also have beneficial and adverse drug reactions, dependent on genetic makeup of an individuals, which is to be investigated through study of plant pharmacogenomics.

Plant pharmacogenomics deals with the study of the genetic processes involved in the differential pharmacological responses to a particular phyto-chemical and vice versa. Whereas variation in drug transport, metabolism, and interaction at the receptor site are some of the representations of these genetic variants.

Understanding of the interrelationship of the genetic diversity of individuals and the administered plant product can help to develop ideal therapeutic strategy for the treatment of a disease. Advanced discoveries and techniques in genomics, transcriptomics, and proteomics have made the functional and structural understanding of the genome efficient and accurate. The pharmacogenomics spreads its scope from simple monogenic traits to complex pathways which involves hundreds of alleles, influencing both pharmacokinetic and pharmacodynamics parameters. Once the correlation between the genetic makeup of an individual and the expected therapeutic response to a particular plant product is established, a personalized pharmacotherapy will be developed.

Pharmacology leading to the development of personalized treatment programs and individualized drug selection for improved safety, efficacy and sustainability. Therefore, its emphasis will be given to:

1. Genomic and proteomic profiling.
2. Genetics and drug metabolism.
3. Targeted drug identification and discovery.
4. Optimizing drug selection & dosage based on patient's genetic profile.
5. Drug related morbidity & mortality intervention.
6. Advanced disease screening and targeted therapeutic intervention.
7. Genetic based vaccine development.
8. Patient satisfaction and preference.
9. Health economic evaluations.
10. Practical and organizational issues in the development and implementation of personalized medicine programs.
11. Pharmacogenetics and pharmacogenomics are two major emerging trends in medical sciences, which influence the success of drug development and therapeutics.

Important Phases in Pharmacogenomics

Drug Targets: Specific and accurate targeting of the molecular mechanisms helps in achieving better outcomes, reducing adverse effects. The massive content of the human genome along with the genetic polymorphism results in the need to identify and develop specific targets. Recent developments in the fields of genomics and proteomics have helped in identifying the genes and proteins responsible for many diseases. These targets serve as biomarkers that can be used for identifying a particular disease or a particular variant of diseased gene. Proteins, as surface receptors, enzymes, ion channels, or secreted proteins are important in the initiation of pharmacological cycle of the drug molecule by involving in drug binding.

Drug Transport: On reaching the desired target, a particular intracellular drug concentration needs to be attained for optimum therapeutic effects. However, different membrane transport systems may prevent the drug from achieving the effective levels within the cell. The efflux mechanisms can cause the drug draining from the cells in genetically predisposed individuals, which may result in the development of resistance or tolerance in susceptible individuals leading to therapeutic failure.

Drug Metabolism: Among drug disposition processes, an important contributor to the altered pharmacological response in view of genetic polymorphism is the drug metabolism. Metabolism refers to the enzymatic and chemical conversion of a drug molecule, so as to change the chemical nature of the drug making it liable to be excreted from the body easily. Occurring chiefly in the liver cells, drug metabolism comprises three steps: chemical modification, conjugation, and supplementary alteration. The first and the last phases bring about a chemical change in the chemical structure of the drug molecule, while conjugation involves the addition of an additional chemical moiety to the drug. The nature and rate of these biochemical steps determine the duration for which drug molecule will remain in the body and, hence, the extent of the pharmacological action of the drug.

Pharmacogenomics Aspects of Some Phytochemicals

SI No.	Phytochemicals	Botanical sources	Main therapeutic applications	Gene targeted
1	Glucosinolates, isothiocyanates	Cruciferous plants	Anticancer	IDO, NRF-2, CYP2E1
2	Polyphenols	Multiple families	Anti-inflammatory, anticancer, antioxidant	NF-KB, apoE,
3	Alkaloids	Cinchona , henbane, Strychnine	Antiarrhythmic, anticholinergic, analgesic, antihypertensive, neuronal	CGRP, CYP3A PIG3, p53
4	Allicin	Alliaceae plants	Antibacterial, antiviral	MTb 85B, WAF1, INK4
5	Ginsenosides (saponins and glycosides)	Araliaceae plants	Vasodilation, anticoagulation, cell proliferation	CAMs, CDK, Rg-1

Some Commonly Used Plants and their Associated Pharmacogenomics Aspects

1. Nicotiana tobaccum: It is the principal source of nicotine, a CNS stimulant. Nicotine is processed by a number of hepatic enzymes of the cytochrome P-450 A2 subclass. They convert the nicotine into cotinine using these enzymatic players (Murphy et al., 2013).

2. Ginkgo biloba: Ginseng is an important source of a pharmacologically active group known as ginsenosides. It acts as an effective CVS, CNS, immunomodulatory, and antineoplastic agent. They act on a number of membrane proteins to show their pharmacological properties. TNF-α, NF-κB, and IL-6 are the major targets of ginsenosides for their therapeutic benefits (Zhou et al., 2006). Polymorphism in these targets can yield to altered pharmacological profile of the drug.

3. Centella asiatica: It is an Indian plant known by the vernacular name of gotukola. The extract contains four active ingredients including asiaticosides, asiatic acid, asiaticoside 6, and SM2, which can prevent the death of the beta-amyloid cells (Rao et al., 2012). Hence, they can be used as neuroprotective agent. However, genetic modification in these target cells may lead to altered therapeutic responses to these phytochemicals.

4. Rauwolfia serpentina: Reserpine, the principal alkaloid, obtained from the plant has been associated with hypotensive and antipsychotic effects. Catecholamine and serotonin (5-HT) are the major targets of the phytochemical (Konno et al., 2010). Polymorphism in the drug-processing enzymes can lead to altered effects of the drug in genetically predisposed individuals.

Drug Discovery and Development Steps

1. Identifying the Target.
2. Ranking and Authenticating Targets.
3. Identifying Leads.
4. Optimizing Leads.

Future Perspective and Conclusion

Apart from providing hope to treat the rare and neglected cases, pharmacogenomics does raise a number of concerns. Ethical issues are worth mentioning among these constraints. A patient's genetic information, including disease susceptibility genetic background, has to be extracted and used in the decision-making process, which renders the additional need to safeguard this data. Additionally, as new and specific drugs would be targeted to a particular subpopulation of patients, the industry's economic concerns and profit margins would need to be addressed. Regulatory authorities would have to devise newer protocols for drug analysis and testing. Pharmacogenomics focuses on the transfer from the current protein based therapeutic targets to the gene-based strategies.

Nevertheless, pharmacogenomics holds the promise of development and provision of rational therapeutic strategies. It helps in isolating new druggable targets in individuals of different ethnical, racial, and genetic backgrounds. The scarcity of health resources in the developing and backward countries, dependence on the complementary and alternate systems of medicines urge the need to exploit the pharmacogenomics basis of phytochemicals.

References

1. Murphy SE, Wickham KM, Lindgren BR, Spector LG, Joseph A (2013) Cotinine and trans 3'-hydroxycotinine in dried blood spots as biomarkers of tobacco exposure and nicotine metabolism. J. Expo. Sci. Environ. Epidemiol. 23:513–518.
2. Zhou Y-H, Yu J-P, Liu Y-F, Teng X-J, Ming M, Lv P, An P, Liu S-Q, Yu H-G (2006) Effects of Ginkgo biloba extract on inflammatory mediators (SOD, MDA, TNF- a, NF-k Bp65, IL-6) in TNBS-induced colitis in rats. Mediat. Inflamm., 5:92642.
3. Rao RV, Descamps O, John V, Bredesen DE (2012) Ayurvedic medicinal plants for Alzheimer's disease: a review. Alzheimers.. Res Ther. 4(3):1–9.
4. Konno A, Terada N, Okamoto Y (2010) Effect of long term use of reserpine, a sympathetic neuron blocker, on muscarinic cholinergic receptors in the guinea pig nasal mucosa. ORL J. Otorhinolaryngol Relat. Spec. 50(5):334–339.

Post-Harvest Operations of Cocoa: A Key to Chocolate Quality

Article ID: 10255

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Abstract
The conversion of cocoa fruit to cocoa beans is an integral part of chocolate processing that determines the flavour of the final product as they are responsible for the production of flavour precursors in them. These processes mainly take place at the household level that are driven by the naturally occurring local microbiota (Ozturk & Young, 2017). So, proper control of process for conversion of cocoa fruits to cocoa nibs for preparation of superior quality chocolate.

Introduction
Cocoa *(Theobroma cacao)* is a small evergreen tree grown mostly in tropics that produce cocoa fruits. Cocoa fruits contain about 30-40 cocoa beans around a white mucilaginous pulp protected by a cocoa pod. Each bean consists of two cotyledons (the nib) and germ, enclosed in seed coat or testa. The pulp is relatively sterile inside the pod but when broken and exposed to environment, a series of microbiological changes occurs that leads to removal of pulp as sweatings (liquid) and killing/ destruction of seed coat of cocoa nib. A series of biochemical changes occur in cocoa nibs that finally results in the production of distinctive flavour and aroma to the chocolate (Aprotosoaie et al., 2016).

Steps in Cocoa Processing
Various steps involved in the cocoa processing are given in the figure 1 and are described as follows:
1. Harvesting of pods: Harvesting is done when the cocoa become ripened from green to yellow or orange. It is generally done by knives or using specially designed machete (cutlass). Main harvest season is from October to December.

2. Opening of pod: The pods are cut open by using a wooden machete or a wooden club that release the pulp.

3. Fermentation: Fermentation is carried out by heaping the pulp or by putting pulps in a wooden box for about 5-7 days. Various natural micro-organisms such as yeasts, aerobic and anaerobic bacteria degrade the white mucilaginous layer and make the medium acidic with rise in temperature. This causes the destruction of seed testa and killing of seed embryo that facilitate the absorption of acids onto the cocoa nibs and release of various endogenous enzymes resulting that specifically act upon to the polyphenolic components for the formation of aroma and flavour precursors in the cocoa beans (Beckett, 2009). Cocoa beans are a source of a number of polyphenols such as anthocyanins, catechins and alkaloids such as theobromine, caffeine, methylxanthines etc that act upon endogenous enzymes such as pectinase, invertase, protease, carboxypeptidase inducing various oxidation, polymerization reactions and characteristic flavour (Aprotosoaie et al., 2016). Fermentation also induces break down of complex carbohydrates and proteins to simpler sugars and amino acids making it available for further reactions.

4. Drying: Drying is mostly carried out by sun drying or by using artificial dryers up to a moisture content of ≤7%. It is done to avoid over-fermentation and development of undesirable microorganisms (especially fungi) during storage thereby increase their shelf life, and facilitate their transport. Browning and other enzymatic reactions continue at this stage and give chocolate its flavour during the end of drying process (Ozturk & Young, 2017). Fine quality cocoa beans are produced at this stage that are then carried onto factories for further processing and conversion of chocolate.

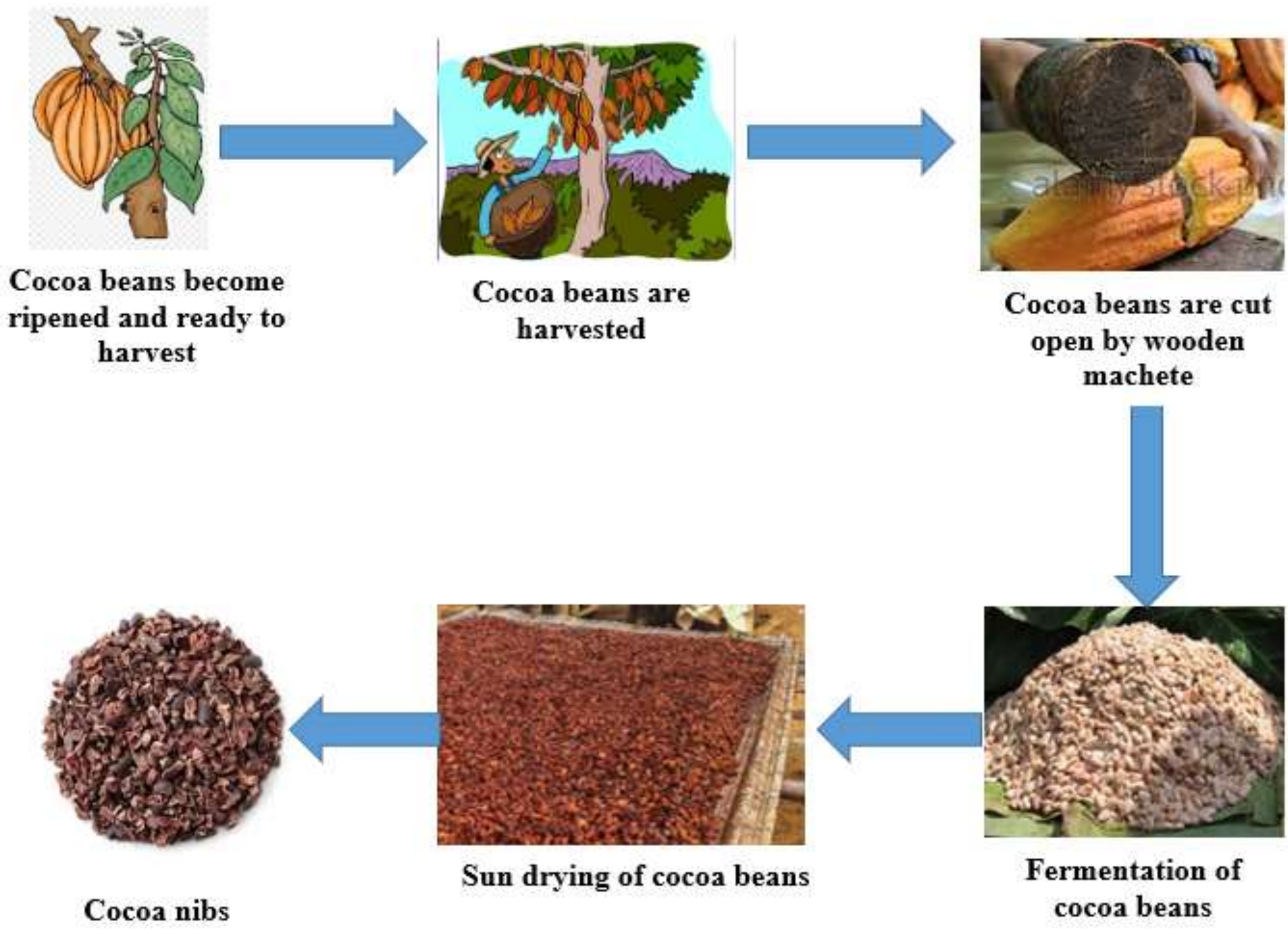

Fig 1: Processing of cocoa fruit to cocoa nibs

References

1. Aprotosoaie, A. C., Luca, S. V., & Miron, A. (2016). Flavor Chemistry of Cocoa and Cocoa Products-An Overview. Comprehensive Reviews in Food Science and Food Safety, 15(1), 73–91. https://doi.org/10.1111/1541-4337.12180.
2. Beckett, S. T. (2009). Industrial Chocolate Manufacture and Use: Fourth Edition. In Industrial Chocolate Manufacture and Use: Fourth Edition. https://doi.org/10.1002/9781444301588.
3. Ozturk, G., & Young, G. M. (2017). Food Evolution: The Impact of Society and Science on the Fermentation of Cocoa Beans. Comprehensive Reviews in Food Science and Food Safety, 16(3), 431–455. https://doi.org/10.1111/1541-4337.12264.

Role of Farm Machineries Testing in Agriculture

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Introduction

Indian agriculture has seen exponential growth in the mechanization of farms. It leads to timeliness that also increase productivity and income in turn (Verma and Guru, 2014). India is very promising farm machinery industry, producing yearly more than 2.5 lakh tractors, 10, 000 power tillers, 4.5 lakh sprayers and dusters, 9.5 lakh pumping sets and 2000 combine harvester and thresher, besides other farm equipment. At present, agriculture machinery population in India is estimated at about 150 million which includes about 3 million tractor and other self-propelled equipment (Sahay, 2010). The increased size and the higher level of mechanization requires increased emphasis on management, thereby it encourages better management of farm enterprises (Kepner, 1987).

Accelerated demand for farm equipment has encouraged many producers to initiate production of farm machinery. With heavy investment on farm machinery, it is necessary to have some means of assessing the performance of machines being brought out by the various manufacturers before being used by the farmers. Farm machines supplied to the farmers must ensure functional and life reliability. For this, testing of machines according to a well-established standardization procedure is important (Anonymous, 2017). The term "testing" is usually used in connection with an analysis of the behaviour of a machine compared with well-defined standards under ideal and conditions. In contrast "evaluation" involves measurement of machine performance under real farm conditions (Mehta et al, 2014).

In order to obtain accurate and repeatable results, it is important to conduct the testing under a set of standardized test conditions and to follow standardized test procedure and formats. To make quality implements and spares available to the farmers, Bureau of Indian Standard operates a Certification Mark Scheme, under which licenses are issued to such manufacturers who apply for the use of ISI marks on their goods, to indicate that the quality is in conformity with the relevant Indian standard (Mehta et al, 2014).

Objective of Testing

1. To test agricultural machinery manufactured within the country with a view to assess their functional suitability and performance reliability so that it will help farmers and other prospective users in determining the comparative performance of machines available in market.
2. Provide materials to engineers and extension workers for guiding users in proper selection of equipment.
3. Form the basis for standard specification to be used by the manufacturers and distributors and help financial institutions in recommending financial assistance both to the manufacturers as well as farmers.
4. To assist Bureau of Indian Standards in formulation of standards for testing of agricultural machines covered under the scope of Certification Marks Scheme.

Types of Test

1. Commercial Tests: It is used to check performance characteristics of machines that are already in commercial production or ready for commercial production.

2. Confidential Tests: It is used for providing confidential information on the performance of machines, whether ready for commercial production or not or to provide any special data that may be required by the manufacturer/applicant.

Test Codes Used for Testing of Agricultural Implements

1. Bureau of Indian Standards (BIS): Bureau of Indian Standards (BIS) is the National Standard Body of India. BIS is responsible for the harmonious development of the activities of standardization, marking and quality certification of goods and for matters connected therewith or incidental thereto.

2. Regional Network for Agricultural Mechanization (RNAM): The main objectives of RNAM Project are: identification and improvement of the national agricultural mechanization policies and strategies and ensuring that the strategy is implemented; strengthening of the capability to develop tools and machines in the field of food and feed crop farm operations such as seeding or planting, harvesting, threshing, drying and milling; strengthening of the capabilities in manufacturing technology to ensure effective and efficient local manufacture of quality agricultural machinery and demonstration with eventual adoption of appropriate technology in selected districts/villages of each Participating Country.

3. Asian and Pacific Network for Testing of Agricultural Machinery (ANTAM): ANTAM will facilitate the trade and use of agricultural machines and implements fulfilling common requirements of safety (operator, environment, and food production) and performance. It is a system based on standardization, testing/ verification and certification for development and trade offering benefits to all stakeholders.

Where Testing can be Done?

1. Farm Machinery Training and Testing Institutes (GOI).
2. Identified State Testing Centres.
3. Other Government/ICAR institutions.

Authorization of Testing

1. CFMTTI (Central Farm Machinery Training & Testing Institute), Budni - will test tractors, power tillers, combine harvesters, and other self-propelled machines.

2. NRFMTTI (North Region Farm Machinery Training & Testing Institute), Hissar - will test Combine harvesters, plant protection equipment, irrigation pumps, diesel engines and other self-propelled crop production equipment and machines.

3. SRFMTTI (Southern Region Farm Machinery Training & Testing Institute) Garladinne - will test power tillers, self-propelled crop production machines/equipment, including power drawn agricultural machines and equipment.

4. NERFMTTI (North Eastern Farm Machinery Training & Testing Institute), Biswanath Chariali (Assam) will test power drawn agricultural machines and equipment including non-self-propelled agricultural equipment.

Beneficiaries of Testing of Farm Machineries

1. Manufacturer.
2. Consumer or users.
3. Exporter.
4. Expert inspection authorities.
5. Organised purchasers.

Figure: Testing of Farm implement (Cultivator)

Conclusion

In order to obtain accurate and repeatable results, it is important to conduct the testing under a set of standardized test conditions and to follow standardized test procedure and formats. Farm machines supplied to the farmers must ensure functional and life reliability. For this, testing of machines according to a well-established standardization procedure is important.

References

1. Anonymous. 2017. Guidelines & regulations of testing of farm machinery. https://www.iari.res.in/files/Farm_Machinery/Test_Guidelines.pdf
2. Kepner, R.A., Bainer, R. and Barger, E.L. 1987. Textbook of Principle of farm machinery. Third edition. CBS publishers and distributors pvt.Ltd. New Delhi. India.
3. Mehta, C.R., Chandel, N.S., Senthilkumar, T. and Singh, K.K. 2014. Trends of Agricultural Mechanization in India. CSAM, Policy.
4. Sahay, J. 1971. Text book of Elements of agricultural engineering. Standard publisher's distributors. New Delhi.
5. Verma, A and Guru, P.K. 2014. Development and evaluation of cultivator cum seed Drill. Article in Ecology, Environment and Conservation 21: 1359-1364.

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A Review on Robotic Harvesting Systems for Greenhouse Sweet Pepper

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Introduction

Digital farming is a modern technology practice such as sensors, big data analysis and robotics, for shifting from tedious operations to automated process (Shamshiri et al., 2018[18]). Due to lack of skilled workforce and high labour costs (Comba et al., 2010[6]), harvesting sweet pepper (Capsicum) is a labour-intensive task that demands to shifting from manual harvesting to automated harvesting. Million tons of Capsicum are still hand-picked every year in open-fields and greenhouses. Researchers and farmers are facing challenges to produce more food by use of less land, in order to meet the demands of predicted population about 9.8 billion in 2050 (King et al., 2017[10]). Therefore, development of an automated robotic harvesting considered as an alternative method for greenhouses for timely and precise operations (Mann et al., 2016[12]). It also plays a vital role in improve the interaction between human, machine and plants (Gonzalez et al., 2009[8]). Also prevent musculoskeletal disorders during manual harvesting in greenhouses has motivated for replacement of human labour by robots for picking the sweet pepper (Shamshiri et al., 2018[17]). In this review paper only focused on published literature for automated sweet pepper harvesting have a vision control with an advanced image processing technique, with the help of a customized platform design software introduce to support robots for precision in agriculture operation with the help of robot components (Figure1) and most useful sweet pepper harvesting robots recently developed for greenhouse are given in Figure 2.

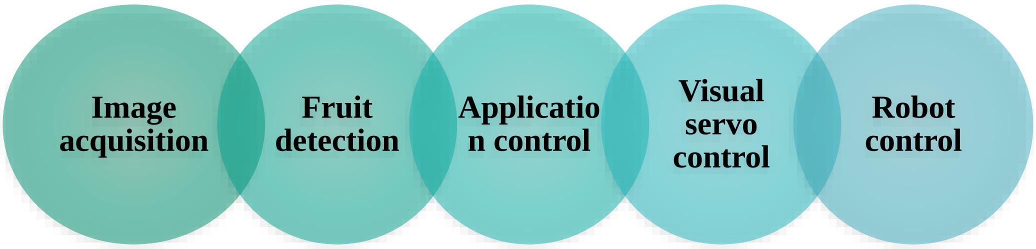

Figure 1. Robot harvester

		
Crops	**Harvey**	**Swepper**

Figure 2. Sweet pepper robots

System Designed for Sweet Pepper Robotic Harvester

A robotic harvester includes eye in hand for visual servo control (Mehta et al., 2016; Barth et al., 2016), manipulator and an end effector for grasping sweet pepper (Murphy. 2000) with gripper design (Eizicovits et al., 2016). Performance of robot is analysing by motion planning algorithms (Bac et al., 2016). Thus, improve and achieve the all challenges which are considered for making a harvesting robot (Sandini et al., 1990). In sweet pepper harvesting robots such as CROPS (Bontsema et al., 2015), HARVEY (Lehnert et al., 2017) and SWEEPER (Ringdahl et al., 2019) are having different system functions with different main components. Authors are reported three key challenges:

1. Detection.
2. Grasp selection.
3. Manipulation.

The system designed for harvesting sweet pepper includes scanning, crop detection, grasp selection, crop attachment and crop detachment is shown Figure3.

Figure 3. Functional components of harvesting robot

1. Scanning: A robot arm is moved in a pre-determined scanning motion to build a 3D model by using an eye in-hand RGB-D camera (Lehnert et al., 2017). These scanned points are determined by programmed algorithms are given in table 1 (Bac et al., 2014).

Sl.no	Authors	Camera	Algorithm
1.	Bontsema et al., 2015	5-megapixel colour cameras and a Time-of-Flight camera	Direct linear transformation (DLT) algorithm
2.	Lehnert et al., 2017	Intel Real sense SR300 RGB-D	Kinect Fusion algorithm
3.	Ringdahl et al., 2019	5250RE RGB camera with DT20HI displacement measurement laser sensor	Standard color segmentation algorithms

Table 1. Different camera of robot harvester

2. Pepper Detection: Sweet peppers from the 3D scene are divided utilizing shading data and restricted by fitting a 3D parametric model to the portioned purposes of sweet pepper.

3. Grasp Selection: Compute a candidate grasp poses by utilizing the segmented sweet pepper point cloud.

4. Pepper Attachment: The end effector grips the sweet pepper before detachment of fruit. All end effector is connected to a robot arm or hand is described in below table 2.

Sl.no	Author	Robot arm
1.	Bontsema et al., 2015[5]	9DOF manupulator
2.	Lehnert et al., 2017[11]	6DOF Universal Robotics UR5
3.	Ringdahl et al., 2019[15]	6DOF manipulator Fanuc LR Mate 200iD

Table 2. Different robot arm or hand used in robot harvester

5. Pepper Detachment: Detaching pepper from plant without harming to plant. This sweet pepper is detached by using cutter with the help of end effector as given in a below Table.3.

Sl.no	Author	cutter	End effector
1.	Bontsema et al., 2015	Lip knife Scissor	Lip type Fin type
2.	Lehnert et al., 2017	Oscillating blade	Decoupled mechanism type
3.	Ringdahl et al., 2019	Oscillating blade	Holder type

Table.3. Different detaches used in robot harvester

6. Platform Design software: The robot was executed utilizing a conventional ROS programming system for advancement of already developed agri-robots (Hellstrom et al., 2013[9]). The structure was built with a cross breed robot architecture, utilizing a state machine actualizing a flowchart.

Discussion

Bontsema et al., 2015, experiment revealed that a CROPS robot successfully harvests in an unmodified crop and it was only between 2 per cent and 6 per cent. After simplifying a crop by removing sweet pepper clusters and occluding leaves leads to a success harvest rate improved up to 33 per cent. For picking a fruit the average cycle time was taken as 94 s. Lehnert et al., 2017, examined HARVEY robot harvester for sweet pepper a novel end-effector was designed. Out of total sweet pepper, 58 per cent and 42 per cent were harvested successfully for two field trial 1 and 2 with two variety such as Claire and Redjet respectively, where harvested sweet pepper includes a successful attachment and detachment. The average picking time was taken for harvest was 35-40 s. Ringdahl et al., 2019, evaluated at two different approach strategies for a case study of sweet pepper for SWEEPER robot. Attempts made by the single approach strategy were successful in 84 per cent of the cases than multiple approach strategy where only 49 percent of the approaches were successful. The average picking time was further reduced to 24 s is as described in table 4.

Sl.no	Author	Type	Percentage successful harvest	Time(s)
1.	Bontsema et al., 2015	End effector Lip type Fin type	2% 6%	94
2.	Lehnert et al., 2017	Field Cultivar: Claire Cultivar: Redjet	58% 42%	35 -40
3.	Ringdahl et al., 2019	Approach single approach strategy multiple approach strategy	84% 49%	24

Table 4: Performance of selected robot

All these robots were harvesting sweet pepper successfully, but till now these robotic harvesters are not commercialized for the fresh market (bac et al., 2015).

Conclusion

Most failures in harvesting of sweet pepper by robotic harvester occurs in the attachment stage. The removal of leaves and multiple fruits can increase the harvesting success of sweet pepper by robots to the tune of 27 per cent. The average picking time for robotic harvesting of sweet pepper varied from 24 s (SWEPPER) to 94 s (CROPS). Hence, use of robotic harvesters for sweet pepper have a great potential in solving some of the today's major grower's issues, such as labor cost, labor availability, food safety and quality.

References

1. Bac C W, Roorda T, Reshef R, Berman S, Hemming J, van Henten E J. Analysis of a motion planning problem for sweet-pepper harvesting in a dense obstacle environment. Biosyst. Eng., 2016; 146: 85–97.

2. Bac, C.W., Henten, E.J., Hemming, J., Edan, Y.: Harvesting robots for high-value crops: state-of-the-art review and challenges ahead. J. Field Rob. 31(6), 888–911 (2014)
3. Bac, C.W.: Improving Obstacle Awareness for Robotic Harvesting of Sweet-Pepper. PhD thesis, Wageningen University (2015)
4. Barth R, Hemming J, van Henten E J. Design of an eye-in-hand sensing and servo control framework for harvesting robotics in dense vegetation. Biosyst. Eng., 2016; 146: 71–84.
5. Bontsema, J., Hemming, J., Pekkeriet, E., Saeys, W., Edan, Y., Shapiro, A., & Baur, J. (2015). CROPS: Clever robots for crops. Eng. Technol, 1(1), 1-11.
6. Comba, L., Gay, P., Piccarolo, P., Ricauda Aimonino, D.: Robotics and automation for crop management: trends and perspective. In: International Conference Ragusa SHWA2010, pp. 471–478 (2010).
7. Eizicovits D, van Tuijl B, Berman S, Edan Y. Integration of perception capabilities in gripper design using graspability maps. Biosyst. Eng., 2016; 146: 98–113.
8. González R, Rodríguez F, Sánchez-Hermosilla J, Donaire J G. Navigation techniques for mobile robots in greenhouses. Appl. Eng. Agric., 2009; 25(2): 153–165.
9. Hellstro¨m, T., Ringdahl, O.: A software framework for agri- cultural and forestry robots. Ind. Robot Int. J. 40(1), 20–26 (2013). https://doi.org/10.1108/01439911311294228. http://www.emeraldinsight.com/journals.htm?issn=0143-991X&volume=40&issue=1&articleid=17072869&show=html
10. King A. Technology: The Future of Agriculture. Nature, 2017; 544: S21.
11. Lehnert, C., English, A., McCool, C., Tow, A. W., & Perez, T. (2017). Autonomous sweet pepper harvesting for protected cropping systems. IEEE Robotics and Automation Letters, 2(2), 872-879.
12. Mann, M.P., Zion, B., Shmulevich, I., Rubinstein, D., Linker, R.: Combinatorial optimization and performance analysis of a multi- arm cartesian robotic fruit harvester-extensions of graph coloring. J. Intell. Robot. Syst. 82(3-4), 399–411 (2016)
13. Mehta S S, MacKunis W, Burks T F. Robust visual servo control in the presence of fruit motion for robotic citrus harvesting. Comput. Electron. Agric., 2016; 123: 362–375.
14. Murphy R. Introduction to AI robotics. MIT Press, 2000.
15. Ringdahl, O., Kurtser, P., & Edan, Y. (2019). Evaluation of approach strategies for harvesting robots: Case study of sweet pepper harvesting. Journal of Intelligent & Robotic Systems, 95(1), 149-164.
16. Sandini G, Buemi F, Massa M, Zucchini M. Visually guided operations in green-houses. IEEE International Workshop on Intelligent Robots and Systems (IROS'90'), 1990; pp.279–285.
17. Shamshiri R R, Hameed I A, Karkee M, Weltzien C. Robotic harvesting of fruiting vegetables: A simulation approach in V-REP, ROS and MATLAB. Proceedings in Automation in Agriculture-Securing Food Supplies for Future Generations, 2018, InTech.
18. Shamshiri, R R., Weltzien, C., Hameed, I. A., J Yule, I., E Grift, T., Balasundram, S. K., & Chowdhary, G. (2018). Research and development in agricultural robotics: A perspective of digital farming. International Journal of Agricultural and Biological Engineering, 11(4), 1-14.

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Benefits of Fenugreek as Medicinal and Spices

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Introduction

Fenugreek is one of the major species of human food. It provides natural food fiber and other much important nutrient products in human body. Its leaves and seeds are used in food and also in Ayurvedic medicinal system. The aromatic and flavorful fenugreek is a popular spice and is broadly used for culinary and medicinal properties. Fenugreek contains strong spicy and seasoning type sweet flavor. "Kasuri methi" is very famous for its amazing fragrance and also used for culinary preparations.

Various Names of *Trigonella foenum graecum*

It is known as Methi in Nepali and various Indian regional languages like Hindi, Urdu, Bangla, Gujarati and Marathi. Other names of Fenugreek in various languages are:
French: Fenugrec Sénegré, Trigonelle.
German: Bockshornklee, Griechisches Heu.
Italian: Fieno Greco.
Spanish: Alholva, Fenogreco.
Tamil: Venthium.
Telugu: Menthulu.
Malayalam: Ulluva.
Kannada: Menthyada Soppu.
Malay: Alba
Sinhalese: Uluhaal.
Arabic: Hilbeh.

Particulars	Contents (g/100 g)	References
Carbohydrates	42.3	El Nasri and El Tinay (2007)
Gum (seeds)	20.9	Kakani et al. (2009)
Ash (seeds)	3.38	Sowmya and Rajyalakshmi (1999)
Fiber (seeds)	50.0	Montgomery (2009)
Soluble		
Raw	21.7	Muralidhara et al. (1999)
Germinated	10.3	Muralidhara et al. (1999)
Insoluble		
Raw	26.8	Muralidhara et al. (1999)
Germinated	23.9	Muralidhara et al. (1999)
Fiber (leaves)		
Soluble	0.7	Altuntas et al. (2005)
Insoluble	4.2	Altuntas et al. (2005)
Dietary fiber	48.0	Brummer et al. (2003)
Fats (seeds)	7.9	El Nasri and El Tinay (2007) Montgomery (2009)
Fats (leaves)	1.0	Montgomery (2009)
Protein (seeds)	25.4	El Nasri and El Tinay (2007)
Protein (leaves)	4.4	Montgomery (2009)
Moisture (seeds)	7.49	Sowmya and Rajyalakshmi (1999)
Moisture (leaves)	86.0	Sowmya and Rajyalakshmi (1999)

Origin of Fenugreek

(Trigonella foenum-graecum), also spelled foenugreek, fragrant herb of the pea family (Fabaceae) and its dried, flavourful seeds. Native to southern Europe and the Mediterranean region, fenugreek is cultivated in central and south-eastern Europe, western Asia, India, and northern Africa.

Biology of Fenugreek

Botanical Classification of *T. foenum graecum:*

Domain	Eukarya
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Fabales
Family	Fabaceae
Sub-family	Trifoliae
Genus	Trigonella
Sub-genus	Foenumgraecum

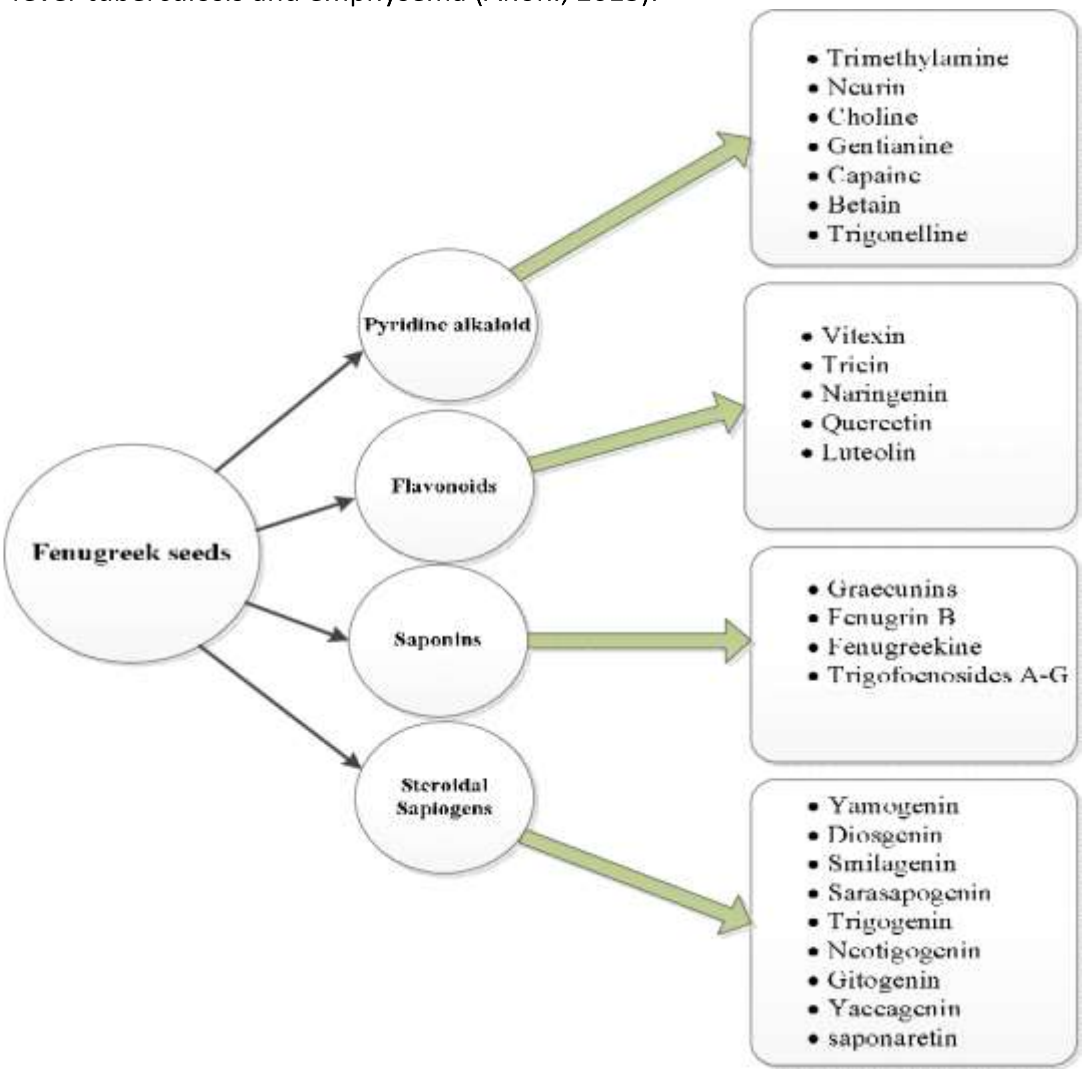
In general, two types of flowering shoots are observed. The common type bears axillary flowers showing an indeterminate growth habit, whereas the less common or so called "blind shoots" have both axillary and terminal flowers, each of which become "tip bearers". Two types of fenugreek flowers also have been described; i.e., cleistogamous (closed) and aneictgamous (open) flowers. However, the majority of fenugreek flowers are cleitogamous; aneictgamous flowers are not common in fenugreek.

Fenugreek is one of the oldest medicinally used plants, with roots in both traditional Indian and Chinese systems of medicine.

Fenugreek is redolent of burnt sugar, which is why it's used in chutneys and to make imitation maple syrup. The spice is known as "helba" in Moroccan cuisine, and it's sometimes an ingredient of the popular Indian spice blend garam masala, along with cumin, cardamom, cinnamon, coriander, and mustard seed.

Fenugreek extracts are ingredients in many common products, including:
1. Soaps.
2. Cosmetics.
3. Teas.
4. Garam masala, a spice blend.
5. Condiments.
6. Imitation maple syrup products.

Nutraceutical properties of Fenugreek: Fenugreek has a beneficial effect on cleansing the blood and as a diaphoretic it is able to bring on a sweat and to help detox the body. Due to pungent aroma of fenugreek, that is smelt on the skin and in under-arm perspiration. Fenugreek is also known for its lymphatic cleansing activity though its vital role is to irrigate the cells with nutrients and to remove toxic wastes, dead cells and trapped proteins from the body. Block in the lymphatic system can mean poor circulation of fluid, fluid retention, pain, energy loss and disease, anywhere in the body of a person. Fenugreek maintains mucus conditions of the body, mostly the lungs, by helping to clear congestion. It also acts as a throat cleanser and mucus solvent that also eases the urge to cough. Drinking water in which seeds of fenugreek have soaked helps in softening and dissolving, accumulating and hardening the masses of cellular debris. Fenugreek has been used to relieve colds, bronchial complaints, influenza, asthma, catarrh, constipation, sinusitis, pleurisy, pneumonia, sore throat, laryngitis, hay fever tuberculosis and emphysema (Anon., 2013).



S. no.	Component used	Utilization of fenugreek
1	Seeds	Bread (Isikli and Karababa, 2005; Thomas et al., 2011; Raju et al., 2001)
2	Fenugreek seeds, leaves	Biscuits (Hussein et al., 2011)
3	Seeds	Extruded product (Shirani and Ganesharanee, 2009)
4	Fenugreek gum	Extruded products (Ravindran et al., 2011)
8	Seed, leaves	Culinary use (color, flavor, aroma) (Ramesh et al., 2001)
9	Leaves and seeds	Spice and seasoning (Sowmya and Rajyalakshmi, 1999; Srinivasan, 2005)
11	Seeds, leaves	Organoleptic character improver (Srinivasan, 2006)
12	Seed	Maple syrup and artificial flavoring (Blank, 1996)
14	Seed	(Mixed with flour for bread, yellow dye) food, (Srinivasan, 2006)
16	Seed	Dietary fiber, galactomannan (Blank, 1996)
17	Seed	Curries, condiments, pickles, chutneys as a flavoring (Madar and Stark, 2002)
20	Seed	Food stabilizer, adhesive and emulsifying agent (Jani et al., 2009; Sowmya and Rajyalakshmi, 1999)

Pharmacological and Therapeutic Actions of Fenugreek

Disease/Disorders	Active constituents	Mechanism of action
Diabetes	4-hydroxyisoleucine; polyphenolics	Stimulation of insulin production and anti-diabetic effects.
Cancer	Flavonoids; saponins, alkaloids, galactomannans, fibres.	Inhibition of hyperplasia and carcinogenesis; decrease of incidence decrease.
Hypercholesterolemia	Flavonoids & polyphenols, saponins	Controls high blood cholesterol & triglycerides; Reduction in blood lipid levels.

Inflammation	Various	Stimulatory effect on immune system; Reduction of swelling & pain.
Indigestion and flatulence	Fibres	Stimulates appetite & acts as laxative.
Aging / Kidney disorders / Bacterial infection	Polyphenols, flavonoids, alkaloids	Antioxidants reduce cell death & aging; Protects functional & histopathologic abnormalities of diabetics; Inhibition of E.coli, S. typhi, S. aureas.

Plant Growth Promoting Rhizobacteria (PGPR): A Boon to Sustainable Agriculture

Article ID: 10259

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Summary

Soil is a vital ecological niche which influences the plant growth and health of the plant starting from germination to senescence. The soil particles which are adhered to the roots of the plants is known as rhizosphere which harbors many microorganisms of both beneficial and harmful character. But, there are certain groups of bacteria present in the rhizosphere helps in the enhancement of the growth and development of plants. They are known as plant growth promoting bacteria (PGPR).

They can minimize the excessive use of agricultural chemicals by solubilizing macro and minor nutrients to enable plants to utilize for their growth. Further some, PGPR have certain mechanisms to suppress the growth and virulence of pathogenic microbes by competing for food and shelter, secreting chemicals which discourages the growth of microbes and also triggers the defense mechanisms like induced systemic resistance (ISR) and Systemic acquired resistance (SAR). Therefore this article has enlighten the significance of PGPR in sustainable agriculture which has an increasing demand for the food day by day without much affecting the limited resources available.

Keywords: Ecological niche, PGPR, ISR, SAR, Sustainable agriculture.

Introduction

Plants are prone to several biotic and abiotic factors in the environment which puts detrimental effects on the establishment and growth of the plant. Many of the factors related to soil adjacent to the root plays a pivotal role in the sustainable growth of the plants.The bulk of soil adjacent to the root harbors many microfauna such as fungi, bacteria, actinomycetes etc. is known as Rhizosphere (Hiltner, 1904). Among the microorganism's bacteria are competent enough to outnumber other microorganisms due to its rapid mode of reproduction and also can use the plant exudates very efficiently.

Those bacteria which are found numerously in rhizosphere are called rhizobacter. The efficient management of resources for agriculture to reassure ever changing human needs in maintenance and enhancement of the quality of the environment as well as conservation of natural resources is known as sustainable agriculture. Use of these plants promoting rhizobacter in agriculture can achieve the goals and objectives of sustainable agriculture by reducing the agricultural chemicals there by reducing the environmental pollution and hazardous effect to mankind. The role of rhizobacteria in satisfying the objectives of sustainability in agriculture has been discussed below.

Plant Growth Promoting Bacteria (PGPR)

An ecological niche surrounding the plant roots which acts as nutrient-rich medium for many microorganisms is called as rhizosphere. Kloepper and Schroth, 1978) has suggested "PGPR" as a group of bacteria confined exclusively to rhizosphere are competent enough to colonize rapidly in the rhizosphere and promotes the growth and development of the plant. They also impart a beneficial effect such as early seedling emergence and substantially boost the vigour, biomass and proliferation of the root system in plants.

Application of PGPR

PGPR promote the plant health by several factors such as secretion of phytohormones, nitrogen fixation, adjustment of ethylene synthesis in roots, nutrients solubilization such as phosphate, siderophore production, enhancing mycorrhizal activity, diminishing heavy metal toxicity are the most crucial (Whipps, 2001). PGPR also helps in developing disease resistance in the plants which is commonly known as “Biocontrol” (Lucy *et al*., 2004) (Fig 1). *Agrobacterium Bacillus*, *Pseudomonas spp.* and Enterobacter are the PGPR active strains and it is also been reported that *Pseudomonas Spp.* interacts with the arbuscular mycorrhizal fungi (AMF) enhancing spore germination and mycelium development. Thus Pseudomonas spp. has been known as mycorrhization helper bacteria.

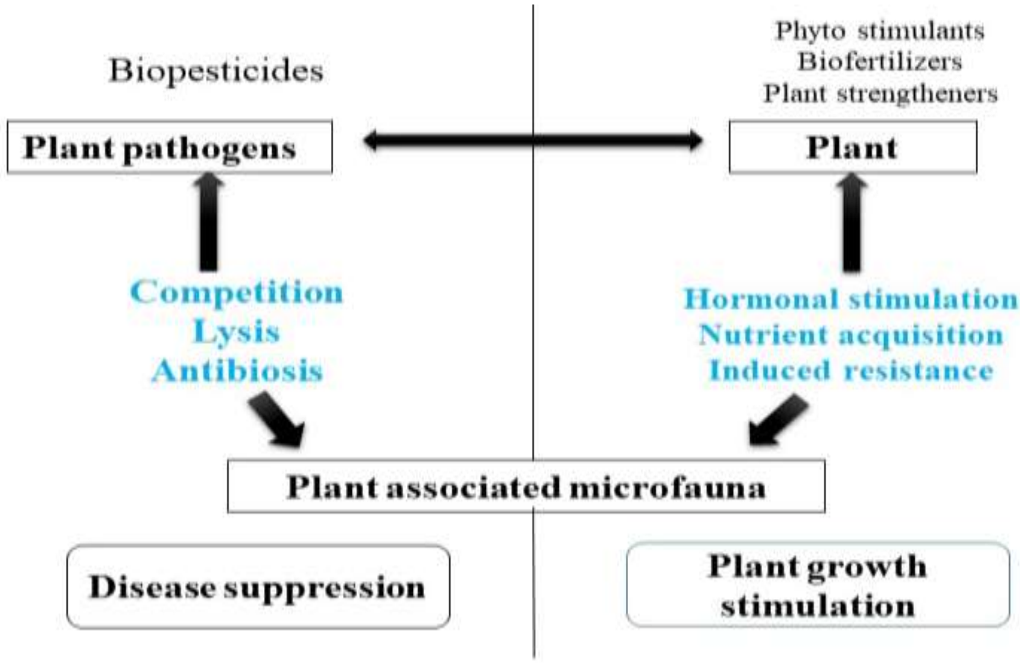

Fig 1. PGPR promoting plant growth and preventing the disease

PGPR in Crop Production

In general, Bacteria enhances crop production by two ways: producing growth enhancing hormones for plants and accelerating the nutrient uptake from rhizospheric region of the soil (Cakmakci et al., 2006). PGPR also imparts resistance to plants against drought and oxidative stress by producing water soluble vitamins such as biotins, riboflavins, niacin, thiamin and pantothenic acids (Revillas et al, 2000). PGPR has the capacity to produce hormones like Auxins (Indole acetic acid), abscission acid, gibberellic acid and cytokinin which increases the root surface and length to facilitate better growth condition for plants. Many bacterial strains of PGPR can fix atmospheric nitrogen in to available form for plants and hence it decreases the chemical use of chemical fertilizer (Urea-N) in agriculture which minimizes the environment pollution in a sustainable manner (Fig 1).

PGPR in Crop Protection

The rhizospheric pathogens which are able to prevent or minimize the disease incidence in plants are popularly termed as biocontrol agents. PGPR are usually antagonistic to the plant pathogenic microorganisms and the mechanism of antagonism is rely upon competition for food, antibiosis, parasitism and induced systemic resistance (ISR) (Podile and Kishore, 2006). The beneficial microorganisms interact with the plant and triggers many signaling pathways for developing resistance to plant pathogenic microorganism is called as Induced systemic resistance. The signaling compounds like jasmolic acid (JA) and salicylic acid (SA) which performs the Systemic acquired resistance (SAR) with respect to pathogenic microbes. The activation of many biochemical substances inside the plants such as pathogenesis-related proteins (PR-proteins), phytoalexins and cell wall reinforcement.

Significance of PGPR

In agricultural view, the microorganisms help in aggregate plant production without hampering the ecology and environment by enhancing the soil health. The PGPR can solubilize insoluble form of phosphorous to plant available forms (Vessey, 2003). Many microorganisms have reported to be synchronously influence the nitrogen utilization ability of plants and also act synergistically on the mycorrhizal association. PGPR acts as an alternative to indiscriminate use of agricultural chemicals for proper plant growth and health. Therefore, careful and proper utilization of these microbes can bring substantial improvement in the productivity of agricultural crops and horticultural crops.

Conclusion and Future Aspects

PGPR are certainly an important organism which helps in boost the plant productivity and plant health in a very conservative and sustainable manner. They are eventually help in minimizing the application of harmful agricultural chemicals to increase the biological form in the soil. Further elaborate and extensive study must be carried out to understand about the genes or traits responsible for the beneficial effect of the PGPR and therefore further it helps in promoting the beneficial effects of PGPR through genetic modification.

References

1. Çakmakçi R., Dönmez F., Aydın A., Şahin F., (2006). Growth promotion of plants by plant growthpromoting rhizobacteria under greenhouse and two different field soil conditions. Soil Biol Biochem. 38:1482–1487.
2. Hiltner L., (1904). Uber neuere Erfahrungen und Probleme auf dem Gebiete der Bodenbakteriologie unter bessonderer Beru¨cksichtigung der Gru¨ndung und Brache. Arb Dtsch Landwirtsch Ges Berl.98:59–78.
3. Kloepper J.W., Schroth M.N., (1978). Plant growth promoting rhizobacteria on radishes. In: Station de Pathologic Vegetal et Phytobacteriologic (ed) Proceedings of the 4th international conference on plant pathogenic bacteria, vol 2. Gilbert-Clarey, Angers. pp. 879–882.
4. Lucy M., Reed E., Glick B.R., (2004). Applications of free-living plant growth-promoting rhizobacteria. Antonie Van Leeuwenhoek. 86:1–25.
5. Podile A.R., Kishore G.K., (2006). Plant growth-promoting rhizobacteria. In: Gnanamanickam SS (ed) Plant-associated bacteria. Springer, The Netherlands. pp 195–230.
6. Revillas J.J., Rodelas B., Pozo C., Martinez-Toledo M.V., Gonzalez L.J., (2000). Production of B-group vitamins by two Azotobacter strains with phenolic compounds as sole carbon source under diazotrophic and adiazotrophic conditions. J Appl Microbiol. 89:486–493.
7. Vessey J.K., (2003). Plant growth promoting rhizobacteria as biofertilizers. Plant Soil. 255:571–586.
8. Whipps J., (2001). Microbial interactions, biocontrol in the rhizosphere. J Exp Bot. 52:487–511.

Health and Nutritional Prospects in the Utilization of Edible Flowers: Antioxidant and Anti-Inflammatory Properties

Article ID: 10260

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Summary of Article

The recently escalated curiosity in antioxidants as a part of the diet, and edible flowers being a substantial source of them has garnered massive spotlight. This restored attention to the utilization of flowers in culinary has also elicited the requirement of knowledge regarding their nutritive and health benefits and the determination of bioactive compounds found in the petals of edible flowers presenting an important task for their evaluation as a natural source of pharmacy in the diet.

Introduction

There has been a boost in consumer awareness as a result of globalization which in turn has led to the return of earlier lifestyle where edible flowers were an integral fraction of the diet. At present, edible flowers are chiefly consumed fresh and employed as garnishes. They are also devoured in the dried form, canned in sugar, added in cocktails, preserved in distillates, etc (Rop et.al., 2012). Flowers are customarily employed for aesthetics. The use of flowers in culinary is relatively infrequent and is largely impacted by geography and culture.

"The edible flower is defined as non-toxic, innocuous flower with health benefits consumed in human diet" (Lu et.al., 2016). They amplify the taste, appearance and aesthetic value of food-aspects that consumers appreciate; which justifies the escalating trend of fresh top quality flowers' sales worldwide. However, consumers also demand foods with functional qualities such as bioactive compounds, antioxidant and antimicrobial attributes; in addition to the nutrients, they contain (Fernandes et.al., 2017). The detailed phyto pharmacological status of several medicinally important flowers such as anti-anxiety, anti-cancer, antidiabetic, anti-inflammatory, antioxidant, aphrodisiac, anti-arthritic, diuretic, anthelmintic, immunomodulatory, anti-microbial along with its effective dosage has been documented (Arya et.al., 2014). Many of the substances present in flowers are believed to manifest either chemoprotective or even curative effects and minimize the risk of various diseases. The health benefits of such physiologically active components in flowers make them potential additives in food to help prevent chronic disease and food oxidation (Cunningham, 2015).

Antioxidant Properties

Autoxidation in biological systems is accountable for a multitude of unfavourable effects and implications in human health and might play a role in the etiology of a myriad of diseases. Antioxidants play a crucial role in preventing free radical induced tissue damage and delaying autoxidation and have therefore attracted much attention as dietary supplements and natural health products (Shahidi *and Zhong,* 2010). A general trend has been observed of substituting synthetic and artificial antioxidants in food with natural oxidation inhibitors (Pokorny, 1991). The existence of a diverse range of phytochemicals in edible flora may present a natural course of adding antioxidants in the diet. The flowers of *Osmanthus fragrans* (91.3%) have only slightly lower antioxidative potential than green tea. Phenolic compounds namely tyrosyl acetate, phillygenin, (8E)-ligustroside, rutin, and verbascoside have been isolated from the methanol extract of *O. fragrans* (Hung *et.al.,* 2012). With huge progress in the mechanization of saffron crop, doors have opened to the opportunity of expanding the uses of *C. sativus* flowers, beyond the usual established spice. The antioxidant potential of flowers of saffron and floral bio-residues have shown to be significantly high (Serrano Díaz *et.al.,* 2012).

Marigold contains the highest level of phenolic compounds, 1107.5 mg/100 g of phenolic compounds on dry weight basis, and also exhibit a total reducing capacity of 329.4±21.8 µmol Fe2+/g dry weight with a cellular antioxidant activity of EC50=413 µg/ml. Marigold flowers also contain lutein which has been linked with risk reduction in many chronic diseases, including age-related macular degeneration, cancer and cardiovascular diseases (Kaisoon *et.al*., 2012). Lutein is found to be non-mutagenic at all doses and also shows an anti-mutagenic effect in a dose-dependent manner (Wang *et.al.,* 2006). Chlorogenic isomers have been identified in *Prunus mume* flowers (Shi *et.al.,* 2009). The flowers of Sophora (*Sophora vicifolia*) also demonstrate parallel antioxidant effects when evaluated, with flavonoids being the major contributors (Tai *et.al.,* 2011). Twenty-four varieties of commonly consumed edible flowers of Thailand investigated for their total phenolic content indicated that the extract of *Quisqualis indica* gave the highest total phenol content (Wetwitayaklung *et.al.,* 2007).

Analgesic and Anti-Inflammatory Properties

A plethora of drugs and medications are available in the market for relieving pain and minimizing inflammation. However, resorting to these medications for an extended period of time may lead to a train of side effects such as headache, gastrointestinal disturbances, dizziness *etc.* Consequently, employing natural and organic alternatives for managing inflammation presents a more desirable solution.

The lingulate flowers of *Chrysanthemum morifolium,* in particular the Makino variety demonstrate a strong inhibitory activity against 12-*O*-tetradecanoyl-phorbol-13-aetate (TPA)-induced inflammation in mice (Yasukawa *et.al.,* 1998). On similar lines, Ukiya *et.al.*, (2006) have documented the considerable anti-inflammatory effects of Marigold (*Calendula officinalis*) flowers. *Opuntia dillenii* flowers of Cactaceae family commonly growing in Egypt are also exploited in traditional medicine as an analgesic.

Ahmed *et.al.,* (2005) also revealed that it has the most powerful anti-inflammatory effect and a notable analgesic activity at a dose level of 200 mg/kg. The *in vivo* analgesic action of commercially available Marigold (*Tagetus erecta*) flower extract on acetic acid induced abdominal writhing suggest a dose dependent analgesic action. (Bashir *and Gilani*, 2008). Corresponding analgesic activity on acetic acid induced writhing was reported in *Calotropis gigantea* flowers in chemical and thermal models in mice. An inhibition of 20.97% and 43.0% in the number of writhes was observed at the doses of 250 and 500 mg/kg, respectively (Pathak *and Argal,* 2007).

Chandra (2001) screened the analgesic action of aqueous and alcoholic extract of *Madhuka longifolia* (Mahua). Graded doses of both aqueous and alcoholic extract of *M. longifolia* induced dose dependent analgesic effect in either in rats or mice. Analgesic effects of orally administered ethanolic extract of male flowers (inflorescences) of *Borassus flabellifer L.* (Arecaceae) suggested significant dose dependent reduction in writhes and enhanced the pain threshold in hot plate test (Paschapur *et.al.,* 2009).

To further strengthen the alternative use of herbal medicines in pain relief, the flowers of *Caesalpinia pulcherrima* were determined for their analgesic additional to its anti-inflammatory capacity. Intraperitoneal administration manifested significant analgesic activity in acetic acid-induced writhing, tail immersion test and hot plate tests and antiinflammatory effect against carrageenan-induced paw edema in experimental animals (Patel *et.al.,* 2010). Comparable results were obtained for the anti-inflammatory and pain-relieving activities of *Couroupita guianensis, Tectona grandis, Woodfordia fruticosa* flowers.

Conclusion

It is evident from the deluge of literature that edible flowers from diverse species may be tapped as a valuable source of functional ingredients for protecting the body against damage caused by numerous oxidation reactions and inflammatory symptoms.

References

1. Rop O., Mlcek J., Jurikova T., Neugebauerova J. and Vabkova J. (2012). Edible flowers—a new promising source of mineral elements in human nutrition. Molecules. 17(6):6672-6683.
2. Lu B., Li M. and Yin R., (2016). Phytochemical content, health benefits, and toxicology of common edible flowers: a review. Critical reviews in food science and nutrition. 56(1):130-148.
3. Fernandes L., Casal S., Pereira, J. A., Saraiva J. A. and Ramalhosa E., (2017). Edible flowers: A review of the nutritional, antioxidant, antimicrobial properties and effects on human health. Journal of Food Composition and Analysis. 60:38-50.
4. Arya V., Kumar D. and Gautam M., (2014). Phytopharmacological review on flowers: Source of inspiration for drug discovery. Biomedicine & Preventive Nutrition. 4(1):45-51.
5. Cunningham E., (2015). What nutritional contribution do edible flowers make?. Journal of the Academy of Nutrition and Dietetics. 115(5):856.
6. Shahidi F. and Zhong, Y., (2010). Novel antioxidants in food quality preservation and health promotion. European Journal of Lipid Science and Technology. 112(9):930-940.
7. Pokorný J., (1991). Natural antioxidants for food use. Trends in Food Science & Technology. 2:223-227.
8. Hung C. Y., Tsai Y. C. and Li K. Y., (2012). Phenolic antioxidants isolated from the flowers of Osmanthus fragrans. Molecules, 17(9):10724-10737.
9. Serrano-Díaz J., Sánchez A. M., Maggi L., Martínez-Tomé M., García-Diz L., Murcia M. A. and Alonso, G. L., (2012). Increasing the applications of Crocus sativus flowers as natural antioxidants. Journal of food science. 77(11):1162-1168.
10. Kaisoon O., Konczak I., and Siriamornpun S., (2012). Potential health enhancing properties of edible flowers from Thailand. Food research international. 46(2):563-571.
11. Wang M., Tsao R., Zhang S., Dong Z., Yang R., Gong J. and Pei Y. (2006). Antioxidant activity, mutagenicity/anti-mutagenicity, and clastogenicity/ anti-clastogenicity of lutein from marigold flowers. Food and chemical toxicology. 44(9):1522-1529.
12. Shi J., Gong J., Wu X., & Zhang Y. (2009). Antioxidant capacity of extract from edible flowers of Prunus mume in China and its active components. LWT-Food Science and Technology. 42(2):477-482.
13. Tai Z., Cai L., Dai L., Dong L., Wang M., Yang Y., Cao Q. and Ding, Z. (2011). Antioxidant activity and chemical constituents of edible flower of Sophora viciifolia. Food chemistry, 126(4):1648-1654.
14. Wetwitayaklung P., Phaechamud T., Limmatvapirat C. and Keokitichai S. (2007, January). The study of antioxidant activities of edible flower extracts. In International Workshop on Medicinal and Aromatic Plants. 786:185-192.
15. Yasukawa K., Akihisa T., Kasahara Y., Ukiya M., Kumaki K., Tamura T., Yamanouchi S. and Takido, M. (1998). Inhibitory effect of heliantriol C; a component of edible Chrysanthemum, on tumor promotion by 12-O-tetradecanoylphorbol-13-acetate in two-stage carcinogenesis in mouse skin. Phytomedicine. 5(3):215-218.
16. Ukiya M., Akihisa T., Yasukawa K., Tokuda H., Suzuki T. and Kimura, Y. (2006). Anti-inflammatory, anti-tumor-promoting, and cytotoxic activities of constituents of marigold (Calendula officinalis) flowers. Journal of natural products. 69(12):1692-1696.
17. Ahmed M. S., Tanbouly N. E., Islam W. T., Sleem A. A. and Senousy A. E., (2005). Antiinflammatory flavonoids from Opuntia dillenii (Ker-Gawl) Haw. flowers growing in Egypt. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 19(9):807-809.
18. Bashir S. and Gilani, A. H., (2008). Studies on the antioxidant and analgesic activities of Aztec marigold (Tagetes erecta) flowers. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 22(12):1692-1694.
19. Pathak A. K. and Argal, A., (2007). Analgesic activity of Calotropis gigantea flower. Fitoterapia. 78(1):40-42.
20. Chandra D., (2001). Analgesic effect of aqueous and alcoholic extracts of Madhuka Longifolia (Koeing). Indian Journal of Pharmacology. 33(2):108-111.
21. Paschapur M. S., Patil S., Patil S. R., Kumar R. and Patil M. B., (2009). Evaluation of the analgesic and antipyretic activities of ethanolic extract of male flowers (inflorescences) of Borassus flabellifer L.(Arecaceae). Int J Pharm Pharm Sci. 1(2):98-106.
22. Patel S.S., Verma N. K., Chatterjee C. and Gauthaman, K., (2010). Screening of Caesalpinia pulcherrima Linn flowers for Analgesic and Anti-inflammatory Activities. International Journal of Applied Research in Natural Products. 3(3):1-5.

Formal and Informal Gardens

Article ID: 10261

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There are mainly two types of gardens: formal, geometrical or symmetrical (including styles viz., American, Arabian, Egyptian, French, German, Italian, Mughal, Persian, Portugese, Spanish, etc.) and informal, asymmetrical or naturalistic including styles viz., Chinese, Japanese, English, etc.).

Formal Garden

A formal garden is a garden with a clear structure, geometric shapes and in most cases a symmetrical layout. In garden design, the formal garden is said to be the opposite to the landscape garden, which follows nature and which came into fashion in the 18th century. Its origin goes back to the gardens which are located in the desert areas of Western Asia and are protected by walls. The style of a formal garden is reflected in the Persian gardens of Iran, and the monastic gardens from the Late Middle Ages. It has found its continuation in the Italian Renaissance gardens and has culminated in the French formal gardens from the Baroque period. Through its design, the garden conveys a sense of established order and transparency to the observer.

The design of formal garden is simple, ordered, elegant, balanced and well-proportioned. In the formal design, the land is forced to fit the plan. Typical feature of formal gardens is the axial and symmetrical arrangement of pathways and beds. Both of these elements are typically enclosed, for example with low box hedges or flower borders. The garden itself is usually surrounded by "green walls", for instance walls covered in climbing plants, fences or clipped hedges. The area that has been created by this procedure is again divided by hedges, espaliers, and trellises. The enclosed areas of the different parts are structured by means of low elements. This creates an atmosphere of clarity and straightness and thus also a certain degree of simplicity. The centre of the garden is often accentuated by a round, oval or square structural element, which is usually made of dimension stone.

In formal gardens, whatever size of space is available, that is utilized to better advantage. The footpaths are covered with materials like brick, bluestone or paving stone. Alternatively, the paths can be covered with scattered gravel or coloured glass chippings. Their straight lines create visual axes. At the end of these axes, eye-catching elements, such as sculptures, ornamental ponds, fountains, planters or seating accommodation can be found.

Mughal Garden, New Delhi

Other eyecatchers that can be found in formal gardens are ornamental structural elements such as beds that are arranged to form intertwined patterns, or beds with complex geometrical arrangements of the plants.

However, formal gardens that contain these elements lose their simplistic design in part and are no longer easy to care for. Most of the plants in a formal garden need pruning once a year. This is mostly necessary for topiary, which is a practice where evergreen woody plants, for example box trees, yew trees, hollies or pine trees are cut into geometric shapes, such as spheres, pyramids, or cones, but also into animal shapes or other more fanciful shapes. In larger formal gardens, usually there are hedge mazes, which are constructed by means of topiary. These mazes include archways, hidden resting places and cul-de-sacs.

Usually, low perennial plants and flowers harmonize well and are planted in herbaceous borders. However, the main criterion is not the bloom but rather the shape and effect produced by the colour of the leaves. Therefore, ornamental foliage plants are often selected for the beds. The type of lawn that can be found in a formal garden, if used, is usually closely cut ornamental lawn.

Informal Garden

Informal gardens are probably the most common garden style. This style of gardening is aimed to imitate nature and strives to produce a natural effect in a closed area. In the informal gardens, geometrical designs are employed without insisting on geometry. The early Hindu and Buddhist gardens laid no emphasis on formalism. In Chinese and Japanese gardens, the art of symmetrical balance was amply demonstrated. After the industrial revolution in England, cities and towns missed the flavour of nature. To come closer to nature, garden planting was restored by organising gardens in a natural style. A completely informal style provides a natural appearance, but such gardens are not usually suited to very small sites.

The informal garden design takes just as much time and consideration as a formal garden in their planning. It's about planning, cohesion, balance, scale, proportion and the right plants and features in the correct place. It's effortless looking but carefully executed. Planting is often of a mixed nature and there is a complete absence of set of lines. An informal garden should have as much design as a formal garden, except that balance is secured by an asymmetrical plan instead of symmetrical one. Smooth curvaceous lines are more appropriate in this design rather than rigid lines. Informal gardens are laid out with open large lawns, bordered by clumps of shady trees or shrubs. Straight paths are avoided, and irregular beds are used instead. Shrubbery and herbaceous borders are so designed as to fit the periphery of the lawn. Sometimes, these designs contain scenes depicting lakes and islands, sinous streams and their embankments, cascades, rocks, etc. In this design, nature is preserved in an artificial way

Informal gardens are sometimes misunderstood with wild or mismanaged gardens but, in fact, if laid properly it looks quite natural. Though it is less labour-intensive but at times this also requires maintenance otherwise it will become quite messy and untidy with straggling branches where human penetration will also become difficult. It is important to ensure in an informal garden that the ultimate height and growing speed is carefully considered.

Buddha Jayanti Park, New Delhi

Tamarind: An Underrated Fruit Crop

Article ID: 10262

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Introduction

Botanical name	Tamarindus indica Linn.
Family	Fabaceae
Origin	Tropical Africa
Chromosome no.	2n=24
Useful part of plant	Pod

It is assumed that the word tamarind derived from the Arabic “Tamar-u’l-Hind” (date of India) as the pulp of this fruits is similar to dried dates.

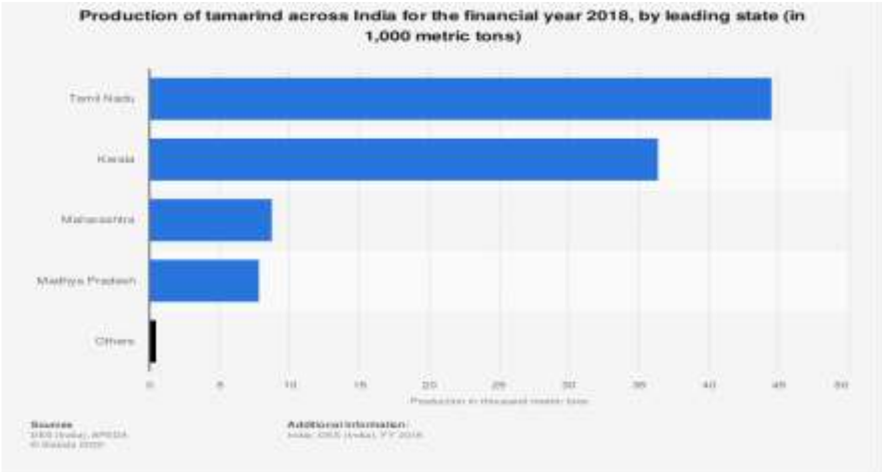
Tamarind is one of the most popular trees found cultivated throughout India as stray plantation or avenue, common crop in waste land, It is a good wind break. Though tamarind is very popular, its large-scale production is not common. However, at several places its regular plantations are being initiated under Agro-forestry systems.

Origin

It most probably originated in tropical Africa (Coates-Palgrave, 1988), although there is a common belief that tamarind is native to India (Morton, 1987) where it is believed to have been introduced thousands of years ago (Hort, 1916), and to have reached Central America in the seventeenth century with the Spanish and Portuguese (Patino, 1969).

Area & Production

1. At present, tamarind is cultivated in 54 countries of the world.
2. Tamarind is abundantly available in the Indian states of Madhya Pradesh, Bihar, Andhra Pradesh, Karnataka, Tamil Nadu, West Bengal, Orissa and Kerala.
3. Extensive tamarind orchards in India produce 275,500 tons annually.
4. India is the world’s largest producer of tamarind products. Annual production of pulp in India is over 3 lakh tones, of which 4,000 tonnes are exported to Europe and North America and the rest is locally consumed. Nearly 20,000 t. of tamarind seed powder is produced annually in India.
5. In 2018, Tamil Nadu accounted for the largest volume of tamarind production in India. This figure stood at almost 45000 MT, making up nearly 45.4 % of tamarind production share. Kerala followed with Maharashtra ranking 3rd that same year. Total tamarind production in the country amounted to just over 98000 MT.



Botany

1. Evergreen leaves: Alternately arranged & pinnately lobed.

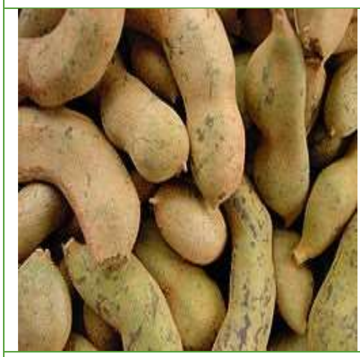
2. Leaflets: Bright green, elliptic-ovular, pinnately veined, and less than 5 cm in length. At night, the leaflets close up.

3. Trunk: Single & Central

4. Timber: Heartwood- Hard & dark red while sapwood- softer yellowish.

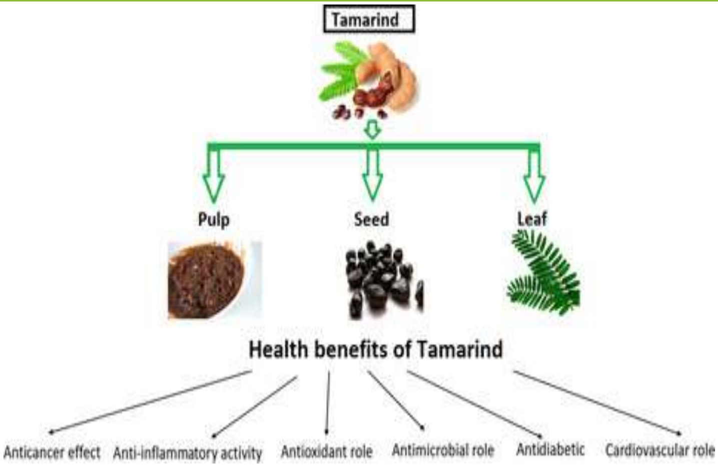
5. Flowers: Red & Yellow, 2.5 cm wide, five-petalled, borne in small racemes.

6. Buds: Pink as the four sepals is pink and are lost when the flower blooms.

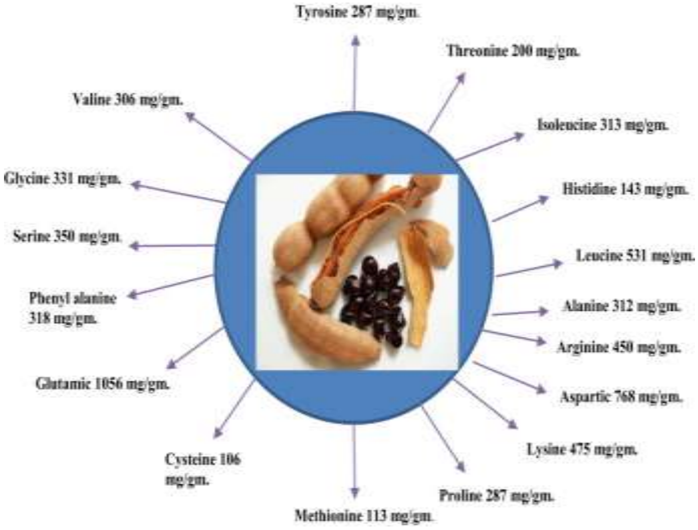
		
Leaves & Pod	**Pollen grains**	**Tree**
		
Raw fruit	**Seedling**	

Composition & Uses

1. The fruit pulp is very popular acidulant in Indian curries especially in South India. Immature fruits are used for chutney and ripe fruit pulp is an important ingredient in South Indian dishes to induce sourness.



2. In India, the fruit is used mainly for culinary purposes, while in other countries; the fruit is processed in to nectar, fruit punch, juice, crystallized fruit and concentrates. The pulp is used to season foods viz., curries, preserves, confectioneries, ice- cream and syrups; chutneys, pickles, Pulp is mixed with jaggery and made into tamarind balls (sweet meat).



3. The unripe fruits are the rich source of tartaric acid. The tender leaves, flowers and young seedlings eaten as vegetable.

4. Wood is used for making agricultural implements, tool handles, wheels, mallets and rice pounders.

5. It is believed that continuous use of tamarind in daily food reduces the chances of stone formation in urinary system.

6. Fruit is a pod and comprises of 55% pulp, 20.6% water, 3.1% protein, 0.4% fat, 70.8% carbohydrates, 3% fibre & 10% tartaric acid. Seeds have 63% starch & 16% protein.

Soil & Climatic Conditions

1. It is self-sown in forest and waste lands, can grow in poor soils.
2. Since, it has deep tap root system and also long-life span, therefore deep loamy soils with adequate moisture would be the best for its growth.
3. It is drought tolerant, but sensitive to frost. Fruits do not ripe properly in cold weather.
4. Productivity is higher in red loamy, deep well drained soils.
5. It prefers pH of 5–6.
6. The absolute maximum temperature varies from 36-47.50C and the absolute minimum temperature varies from 0-17.50C.
7. Rainfall requirement: 750-1900 mm.

8. Altitude: Up to 100 m above MSL.

Cultivars

1. Based on fruit size & shape:

a. East Indian type: Long pods with 6 – 12 seeds.

b. West Indian type: Shorter pods with 1-3 seeds.

2. Based on pulp colour:

a. Yellow or brown pulp type: Turning dark brown on storage it is harvested after full maturity.

b. Reddish pulp type: locally known as Raktichinch.

c. Yogeshwari: A high yielding red type released by Marathwada Agriculture University, Parbhani, Maharashtra.

3. Based on organoleptic taste:

a. Sweet type: The ripe fruits have sweet pulp coupled with less acidity, fruits are used for desert purpose, important varieties are; Makham, Waan, Secthong, Manila sweet.

i. Pratisthan: Released by the fruit Research Station, Aurangabad.

b. Sour type: The ripe fruits have sour pulp with more acidity, important varieties are No. 263 – Fruit Research Station, Aurangabad, Urigam, Cumbum.

i. PKM-1: Released by Hort. Research Institute, Periyakulam, Tamil Nadu: Best for HDP (160 plants/acre).

ii. DTS-1 & DTS-2: Released by Dharwad Agricultural University.

Propagation

1. Tamarind is propagated mainly by seeds, budding, air layering, approach grafting, the most appropriate technique (in- situ soft wood grafting on 1 year old rootstock).
2. However, layers are suitable for planting under dryland conditions for lack of deep growing tap root system.
3. In order to obtain true to type plants with reduced pre-bearing age, uniform growth and yield vegetative methods like budding and grafting be used in establishing Tamarind orchards.

Vegetative propagation:

1. Softwood grafting: March- April

2. Air Layering: Shoots treated with IBA 4000 ppm.

a. 2.0 -2.5 kg/ha seeds are needed to raise seedlings.

b. Fresh seeds are sown in nursery beds in March-April. Soaking of seeds in 10% cow urine or in cow dung solution for 24 hours. 2-year-old seedlings are transplanted to the main field.

c. Seedlings ready for planting in July-August planting is done in 75 cm3 pits, the tap roots are trimmed at the time of planting, it should be planted at 4 x 4/5 x 5 m. at beginning, which remains after thinning twice or thrice 12 x 12/15 x 15 m.

Planting

1. The grafts should be planted in the pits of 1 m x 1 m x 1 m filled with FYM and top soil.
2. Add 50g of Methyl parathion 1.3% dust in the pit. Immediately after planting, support the graft with stakes.
3. Rootstock seedlings be planted in situ during monsoon (June-July) and budded by patched method using a bud from improved variety.
4. Spacing: 8-10m x 8-10m is adopted.

Fertilizer & Irrigation

1. Being a leguminous tree, may not require nitrogenous fertilizer. Phosphorus application at pit filling will be advantageous.
2. Application of compost/FYM at 40-50 kg/tree/year would suffice the most need of nutrients.
3. One year old plants be given 10 litres water at an interval of 6-8 days during summer which may be doubled during 2nd & 3rd year. Once the plant has established it hardly needs any irrigation. However, water harvesting in rhizosphere during rainy season would be advantageous.
4. Inter crops: During pre-bearing period- it is preferred to grow some of the annual fruits, vegetables and leguminous crops.
5. Training: Early training is necessary to form a high head and uniform scaffold branches in all directions.
6. Pruning: Removal of dried, diseased and criss cross branches.
7. Fruiting: Seedling tree of tamarind comes to bearing in 10-14 years after planting, whereas, vegetatively propagated tree requires 7-8 years. Flowering starts from April-June & pods ripen from Feb-April. The productive life of tree remains up to 60-70 years.

Harvesting & Yield

1.Plants starts bearing from 4th year onwards and the economic yield will be achieved from 9th year onwards.
2. Both immature and mature fruits are harvested depending upon demand and their uses.

3. Fruits are harvested during February-April months.
4. Harvesting is done by collecting:
    a. Individual fruits with fruit picker
    b. Or sometimes a man can climb
    c. On the tree and shakes the branches.
5. A fully developed tree can give about 200-250 kg fruits/year.

Post-Harvest Handling

1. After harvest the fruits are allowed to dry and their hard shell is removed.
2. Tamarind pulp is also exported to Europe and America for preparing chutney and meat sauces.
3. Under ordinary conditions the pulp remains good for about a year provided it is kept in dry conditions.

Plant Protection

1. Pests:

a. Leaf caterpillar *(Achaea janata)*

i. Leaf caterpillar can be controlled by spraying Quinalphos 25 EC 2 ml/lit or Monocrotophos 36 WSC 2 ml/lit.

2. Diseases:

a. Powery mildew:

i. It can be controlled by spraying Dinocap 1 g/lit.

3. There are hardly any pests & diseases on Tamarind plant. So far, no serious pests and diseases have been reported.

Processing

Some of the most common products produced from Tamarind include juice, pulp, powder, chutney, pickles, sauces, sugar coated candies and tamarind kernel powder (TKP).

		
Pickle	**Paste**	**Juice**

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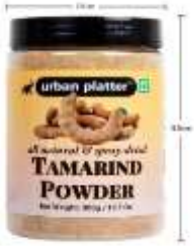
<td>
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<td>Jam</td>
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Nano Technology for Increasing Productivity in Agriculture

Article ID: 10263

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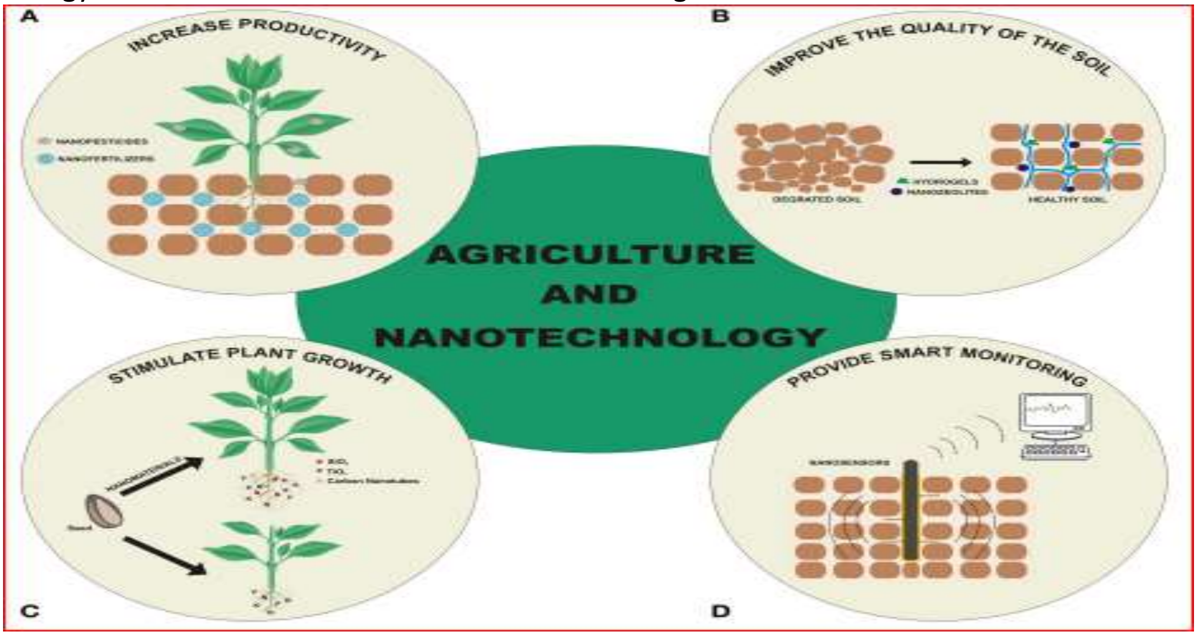
Introduction

Indian agriculture suffers from low productivity due to conventional farmer's practices. With limited water and land resources, targeted agricultural growth can be obtained by increasing per unit natural resources productivity and farm income through judicious use of advanced technologies. Among the many scientific advancements, nanotechnology (NT) has been identified as one of the potential technologies that can revive the agriculture and food industry. The term "nanotechnology" was first used by Norio Taniguchi in 1974. Nanotechnology is the branch of science which studies the understanding of matter at nanometer dimensions (1–100 nm). Nanotechnology will increase the crop yield by withstanding environmental conditions, detection and control of crop diseases, improved crops with efficient capabilities for mineral uptake from the soil. Nanoparticles may have different surface composition, types, densities, and reactivity with respect to processes such as adsorption and redox reactions. These particles have high proportion of atoms present on their surface which could be used in synthesizing nano-materials of agricultural use. Nanotechnology may answer these shortcomings of chemical fertilizers/pesticides and other agricultural conditions. Nanotechnology has evidenced its place in agricultural sciences and connected industries as a knowledge base technology and a pioneer in solving issues related to agriculture. Thus, nanotechnology can provide the much required second green revolution in Indian agricultural sector with emphasis on sustainable production. The applications of nanotechnology have been discussed in detail in the following sections.



Potential applications of nanotechnology in agriculture. (A) Increase the productivity using nanopesticides and nanofertilizers; (B) Improve the quality of the soil using nanozeolites and hydrogels; (C) Stimulate plant growth using nanomaterials (SiO2 , TiO2 , and carbon nanotubes); (D) Provide smart monitoring using nanosensors by wireless communication devices.

Applications of Nanotechnology

1. Detection and control of the plant diseases: Nanoparticles may be useful in the treatment and monitoring of food crops diseases by targeting pathogens. Some of the nanoparticles are nano-forms of carbon, silver, silica and alumina silicates that are used in control of crops diseases. Nano silver is the most exploited nanoparticles in biological system. The capsulated nano silver removes unwanted microbes in planting soils and restricts several other plant diseases.

2. Food crop production: Globally, there is increasing demands for safe food due to the ever-increasing population. Thus, technological advancement is necessary for completing demands of healthy food. Nanotechnology can be boon in current scenario and used in the crops production and their processing. Agro-nanotechnology focus on the sustainable food production and protection of food crops for both human nutrition and animal feeding and against pests and diseases.

3. Nano-fertilizers: The augmentation of fertilizers in soil is essential to supplement the soil fertility for better yield of food crops. However, the use of chemical fertilizers causes many adverse environmental effects and damaged the soil health. Thus, there is requirement a new cost-effective eco-friendly technique for better crop production.

In this context, the use of nano-fertilizers instead of using conventional fertilizers will assist in controlled release of nutrients in soil and prevent loss due to chemical fertilizers. In nano-fertilization, nutrients may be entrapped using nano-materials coated with a thin film or delivered as emulsions. The slow release of nutrients from nanoparticles coated fertilizers increase the use efficiency of nutrient by crops. Several researchers reported the possible use of nano-fertilizers as an alternative to conventional fertilization processes at low cost and in smaller quantity.

4. Nano-pesticides: In agriculture, pesticides or weedicides are used to control pests or weeds for increasing crop yield. However, they also damage the soil health. Nano-pesticide is an agrochemical combination used to overcome the problems caused by conventional pesticides.

Several types of materials viz., surfactants, organic polymers and mineral nanoparticles that fall in the nanometer size range are used in formulation of nano-pesticides. The new generation of nanopesticides will be specific in action against insects and does not have any harm to other important insects of soil.

5. Nano-biofarming: Nanotechnology can enhance crop's yield and nutritional values and may add value to crops or environmental remediation. The most up-to-date research in this field is cantered on the production of gold and silver nanoparticles with diverse plants including *Medicago sativa, Vigna radiata, Arachis hypogea, Cyamopsis tetragonolobus, Zea mays, Pennisetum glaucum, Sorghum vulgare, Brassica juncea, Allium sativum* L. etc.

Depending on the nature of the nanoparticle, species of plant or tissue in which they are stored, metal nanoparticles of diverse shapes and sizes can be obtained. Preparation of metal nanoparticles has the advantage of being simple, cost-effective and environmental-friendly.

6. Nano-sensors: Nano sensors with immobilized bio-receptor probes that are selective for target analyte molecules are called nano biosensors. Their applications include detection of analyses like urea, glucose, pesticides etc., monitoring of metabolites and detection of various microorganisms /pathogens.Controlled Environmental Agriculture (CEA) can be improved by the utilization of nano-sensors enhancing the aptitude to work out the time of crop harvest, detect crop health and determine microbial or chemical contamination of the crop. Smart nano sensors are being developed which may be linked to GPS system.

Nanosensors can be use all over the agricultural fields for monitoring the fertility of soil and other agro climatic conditions. Such measures will lead to enhanced crops yield at very low economy. Researchers are working on nano systems for the release of fertilizers and pesticides as per agro-climatic conditions monitored by nano-sensors.

Conclusion

Nanotechnology plays a role in agriculture, food processing and packaging, food security, water purification, environmental remediation, crop improvement and plant protection. It is an eco-friendly and cost-effective technology for agriculture. It has the potential of precise delivery of agrochemicals for improving disease resistance, plant growth and nutrient use. It is successfully used in postharvest for maintaining freshness, quality, shelf life of stored product and check disease occurrences in a fairly safer way.

References

1. Manikant T., Suresh K., Amit K., Poonam T. and Shailendra K., (2018). Agro-nanotechnology: Future Technology for Sustainable Agriculture. International Journal of Current Microbiology and Applied Sciences. 7: 196-200.
2. Waleed Fouad Abobatta., (2018). Nanotechnology Application in Agriculture. Acta Scientific Agriculture. 2(6): 99-102.

Profiling the Transcriptome with RNA SPOTs

Article ID: 10264

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Introduction

Single-molecule fish (smFISH) has been the gold standard for quantifying individual transcript abundances. Here, we scale up multiplexed smFISH to the transcriptome level and profile 10,212 different mRNAs from mouse fibroblast and embryonic stem cells. This method, called RNA sequential probing of targets (spots), provides an accurate, flexible, and low-cost alternative to sequencing for profiling transcriptomes.

Transcriptome and Transcriptomics

The transcriptome is the set of all RNA molecules in one cell or in a population of cells. It is sometimes used to refer to all RNAs, or just mRNA, depending on the particular experiment. It differs from the exome in that it includes only those RNA molecules found in a specified cell population. The branch of functional genomics that deals with structural and functional analysis of the transcriptome is called Transcriptomics.

Methods for Transcriptome Analysis

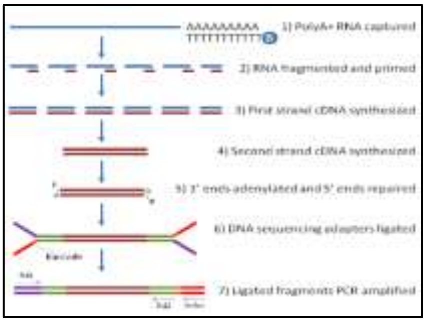
1. One or few genes:

a. Northern Blotting.
b. RT-PCR.
c. 5’ and 3’ RACE.
d. Quantitative RT-PCR (Real-Time PCR).

2. Whole transcriptome:

a. EST sequencing.
b. SAGE.
c. Microarrays.
d. RNA-Seq.

RNA Sequencing



RNA-Seq (RNA sequencing), also called whole transcriptome shotgun sequencing (WTSS). Uses next-generation sequencing (NGS) to reveal the presence and quantity of RNA in a biological sample at a given moment in time.

RNA-Seq is used to analyse the continuously changing cellular transcriptome. Specifically, RNA-Seq facilitates the ability to look at:

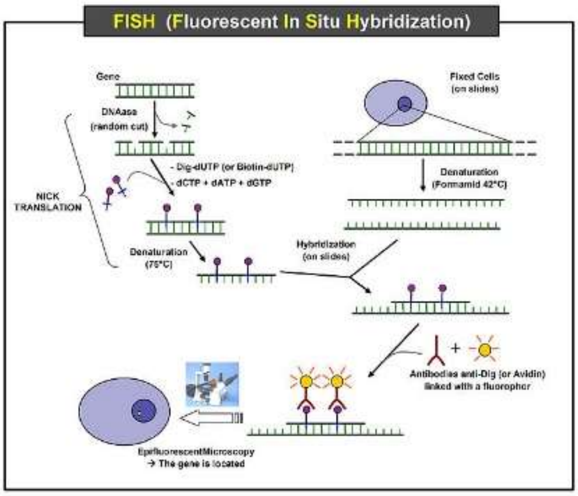
1. Alternative gene spliced transcripts.
2. Post-transcriptional modifications.
3. Gene fusion.
4. Mutations/SNPs.
5. Changes in gene expression over time, or differences in gene expression.
6. Different populations of RNA i.e., small RNAs, such as miRNA, tRNA, and ribosomal profiling.
7. Exon/intron boundaries.

RNA In-Situ Hybridization

ISH is a method for localization and quantification of specific nucleic acid sequences in individual cells and tissues. This method provides information about tissue-specific, cell-specific, and subcellular gene expression at different developmental stages. ISH is performed, using hybridization procedures between the specifically labelled probe and its complementary RNA sequences in fixed tissues or cells. Followed by visualization of the target transcript through the radioisotope-labelled probe or with immunological detection.

FISH: Fluorescence In-Situ Hybridization

In the late 1970s, fluorescence-labeled probes were introduced to ISH (FISH: fluorescence in situ hybridization). Numerous technical advancements in the engineering of FISH probes and protocols improved the resolution, specificity, and speed of FISH. Currently, FISH is an invaluable method for the simultaneous detection of multiple RNAs, providing essential information of gene expression in biological science.



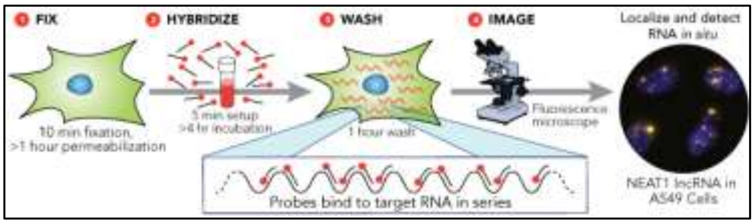
Single-Molecule Fluorescence In-Situ Hybridization

Singer and colleagues developed FISH technology to detect RNA at the single-molecule level, in single cells. To generate high-intensity signals from the hybridization of individual RNAs, they used several short probes (50 nucleotides long) that were complementary to sequential parts of the target mRNA and were each coupled to five fluorescent dyes at predefined positions. They detected single mRNA molecules as diffraction-limited spots. Thereafter, many different FISH probes have been developed for enhanced detection of single RNA molecules, resulting in robust and sensitive FISH analyses. smFISH is now a powerful, single-cell transcript profiling method that provides the transcriptional state of any individual cell via quantitation of numerous RNAs in single molecule level.

These single-molecule FISH (smFISH) methodologies have been classified, based on probe designs, as follows:

1. Short probes labelled with multiple fluorophores.
2. Short probes labelled with single fluorophores.

3. Short probes with modified backbones.
4. Signal amplification of single-molecule probes.



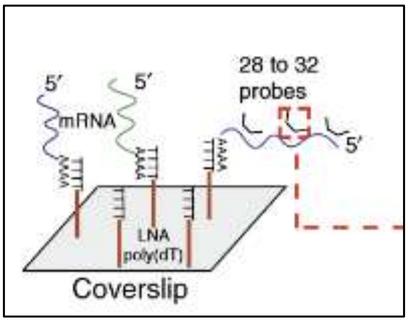
Single Cell In-Situ RNA Profiling by Sequential Hybridization (seqFISH)

The mRNAs in cells are barcoded by sequential rounds of hybridization, imaging and probe stripping. As the transcripts are fixed in cells, the corresponding fluorescent spots remain in place during multiple rounds of hybridization and can be aligned to read out a fluorophore sequence. This sequential barcode is designed to uniquely identify an mRNA. seqFISH can be used to image hundreds of transcripts in cells and tissues, to image chromosome dynamics, and to track cell lineages with single-cell resolution.

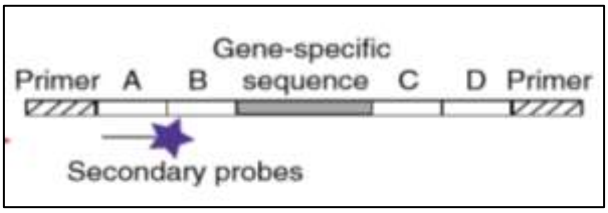
Mechanism: During each round of hybridization, each transcript is targeted with a set of FISH probes labelled with a single type of fluorophore. The sample is imaged and then treated with DNase I to remove the FISH probes. In a subsequent round the mRNA is hybridized with the same FISH probes but labelled with a different dye. The number of barcodes available scales as FN, where F is the number of fluorophores and N is the number of hybridization rounds. The DNA probes are hybridized, imaged and then removed by DNase I treatment.

RNA Sequential Probing of Targets (SPOTs)

This technique involves transcriptome-level profiling of mRNAs with single-molecule sensitivity and high accuracy using a method based on sequential FISH (seqFISH). The major limitation of seqFISH is that the optical diffraction limit prevents many mRNAs from being resolved simultaneously in single cells. This technique helps to solve the problem of optical crowding by capturing transcripts onto an oligo (dT) surface and adjusting the dilution factors, thus allowing seqFISH to decode the transcriptome. To distinguish this in vitro application from in situ seqFISH, this approach is referred as RNA SPOTs.

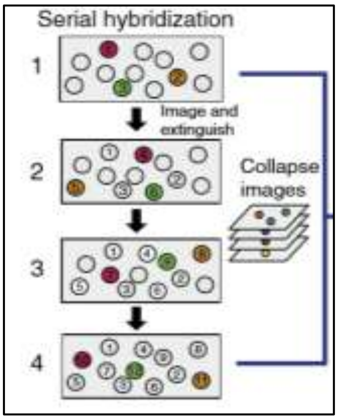


Mechanism

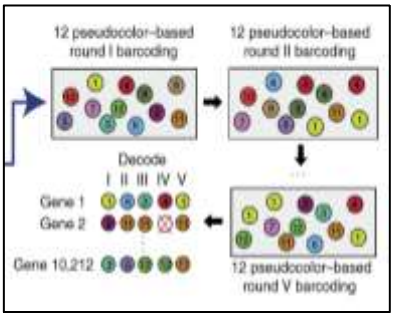


The mRNAs are isolated from the cells. Isolated mRNA i.e., transcripts are captured on a locked nucleic acid (LNA) poly (dT)-functionalized coverslip. Then hybridized with a pool of primary probes targeting the coding regions of mRNAs. To barcode the genes with sequential hybridization, a 12 'pseudocolor' scheme is used. To implement the pseudocolor scheme, primary probes to contain a 25-nt RNA-binding sequence as well as four overhang sites are designed that can be bound by dye-labeled readout oligos.

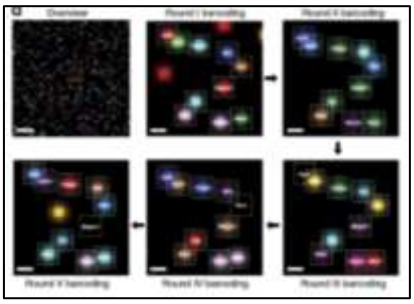
A 12 ‘pseudo color’ scheme is followed such that four rounds of barcoding are sufficient to cover the transcriptome. An additional round of error correction is done to compensate for a drop in any single round of barcoding. The pseudo color design shortens the number of barcoding rounds, which reduces the error in barcode readout. Each site has 12 possible sequences corresponding to the 12 pseudo colors. To read out the 12 pseudo colors, three of the readout oligos are hybridized at a time, imaged in the Cy3b, Alexa 594, and Alexa 647 fluorescence channels.This is repeated four times to perform through all 12 readout sequences, and disulfide cleavage is performed between the hybridizations to remove the fluorophores.



With five rounds of barcoding using the 12 pseudo color readout scheme, a total of 60 readout oligos are used to decode the genes targeted. Each set of primary probes that target a specific gene contain four unique readout sequences that are spread out over the overhang sites. A total of 20 rounds of hybridization, or five barcoding rounds that each contained four serial hybridization, are performed. Each set of four serial hybridizations is collapsed into a single image with 12 pseudo colors. The barcodes are determined by aligning five barcoding rounds of the pseudo color images. The switching and rehybridization time are fast, and the overall speed is limited by imaging speed.



Typically, 100–200 fields of view containing more than 106 mRNAs can be imaged with 20 rounds of serial hybridization in a 14-h period through an automated fluidics system. Spots per millions (SPM) are used to normalize spot counts for individual genes.



Advantages

1. Specific sets of genes can be selectively profiled with RNA SPOTs.
2. As each dot detected in assay corresponds to a single mRNA, RNA SPOTs is more efficient in term of imaging compared with RNA-seq.

3. Profiling of ribosomal RNA and highly expressed housekeeping genes can be avoided simply by eliminating the probes from the gene set.
4. The current barcoding space is sufficient to encode the entire transcriptome, and noncoding RNAs.
5. As cost of sequencing is a limiting factor in many genomics experiments, RNA SPOTs enable an accurate and low-cost alternative to sequencing with many applications.

References

1. Eng, C. H. L., Shah, S., Thomassie, J., & Cai, L. (2017). Profiling the transcriptome with RNA SPOTs. Nature methods, 14(12), 1153-1155.
2. Mortazavi, A., Williams, B. A., McCue, K., Schaeffer, L., & Wold, B. (2008). Mapping and quantifying mammalian transcriptomes by RNA-Seq. Nature methods, 5(7), 621-628.
3. Raj, A., Peskin, C. S., Tranchina, D., Vargas, D. Y., & Tyagi, S. (2006). Stochastic mRNA synthesis in mammalian cells. PLoS Biol, 4(10), e309.
4. Lubeck, E., & Cai, L. (2012). Single-cell systems biology by super-resolution imaging and combinatorial labeling. Nature methods, 9(7), 743-748.

Chrysanthemum Production Under Protected Conditions

Article ID: 10265

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Chrysanthemum *(Dendranthema grandiflora)* has origin in Northern hemisphere in China. It is extensively grown in greenhouses in developed countries for year-round commercial production of pot plants and cut flowers. It is primarily a photosensitive, long-night plant and flowers are induced under natural conditions during autumn when day length is shortened. In India, it is grown in 16,630 ha area with a production of 179, 370 tonnes of loose flowers and 5,720 tonnes as cut flowers.

Importance and Uses

Chrysanthemum is a highly versatile flower with varying types, size and colours. Tall growing and erect cultivars are suitable as cut flowers. The dwarf and compact cultivars are suitable for pot cultures. The decorative and feathery-bloomed cultivars are suitable for floral ornaments, garland making etc. The extra-large-bloomed cultivars are prized for their exhibition value.

Classification According to Commercial Use

Disbudded Inflorescence: In the large-flowered cultivar, with one terminal flower head produced per stem, the lateral buds and side shoots are disbudded to encourage the growth of the central bud. The flower heads of incurved or reflex form are mainly used as standards in greater proportion than those of spiders, fuji or quill cultivar.

Spray Inflorescence: In the small-flowered cultivar, spay of flowers per stem is encouraged by pinching the terminal flower-bud. The pompons are the most common spray chrysanthemum produced in the USA and Europe.

Greenhouse Cultivation

Cut chrysanthemums require a temperature of 16 - 25^{o}C with Carbon dioxide enrichment (600 - 900 ppm) and humidity is maintained between 70 - 85 %.

Growing media: The growing media should consist of soil, compost and coco peat in the ratio of 1:1:2. The beds are formed with 1 m width, 0.3m height and at convenient length. The soil pH must be 6.5 with 1 to 1.5 EC.

Selection of Cultivars: Cultivars belonging to 7–9-week response groups, grown in greenhouse located in high light intensity area, produce good flowers while cultivars of 12–14-week type produce quality flowers in greenhouse which receive low light intensity. For standards, 10-week cultivars are used viz., Snowdon, Hurricane, Fandango etc.

Propagation: Terminal cuttings and tissue culture plants are used. Terminal cuttings are widely used for commercial cultivation. Cuttings of 5-7 cm length are taken from healthy stock plants and are induced to root by treating with IBA (1000 ppm).

Planting density: Planting density varies according to cultivar, growing environment and time of planting. It has been observed that the best plant population was 32 cuttings/m2 considering cost and market returns. For winter-spray chrysanthemums, 40 cuttings/m2 gave higher percentage of first quality flowers compared to closer spacing with 54 cutting/m2.

Planting: Planting should be done soon after rooting. While planting, root should be spread out and the cuttings should not be buried deeper than 12 mm. Beds of 1m width, 0.3m height and convenient length are formed. Nets (with cell size depending on the spacing adopted) are placed on the beds and planting is done.

Irrigation: Agood control over water supply and its distribution can be made by installing drips and overhead rotating sprinkler. Drip irrigation with 8-9 litres of water/ m2 day is required for production of quality flowers.

Nutrition:

Basal application of DAP - 50 g/m^2

Weekly schedule: from 3rd week after planting.

Fertilizer	Quantity (g/m^2)	
	Monday	Wednesday
19-19-19	3.0	1.0
KNO_3	3.0	1.0
Ammonium nitrate	3.0	1.0
CAN	2.0	1.0
$MgSO_4$	2.0	1.0

Fertilization: Nitrogen requirement is high, particularly during the early stages of growth whereas potassium requirement increases after flower bud formation. NPK @ 20:20:10 g/ m2 is applied through fertigation at weekly intervals.

Growth regulators: Alar 50-150 gm/100 lit water and B-9 at 8 – 25 ml/lit of water is used twice at the growing stage.

Pinching: First pinching should be done 3 (three) weeks after planting and second pinching should be 5 weeks after planting.

Disbudding: In standard types, the apical bud is retained and all axillary buds are removed as soon as they are large enough to handle. In spray types, only the large apical bud is removed and the axillary buds are allowed to develop.

Blindness: It occurs when the night temperature is too low and the days are short at the time when flower buds are forming. A rosetted type of growth is indicative of this difficulty. Centre petals that fail to develop can be due to excessive heat; or in dark weather some varieties apparently lack enough food to open the flower. Chlorosis, or yellowing of the upper foliage, is generally associated with over watering, excessive fertilizer in the soil, or insects or diseases attacking the root system.

Light requirement: Regulation of photoperiod is necessary as chrysanthemum is very much influenced by light:

Growth phase	Weeks from planting	Photoperiod
Vegetative phase	Up to 4-5 weeks from planting till the plant attains 50 to 60 cm height	Long day: 13 hrs light and 11 hrs dark
Flowering	5-6 weeks after planting till harvest	Short day: 10 hrs light and 14 hrs dark

Growth Regulators: Spray GA3 (50 ppm) at 30, 45 and 60 DAPS to increase flower stem length.

Weed management: Weeding and hoeing are done manually as and when required.

Pests and Diseases:

Pests:

i. Leaf miner: Spray Imidacloprid @ 0.5 ml/l or Acetamiprid @ 0.3 g/l.
ii. Thrips: Spray Fipronil @ 1.0 ml/l. Keep Yellow Sticky Trap 10 nos. for 100 sq.m area.
iii. Aphids: Spray Methyl demeton @ 2 ml/l or Monocrotophos @ 1 ml/l.
iv. Red spider mite: Spray Abamectin 1.9 EC @ 0.5 ml/l or Propargite @ 2 ml/l.

Diseases:

i. White Rust: Spray Azoxystrobin @ 1ml/l or Triflooxystrobin + Tebuconazole @ 0.75 g/l.

ii. Leaf spot: Spray Macozeb @ 2g/l or Azoxystrobin @ 2 ml/l or Difenoconazole @ 0.5ml/l.
iii. Wilt: Soil drenching with Carbendazim @ 1 g/l @ 0.75 g/l.
iv. Powdery mildew: Spray Wettable Sulphur @ 2g/l or Azoxystrobin @ 1ml/l.

Harvesting Stages

Standard types: Flowers are harvested when 2 - 3 rows of ray's florets are perpendicular to the flower stalk.

Spray types: When 50% flowers have shown colour for distant markets; when two flowers have opened and others have shown colour for local markets.

Yield:

a. Standard types: 67 flower stems/ m^2 / year.
b. Spray types : 260 flower stems/ m^2 / year.

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An Innovative Approach for Low Input Wheat Cultivation

Article ID: 10266

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Abstract
Wheat is the main cereal crop in India next to rice. Wheat is a staple food for more than 50 % of the world population. Wheat is known as "king of cereals". The major Wheat producing states are Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Rajasthan, Bihar, Karnataka, Maharashtra, Gujarat, West Bengal and Uttaranchal. The innovative approach for low input wheat cultivation is named "system of wheat intensification (SWI)". The Seed priming, line sowing, gap filling and weeding are some tedious tasks required to perform in SWI, introduction and use of simple tools for seed sowing and weeding is recommended. The results have shown that increased yield through complete SWI technique can ensure food availability for extra 6 months for a typical 6-member household with average land holdings. So, SWI technique is very crucial for the food security of poor, marginal and landless farmers.

Keywords: Food Security, System of Wheat Intensification, Shri vidhi.

Introduction
System of wheat intensification is an alternate method of wheat cultivation, popularly known as "shri vidhi gehun" in India. It is a new practice of wheat cultivation manipulating the soil environment favourably for better root and shoot growth. System of wheat intensification may give 54% more yield than the available best practices (Upoff et al. 2011) and showed better economic return (Raol, 2012). This is a system of modified intensive agronomic practices such as lower seed rate, seed treatment, proper spacing, fertilizer management and weeding or hoeing, which result in increased no. of effective tillers per hill, enhance panicle length, bolder grains and finally increased yield of wheat.

Review of Literature
Effect of sowing methods: Navrang and Tomar (2015) reported that sowing of sprouted seeds at 20 cm X 20 cm spacing under SWI produced higher plant height, effective no. of tillers, test weight and grain yield than the line and broadcasting method of sowing.

Mithilesh and Thomas (2017) also reported that cultivation of wheat with SWI method produced higher growth and yield parameters of wheat as compared to other treatments like ridged bed, furrow irrigated raised bed, conventional method.

Effect of seed treatment: Kumar et al. (2015) also revealed that treated seeds with organic sources and fungicide similarly produced significantly higher effective no. of tillers, grains per spike, grain yield and straw yield at IARI, New Delhi. Similar increase in yield and grain to straw ratio were also reported by Bhandalwar et al. (2015) with organic sources and fungicide treated seeds under system of wheat cultivation at Akola, Maharashtra.

Effect of spacing: Chopra and Sen (2013) also observed higher growth and yield attributes as well as higher yield in 20 cm X 20 cm spacing under SWI as compared to 15 cm X 15 cm spacing and line sowing methods.

Effect of fertilizer: Navrang and Tomar (2015) revealed that application of 50% RDN from Urea + 50 % RDN from FYM produced significantly higher growth and yield parameter of wheat as compared to other treatments like 75% RDN from Urea + 25 % RDN from FYM, 25% RDN from Urea + 75 % RDN from FYM, RDN 100% from urea and 100% RDN from FYM.

Mithilesh and Thomas (2017) also reported that (cultivation of wheat with SWI method) application of FYM (16 t/ha) produced higher growth and yield parameters of wheat as compared to application of poultry manure and FYM.

Effect of weed management: Tesfay et al. (2014) reported that hand weeding at early jointing stage, earhead formation stage and dough stage produced higher weed control efficiency than the chemical treatments under SWI.

Sen et al. (2010) also reported that two hand weedings at 30 and 50 DAS produced higher weed control efficiency (%) and lower weed index (%) than isoproturan @ 1.0 Kg/ha at 30 DAS and clodinafop @ 0.06 Kg/ha at 30 DAS under SWI.

Benefits of System of Wheat Intensification

Simple technology, High seed germination rate and Less seed requirement, Weeding facilitated good aeration to roots and enhance the yield and quality, Lesser disease incidence and insect infestation Less seed requirement, Suitable for organic farming.

Conclusion

The system of wheat intensification in which seed treated with organic sources /sprouted seeds are sown at plant to plant optimum spacing, addition of organic fertilizers and hand weeding at 2-3 times recorded the highest growth and yield attributes among different methods of cultivation and produced significantly higher grain and straw yields over traditional methods. The SWI technology requires less agro inputs such as seeds, chemical fertilizers and effectively control the weeds. Residual soil fertility was higher in SWI over all other methods. Despite higher labour requirements in sowing and weeding operations, SWI system gave higher net returns even under high cost of cultivation.

References

1. Bhandalwar, S. D., Toncher, S. S., Gite, D. P. and Wanjari, S. S. (2015). Plant Archive. 15 (1): 271-275.
2. Chopra, R. and Sen, D. (2013). Golden wheat becomes more golden: Extending SRI to wheat. LEISA, India.p-30-32.
3. Dhar, S. (2014). Indian Agricultural Research institute (SDM, Project 2009-14, SWI Experiment).
4. Kumar, A., Raj, R., Dhar, S. and Pandey, U. C. (2015). Ann. Agric. Res., 36(3): 258-262.
5. Mithilesh and Thomas, A. (2017). Int. J. Curr. Microbiol. App. Sci. 6(7): 1248-1253.
6. Navrang, S. and Tomar, G. S. (2015). Enviornment & Ecology. 33(4A): 1704-1707.
7. Raol, R. K. (2012). SWI Experiment in Bihar. Agakhan Rural Support Programme- India, New Delhi.
8. Tesfay, A., Sharma, J.J. and kassahun, Z. (2014). World J. Agric. Res. 2(3): 124-128.
9. Upoff, N. T., Maruerite, D. J., Behera, D., Verma, A. K., and Pandian, B. J. (2011). Paddy Water Environ. 9:3-11.

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Mating Systems in Plant Breeding

Article ID: 10267

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Abstract

The mating system provides a description of the distribution of mating unions in a population; in hermaphrodites, such as most flowering plants, this amounts to the rate of self-fertilisation versus outcrossing. Selfing has evolved numerous times in flowering plants, probably because selfers transmit an extra copy of their genes to their seed progenies and/or because they can reproduce in the absence of mates. The mating system also has important implications for the genetic structure of individuals and populations: selfing individuals show reduced heterozygosity, reduced effective recombination and reduced effects of genetic conflict and populations of selfers tend to be more genetically differentiated from one another than do those of out-crossers.

Introduction and History

May be defined as the method by which individuals are paired for crossing. Or various schemes which are used for crossing or mating of individuals.

Five systems of mating were given by Sewall Wright in 1921

Variation of mating systems in plants. Plants vary in their mating system from completely selfing to completely outcrossing. Anther - stigma distance is a useful measure of mating system. Anther stigma distance determine if the mating system differed between the two species.

Types of Mating System

There are five different types of mating systems:

1. Random mating.
2. Genetic assortative mating.
3. Genetic disassortative mating.
4. Phenotypic assortative mating.
5. Phenotypic disassortative mating.

Random Mating System

In random mating each female gamete has equal chances to unite with every male gamete. It is a form of outbreeding.

In plant breeding some form of selection is practiced such mating system called as random mating with selection.

Random mating with selection Increases frequency of alleles for which selection is practiced. Reduces frequency of other alleles. Increases variance. Changes mean of character.

Random mating with selection increases the frequency of alleles for which selection is practiced and reduces the frequency of other alleles. Random mating with selection alters the gene frequency and population mean, but has little effect on homozygosity, population variance and genetic correlation between relatives.

Random mating without selection does not change gene frequency, variability, population mean and genetic correlation between relatives in a population.

Uses of random mating in plant breeding:

1. Progeny testing.
2. Production and maintenance of synthetic and composite varieties.
3. Production of poly cross progenies.
4. Evolutionary advantages - maintain high level of diversity.

Genetic Assortative Mating System

Mating occurs between individuals that are more closely related by ancestry than in random mating:
1. More commonly known as INBREEDING.
2. Inbreeding has following effects in the population:
3. Increases homozygosity and decreases heterozygosity
4. Characters/alleles are fixed.
5. Genetic variability of the population is increased but within line is reduced (under selection).
6. The Prepotency of individuals increases under inbreeding.

Prepotency: Prepotency is the property of an individual to produce progeny which are similar to each other and to parent. Prepotency is affected by:
1. Homozygosity
2. Dominance
3. Epistasis
4. Linkage
5. Homozygosity is the most important factor and is under the control of the breeder. As homozygosity increases the prepotency of the individuals also increases.
6. An individual completely homozygous for all the dominant allele will be most Prepotent.

Uses: Genetic Assortative mating is useful in making of partial and complete inbreeds.

Genetic Disassortative Mating System

Such individuals are mated which are less closely related by ancestry than random mating.

Commonly called as outbreeding.

Totally unrelated individuals are mated. These individuals belong to different Populations. Effect similar to those of migration.
1. Variability- Increased due to combining of two or more genes from two or more different sources.
2. Heterozygosity - Increased due to combining of genes from different lines.
3. Homozygosity - reduced rapidly because outbreeding favours heterozygotes.
4. Population mean - increased due to combining more dominant genes from different lines.
5. Genetic correlation - decrease due to decrease in homozygosity.
6. Decrease in prepotency- because heterozygosity increased.

Phenotypic Assortative Mating System

Mating between individuals which are phenotypically more similar than would be expected under random mating. Refers to mating of extreme types, i.e., cross between AA & AA and aa & aa.

Only two extreme phenotypes i.e., lowest and highest remain in the population:
1. Variability: Increases since it divides the population into two extreme phenotypes.
2. Homozygosity : Leads to complete homozygosity in single generation
3. Genetic correlation: Perfect genetic correlation between numbers of progenies is achieved in one generation.
4. In some breeding schemes like recurrent selection... Useful in isolation of extreme phenotypes.

Phenotypic Disassortative Mating System

Mating between phenotypic dissimilar individuals belonging to same populations.

I.e., mating between individuals having genotypes AA & aa and Aa & aa

Variability: Constant, since it reduces inbreeding.

Heterozygosity: Remains constant or slight Increase.

Genetic correlation: Decreases due to decrease in prepotency.

Prepotency: Decreased due to decrease in homozygosity.

Use of phenotypic disassortative mating system:

1. In making population stable i.e., maintaining variability.
2. Progeny more desirable than parents.
3. Useful when desirable type is an intermediate one and the available parents have the extreme phenotypes.
4. Most notable - Maintaining variability in relatively smaller populations.

Conclusion

The mating systems are important implications for the genetic structure of individuals and populations. It is very useful to create a heterozygosity in the population, through which we can make population stable i.e., in maintaining variability.

References

Singh B. D. 2009. Plant Breeding Principles and Methods, Kalyani Publishers, New Delhi.

Albinism: An Important Physiological Disorder of Strawberry

Article ID: 10268

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Introduction

Strawberry (*Fragaria × ananassa* Duch.) is one of the most important fruit crops belongs to family Rosaceae. It is the most delicious, refreshing and soft attractive red coloured fruit crop with pleasant aroma. Being the rich source of vitamins and minerals coupled with delicate flavour, strawberry has now become an important table-fruit of millions of people around the globe (Sharma and Singh, 1999). The cultivation of strawberry might bring significant changes in the socio-economic conditions and living standards of the growers. Since, it gives the quickest return in the shortest possible time (Singh and Singh, 2009). There are some physiological disorders that adversely affect the strawberry production. Loss of yield due to various physiological disorders in strawberries is reported to be 20-30 per cent. Fasciation, fruit malformation, Phyllody and Albinism are the major physiological disorders found in strawberry field. Among them Albinism is one of the most serious disorder in strawberry production. It is the most common and serious disorder of strawberry, occurring primarily at the time of ripening. It is particularly serious in greenhouse grown strawberries and field grown strawberries under sub-tropical climates. It has alarming situation in USA, Belgium and the Netherlands. The marketing of such a fruit is very difficult, and if marketed, it fetches a very poor price, giving to farmers fewer return for their investment. Therefore, management of albinism disorder is important for quality production.

Symptoms of Albinism Disorder

Fruits have this disorder show bloated appearance and develop white or pink areas on the fruit surface. The pulp remains pale. These fruits have poor flavour and are acidic in nature. (Lieten, 1998).

Effect of Albinism on Fruit Quality

Due to this disorder fruits become acidic, highly susceptible to fruit-rot during storage, do not ripen uniformly and show waxy appearance.

Albinism in strawberry fruits

	
Waxy appearance of fruit	**Fruit rot**

Causes of Albinism in Strawberry

1. Low light intensity increases the incidence of albinism possibly by decreasing the supply of sugars in fruit.
2. More albino fruits occurred in the fields during peak fruit production in warm weather, followed by cloudy seasons (Ulrich, 1980).
3. It occurs in soils of sandy texture with high pH or alkaline condition with high N, K and Ca.
4. Dense planting may affect the light interception inside the canopy and thus increases the albinism incidence.
5. Some genetically causes like cytoplasmic or a 'maternal effect' has been observed in some crops as a cause of albinism. Incompatibility between the plastid and nuclear genome is believed to be an important cause of albinism in hybrids.
6. Its incidence is also high in crops mulched with black film due to high N mineralization under black film that is responsible for increases higher temperature.
7. High Concentration of Silicon in plant shows significant lower content of the two major anthocyanins, pelargonidin 3-glucoside and cyanidin 3-glucoside in albino berries. (Wesche-Ebeling and Montgomery 1990).

Management of Albinism in Strawberry

1. Plant runners of Sweet Charlie or Chandler variety of strawberry at a spacing of 20 cm x 25 cm on the raised beds during mid-October.
2. Avoid dense planting.
3. Beds must be mulched with paddy straw in November after the proper establishment of plants.
4. A spray of GA3 (75 ppm) is given in the mid-November.
5. Avoid excessive application of fertilizers especially N and K.
6. Grow varieties showing lower incidence of albinism such as a Sweet Charlie.

Conclusion

Abnormal growth pattern or abnormal external or internal condition of fruits due to deviation from normal state of temperature, light, moisture, nutrients, harmful gases and inadequate supply of growth regulators called as physiological disorders.

Among different disorder in strawberry serious disorder is albinism and that can be control by selection of suitable variety, avoiding dense planting and excessive application of fertilizers, particularly N and K. Management practices is very essential to avoid fruit production loss.

References

1. Lieten, F. (1998). Albinism in strawberries. Informatore Agrario, 54 (29): 55-56.
2. Sharma, R. R. and Singh, S. K. (1999). Strawberry cultivation- a highly remunerative farming enterprise, Agro India, 3 (2): 29-31.
3. Singh, A. and Singh, J. N. (2009). Effect of biofertilizers and bioregulators on growth, yield and nutrient status of strawberry cv. Sweet Charlie. Indian Journal of Horticulture, 66 (2): 220-224.
4. Ulrich (1980). A visual and plant analysis guide to fertilization. Publication No. 4098, University of California, pp.58.
5. Wesche-Ebeling, P. and Montgomery, M. W. (1990). Strawberry polyphenoloxidase, its role in anthocyanin degradation. Journal of food science, 55 (3): 731-734.

Agronomic Ways of Managing Stress in Pulses and Oilseeds for Optimizing Yield

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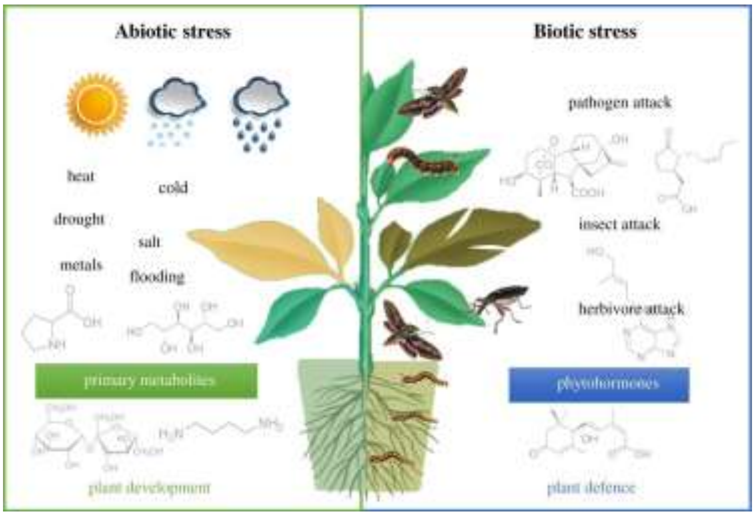
Even though India is the largest producer and consumer of pulse and oilseeds in the world. India is importing 4-6 mt of pulses and 10- 15 mt oilseeds annually thus the availability of pulses and oilseeds falls below the minimum 70gm/ day/ person pulses and 16 kg/ year/ person oilseeds respectively. Productivity level needs to be enhanced to meet deficit in demand. The huge difference in potential and actual yield is attributed to growing of pulses in the unfavourable environment. From the agriculture point of view stress can be the condition prevailing in a given atmosphere that limits the crop productivity. Stress causes the deviation in normal metabolic functions of the plants which may be imposed due to biotic or abiotic factors. Common vogue of cultivation of Pulses and oilseeds is on marginal lands and also poor agroecological condition wherein they will severely hit by stresses during their phenological stages of growth so agronomic way of management of stresses is one of prime most importance in optimizing the yield of pulses and oilseeds.

Stress may Resulting in Following Changes in Plant Metabolism

1. Closure of stomata due to decreased turgor pressure of the guard cells resulting in loss of net photosynthates which will translocate to sink.
2. Higher net respiration rate which was not compensated by reduced photo synthesis.
3. Increased degradation of existing proteins, alteration in the composition of saturated to unsaturated fatty acids ratios in the cell membrane.



Abiotic stresses that limit the crops production are intermittent drought, terminal drought, salinity, high temperature, low temperature, frost, chilling injury excessive moisture stress, this resulting in partial or total crop failure which affects individual livelihood, national economy, food security, biodiversity and species of an ecosystem. For example, chickpea grown under timely sowing experience low temperature and nutrient stress, similarly long duration pigeon pea experiences all types of stresses (low temperature, nutrient, water, frost), Intermittent drought of 10-15 days is common under rainfed condition, this can manage by use of antitranspirants (Phenyl mercuric acetate, silicone, kaolinite) and thus crops can be saved. Terminal stress Common in semiarid region where crops grown on rainfed condition or residual moisture experiences terminal stress. Agronomic Management of terminal stress relies on following aspects:

1. Reproduction before the onset of severe stress, that is short life cycle with high rates of growth and gas exchange, using maximum available resources until the moisture is present.
2. Use of genotypes that are having mechanism of Minimizing water loss by altering leaf morphology like thick cuticle, waxy coating etc., or maximizing water uptake by maintain high root to shoot to ratio reallocation of nutrients.

Salinity stress common in problematic soil in this condition plant cannot able to absorb the water and nutrients from the soil due to higher osmotic pressure in the soil. To overcome this problem certain plants have developed the mechanism of osmotic adjustment. it is an active process of increasing the number of solute particles in the plant that results in a reduced osmotic and water potential in the cell and enables the plant to absorb water from saline habitat. different plants have different mechanisms such as salt dilution , salt exclusion, salt excertion, so selection of plant varieties that are having this type of mechanism will help in stabilizing the yields even in the problematic soils.

Low temperature stress is one of the common stress phenomena seen in winter crops this can be managed by sprinkler irrigation, mulching with residues, smoking during night. Apart from abiotic stress biotic stress also limits the pulse and oilseed crop production such as diseases, weeds , insect infestation.

Some of the Oilseed and Pulse Crop Varieties which are Having Special Character in Combating Stress

Crop	Variety	Special characters
Rapeseed - mustard	Pusa bold, RH781, RH919.	Drought/ moisture deficit – stress tolerant.
	Vardan, Navgold, RGN145.	High temperature stress tolerant.
Groundnut	TG3, TG22	Soil acidity stress tolerant
	Anantha, Rohini, kadhiri5,6,9 Abhaya series	Drought / moisture stress condition
Chickpea	CSG8962, C255, G24	Drought stress tolerant
	DCP92-3 HC3, HC5	Excessive moisture stress tolerant
Green gram	PDM 54 (Moti)	Early maturity, multiple disease resistance
	Pusa virat	Extra early duration

Agronomic Cultivation Practices that will Help in Mitigating the Stress are

1. Seed hardening by using leaf extracts such as Prosopis leaf extract will help in withstanding drought during germination.
2. Seed treatment practices such as Priming substantially improves the tissue water status, membrane stability, gas exchange, water productivity.
3. Sowing date can be adjusted so that critical stages may not coincide with stress.
4. Planting on the side of the ridge help in overcoming salt stress.
5. By following micro irrigation techniques.
6. Insitu moisture conservation practices like tied ridging, dead furrows, inter row water harvesting, etc.,
7. Cultivation across the slope dust mulching, summer ploughing during offseason.
8. Use of Organic mulches resulting in evaporation suppression of the infiltrated water that apparently contributes to soil moisture.
9. Conservation agriculture.
10. Application of chemicals such as Salcylic acid, brassinole to reduce the transpiration.

Conclusion

Adoption of good agronomic practices like early sowing and optimum date of planting will provide moisture at critical growth period of the crop. Moisture conservation practices are one of the important tools for modifying the physiological and morphological changes in plants under stress condition.

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Organic Composting with Special Reference to Vermicompost

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Wastes are nothing but misplaced resources. A large volume of organic matter is generated from agricultural activities, dairy farms and animal shelters which usually is dumped in corners where it putrefies, usually emanating foul smell. This valuable resource can be utilised by properly composting it into a value-added end product called manure. The chief objective to compost organic wastes should not be for the disposal of solid organic wastes but to produce superior quality manure to feed our “nutrient-organic-matter-hungry” soils.

Composting is a controlled process of decomposition used to transform organic material such as kitchen scraps, yard wastes and paper products into humus. Humus, or compost, is a dark, soil-like substance that enriches soil with nutrients, increases moisture retention, improves structure and provides a good environment for beneficial soil organisms. Composting is usually done outdoors, but the process can easily be adapted for indoor use. So, you can compost even if you don't have a yard, or if you don't like going out to a compost bin in the snow, or if you want to produce the highest quality compost there is: vermicompost. Two types of composting practices have been in vogue called the anaerobic composting and the aerobic composting. Anaerobic composting has been practised in India from the past, where pits are made into which the wastes are dumped and the pit closed. On completion of six months the manure is excavated and put to use. Aerobic composting is a scientific process where the duration of composting is drastically reduced. Several aerobic methods exist today. Some of them are NADEP, Vermicomposting, composting by adding effective microbes, etc. Biodung composting is a very interesting method, which is partially aerobic and partially anaerobic. This method is generally applied as a prerequisite to vermicomposting. The reason is that the biodung method can destroy parasites and pests and viable seeds of weeds etc in farm waste due to increased thermal activity in the heap or pile. These temperatures may reach as high as 65 to 75°C between three and six days of setting it up. With one or two turnovers of the pile in 30 days the material can be used for vermicomposting. Vermicomposting utilises earthworms for the purpose of producing value-added manure.

Earthworms have occupied an important position in the functioning of terrestrial ecosystems. This made the famous biologist Charles Darwin declare “It may be doubted whether there are many other animals which have played so important a part in the history of the world as have these lowly organised creatures.”

Chemicals were considered a breakthrough in agricultural production when they made an entry into India in the name of Green Revolution during the sixties. They were magical ingredients that increased agricultural produce by leaps and bounds. It was only later that it was realised that chemicals were not a boon but a bane. To begin with, chemical fertilisers may appear to result in faster and healthier growth of plants, but they sacrifice the long-term benefits by destroying the soil and the ecosystem. Chemicals can be very harmful to the soil and plants especially when used repeatedly.

Chemical fertilisers have been responsible for deterioration of soil friability (crumbling), and destruction of beneficial soil life such as earthworms, bacteria and micro-arthropods. Moreover, plants grown on artificial fertilisers have lower nutrient value than their organically grown counterparts.

The most harmful impact of chemical fertilisers is that these fertilisers leach into the subsoil and permanently contaminate the soil and the groundwater. Moreover, they also enter the food chain and harm organisms including man depending upon them. This inevitably upsets ecological balance and has a negative impact on the beneficial birds and insects in the garden. Gardening without chemical concoctions is safer and works with, and not against, the environment. This helps build healthier plants, which naturally discourage attacks from pests. Composting imitates nature’s way of rebuilding soil by encouraging the decomposition of organic substances, but it does so more rapidly because heat, microbes, and then the worms combine to speed up the process. Compost prepares the soil for plant roots to penetrate. Besides, it is the cheapest, most practical and environment-friendly method of disposing organic wastes.

Apart from adequate nutrient, plants need helpful microorganisms like bacteria, fungi, actinomycetes and protozoon, and other soil symbionts. These provide a good structure to the soil to allow the root zone to breathe and absorb moisture.

Where to Get Organic Biomass to Produce Large Volumes of Manure to Meet the Demand?

Most towns and cities in India do not have proper waste management systems and untreated solid waste is generally dumped in landfills or on the roadsides and the liquid wastes are discharged into rivers or seas.

In India, domestic waste is mostly organic, and at an average is about fifty per cent of the total waste. It is estimated that each household produces not less than 200 Kg of organic solid wastes per year. This can be put to good, productive use rather than being thrown into the bin from where it makes its way to overloaded landfills. These wastes have to be considered a resource to produce manure for the soils. Other sources include lawn mowing, garden litter, wastes from animal shelters as well as dairy sheds.

Can Compost be Made without Earthworms?

Yes! But vermicompost is considered superior to other types of compost because of its quality. Moreover, earthworms ingest litter, dung and other organic matter and grind it into fine particles, thereby increasing the surface area and promoting faster decomposition. The material passes through the body of the earthworm to produce vermicast. Soils with vermicasts have roughly 100 times more bacteria than soil without worms. Moreover, plant growth promoting substances have been reported to be present in vermicasts.

What Is Vermiculture?

Vermiculture can be defined as culture of earthworms. Earthworms are divided into two groups: humus formers and humus feeders. The first group dwells on the surface and feed on nearly 90% organic materials. They are generally darker in colour, and are also called epigeic or detritivorous earthworms. It is these worms that are generally harnessed for vermicomposting. The second group, the humus feeders, includes burrowing worms some of, which are useful in both compost preparations, as well as making the soil porous. Generally, the "burrowers" help in mixing and distributing humus through the soil.

It has been proved that earthworms can degrade organic wastes speedily and efficiently. However, to increase the efficiency of vermicomposting, care should be taken to see that worms thrive well on organic matter, breed faster adapting to moisture and climatic fluctuations. The most beneficial feature of vermicomposting is that it eliminates foul smell of decaying organic wastes, as it is a fully aerobic system.

How does Vermiculture Work?

Earthworms feed on organic waste, consuming two to five times their body weight. They use a relatively small amount of their intake for their growth and excrete the mucus coated undigested matter as vermicasts. Vermicasts consist of organic matter that has undergone physical and chemical breakdown through the activity of the muscular gizzard that grinds the material. The nutrients present in the vermicasts are readily soluble in water for uptake by plants. Vermicast is a rich source of macro and micronutrients, vitamins, enzymes, antibiotics, growth hormones and microflora.

Vermicomposting Using Local Varieties of Earthworms

About two thousand five hundred species of earthworms have been identified in the world of which more than five hundred species of earthworms have been identified in India.

These earthworms can be cultured or used in composting applying simple procedures either in pits, crates, tanks, concrete rings or any containers. Organic material to be used is recommended only after pre-processing or pre-digestion of respective material through partial anaerobic phase (done under black polythene cover or with a clay seal layer). The biodung composting technology is highly recommended as a pre-digestion mechanism.

Diversity of earthworm species varies with different types of soils and hence choosing a local or native species of earthworm for the local soil and for vermicomposting is an important step. There is no need to import earthworms from elsewhere. Local species of earthworms that are generally used in India are *Perionyx excavatus* and *Lampito mauritii*.

How to Collect Native Earthworms?

Identify worm-inhabited soils marked by visible earthworm castings on the soil surface is. Dissolve about 500gm jaggery (native sugar) and 500gm fresh cattle dung in 20 litres of water. Sprinkle on an area 1m x 1m. Cover with straw, leave cattle dung lumps and cover with an old gunny bag. Keep watering for about 20 to 30 days. A combination of epigeic and anecic native worms will aggregate here that could be collected and used.

Compost pit of any convenient dimension can be dug in the backyard or garden or in a field. The most convenient pit of easily manageable size is 2m x 1m x 0.75m. [A tank may be constructed with brick and mortar with proper water outlets, or a plastic crate (600 mm x 300 mm x 300 mm) with holes drilled at the bottom or empty wooden crates (deal wood boxes/apple cases) or well rings made of cement or clay of 750 mm diameter and 300 to 450 mm height can also be used with slight modifications in the thickness of layers used. If nothing is available then four worn out car-tyres are placed one above the other and composting started in it. To make it simpler it can also be done in a 25-litre bucket].

Vermibed (vermes= earthworms; bed= bedding) is the actual layer of good moist loamy soil placed at the bottom, about 150 to 200 mm thick above a thin layer (50 mm) of broken bricks and coarse sand. Earthworms are introduced into the loamy soil, which the worms will inhabit as their home. About 100 earthworms (a combination of epigeics and anecics) may be introduced into a compost pit of about 2m x 1m x 0.75m, with a vermibed of about 15 to 20 cm thick. The vermibed should always be kept moist, but should never be flooded.

Handful lumps of fresh cattle dung are then placed at random over the vermibed. The compost pit is then layered to about 50 mm with dry leaves or preferably chopped hay/straw. For the next 30 days the pit is kept moist by watering it whenever necessary. The bed should neither be dry or soggy. The pit may then be covered with coconut or Palmyra leaves or an old jute (gunny) bag to discourage birds. Plastic sheets on the bed are to be avoided as they trap heat. After the first 30 days, as above, wet organic waste of animal and/or plant origin from the kitchen or hotel or hostel or farm that has been pre-digested is spread over it to a thickness of about 50 mm. This can be repeated twice a week. All these organic wastes can be turned over or mixed periodically with a pickaxe or a spade. Care should be taken not to disturb the vermibed in which the worms live. Keep adding garbage till the compost pit is nearly full. Continue to keep the pit moist for another 30 to 45 days, turning over the material in the pit with care avoiding injury to the worms. Turning over can be done on every fifth or seventh day with the help of a forked spade.

Regular watering should be done to keep the right amount of moisture in the pits. In 60 to 90 days the compost should be ready as indicated by the presence of earthworm castings (vermicompost) on the top of the bed. The compost should be turned occasionally since this allows for aeration. If the weather is very dry it should be dampened periodically. The pile should be moist not wet and soggy.

Vermicompost can now be harvested from the bin/pit. The material should be placed in a heap in the sun so that most of the worms move down to the cool base of the heap. The compost is then sieved before being packed. . The earthworms and the thicker material, which remains on top of the sieve, go back in the bin and the process starts again. Compost works best with a mixture of course and fine materials, layered together.

To obtain earthworms one can also contact the local agricultural department, municipalities, and nurseries of the forest departments for earthworms. Since earthworms are now becoming big business one can also check in the for firms/horticulturists/nurseries, which deal in earthworms, but is always desirable to collect them yourselves.

Four-Tank System

A Four-Tank Unit

Farmer Loading A Four-Tank Unit

To simplify the loading procedure for composting in rural sectors where the availability of organic material is not in bulk, a four-tank system can be set up. This is based on a combination of biodung composting method and vermitech that enables continuous compost production using cattle dung produced daily at cattle sheds, weeds, leaf litter and other farm waste. A tank 4m x 4m x 1m (l x b x h) is preferably made under shade of tree.

A Two-Tank Unit

This is then divided into four equal parts with 22.5cm brick walls that have vents to facilitate aeration as well as migration of earthworms from one tank to another. This unit is designed especially for the small farmer who approximately collects 20 to 30 kg of cattle or farm waste per day. The schedule of loading the unit is described in the table.

Schedule for a Four-Tank System

Period (Days)	Tank	Process
000 – 030	01	Collection of biomass and cattle dung
030 – 060	01	Soaking of biomass with water, cattle dung slurry, and covering it with black polythene sheet. This could be called as Biodung preparation.
	02	Collection of biomasses
060 – 090	01	Inoculation of earthworms
	02	Biodung preparation
	03	Biomass collection
090 – 120	01	Vermicompost ready and migration of earthworms from pit 1 to pit 2.
	02	Vermicomposting
	03	Biodung preparation
	04	Biomass collection
120 – 140	01	Harvesting of compost and collection of biomasses
	02	Vermicompost ready and migration of earthworms from pit 2 to pit 3.
	03	Vermicomposting
	04	Biodung preparation

The tank may be kept closed with a steel mesh cover to keep other animals away from damaging the set up. Outdoor plan requires about 10-20% more worms than the indoor method, as there are more predators and other climatic variables in open cage system.

Vermicomposting Using Exotic Species of Earthworms

Exotic species of earthworms have also been used in India for vermicomposting. Internationally three species of earthworms have received acclaim for vermicomposting, they being *Eisenia fetida* and *Eudrilus eugeniae*, which are exotic, and *Perionyx excavatus*, which is endemic.

Since 1982 *E. eugeniae* has been promoted for waste degradation. *Eudrilus eugeniae* is reported to have surpassed both in feeding and reproductive rates compared to other species of earthworms. *Eisenia fetida* however is used in certain areas in India for domestic waste composting. After several experimentation the recommended method is as follows:

Fill the waste material into tanks followed by sufficient water to moisten the waste. The surface is then sealed with 25mm thick layer of soil paste, and at every 300mm distance, holes of 50mm diameter are made and sticks are introduced into them for two days and are later removed. This provides the track for air circulation. The tanks can also have holes of 15mm diameter all-round (walls) at 300mm apart to provide cross ventilation. The well-aerated material does not emit any foul smell. After two weeks the earthworms are released on the soil surface. They enter into the organic matter and mix through the crevices left on the surface. The set-up is left without disturbance for six weeks. Water is sprinkled occasionally on the surface during the composting process. The soil pack is then separated easily after two months, as these earthworms do not feed on the soil. The compost along with the earthworms is collected. In place of the mudpack, old jute (gunny) bags can also be used to cover the containers, but the bags themselves will get composted after some time. A crate (600mm x 45mm x 600mm) can hold a population of 1500 adult *Eudrilus eugeniae,* and 3000 to 5000 *Eisenia fetida* and *Perionyx excavatus*. Frequent harvesting of *Eudrilus eugeniae* is necessary to reduce population pressure and enables continuous growth of earthworm population.

When is the Compost Ready?

The compost is ready when the material is moderately loose and crumbly and the colour of the compost is dark brown. It will be black, granular, lightweight and humus-rich. To facilitate separating the worms from the compost, stop watering two to three days before emptying the beds. This will force about 80 per cent of the worms to the bottom of the bed. The rest of the worms can be removed by hand, and are ready to be dumped into the next round of compost making. The vermicompost is then ready for application.

The smell is earth-like. Any bad odour is a sign that fermentation has not reached its final goal and that the bacterial processes are still going on.

A musty smell indicates the presence of mould or overheating which leads to loss of nitrogen. If this happens, aerate the heap better or start again, adding more fibrous material and keeping the heap drier.

The compost heap can become ripe in three weeks but it can take up to three months also.

General Composting

A compost heap can also be made layer by layer. In the bottom layer, place twigs, stalks, hay, wood chips or other coarse material, this allows air to flow at the bottom. Follow with a layer of high nitrogen material like manure or grass clippings (avoid grass if chemical pesticides have been used), leaves, manure, wood shavings, chopped weeds (picked before going to seed), vegetable and fruit scrapes, nut and eggshells. Sprinkle the material with water as you build the pile and repeat the sequence. The pile should be at least three feet high to trigger and sustain the required biological reactions. Don't let the pile get over five feet high, in which case the mass may pack down, squeeze out air and slow down decomposition. You can use a black polythene sheet to cover or alternatively use a jute sack as cover over the heap to retain the moisture. This is the set up for the Biodung method of composting. This can also be used as a pre-digestion exercise. Once cool (say after about thirty days), the earthworms can be introduced into the heap to proceed with vermicomposting.

Biodynamic method of composting includes the production of BD preparations in the form of BD 500 and CPP. Heap/windrow composting with biodynamic principles can also be practised.

Effective microbes are also being introduced to accelerate the composting processes. Whatever the method followed; proper mulching should follow application of compost accompanied with other organic practices.

You can use the compost in your fields, farms and gardens, around shrubs, bushes and trees and in potted plants. Compost can be spread on the top of the soil and hoed in lightly to encourage the surface soil life. Roots from tender plants are then able to reach the compost and draw out its nutrients.

How Can I Use the Finished Compost?

Vermicompost, or worm castings, provides nutrients to your plants and helps the soil hold moisture. Growth trials indicate vermicompost has a more beneficial effect on plants than compost produced without worms, although the reasons for this are still not entirely understood. Vermicompost can be used in a number of different ways:

1. Mix it into the seed row when planting.
2. When transplanting, add a handful of vermicompost to the hole you have dug for the plant.
3. Use as a top dressing, placing a layer of vermicompost around the base of plants (but not in contact with the stems).
4. Mix with potting soil and sand (1/3rd each) for house plants/gardens.
5. Give a quart away (with the worms still in it) to someone else who wants to start vermicomposting.
6. Vermicomposting is easy to practise, is ecologically safe and economically sound.

Marketing

Marketing vermicomposting is now a potential and flourishing industry due to the growing awareness among the people the ill effects of chemical fertilisers and the relative benefits of organic farming. The cost of vermicompost ranges between (Indian) Rs.1500-4000 per ton of compost. The retail market in urban areas is more promising with the sale price of vermicompost, in neatly designed and printed packets, fetching rates as high as Rs.15/- per kg. Today, young people are involved in producing and selling vermicompost in many cities in India. For a kitchen garden or for growing ornamental plants, the compost prepared at home is sufficient and will not only serve as excellent manure but will also save money usually spent on fertilisers.

Unfortunately, the sale of earthworms as such has not been very promising in India so far as the desire for angling as a game is not as popular as it is in the west. However, worms like *Eisenia foetida* and *Eisenia euginiae* are sold by agencies in the Indian markets especially in Pune and Bangalore. In India, *Lampito rubellus* also has a market. Worms may fetch a fancy price depending on the desire of a person to pay for them. At the MCRC, Chennai, local varieties of worms are used extensively to discourage the sale of exotic species.

It should be realised that vermicomposting can be a useful cottage industry for the underprivileged and the economically weak as it can provide them with a supplementary income. If every village can formulate a cooperative society of unemployed youth/women group, it could be a wise venture for them to produce vermicompost and sell it back to the village at a recommended price. The youth will not only earn money, but also aid society by providing excellent quality organic manure for sustainable agro-practices. Moreover, with garbage recycled, the surroundings will be kept clean and tidy, which is a formidable task at the best of times for any organisation to cope with.

Economics of Vermicompost

Construction and maintenance of a TWIN TANK SYSTEM:

Production Capacity			
Total surface area of production			
(2m x 1m x 1m) per tank 2 tanks		=	4 sq m
Annual targeted production capacity	1500 kg x 2 tank	=	3000 kg
Duration of each run (average per unit)		=	120 days
Number of harvest of compost/year	3/tank x 2 tank	=	6 approximately
FEASIBILITY REPORT			
Estimated capital investment			
Vermicompost units			
Construction, implements and contingencies		=	10,000
Variable costs			
Cost of inputs @ Rs.250/produce	=	1,500	
Labour 2hr/day @ Rs.10/hr	=	1,800	
Harvesting & packing @ Rs.100/harvest	=	600	

		3,900	

Total variable cost approximately Rs.4000/- only			
COST RETURN ANALYSIS			
1. Total cultivable space			4 sq m
2. Estimated production (minimum)			3000 kg
3. Sale revenue (@ Rs.5/kg)			Rs.15,000.00
4. Total variable cost			Rs. 4,000.00
5. Profit (3 – 4)			Rs. 11,000.00
6. Total capital investment			Rs. 10,000.00
Cost of production per kg			= Rs. 2.50 approximately.

(A minimum of six harvests can be made in the first year. A minimum of seven to eight harvests can be made subsequently after the first year. With proper management, the cost of production will also be reduced appreciably).

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Innovations in the vermicomposting technology and introduction of the 'four tanks' or 'four chambers' method to facilitate movement of earthworms from the chamber with fully composted matter to the one with the pre-processed waste, have already started yielding quality manure. Supplementation of the vermicast / vermicompost with a variety of phosphate solubilizers and mobilizers, plant growth promoting rhizobacteria and biocontrol agents is being planned for the future.

References

1. Aira, M., Monroy, F., and Domínguez, J. (2007). Earthworms strongly modify microbial biomass and activity triggering enzymatic activities during vermicomposting independently of the application rates of pig slurry. Science of the Total Environment385, 252-261.
2. Atiyeh, R.M., Edwards, C.A., Subler, S., and Metzger, J.D. (2001). Pig manure vermicompost as a component of a horticultural bedding plant medium: Effects on physicochemical properties and plant growth. Bioresource Technology 78, 11-20.
3. Atiyeh, R.M., Subler, S., Edwards, C.A., and Metzger, J. (1999). Growth of tomato plants in horticultural media amended with vermicompost. Pedobiologia, 43, 724-728.
4. Bachman, G.R., Metzger, J.D., 2007. Physical and chemical characteristics of a commercial potting substrate amended with vermicompost produced from two different manure sources. HortTechnology17(3), 336-340.
5. Chalasani, D., Krishna, S. R., Reddy, A. V. S. and Dutt. C. 1998. Vermiculture biotechnology for promoting sustainable agriculture. Asia Pacific Journal of Rural Development., 8: 105-117.
6. Ismail, S. A. 1997. Vermicology: The Biology of Earthworms. Orient longman Press, Hyderabad. 92 pp.
7. Kumar, A. 2005. Verms and Vermitechnology. Vedams eBooks (P) Ltd, New Delhi India. pp. 110-034.
8. THE HINDU (2019) TIRUCHIRAPALLI—NIT: kick-starts programme under GIAN.

Ethnomedicinally Important Endangered Orchids in India - Its Status and Conservation

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Orchids are among the highly prized ornamental flower in the plant kingdom. Hence, they used for decorative purposes throughout the world. They are known for longer time in vases. The presence of chemicals for curative properties is not that much known to the world. Over exploitation of various orchid species from the wild and degeneration of forest land for commercial activities of man has brought many orchids rare and endangered. There is an urgent need for conservation of orchids for the next generation. Conservation can be done by establishing, Sanctuaries, Biosphere reserve, Forest reserves. Apart from conservation in orchid, Orchid Botanical Garden one of the well-known methods in conservation and also conserved in *in vitro* &*in vivo* methods (Ramesh *et al*., 2019).

Two rare, endangered orchid specie of *Renanthera imschootiana* and *Vanda coerulea* listed in Red Data Book of Indian Plants, and are renowned for their unique ornamental traits. The hybridization work was done between these two species. The resulting immature hybrid embryos were germinated *in vitro* on Vacin and Went (VW, 1949) medium supplemented with 15% v/v coconut water. Best seedling growth was observed on half-strength Murashige and Skoog medium devoid of any plant growth regulators while the transplanted seedlings grew beston brick chips: charcoal pieces (2:1) potting mix in community earthen trays. (Rajkumar and Gurumayum, 2009).

To conserve the medicinal orchids in Uttarakhand habitat study was conducted between the years 2003 to 2005 covering an altitudinal range of 600 – 3600 m. Transects of 1 km length were laid randomly in various habitat types depending upon the geographical coverage of the habitats. Six medicinal orchid species belonging to four genera were recorded in different habitats. *Dactylorhiza hatagirea* and *Habenaria intermedia* are highly endangered in the state. Seven-habitat types were identified where medicinal orchids were found. Among seven habitats Banj-oak habitat was found the most suitable habitat for the orchids followed by Mixed-oak and Banj Grassy Slopes (Jeewan and Gopal, 2009).

Juvenility of the tissues and chemical stimulus are the important factors in regeneration of explant. Foliar explant of *Vanda testacea* was cultured on Mitra (M, 1950) medium containing BAP, Kn individually. PLBs were directly regenerated when used Mitra medium with NAA. The explant showed callus proliferation and further differentiated in to PLBs. The best response was observed in the explant containing 1.0 mg/l BAO alone /with 1.0 mg/l NAA + activated charcoal. The plantlets were transferred to pots containing epiphytic compost (1 charcoal : 1 brick pieces :1 bats). Nearly 75 percent of plantlets survival was recorded (Saranjeet and Bhutani, 2009)

Synthetic seed technology was used to conserve the valuable germplasm of *D. nobile* a rare and endangered medicinal orchid by using different osmotica (sucrose and mannitol). Incorporation of low sucrose and mannitol (3 and 5 %) in the encapsulating matrix showed almost similar results with that of control. In all these cases, more than half of PLBs burst out from the matrix thus making these concentrations of sucrose and mannitol along with control However, with the increase in concentration to 7.5 and 12.5 % in the encapsulating matrix, no outburst of encapsulated PLBs was recorded till 60 days of storage; hence it can be concluded that these concentrations play an important role in minimizing the growth of PLBs during storage condition (Padmaja *et al*., 2013).

Extensive research is need to be conducted for commercial purpose beat for flow or for their ethnomedicinally importance orchid species. Due to their small population size and restricted distribution, intensive care and habitat management is highly recommended. Very little effort has been made to cultivate the medicinal orchids for commercial scale. The species which has reached the threatened category because of the human activities can survive only with human support. Plant tissue culture could be one of the most suitable alternative tools to conserve the rare and endangered orchids to minimize the pressure on natural population of medicinal orchids and their sustainable utilization.

References

1. JEEWAN SINGH JALAL AND GOPAL SINGH RAWAT, 2009, Habitat studies for conservation of medicinal orchids of Uttarakhand, Western Himalaya. Afr. J. Plant Sci.,3 (9) :200-204.
2. PADMAJA MOHANTY, PYNBEITSYON NONGKLING, MEERA C. DAS, SUMAN KUMARIA, PRAMOD TANDON, 2013, Short-term storage of alginate-encapsulated protocorm-like bodies of Dendrobium nobile Lindl.: an endangered medicinal orchid from North-east India. Biotech, 3: 235–239.
3. RAJKUMAR KISHOREAND GURUMAYUM JITENDRA SHARMA, 2009 Intergeneric hybrid of two rare and endangered orchids, Renanthera imschootiana Rolfe and Vanda coerulea Griff. ex L. (Orchidaceae): Synthesis and characterization. Euphytica, 165 : 247–256.
4. RAMESH, T. M., KOPERUNCHOLAN1, M., PRAVEENA1, R., GANESHKUMARI, R., VANITHAMANI1, J., MURUGANANTHAM, P. AND RENGANATHAN, R., 2019, Medicinal properties of some Dendrobium orchids – A review, J. Adv. Res., 2019: 4 (4): 119-128.
5. SARANJEET KAUR AND K.K. BHUTANI ,2009,In vitro Propagation of Vanda testacea (Lindl.) Reichb.f. – A Rare Orchid of High Medicinal Value. Plant Tissue Cult. & Biotech, 19 (1): 1-7.

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Cryopreservation: A Tool of Germplasm Conservation

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Cryopreservation

Cryopreservation (Greek, krayos-frost) literally means preservation in the frozen state. The principle involved in cryopreservation is to bring the plant cell and tissue cultures to a zero metabolism or non-dividing state by reducing the temperature in the presence of cryoprotectants. Cryopreservation broadly means the storage of germplasm at very low temperatures:

1. Over solid carbon dioxide (at -79°C)
2. Low temperature deep freezers (at -80°C)
3. In vapour phase nitrogen (at -150°C)
4. In liquid nitrogen (at -196°C)

Among these, the most commonly used cryopreservation is by employing liquid nitrogen. At the temperature of liquid nitrogen (-196°C), the cells stay in a completely inactive state and thus can be conserved for long periods. In fact, cryopreservation has been successfully applied for germplasm conservation of a wide range of plant species e.g., rice, wheat, peanut, cassava, sugarcane, strawberry, coconut. Several plants can be regenerated from cells, meristems and embryos stored in cryopreservation.

Mechanism of Cryopreservation

The technique of freeze preservation is based on the transfer of water present in the cells from a liquid to a solid state. Due to the presence of salts and organic molecules in the cells, the cell water requires much lower temperature to freeze (even up to -68°C) compared to the freezing point of pure water (around 0°C). When stored at low temperature, the metabolic processes and biological deteriorations in the cells/tissues almost come to a standstill.

Precautions / Limitations for Successful Cryopreservation

Good technical and theoretical knowledge of living plant cells and as well as cryopreservation technique are essential.

Technique of Cryopreservation

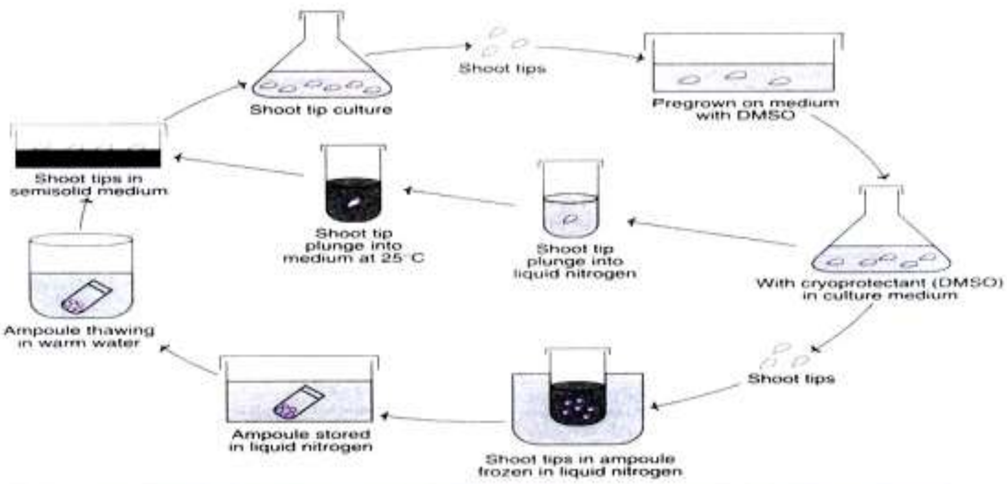

Fig. 48.1 : An outline of the protocol for cryopreservation of shoot tip (DMSO–Dimethyl sulfoxide)

An outline of the protocol for cryopreservation of shoot tip is depicted in Fig. 48.1.

The cryopreservation of plant cell culture followed by the regeneration of plants broadly involves the following stages:
1. Development of sterile tissue cultures.
2. Addition of cryoprotectants and pre-treatment
3. Freezing.
4. Storage.
5. Thawing.
6. Re-culture.
7. Measurement of survival/viability.
8. Plant regeneration.

The salient features of the above stages are briefly described.

Development of Sterile Tissue Culture

The selection of plant species and the tissues with particular reference to the morphological and physiological characters largely influence the ability of the explant to survive in cryopreservation. Any tissue from a plant can be used for cryopreservation e.g., meristems, embryos, endosperms, ovules, seeds, cultured plant cells, protoplasts, calluses. Among these, meristematic cells and suspension cell cultures, in the late lag phase or log phase are most suitable.

Addition of Cryoprotectants and Pre-Treatment

Cryoprotectants are the compounds that can prevent the damage caused to cells by freezing or thawing. The freezing point and super-cooling point of water are reduced by the presence of cryoprotectants. As a result, the ice crystal formation is retarded during the process of cryopreservation.

There are several cryoprotectants which include dimethyl sulfoxide (DMSO), glycerol, ethylene, propylene, sucrose, mannose, glucose, proline and acetamide. Among these, DMSO, sucrose and glycerol are most widely used. Generally, a mixture of cryoprotectants instead of a single one is used for more effective cryopreservation without damage to cells/tissues.

Freezing

The sensitivity of the cells to low temperature is variable and largely depends on the plant species.

Four Different Types of Freezing Methods are used

1. Slow-freezing method: The tissue or the requisite plant material is slowly frozen at a slow cooling rates of 0.5-5°C/min from 0°C to -100°C, and then transferred to liquid nitrogen. The advantage of slow-freezing method is that some amount of water flows from the cells to the outside. This promotes extracellular ice formation rather than intracellular freezing. As a result of this, the plant cells are partially dehydrated and survive better. The slow-freezing procedure is successfully used for the cryopreservation of suspension cultures.

2. Rapid freezing method: This technique is quite simple and involves plunging of the vial containing plant material into liquid nitrogen. During rapid freezing, a decrease in temperature -300° to -1000°C/min occurs. The freezing process is carried out so quickly that small ice crystals are formed within the cells. Further, the growth of intracellular ice crystals is also minimal. Rapid freezing technique is used for the cryopreservation of shoot tips and somatic embryos.

3. Stepwise freezing method: This is a combination of slow and rapid freezing procedures (with the advantages of both), and is carried out in a stepwise manner. The plant material is first cooled to an intermediate temperature and maintained there for about 30 minutes and then rapidly cooled by plunging it into liquid nitrogen. Stepwise freezing method has been successfully used for cryopreservation of suspension cultures, shoot apices and buds.

4. Dry freezing method: Some workers have reported that the non-germinated dry seeds can survive freezing at very low temperature in contrast to water-imbibing seeds which are susceptible to cryogenic injuries. In a similar fashion, dehydrated cells are found to have a better survival rate after cryopreservation.

Storage

Maintenance of the frozen cultures at the specific temperature is as important as freezing. In general, the frozen cells/tissues are kept for storage at temperatures in the range of -70 to -196°C. However, with temperatures above -130°C, ice crystal growth may occur inside the cells which reduces viability of cells. Storage is ideally done in liquid nitrogen refrigerator — at 1 50°C in the vapour phase, or at -196°C in the liquid phase.

The ultimate objective of storage is to stop all the cellular metabolic activities and maintain their viability. For long term storage, temperature at -196°C in liquid nitrogen is ideal. A regular and constant supply of liquid nitrogen to the liquid nitrogen refrigerator is essential. It is necessary to check the viability of the germplasm periodically in some samples. Proper documentation of the germplasm storage has to be done.

The Documented Information must be Comprehensive with the Following Particulars

1. Taxonomic classification of the material.
2. History of culture.
3. Morphogenic potential.
4. Genetic manipulations done.
5. Somaclonal variations.
6. Culture medium.
7. Growth kinetics.

Thawing

Thawing is usually carried out by plunging the frozen samples in ampoules into a warm water (temperature 37-45°C) bath with vigorous swirling. By this approach, rapid thawing (at the rate of 500- 750°C min-1) occurs, and this protects the cells from the damaging effects ice crystal formation.

As the thawing occurs (ice completely melts) the ampoules are quickly transferred to a water bath at temperature 20-25°C. This transfer is necessary since the cells get damaged if left for long in warm (37-45°C) water bath. For the cryopreserved material (cells/tissues) where the water content has been reduced to an optimal level before freezing, the process of throwing becomes less critical.

Re-Culture

In general, thawed germplasm is washed several times to remove cryoprotectants. This material is then re-cultured in a fresh medium following standard procedure. Some workers prefer to directly culture the thawed material without washing. This is because certain vital substances, released from the cells during freezing, are believed to promote in vitro cultures.

Measurement of Survival / Viability

The viability/survival of the frozen cells can be measured at any stage of cryopreservation or after thawing or re-culture.

The techniques employed to determine viability of cryopreserved cells are the same as used for cell cultures. Staining techniques using triphenyl tetrazolium chloride (TTC), Evan's blue and fluorescein diacetate (FDA) are commonly used.

The best indicator to measure the viability of cryopreserved cells is their entry into cell division and regrowth in culture.

Plant Regeneration

The ultimate purpose of cryopreservation of germplasm is to regenerate the desired plant. For appropriate plant growth and regeneration, the cryopreserved cells/tissues have to be carefully nursed, and grown. Addition of certain growth promoting substances, besides maintenance of appropriate environmental conditions is often necessary for successful plant regeneration.

Germplasm Conservation in Crop Plants

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Germplasm Conservation

Germplasm broadly refers to the hereditary material (total content of genes) transmitted to the offspring through germ cells. The sum total of all the genes present in a crop and its related species constitutes its germplasm. It is ordinarily represented by a collection of various strains and species. Germplasm provides the raw .materials (genes). The breeder uses these to develop commercial crop varieties. Therefore, germplasm is the basic indispensable ingredient of all breeding programmes.

Thus, a great emphasis is placed on collection, evaluation and conservation of germplasm. Conventionally, germplasm is conserved as seeds stored at ambient temperature, low temperature or ultralow temperature.

Applications or Significance of Germplasm Conservation

1. The conservation of germplasm involves the preservation of the genetic diversity of a particular plant or genetic stock. It can be used at any time in future.
2. It is important to conserve the endangered plants or else some of the valuable genetic traits present in the existing and primitive plants will be lost.
3. Main crops produce recalcitrant or short-lived seeds.
4. Similarly, in case of clonal crops seeds are not the best material to conserve due to their genetic heterogeneity and unknown worth. Their genes need to be conserved.
5. The roots and tubers loose viability rapidly. Their storage requires large space, low temperature and is expensive. In addition, materials modified by genetic engineering may some, times be unstable. Such materials are needed to be conserved intact for future use.

Precautions / Limitations for Successful Cryopreservation

A global body namely International Board of Plant Genetic Resources (IBPGR) has been established for germplasm conservation. Its main objective is to provide necessary support for collection, conservation and utilization of plant genetic resources throughout the world. The germplasm is preserved by the following two ways:

1. In-situ conservation: The conservation of germplasm in their natural environment by establishing biosphere reserves (or national parks/gene sanctuaries) is regarded as in-situ conservation. This approach is particularly useful for preservation of land plants in a near natural habitat along with several wild relatives with genetic diversity. The in-situ conservation is considered as a high priority germplasm preservation programme.

The major limitations of in-situ conservation are listed below:

a. The risk of losing germplasm due to environmental hazards
b. The cost of maintenance of a large number of genotypes is very high.

2. Ex-situ conservation: Ex-situ conservation is the chief method for the preservation of germplasm obtained from cultivated and wild plant materials. The genetic materials in the form of seeds or from in vitro cultures (plant cells, tissues or organs) can be preserved as gene banks for long term storage under suitable conditions. For successful establishment of gene banks, adequate knowledge of genetic structure of plant populations, and the techniques involved in sampling, regeneration, maintenance of gene pools etc. are essential. It is stored as gene banks for long term use. There are two types of gene banking.

a. In vivo gene banks have been made to preserve the genetic resources by conventional methods e.g. seeds, vegetative propagules, etc.

b. In vitro gene banks have been made to preserve the genetic resources by non – conventional methods such as cell and tissue culture methods. This will ensure the availability of valuable germplasm to breeder to develop new and improved varieties.

Germplasm Conservation in the Form of Seeds

Usually, seeds are the most common and convenient materials to conserve plant germplasm. This is because many plants are propagated through seeds, and seeds occupy relatively small space. Further, seeds can be easily transported to various places.

Limitations:

1. Viability of seeds is reduced or lost with passage of time.
2. Seeds are susceptible to insect or pathogen attack, often leading to their destruction.
3. This approach is exclusively confined to seed propagating plants, and therefore it is of no use for vegetatively propagated plants e.g., potato, Ipomoea, Dioscorea.
4. It is difficult to maintain clones through seed conservation.

In Vitro Methods for Germplasm Conservation

In vitro methods employing shoots, meristems and embryos are ideally suited for the conservation of germplasm of vegetatively propagated plants. The plants with recalcitrant seeds and genetically engineered materials can also be preserved by this in vitro approach.

Advantages:

1. Large quantities of materials can be preserved in small space.
2. The germplasm preserved can be maintained in an environment, free from pathogens.
3. It can be protected against the nature's hazards.
4. From the germplasm stock, large number of plants can be obtained whenever needed.

Approaches for the In Vitro Conservation of Germplasm

1. Cryopreservation (freeze-preservation).
2. Cold storage.
3. Low-pressure and low-oxygen storage.

Cryopreservation

Cryopreservation (Greek, krayos-frost) literally means preservation in the frozen state. The principle involved in cryopreservation is to bring the plant cell and tissue cultures to a zero metabolism or non-dividing state by reducing the temperature in the presence of cryoprotectants. Cryopreservation broadly means the storage of germplasm at very low temperatures:

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3. In vapour phase nitrogen (at -150°C).
4. In liquid nitrogen (at -196°C).

Lo1w-Pressure Storage (LPS)

In low-pressure storage, the atmospheric pressure surrounding the plant material is reduced. This results in a partial decrease of the pressure exerted by the gases around the germplasm. The lowered partial pressure reduces the in vitro growth of plants (of organized or unorganized tissues). Low-pressure storage systems are useful for short-term and long-term storage of plant materials.

The short-term storage is particularly useful to increase the shelf life of many plant materials e.g., fruits, vegetables, cut flowers, plant cuttings. The germplasm grown in cultures can be stored for long term under low pressure. Besides germplasm preservation, LPS reduces the activity of pathogenic organisms and inhibits spore germination in the plant culture systems.

Low-Oxygen Storage (LOS)

In the low-oxygen storage, the oxygen concentration is reduced, but the atmospheric pressure (260 mm Hg) is maintained by the addition of inert gases (particularly nitrogen). The partial pressure of oxygen below 50 mm Hg reduces plant tissue growth (organized or unorganized tissue). This is due to the fact that with reduced availability of O_2, the production of CO_2 is low. As a consequence, the photosynthetic activity is reduced, thereby inhibiting the plant tissue growth and dimension.

Limitations of LOS

The long-term conservation of plant materials by low-oxygen storage is likely to inhibit the plant growth after certain dimensions.

Applications of Germplasm Storage

The germplasm storage has become a boon to plant breeders and biotechnologists:

1. Maintenance of stock cultures: Plant materials (cell/tissue cultures) of several species can be cryopreserved and maintained for several years, and used as and when needed. This is in contrast to an in vitro cell line maintenance which has to be sub-cultured and transferred periodically to extend viability. Thus, germplasm storage is an ideal method to avoid sub-culturing, and maintain cells/ tissues in a viable state for many years.
2. Cryopreservation is an ideal method for long term conservation of cell cultures which produce secondary metabolites (e.g., medicines).
3. Disease (pathogen)-free plant materials can be frozen, and propagated whenever required.
4. Recalcitrant seeds can be maintained for long.
5. Conservation of somaclonal and gametoclonal variations in cultures.
6. Plant materials from endangered species can be conserved.
7. Conservation of pollen for enhancing longevity.
8. Rare germplasms developed through somatic hybridization and other genetic manipulations can be stored.
9. Cryopreservation is a good method for the selection of cold resistant mutant cell lines which could develop into frost resistant plants.
10. Establishment of germplasm banks for exchange of information at the international level.

Limitations of Germplasm Storage

The major limitations of germplasm storage are the expensive equipment and the trained personnel. It may, however, be possible in the near future to develop low-cost technology for cryopreservation of plant materials.

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Post-Harvest Role of LED (Light-Emitting Diode)

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Introduction

For every three tons of food produced in the world, there is one ton of food that is wasted in the dynamic food-supply system and this amounts to 1.3 billion tons every year (Gustavsson et al. 2011). This wastage can be attributed to an absence of efficient post-harvest infrastructure (Moustafa 2016), poor harvesting and storage techniques (Kiaya 2014), and issues with marketing facilities (Prusky 2011). As stated by the Food and Agriculture Organization of the United Nations, fruits and vegetables are the most wasted commodity, amounting to 40-50% losses (Gustavsson et al. 2011). In fact, spoilage of fruits and vegetables occurs at every stage of the food chain supply, from farm to table, and this represents a fundamental challenge for food engineers (Gunders 2012). Given this challenge, there is an increasing interest in reducing (or eliminating) spoilage of fruits and vegetables (Ma et al. 2017). This interest is a focus of recent research, given modern trends in consumer behaviour towards increased intake of health-promoting foods like fruits and vegetables (Slavin and Lloyd 2012). In response, various approaches are being developed and utilized. Examples of these developing approaches included increased storage facilities and infrastructure (Muir et al. 2010), strategic modifications to the food chain supply (Parfitt, Barthel, and Macnaughton 2010), optimization of processing technologies (Gustavsson et al. 2011), and the application of light emitting diodes (LEDs) in the food industry (Hasperué et al. 2016).

This application of LEDs in the food industry is a particularly appealing approach to reduce spoilage of fruits and vegetables, as LEDs have many advantageous properties, including low radiant heat emissions, electrical luminosity, strong emission of monochromatic (well-controlled) light (D'Souza et al. 2015), high photon efficiency, and long operational lifespan (Chen et al. 2016). These advantageous properties make the application of LEDs for post-harvest preservation a viable option. Additionally, light plays a major role in affecting phytochemical concentrations, biosynthesizing secondary metabolites (Xu et al. 2014), and driving photosynthesis and ripening processes (D'Souza et al. 2015). Furthermore, the reduced heat generation and the control over light quality of LEDs can enhance nutritional and antioxidant activity (Kim et al. 2011) and LEDs of different colours/wavelengths can initiate a variety of responses in plants (Kasim and Kasim 2017).

Uses in Different Horticulture Crops at Post-Harvest

The use of red LED has been reported to improve the quality of broccoli florets (Ma et al., 2014), and white and blue LEDs showed the highest levels of chlorophylls (Hasperué, Guardianelli, Rodoni, Chaves, & Martínez, 2016).

In tomato, for example, exposure to red light increases accumulation of lycopene (Liu LH et al.2009) whereas, in raspberries, storage under visible light causes higher levels of soluble solids and lower values of titratable acidity (Wang SY et al. 2009). In green tissues such as Chinese kale (Noichinda S et al. 2007) and spinach (Toledo MEA et al. 2003) storage under light can delay chlorophyll degradation and improve ascorbic acid accumulation respectively.

Storage under continuous low-intensity light is an efficient and low-cost treatment that delays postharvest senescence while maintaining the quality of harvested broccoli florets (Agustin M Buchert et al. 2010).

M. Ufuk Kasim and Rezzan Kasim (2016) demonstrated that white LED light showed up the best application in terms of maintaining green color, reducing chlorophyll degradation, and increasing the total soluble solid content of lettuce. While the weight loss was reduced by red LED light treatment, the green LED light was effective in reducing the decay rate of lettuce. It was concluded that white, red and green LED lighting treatments are useful for enhancing the storage life of leaf lettuce, whereas the blue LED light treatment showed negative effects.

Blue light reduced post-harvest decay and suppressed fungal growth of P. italicum and P. citri, reduced cell wall digestion enzyme activity of P.digitatum, and induced flavedo octanal production in citrus (Hui-Ling et al. 2013).

Martina Loi et al. (2019) reported that green LED increased the chlorophyll and ascorbic acid content; white, red and yellow LEDs had a positive effect on the redox status of broccoli. Globally, only green LED had a statistically significant positive effect when considering all analysed parameters and could be proposed to prolong the shelf life of broccoli during cold storage.

Gang Ma et al. (2012) found that accumulation of β-cry was induced by red light, while it was not affected by blue light. The accumulation of β-cry under red light was attributed to simultaneous increases in the expression of CitPSY, CitPDS, CitZDS, CitLCYb1, CitLCYb2, CitHYb, and CitZEP. The results presented herein might provide new strategies to enhance the commercial and nutritional value of citrus fruits.

Compared to storage in darkness, the shelf life of fresh-cut lettuce was prolonged under low irradiance red, blue and green LED light. The longer shelf life under LEDs was accompanied by high carbohydrate levels. The applied light levels were below the LCP and no net photosynthesis were detected. The carbohydrates may therefore be produced through alternative mechanisms (E.J. Woltering and Y.W. Seifu. 2015).

Blue light irradiation was applied to postharvest strawberry fruit to explore its influence on anthocyanin content and anthocyanin biosynthetic enzyme activities. Strawberry fruit was irradiated with blue light at 40 μmol m^{-2} s^{-1} for 12 days at 5 °C. The results indicated that blue light treatment improved total anthocyanin content in strawberry fruit during storage. Blue light might be proposed as a supplemental light source in the storage of strawberry fruit to improve its anthocyanin content (Feng Xu et al. 2014).

References

1. Agustin M Buchert, Maria E Gomez Lobato,Natalia M Villarreal, Pedro M Civelloa, and Gustavo A Martıneza.,(2010). Effect of visible light treatments on postharvest senescence of broccoli (BrassicaoleraceaL.). J. Sci. Food Agric, 91:355-361.
2. Chen, Zhuo.,(2016). "Effect of Chain Flexibility of Epoxy Encapsulants on the Performance and Reliability of Light-Emitting Diodes." Industrial and Engineering Chemistry Research, 55(28):7635–45.
3. D'Souza, Craig, Hyun Gyun Yuk, Gek Hoon Khoo, and Weibiao Zhou.,(2015). "Application of LightEmitting Diodes in Food Production, Postharvest Preservation, and Microbiological Food Safety." Comprehensive Reviews in Food Science and Food Safety 14(6):719–40.
4. E.J. Woltering and Y.W. Seifu.,(2015). Low Intensity Monochromatic Red, Blue or Green Light Increases the Carbohydrate Levels and Substantially Extends the Shelf Life of Fresh-Cut Lettuce, Proc. Vth International Conference Postharvest Unlimited Eds.: G.A. Manganaris et al. Acta Hort. 1079, ISHS 2015.
5. Feng Xu, Shifeng Cao, Liyu Shi,Wei Chen, Xinguo Su and Zhenfeng Yang.,(2014). Blue Light Irradiation Affects Anthocyanin Content and Enzyme Activities Involved in Postharvest Strawberry Fruit. J. Agric. Food Chem., 62:4778−4783
6. Gang Ma,Lancui Zhang, Masaya Kato, Kazuki Yamawaki, Yoshikazu Kiriiwa, Masaki Yahata,Yoshinori Ikoma, and Hikaru Matsumoto.,(2012). Effect of Blue and Red LED Light Irradiation on β-Cryptoxanthin Accumulation in the Flavedo of Citrus Fruits, J. Agric. Food Chem., 60:197–201.
7. Gunders Dana., (2012). "Wasted: How America Is Losing up to 40 Percent of Its Food from Farm to Fork to Landfill." NRDC Issue Paper (August):1–26.
8. Gustavsson, J., C. Cederberg, U. Sonesson, R. van Otterdijk, and A. Meybeck., (2011). "Global Food Losses and Food Waste: Extent, Causes and Prevention." International Congress: Save Food! 38.
9. Hasperue, Joaquín H., Luis M. Rodoni, Luciano M. Guardianelli, Alicia R. Chaves, and Gustavo A. Martínez., (2016). "Use of LED Light for Brussels Sprout Postharvest Conservation."Scientia Horticulturae, 213:281–86.
10. Hasperue, J. H., Guardianelli, L., Rodoni, L. M., Chaves, A. R., and Martínez, G. A., (2016). Continuous white-blue LED light exposition delays postharvest senescence of broccoli. Postharvest Biology and Technology, 65: 495–502.
11. Hui-Ling Liao, Fernando Alferez and Jacqueline K. Burns., (2013). Assesment of blue light treatments on citrus post-harvest diseases. Postharvest Biology and Technology, 81:81-88.
12. Kasim MU and Kasim R., (2017). While continuous white LED lighting increases chlorophyll content (SPAD), green LED light reduces the infection rate of lettuce during storage and shelf-life conditions. J Food Process Preserv, 41: e13266.
13. Kiaya Victor., (2014). "Post-Harvest Losses and Strategies To." (January):1–25.
14. Kim Byeong Sam et al. (2011). "An Effect of Light Emitting Diode (LED) Irradiation Treatment on the Amplification of Functional Components of Immature Strawberry." Horticulture Environment and Biotechnology, 52(1):35–39.
15. Liu LH, Zabaras D, Bennett LE, Aguas P and Woonton BW., (2009). Effects of UV-C, red light and sun light on the carotenoid content and physical qualities of tomatoes during post-harvest storage. Food Chem,115: 495–500.
16. Ma, Liang, Min Zhang, Bhesh Bhandari, and Zhongxue Gao., (2017). "Recent Developments in Novel Shelf Life Extension Technologies of Fresh-Cut Fruits and Vegetables." Trends in Food Science and Technology, 64:23–38.

17. Ma, G., Zang, L. C., Setiawan, C. K., Yamawaki, K., Asai, T., Nishikawa, F., et al., (2014). Effect of red and blue LED light irradiation on ascorbate content and expression of genes related to ascorbate metabolism in postharvest broccoli. Postharvest Biology and Technology, 94:97 –103
18. Martina Loi, Vania C. Liuzzi, Francesca Fanelli, Silvana De Leonardis, Teresa Maria Creanza, Nicola Ancona, Costantino Paciolla and Giuseppina Mule., (2019). Effect of different light-emitting diode (LED) irradiation on the shelf life and phytonutrient content of broccoli (Brassica oleracea L. var. italica), Food chemistry, 283: 206-214.
19. Moustafa Khaled., (2016). "Food and Sustainability Challenges under Climate Changes." Science and Engineering Ethics, 22(6):1831–36.
20. Muir, James F., Jules Pretty, Sherman Robinson, Sandy M. Thomas, and Camilla Toulmin., (2010). "Food Security : The Challenge of." Science 327(February):812–18.
21. Noichinda S, Bodhipadma K, Mahamontri C and Narongruk TandKetsa S., (2007). Light during storage prevents loss of ascorbic acid, and increases glucose and fructose levels in Chinese kale (Brassica oleracea var. alboglabra). Postharv Biol Technol, 44:312–315.
22. Parfitt, Julian, Mark Barthel, and Sarah Macnaughton., (2010). "Food Waste within Food Supply Chains: Quantification and Potential for Change to 2050." Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, 365(1554):3065–81.
23. Prusky Dov., (2011). "Reduction of the Incidence of Postharvest Quality Losses, and Future Prospects." Food Security, 3(4):463–74.
24. Slavin, Jl and B. Lloyd., (2012). "Health Benefits of Fruits and Vegetables." Advances in Nutrition, 3(4):506–16.
25. Toledo MEA, Ueda Y, Imahori Y and Ayaki M., (2003). L-Ascorbic acid metabolism in spinach (Spinacia oleracea L.) during postharvest storage in light and dark. Postharv Biol Technol, 28:47–57.
26. Wang SY, Chen CT and Wang CY., (2009). The influence of light and maturity on fruit quality andflavonoid content of red raspberries. Food Chem, 112:676–684.
27. Xu, Feng et al., (2014). "Effect of Blue Light Treatment on Fruit Quality, Antioxidant Enzymes and Radical-Scavenging Activity in Strawberry Fruit." Scientia Horticulturae, 175:181–86.

Contract Farming: Prospects and Constraints from Perspective of Farmers' Interests

Article ID: 10275

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Introduction

Agriculture has become the backbone of Indian economy and due to the globalization and liberalization, cropping patterns are rapidly changing; besides, agricultural sector is now seen with a commercial outlook. In our country majority of the farmers belong to small and marginal categories and have poor resource base. Export oriented products and processed food items occupy vital position in market. In this context, contract farming is attaining an important place in agriculture in India. It is a form of vertical integration within agricultural commodity chains so that the firm has greater control over production process and final product (Chakrabarti, 2015). Contract farming generally facilitates the farmers to obtain necessary inputs and technical advices on time as well as helps the firms involved in contracts to earn monetary profits from crop production either by increasing productivity levels and supplying the products to agro-processing companies or by exporting those commodities after processing by its own.

What is Contract Farming?

Contract farming is defined as the procedure of crop production which is carried out according to an agreement between unequal parties, companies, government bodies or individual entrepreneurs on one side (buyers) and economically weaker section of farmers on the other side thereby establishing circumstances for production and marketing of agricultural products. Customarily, the cultivators agree to contribute the predetermined quantities of specific agricultural product/products to the buyers which must fulfil the quality standards of the purchaser and be supplied at the time decided by the client. Consecutively, the consumer is committed to purchase the product and in certain situations, may support the entire production process thoroughly such as supply of farm inputs, land preparation and provision of technical guidance.

Features of Contract Farming

1. Creating new markets.
2. Efficiency and economics of scale.
3. Ensuring quality standards.
4. Facilitating diffusion of modern technologies.
5. Minimizing transaction costs.
6. Coping with information asymmetries.
7. Price volatility.
8. Sharing of risk.

Why Contract Farming?

1. To reduce the load on central and state level procurement system.
2. To increase private sector investment in agriculture.
3. To bring about a market focus in terms of crop selection by Indian farmers.
4. To generate a steady source of income at individual farmer level.
5. To promote processing and value addition.
6. To generate gainful employment opportunities in rural communities, particularly for landless agricultural labourers.

7. To flatten as far as possible, any seasonality associated with such employment.
8. To reduce migration from rural to urban areas.
9. To promote rural self-reliance in general by pooling locally available resources and expertise to meet new challenges.

Prospects of Contract Farming

1. Small scale farming is becoming competitive; small and marginal farmers may have accessibility to the technologies, credit facilities, marketing channels and proper information besides decreased expenditures of transactions.
2. It gives an assured marketing structure for their produce at their doorsteps that may help to reduce the marketing and transaction costs.
3. Contract farming can reduce the risk/challenges of production, price and marketing costs.
4. It may certainly open up new marketing facilities which would otherwise be inaccessible to the small farmers.
5. Contract farming gives guarantee of achieving greater production with superior quality, financial support in terms of cash and technical guidance to the farmers.
6. Contract farming can ensure a consistent supply of quality agricultural products at the appropriate time and lesser cost while considering agri-processing level.

Constraints of Contract Farming

1. Small and fragmented landholdings of farmers.
2. Loss of flexibility to sell to alternative buyers when prices increase.
3. Possible delays in payments.
4. Late delivery of inputs.
5. Need to contract with a larger number.
6. Risk of indebtedness from loans provided by the buyer.
7. Environmental risks from growing only one type of crop.
8. Unequal bargaining power between farmers and buyers.
9. No mechanism to discourage default.
10. No legal recourse when faced with large scale opposition of contracts.
11. Lack of comprehensive crop insurance scheme in order to give protection against natural calamities.

Contract Farming is a Suitable Means to Curb the Impediments Posed by Existing Marketing Mechanism

Contract farming can control the hindrances faced by the current marketing system through different models:
1. Firstly, an informal model is the most theoretical model in which the companies are involved in informal seasonal production agreements with smallholders possessing a detriment of default profit or loss for the promoter as well as the farmer. Nevertheless, the continuing relationships may curb the risk of self-centred attitude thereby increasing the possibilities of considerable production levels.

2. Intermediary model is an important model in which the purchaser subcontracts an intermediary farm aggregator with an aim to produce and purchase the crop, contribute embedded assistance and encouragement to the producers and assure quality of the product.

3. Multipartite model may be constituted from the previously existing centralised models which involve different types of organisations like statutory bodies, private companies, financial institutions, and third party service providers thereby guaranteeing equity share schemes for farmers and attracting the investors to draw attention in direction of the food processing industry on a wide scale.

4. Moreover, in the Nucleus estate model the company usually may administer and inspect the plantation or production facilities in order to complement the production of smallholders and contribute provide minimal efficiency through the year which is particularly suitable for tree crops, oilseeds, rubber etc.

5. A representative marketing contradiction suggests that the purchasers like supermarkets and processors have complaints regarding insufficient supply of products whereas producers may protest for having dearth of proper markets. Most evidently the buyers are not very much efficient to search for new suppliers; besides, the cultivators possess inadequate technical skills and resources in order to diagnose new markets. This type of problem is effectively solved by the contract farming.

6. Majority of the developing countries can effectively supply organic products due to current package of practices of production involving nil/negligible chemical utilization but certification procedure at many a time may be very expensive. Further research is entirely dependent upon the fact that to which extent the provision of organic products to world markets by groups of small farmers can be maintained sustainable. It is evident that contract farming is turning into an excessively tempting method mainly for large and commercial farms with the advancement in requirements of organics.

7. Diversification of export markets is highly advantageous and additionally a tendency for supermarkets to amalgamate the suppliers to facilitate chain coordination and quality control is observed.

8. Producers are reciprocating to low commodity prices by marketing identifiable brands which may be organic or fair-trade brands but others may purely offer quality/taste parameters requiring no certification, frequently with the assistance of donors and NGOs. On the other hand, an extreme interest is being showed about the geographical origin of the product and the developmental procedure of the brands reflecting specific origin.

Suggestions for Improvement of Contract Farming in India

1. Emphasis should be on infrastructure development.
2. For better understanding of terms and condition of contract farming, the agreement should be in regional languages.
3. The data should be maintained at state level as well as country level to make them available for effective policy making.
4. Success in developing contracting models or other forms of farm-firm linkages such as clusters that are effective for small holders will be a key to small holder participation.
5. The contract farming in India is yet in nascent stage; therefore, steps should be taken to boost the growth of contract farming.
6. Government needs to assure that contract farming is generally commodity specific tending to promote monoculture thereby making land use planning necessary.
7. Government should give some incentives to contract farming firms.

Conclusion

Accelerating the progress of accomplishment of contract farming in our country can produce a new ray of hope in the fore coming years for agrarian sector. Once it is properly implemented in India, the improved transfer of technologies and capital inflow are anticipated to penetrate along with the growth of an assured market for crop production which will not only safeguard the interest of small and marginal farmers but also can lead to a complete makeover of the agriculture industry.

References

Chakrabarti M., (2015). An Empirical Study on Contract Farming In India. International Journal of Informative and Futuristic Research. Volume 2, Issue 5.

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Sericulture: A Profitable Agro-Based Enterprise

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Introduction

Sericulture is a labour intensive agro based cottage industry that contributes significantly to employment in rural areas in some of the states where it is predominant. Sericulture, a recognized practice in India, is defined as a practice of combining mulberry cultivation, silkworm rearing and silk reeling. There are four varieties or types of silk worms generally reared in India *viz.* Mulberry silk worm/domestic silk moth (*Bombyx mori*), Eri silk worm (*Philosamia ricini*), Tassar silk worm (*Antheraea mylitta*) and Muga silk worm (*Antheraea assamensis*). Mulberry is taken up in several parts of the country such as Karnataka, West Bengal and Jammu and Kashmir; muga silk production is mainly confined to Assam; and tassar silk production is mainly taken up in Bihar, West Bengal, Madhya Pradesh and Orissa and is identified as an activity mostly associated with tribal communities. Besides, eri silk production is restricted to Assam and Orissa states. In West Bengal, mulberry sericulture is a traditional activity predominant in several districts such as Malda, Murshidabad, Bankura, Purulia, Darjeeling, Uttar Dinajpur, Cooch Behar, North and South 24-Parganas, Jalpaiguri, Midnapur, Dakshin Dinajpur, Burdwan, Birbhum and Nadia. While considering tassar silk, the activity is predominant in Purulia, Bankura, Midnapur and Birbhum. The major crop under expansion programme in West Bengal is mulberry. India occupies the second position in the world, next to China in terms of silk production where it plays a vital role in development of socio-economic conditions and generation of employment opportunities to the rural poor. The total area under mulberry cultivation is approximately 188 thousand ha in the country. In India more than 98% of mulberry silk is produced from five traditional states like Karnataka, Andhra Pradesh, West Bengal, Tamil Nadu, and Jammu and Kashmir. The climatic situations in our country are very much favourable for luxuriant growth of mulberry and rearing silkworms throughout the year. The temperature in Karnataka, the major silk producing state in India, ranges from 21.2 to 30^{0}C whereas the climate in Kashmir is more advantageous to silk worm from the months of May to October. Cultivation of mulberry plants is termed as Moriculture. There are about 20 species of mulberry, among which four species like *Morus alba*, *M. indica*, *M. serrata* and *M. latifolia* are usually cultivated. The crop can yield well for 12 years, after that they are pulled out and fresh planting is done. Yield of mulberry leaves is approximately 30-40 t/ha/year.

Major Benefits of Sericulture

India is the only country in world which produces all varieties of silk namely mulberry, tassar, muga and eri (Anitha, 2011). Silk reeling is an activity where people with little education and technical knowledge can also learn reeling skills while being employed in the reeling units (Inbanathan and Prakash, 2002).

1. High employment generation: About 60-100 lakh people especially in forest areas like tribal are engaged in various on-farm and off-farm activities and sericulture can generate employment @ 11 man days per kg of raw silk production throughout the year leading to rural economy upliftment.
2. Provides vibrancy to village economies: About 57% of the gross value of silk fabrics flows back to the cocoon growers with share of income to different groups.
3. Low gestation but high returns: Mulberry takes 6 months to grow and once planted can support silkworm rearing for 15-20 years depending on inputs and management provided.
4. Five crops can be taken in one year under tropical conditions.
5. Women friendly occupation: Women constitute over 60% of total employed in down-stream activities in India; mulberry garden management, leaf harvesting and silkworm rearing are effectively carried out by the women folk and silk reeling industry including weaving is 100% supported by them.

6. Sericulture is an ideal program for weaker sections of the society and an eco-friendly activity.
7. Sericulture can be practiced even with very low land holding.
8. Being a deep-rooted perennial crop with good foliage, mulberry contributes to soil conservation and provides green cover and can be raised in vacant lands, hill slopes and watershed areas.
9. Being a labour intensive and predominantly agro-based activity, involvement of smoke-emitting machinery is minimal.
10. Developmental program initiated for mulberry plantation are mainly taken up in upland areas where unutilized cultivable lands are made productive.
11. Mulberry can also be cultivated as intercrop with numerous plantations.

Major Constraints in Sericulture

Followings are the major hindrances in case of sericulture:

1. Constrains in mulberry cultivation:

a. Labour scarcity due to diversified employment opportunities.
b. Even though they are available, they have to be paid with higher wages (high labour cost).
c. Harvesting of mulberry leaves is a labour-intensive operation.
d. Harvesting requires frequent and a greater number of harvests.
e. Inadequate water supply during summer as water level would go down thereby limiting the availability of water for irrigation purpose.
f. Therefore, the farmers can not undertake cultivation of mulberry in larger area.
g. Pest and disease attack; leaf eating caterpillars and stem borers are the major pest causing huge reduction of yield.
h. Non-availability of farm yard manure due to the fact that most of the farmers are not rearing cattle now-a-days.
i. Lack of awareness about application of bio-fertilizers due to lack of visual impact.
j. Lack of awareness about suitable varieties.

2. Constraints in silkworm rearing:

a. Non-availability of skilled labourers
b. Lack of awareness on maintenance and regulation of the room temperature, aeration and sunlight
c. Lack of knowledge about disinfectants
d. Rearing of silkworms requires skill in various steps like cutting of mulberry leaves, feeding, changing of beds, maintenance of temperature and aeration and maintenance of hygienic environment.
e. All these operations can be carried out properly only when the labourers are skilled and trained.
f. The labourers can learn skills only after some years of their experience and training.
g. Maintenance of optimum temperature, aeration and sunlight is very important for producing quality cocoons.
h. Majority of the farmers don't have adequate knowledge about identification of disinfectants thereby leading to more infection.

3. Constraints in marketing of cocoons:

a. Fluctuation in market price as the market price for cocoons is decided mainly based on the quality of cocoons
b. The poor-quality cocoons may be produced due to various reasons such as improper feeding schedules, disinfectant larvae, maintenance of irregular room temperature etc.
c. Only lower prices will be paid for poor quality cocoons and hence there may be fluctuation in market prices.
d. Distant location of market
i. The respondents have to take their products to market centres for marketing.

ii. Some villages are far away from market centres and the farmers feel the difficulty to take their products to market.

e. More expenditure on transport.

i. As market centres is located in distant places, they face the constraint of transport.

ii. Few respondents have the mode of own transport.

iii. Many of them depend on hiring vehicles like van, tempos and buses, for that they have to spend more money.

f. Delayed payments from buyers: As the marketing is mainly undertaken by government, sometimes there may be a delayed repayment from buyers.

Key Interventions of Sericulture Department

In order to achieve a better production level after mitigating the challenges, the department of sericulture has proposed some key interventions:

1. Introduction of high yielding varieties of mulberry.
2. Supply planting materials at subsidized rates.
3. Supply of rearing inputs/appliances to the beneficiaries.
4. Maintenance and multiplication of basic silkworm seeds.
5. Promotion of post cocoon sector through development of reeling/twisting infrastructure.
6. Encourage cultivation of eri and muga in the district of Jalpaiguri and Cooch Behar in West Bengal, respectively, by providing necessary infrastructure and assistance to the tribes engaged in these activities.
7. Training and capacity building of stakeholders viz., officials, farmers, reelers and private seed producers.
8. Marketing support to the producers.

Conclusion

Silk is considered the queen of textiles fibres because of its unique properties, which compile lightness with warmth, sheerness with strength, delicacy with resilience. Though it commands a high price which only the rich can afford, yet the industry is extremely important for the poor. Sericulture is an agro-based industry involving silkworms rearing for production of raw silk, which is the yarn obtained out of cocoons spun by certain species of insects. If fashion is a fine art, then silk is its biggest canvas, and if silk is the canvas, then all its weavers, dyers, designers, embroiderers are the greatest artists. Indian silk has enthralled fashion watchers and all categories of consumers across the world with its vast repertoire of motifs, techniques and brilliant hues. India's traditional and culture bound domestic market and an amazing diversity of silk garments that reflect 'geographic specificity' has helped the country to achieve a leading position in silk industry.

References

1. Anitha R., (2011). "Indian silk Industry in the Global Scenario". International Journal of Multidisciplinary management studies. 1(3):100- 110.
2. Inbanathan A. and Prakash O., (2002). "Silk Reeling and health: Lifestyle and quality of life of workers", Institute for Social and Economic Change. pp. 1-27.

Periwinkle Cultivation Practices in India and its Uses

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Catharanthus roseus is an evergreen sub herb or herbaceous plant. A native to Madagascar, this herbaceous plant grows to 80 cm to 1 m high and blooms continuously year-round with pink, purple, or white flowers (Hogan, 2003). The leaves are oval to oblong, 2.5- 9.0 cm. long and 1- 3.5 cm. broad glossy green hairless with a pale midrib and a short petiole about 1- 1.8 cm. long and they are arranged in the opposite pairs.

Production Technology

Climate: It can be successfully grown up to an elevation of 1300 m above sea level. A well distributed rainfall of 100 cm or more is ideal for raising this crop on commercial scale under rain-fed conditions.

Soil: The crop is hardy and grows well on a wide variety of soils, except those which are alkaline or water-logged. Deep sandy loam to loam soils of medium fertility is preferred for its large-scale cultivation because of better development of roots and also easy to collect at harvest time.

Types and Varieties

There are three variants in periwinkle, those with:
1. Rose purple flowers.
2. White flowers.
3. White flowers with a rose purple spot in the centre.

The first type is being cultivated because of its higher alkaloid content. Recently, two white flowered varieties named “Nirmal” and “Dhawal” have been released by the CIMAP, Lucknow, which although equal in active principles are reported to yield a higher biomass.

Propagation

The plants can either be propagated by seeds or vegetatively through cuttings.

Propagation by Seeds

Fresh seeds collected a few months in advance are preferred for sowing as they lose viability on long storage. The seeds can either be directly sown in the field or a nursery can be raised and the seedlings are transplanted.

Direct Sowing

The land is ploughed twice and brought to fine tilth. Weeds, stubble and pebbles are removed. The field is divided into plots of convenient size and the soil is mixed with the recommended dose of manures and fertilizers. The seeds at the rate of 2.5kg/ha are broadcasted at the onset of monsoon in June – July, in lines spaced 30 -45 cm apart and lightly covered. Since the seeds are very small, for ease in handling and distribution, they are mixed with sand about 10 times their weight. Germination takes place after about 7 – 8 days. After germination is complete the seedlings are thinned at a spacing of 30 – 40 cm within the row. The flowering starts 40 – 45 days after sowing.

Nursery Preparation and Transplanting

The seeds are sown in well prepared, raised nursery beds in March – April in rows spaced at 8 – 10 cm apart and about 1.5cm deep. About 500 gm of seeds will be enough to raise seedlings to cover 1 ha area. After two months of germination, the seedlings are ready for transplanting into the field. The seedlings are transplanted at a spacing of 45 x 30 cm in the field. A population of 74, 000 plants per ha may be accommodated.

Vegetative Propagation

To raise plants by this method, soft wood cuttings obtained from the lateral shoots have proved better than either hard or semi hard wood cuttings. Cuttings of about 10 – 15 cm length with a minimum of 5-6 nodes are ideal and result in about 90% rooting. Soaking the cuttings overnight in NAA solution of 25 or 50 ppm concentration has been found to further improve rooting to the extent of 96%. This method can be profitably used for multiplying the clones which have high alkaloid content and also where seed alone is to be produced.

Manures and Fertilizers

Apply FYM 10-15 t/ha and basal dose of 20 kg N, 30 kg P_2O_5 and 30 kg of K_2O per hectare per year.

Irrigation and Interculture

In the beginning, the field is irrigated at an interval of 6-7 days and later the intervals widened to 15-20 days depending on the weather and soil conditions.

Plots are kept weed free by earthling up the soil after 6 weeks of sowing and after each harvest.

Plant Protection

Plant is hardy hence devoid of pest and diseases. Occasionally they suffer from little leaf due to infection by mycoplasma resulting in stunted growth. This can be effectively checked by uprooting and destroying the affected plants. Die back / Twig blight/top rot is reported during monsoon.

Harvesting and Processing

1. Leaves, stem and seeds: For leaves, leaf stripping twice, first after 6 months and the second after 9 months of sowing can be taken. A third leaf stripping is also obtained when the whole plant is harvested. After the plant is harvested, it is dried in the shade.

2. Roots: The crop is harvested 12 months of sowing. The plants are cut about 7.5 cm above the ground level and dried for the stem, leaves and seeds. The field is then copiously irrigated and when it reaches proper condition for digging, it is ploughed and the roots are collected. The roots are washed well and dried in the shade.

For Seed

It has to be collected from matured pods 2 to 3 months before the harvest of the whole plant. The aerial part of the plant between 7.5cm and about 25 cm above the ground level is taken as the stem for the purpose of marketing.

Yield

Under irrigated conditions, about 4t/ha of leaves, 1.5t/ha of stem and 1.5t/ha of roots, on air dried basis may be obtained. Whereas, under rainfed conditions, the yield will be about 2 t/ha of leaves and 0.75t/ha each of stem and roots on air dried basis. The total alkaloid content in the leaf varies from 0.15 to 1.34 % of which the average content of Vinblastine is 0.002% while that of Vincristine is 0.005%.

Medicinal Uses

1. There are many traditional and folkloric uses of periwinkle which are time-tested and confirmed with peoples' belief.
2. The paste prepared from the leaves is an excellent wound healer and also relieve the wasp sting pain. It can stop bleeding, thereby quickening the healing process. Many also say that periwinkle is useful in bringing relief from depression, headaches and fatigue.
3. The juice of leaves is used as application to bee sting/ wasp sting
4. The bitter and astringent leaves are used as vomitive, roots used as purgative, vermifugl, depurative, hemostatic and toothache remedies
5. Decoction of flower is used in asthma, tuberculosis and flatulence
6. Stems and branches are bio-wastes. Powdered stems and branches can be applied to fields to serve as manure, thus recycling some of the nutrient elements removed from the soil during plant growth. They can also be dried and used as domestic fuel.
7. In the modern system of medicine, vinblastine sulphate (sold as Velban) is widely used in the treatment of cancers like Hodgkin's choriocarcinoma, lymphosarcoma, neuroblastoma, carcinoma of breasts / lttngs/ other organs, leukemia etc., and vincristine sulphate (sold as Oncovin) is extensively used in acute leukemia in children, lymphocytic leukemia, Hodgkin's disease, neuroblastoma, Wilm's tumor, rhabdosarcoma and reticulum cell sarcoma. Ajmalicine is used in the management of circulatory disorders, spasms, anxiety pain, etc

References

Hogan S. Flora: A gardener's encyclopedia. Timber Press, Inc., Portland, OR, 2003.

Resistance in Storage Pests to Phosphine: An Emerging Issue and Its Mitigation

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Introduction

Phosphine (Hydrogen phosphide, PH3) is an essential fumigant used globally of about 100 years of history after it was first described chemically by Philippe Gengembre in 1783 to disinfest stored products, thus maintaining the integrity of food and to facilitate international trade through the provision of pest and residue free commodities. The key to phosphine's success and popularity in stored product pest control over several decades includes its ease of application in different storage structures, effectiveness against major pest species, relatively low cost and acceptance by markets and regulatory authorities as a residue-free treatment (Nayak et al., 2017).

Formulation of phosphine: The commercial formulations include liquid, solid tablets, blankets and sachets or as a cylindered gas. The liquid phosphine is restricted due to some of the regulatory actions.

Mode of action: Phosphine acts as the respiratory poison. It mainly mediated inhibition of enzymes such as cytochrome-oxidase and catalase. Once the insect exposes on phosphine, it exerted a narcotic effect on the insects by decreasing the oxygen uptake as the mitochondria reached, then leads to respiration and cytochrome oxidase was reduced.

Development of Resistance and its Diagnosis

Due to lack of some other alternatives in that time multiple pest species got resistance against the phosphine. Phosphine resistance is genetically controlled and heritable traits allowing the carriers to survive a dose of phosphine that would normally kill conspecifies lacking the trait. In Australia, the strong resistance in *R.dominica* was first detected in 1997 and in *T. Castaneum* strong resistance was detected in 2000 (Jagadeesan *et al*., 2017). Utilizing the so-called FAO test, a global survey was undertaken and provided as a starting point for the historical accounting of phosphine resistance in storage pests. The FAO test determines the presence of resistance in a population based on the survival of adult beetles following exposure to a discriminating dose for that species under standard laboratory conditions. The rapid knockdown criterion implies that inability of insects to move in a coordinated manner. Based on this principle, rapid resistance diagnostic tests were developed for several stored product pests, including *T. Castaneum*, *R. dominica*, *S. Oryzae*, *L. Serricorne*, *O. surinamensis,* and *S. Granarius* (Afful, 2018). The basis of resistance was elaborated using classical and molecular genetics that identified genes at two separate loci conferring either weak or strong resistant phenotypes (Schlipalius *et al.,* 2018).

Pests Developed Phosphine Resistance

1. Lesser grain borer, *Rhyzopertha dominica*.
2. Rice weevil, *Sitophilus oryzae.*
3. Red flour beetle, *Tribolium castaneum.*
4. Saw-toothed grain beetle, *Oryzaephilus surinamensis.*
5. Khapra beetle, *Trogoderma granarium.*
6. Rusty grain beetle, *Cryptolestes ferrugineus*.

7. Psocids, *Liposcelis bostrychophila.*

Measurement of Strength of Resistance

The characterized strength of phosphine resistance of insects is measured by:

1. Probit regression analysis: Once a population is diagnosed as resistant, a group of adults from this population are exposed to a range of low to high concentrations of phosphine and the dose-mortality data from respective concentrations are collected.

2. Resistance ratio: A resistance ratio (RR) is then calculated by dividing the LC_{50} (the lethal concentration estimated to kill 50% of the tested insects) for a resistant population by the LC_{50} for a reference susceptible population.

Mitigation Approaches

1. Monitoring of resistance: The resistance monitoring has traditionally been based on bioassays; recent developments open up the possibility of using molecular diagnostics to screen for the presence of resistance variants in pest populations across the grain value chain.

2. Reducing selection: The phosphine resistance develops in a pest population mainly due to failure to maintain the recommended concentration within the storage enclosure, resulting in selection for resistance, given that resistance genotypes are present. The strategies to reduce the selection pressure for phosphine resistance are air-tightness of storage structures, limiting the number of repeat fumigations on the same batch of commodity, minimizing the application of phosphine through rotation with other treatments including grain protectant or another fumigant.

3. Resistance breaker: Several fumigants have been evaluated as alternatives to phosphine. Sulfuryl fluoride (SO_2F_2) is registered in some countries for use on stored products and recent laboratory studies have found no evidence of cross-resistance to sulfuryl fluoride in phosphine resistant *R. dominica*, *T. Castaneum* and *S. Oryzae* (Jagadeesan and Nayak, 2017).

4. Alternative application of Fumigants: Other fumigant treatments have shown potential in laboratory experiments to control phosphine-resistant insects in a range of species; these treatments include ozone, chlorine dioxide, and combinations of phosphine with carbon dioxide or sulfuryl fluoride (Jagadeesan *et al*., 2018).

5. Optimizing the phosphine fumigation: Several biological (Developmental stages of insects) and non-biological (Concentration and exposure time) factors affect phosphine efficacy and should be considered in research aimed at optimizing phosphine fumigations. Before the exposure of phosphine, the specific developmental stages of insects can be tested or populations containing all development of life stages can be tested.

6. Integrated strategies: Affected grain companies has developed an eradication strategy in collaboration with researchers involving regular monitoring, strategic use of sulfuryl fluoride only in case of failure of phosphine, isolation of grain with resistant pests, treatment with registered contact insecticides and adoption of an intensive hygiene program.

Conclusion

This resistance threatens the sustainability of phosphine as the cheapest and most versatile fumigant for disinfestation of stored products. Over the past decade, we have gleaned new insights into the ecological implications of phosphine resistance from field studies on dispersal, gene flow and polyandry. There are ongoing attempts in many countries to manage strong levels of resistance in major pests that are seriously compromising the effectiveness of currently registered rates of phosphine. However, several areas need attention from future research that will help in extending the usefulness of this unique fumigant into the foreseeable future.

References

1. Afful, E. 2018.Resistance of Rhyzopertha dominica (Coleoptera: Bostrichidae) to phosphine fumigation; geo-graphic variation, high dose treatments and rapid assay assessment. Ph. D. Thesis, Kansas State Univ., Manhat-tan.
2. Jagadeesan, R. and Nayak, M. K. 2017. Phosphine resistance does not confer cross-resistance to sulfuryl fluoride in four major stored grain insect pests. Pest Manag. Sci.,73: 1391-401.
3. Jagadeesan, R., Singarayan, V. T., Ebert, P. R. and Nayak, M. K. 2018. Potential of co-fumigation with phosphine (PH3) and sulfuryl fluoride (SO2F2) for the management of strongly phosphine resistant insect pests of stored grain. J. Econ. Entomol., 111: 2956–65.
4. Nayak, M. K., Falk, M. G., Emery, R. N., Collins, P. J. and Holloway, J. C. 2017. An analysis of trends, frequencies and factors influencing the development of resistance to phosphine in the red flour beetle Tribolium castaneum (Herbst) in Australia. J. Stored Prod. Res., 72:35–48.
5. Schlipalius, D. I., Tuck, A. G., Pavic, H., Daglish, G. J., Nayak, M. K. and Ebert, P. R. 2018. A high-throughput system used to determine frequency and distribution of phosphine resistance across large geographical regions. Pest Manag. Sci., 75: 1091–98.

The Brief About in Lac Culture Practices

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Introduction

1. The term "Lac" derived from the Sanskrit word "Laksha" meaning a hundred thousand and is suggestive of the large number of insects involved in its production.
2. The description of the insect and its host plant (Food plant) – Palas (*Lakshataru)* is recorded in the *Atharva Veda.*
3. It is mentioned in the Mahabharata mentioned lakhagriha or Jadugriha (Lac house) which the *Kauravas* had got construct to burn alive the Pandavas by setting the lac palace on fire.
4. Rearing of lac insects for commercial production of the lac is called as lac culture.
5. Lac is produced by an insect *Laccifer lacca*.
6. The first scientific account of the lac insect was given by J. Kerr in 1782.

Classification of Lac Insect

Phylum	Arthropoda
Class	Insecta
Order	Hemiptera
Family	Kerriidae
Genus	Kerrica
Species	lacca

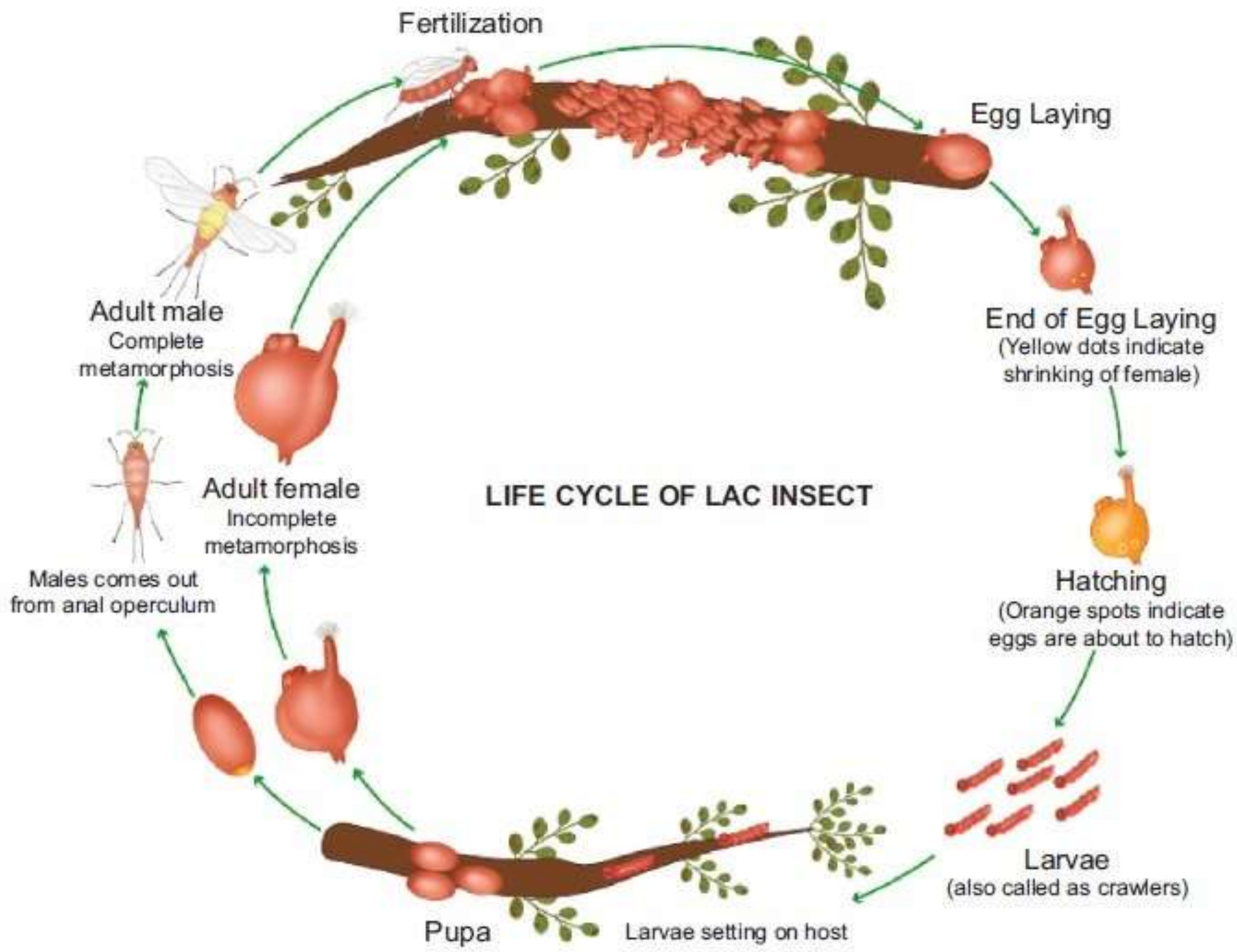
Importance of Lac Culture

1. Lac is used in preparing a Bangles.
2. Lac is used in preparation of toys.
3. Lac is used in the preparation of inks and polishes.
4. Lac is used in wood work and for making ornamental things.
5. Lac is used in process of silvering the back of mirror.
6. Government of India has started research work in 1921 and established Indian Lac Research Institute at Ranchi in Bihar in 1925 (Indian Institute of Natural Resins and Gums).
7. A good source of livelihood resource for poor farmers. Avoids migration of rural population to urban areas.
8. Assured source of income during drought years.
9. Require meager inputs (like water, pesticides etc.)
10. Most suitably grown on marginal and degraded land.
11. No competition with other horticultural, agricultural crops for land and farm operation.
12. Do not harm host tree health neither other flora and fauna.
13. India is highest lac producing country in world near about 65% of total lac production seen in India.

Biology

Laccifer lacca, Female insect is viviparous, producing about 1000 nymphs, deep red in colour with black eyes, soft bodied, 0.6mm long, 3 pairs of leg and a pair of antennae. The larvae settle down on a suitable place of the host plant. A day or two after settlement, the larvae start secreting lac all around the body except on the rostrum, spiracles and on the tip of abdomen.

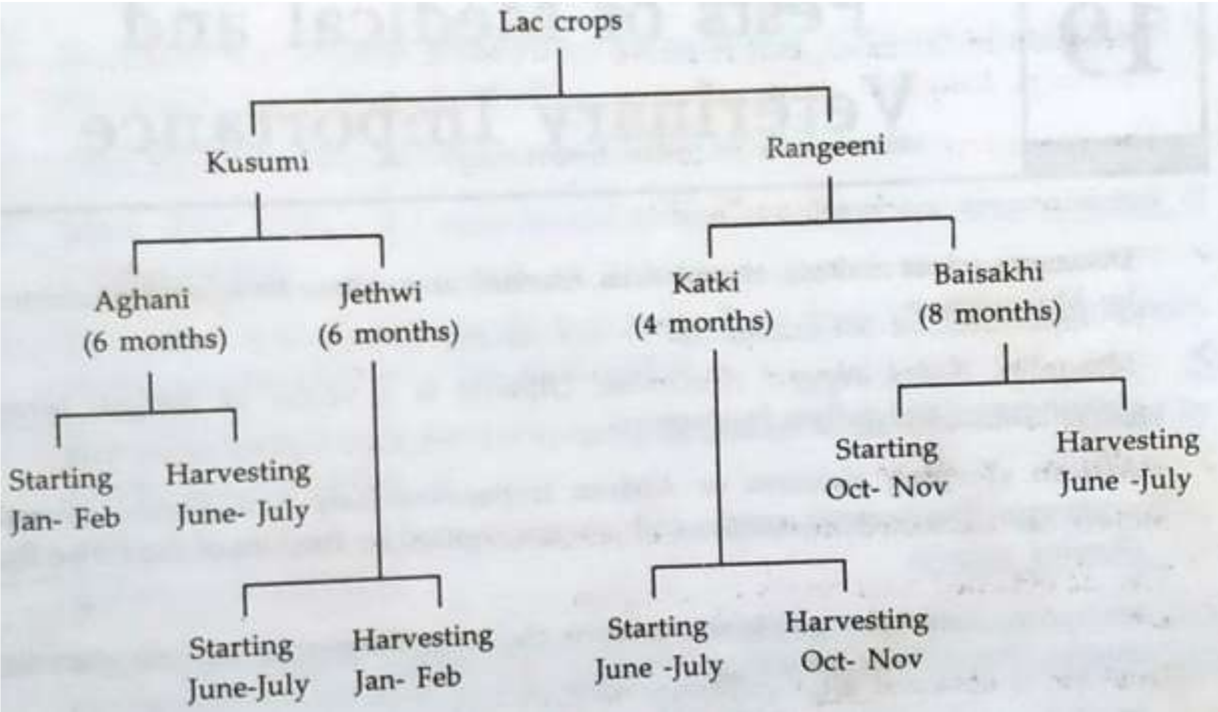
Thus, it gets encased in a cell of lac which gradually increases in size along with the increase in size of the insect. The female nymph never regains appendages and continue to remain under the lac cell, become adults and reproduce. As the lac insects remain close together, lac secretion from adjacent cells coalesces with each other and forms a continuous encrustation on the tree branch. Males walk over the lac encrustation, fertilize the females present inside cell through anal tubercular opening. Female after maturity grow very fast, secrets lack abundantly. Size of the female cell is several times larger than male cell.



Lac Culture Host Plants

Sl. No.	Crop name	Scientific name
1.	Khair	*Acacia catechu*
2.	Palas	*Butea monosperma*
3.	Babul	*Acacia Arabica*
4.	Ber	*Zizyphus jujuba*
5.	Ghont	*Zizyphus xylopyra*
6.	Arhar	*Cajanus cajan*
7.	Jallari	*Shorea talura*
8.	Grwia	*Grewia spp*
9.	Kusum	*Schleichera oleosa*

1. There are two distinct strains of lac insect India called Kusumi and rangeeni.
2. The kusumi strain is raised mainly kusum tree and the rangeeni on all other hosts such as palas, ber, ghont, arhar etc.,
3. Each of the strains produce two crops in a year thus there are four crops.



Pruning Operation for Lac Culture

1. Pruning means cutting away old, weak and disease branches to inducing the tree to produce maximum number of shoots for successful colonization by the lac insect.
2. Pruning should always be carried out lightly and branches more than 2.5 cm in diameter should not be cut.
3. Branches between 1.25 cm to 2.5 cm in diameter are cut, so as to leave behind a stalk of about 30-45 cm in length.

Types of Pruning in Lac Host Plant

1. Light pruning:

a. Light pruning is recommended for slow growing conventional host tree species like palas, kusum and ber.

b. Diseased and dead portion of branches should be removed completely.

2. Basal/heavy pruning: In quick growing bushy host, pruning should be done at a height of 10-15 cm from the ground level Eg: *F. semialata*, *F. macrophylla*.

Kusum *(Schleichera oleosa)*: Either in January / February or in June / July.

Khair *(Acacia catechu)*: Done in March. However, harvesting of lac crop during February may be used to serve as pruning also.

Ber *(Zizyphus mauritiana)* or Palas *(Butea monosperma)*: Done in February for inoculation in July and in April / May for inoculation in October-November.

Ficus spp.: Pruning is to be done in April for inoculation in July and in May for inoculation in October.

Pruning Instruments of Lac Culture

1. The ideal pruning instruments are secateurs.
2. Pruning is dining with axe.
3. Pruning is also done with pruning knife and Dauli.
4. The use of pruning shear and pruning saw fitted in long handle makes the operation easier as the pruning is done directly by standing on ground and climbing is avoided.

Main Steps of Lac Culture

1. Inoculation.
2. Swarming.
3. Harvesting.

Inoculation

The method by which the lac insects are introduced to the new lac host plant is known as inoculation.

1. Natural inoculation:

a. When infection from one plant to other occurs by natural movements of insect, it is called natural inoculation.

b. This may be due to overcrowding of insect population and non-availability of tender shoots on a particular tree.

Brood lac collection:

a. Lac sticks, having mature female insects ready to give rise to the next generation are called Brood lac.

b. Selection of brood lac healthy lac with the minimum signs of predator and parasite damage is selected for use as brood lac.

2. Artificial inoculation: Brood lacs are then kept for about two weeks in some cool place, when the larvae start emerging from this brood lac, they are supposed to be ready for inoculation.

Harvesting

1. Ari Lac: If lac crops are harvested little before the larval emergence (immature lac).

2. Phunki Lac: After the emergence is over, that is called Phunki Lac (empty lac).

Enemies of lac insects:

a. Squirrels and rats and the damage caused up to 50% of brood sticks.

b. Squirrels are active during the day time and the damage by them is more common under forest condition.

c. Rats are active at night time and the damage usually occurs near about the villages.

Control:

a. It is difficult to control the squirrels and rats under the open field conditions.

b. However, scaring away of these animals or poisoning them may be adopted to keep the rodents under attack.

Parasites:

Sl. No.	Parasites name	Family
1.	*Parageniaspis indicus*	*Encyrtidae*
2.	*Parechthrodryinus clavicornis*	*Encyrtidae*
3.	*Eurymyiocnema aphelinoides*	*Aphelinidae*
4.	*Lyka lacca*	*Encyrtidae*
5.	*Marietta javensis*	*Aphelinidae*
6.	*Eupelmus tachardiae*	*Eupelmidae*
7.	*Anicetus dodonia*	*Encyrtidae*
8.	*Atropates hautefeuilli*	*Encyrtidae*
9.	*Aphrastobracon flavipennis*	*Encyrtidae*
10.	*Bracon greeni*	*Encyrtidae*
11.	*Campyloneurus indicus*	*Encyrtidae*
12.	*Coccophaqus tchirchii*	*Aphelinidae*
13.	*Erencyrtus dewitzi*	*Encyrtidae*
14.	*Tachardiaephagus tachardiae*	*Encyrtidae*

15.	*Protyndarichus submettalicus*	*Encyrtidae*
16.	*Teachardiobius nigricans*	*Encyrtidae*
17.	*Aprostocetus(Tetrastichus) purpureus*	*Eulophidae*

Predators:

Sl. No.	Predators name	Family
1.	*Eublemma. scitula*	*Noctuidae*
2.	*E. cretacea*	*Noctuidae*
3.	*Catablemma sumbavensis*	*Blastobasidae*
4.	*Cryptoblabes ephestialis*	*Blastobasidae*
5.	*Eublemma amabilis*	*Noctuidae*
6.	*E. coccidiphaga*	*Noctuidae*
7.	*Pseudohypatopa pulverea*	*Blastobasidae*
8.	*Phroderces falcatella*	*Cosmopterygidae*
9.	*Lacciferophaga yunnanea*	*Momphidae*
10.	*Berginus maindroni*	*Mycetophagidae*
11.	*Tribolium ferrugineum*	*Tenebrionidae*
12.	*Silvanus iyeri*	*Cucujidae*
13.	*Chrysopa madestes*	*Chrysopidae*
14.	*C. lacciperda*	*Chrysopidae*
15.	*Ischonoptera fulvastrata*	*Blattellidae*
16.	*Phyllodromia humbertiana*	*Blattellidae*

Management Practices

1. Preventive measures:

a. Parasite and predator free brood lac should be used for inoculation.
b. Self-inoculation of lac crops should be avoided as far as possible.
c. Inoculated brood bundles should be kept on the host tree for a minimum period only.
d. Phunki should be removed from the inoculated trees in 2 – 3 weeks' time.
e. Cultivation of Kusumi strain of lac should be avoided in predominantly rangeeni area and vice versa.

2. Mechanical control:

a. Use of 60 mesh synthetic netting (brood bag) to enclose brood lac for inoculation purposes can reduce infestation of enemy insects of lac.
b. The emerging lac larvae easily crawl out from the minute pores of the net and settle on the twigs of the lac host plants, whereas the emerging adult predator enemies cannot move out of the brood bags and get entrapped within the net.
c. This can check the egg laying by the predator moths on the new crop.

3. Biological control:

a. Egg parasitoids *viz. Trichogramma achaeae, T. exiguum* and *T. ostrniae* are able to suppress the *Eublemma amabilis.*
b. The reduction in the population of *E. amabilis* up to 77-86 per cent in case of rangeeni crop and up to 52-72 per cent in kusum crop at the dose of 20 egg parasitoid per bush.

4. Chemical management: Lambdacyhalothrin, ethofenprox, DDVP, carbosulfan, indoxacarb, spinosad, fipronil, and alphamethrin shall be incorporated in IPM programs for the effective management of redators of lac insect without adversely affecting the lac insect.

The Important Properties of Lac

1. Soluble in alcohol and weak alkalis.

2. Capacity of forming uniform durable film.
3. Possess high scratch hardness.
4. Resistance to water.
5. Good adhesive nature.
6. Ability to form good sealers.
7. Capacity to allow quick rubbing with sandpaper without slicking or gumming.

Composition of Stick Lac

Lac resin	68%
Lac dye	1%
Lac wax	6%
Others	25%

Uses of Lac

1. Lac dye is used in dying of wool and silk, soft drink formulation, pill coating, confectionary and chocolate coating.
2. Lac wax has wide variety of uses in manufacturing shoe polishes, tailor's chalk, lipstick, crayons (for writing in glass). Now a days it is also used Lac dye (Erythrolaccin) has been used in India as a skin cosmetic and dye for wool and silk.
3. Bleached lac has specialised demand for coating medicinal tablets, confectioneries etc.
4. Because of its unique combination of properties, lac finds a wide variety of application in paint, electrical, automobile, cosmetic, leather, wood finishing and other industries.
5. Earlier about half of the total output was consumed in gramophone industry.
6. Lac has long been in use both for decorative and insulating varnishes.
7. It is usually used as a first coating on wood to fill the pores.
8. Lac is used in manufacture of glazed paper, printing and water proofing inks, lac bangles, dental plates and optical frames.
9. It is also used for finishing various products such as playing cards, oil cloth and for preserving archeological and zoological specimen.
10. In electrical industry, lac is used as coating of insulator, coating of spark plugs, cement of sockets of electrical lamp, anti-tracking insulating etc.
11. In Pharmaceutical industry, lac is used in coating of tablets, micro-encapsulation of vitamins and coating of medicines.

Conclusion

K. lacca is a valuable insect of money saving and ecological attentiveness. Lac production is an economic activity among rainfed farmers and forest dependants in Central Indian region. *K. lacca* is engaged to biotic and abiotic exertion, thus affects the producibility. Biotic factors, predators and parasites cause bulky yield loss to the lac crop, requires to be management strategy. Management of biotic factors may be a blending of chemical, cultural and biological. This approach will reduce the cost as well as protect the environment. Manipulation of the host and location to combat climate change may be strategically plan, so that lac production is able to be upheld or defended and economical.

References

1. Bhattacharya, A., Jaiswal, A. K., Singh, J. P., and Goel, S. C. 2008. Management of Lac Insect Predators through IPM based Biorational Approaches. In: Emerging Trends of Researches in Insect Pest Management and Environmental Safety, Goel, S.C. (Ed.). Vol. 1, Uttar Pradesh Zoological Society, India, pp: 221-226.
2. Bhattacharya, A., Jaiswal, A.K. and Kumar, S. 2005. Effect of treatment of broodlac with a few insecticides on the harboured inimical insects. J. Entomol. Res., 29: 223-225.

3. Bhattacharya, A., Kumar, S. and Jaiswal, A. K. 2007. Evaluation of Trichogramma species for the suppression of lepidopteran insect predator, Eublemma amabilis Moore, in lac culture on Flemingia macrophylla. J. Biol. Control, 21: 267-270.347035ja
4. Bhattacharya, A., Kumar, S., Jaiswal, A. K. and Kumar, K. K. 2006. Trichogramma spp. for the management of Eublemma amabilis Moore (Lepidoptera: Noctuidae) – a predator of Indian lac insect. Entomon., 31(2): 121-124.
5. Chattopadhyay, S. 2011. Introduction to lac and lac culture. Tech. Bull. FBTI: 01/2011, Department of Forest Biology and Tree Improvement, Faculty of Forestry, Birsa Agricultural University, Kanke, Ranchi, India, May 2011. http://www.wkfinetools.com/wWorking/z_recipes/LacCulture/0_img-pdf/IntroductionToLac&LacCulture.pdf.
6. Chaudhary, S.G. 1983. Chemical control of Chrysopa Sp. Annual Report, Indian Lac Research Institute, Ranchi, India, pp: 1-21.
7. Samiksha S. Scientific study of lac started much later. In 1709 Father Tachard discovered the insect that produced lac. First of all Kerr J. (1782).

Social Economical and Medicinal Importance of *Grewia optiva*

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Introduction

Grewia optiva locally called as Bhimal, Beul or Dhaman is a unique medicinal tree of the sub-Himalayan terrains often used for fibre and fodder by local farmers. Genus *Grewia* got the name after a founder of Plant Physiology Nehemiah Grew (1964-1712). Bhimal belongs to Tiliaceae family and it is native to India. Bark of tree is white and very smooth and used for fodder, fibres and fuelwood.*Grewia optiva* provides nutritive and palatable fodder along with bast fibre and fuelwood during the lean winter season. A considerable amount of organic matter is also gets added to the soil through litter fall of Bhimal leaves (Kar *et al.,* 2019). It is Commonly known as Dhaman, Biung, Biul, Bihul, Bhimal, Bhengal, Bewal and behal in Hindi and Shayalphusro, phusre, ghotli, Bhimal in Nepali language.

Botanical Description of the Tree

Bhimal is a deciduous tree with small to medium sized stature and generally having height from 9 m to 12 m; it has spreading type of crown; clear bole having around 1 m diameter. This tree has smooth pale silvery brown branches with thick and roughish texture. Leaves are having opposite phyllotaxy, having ovate acuminate shape, 5-13 cm x 36 cm in length, serrate margins, pubescent at abaxial surface, rounded base, petiole is 0.3-1 cm long, and rounded, stipules are present having 0.5 cm length and caducous in nature. Leaves of Bhimal are carry high amount of nutrients and protein while do not contain any tannins. Flowers One to eight in number having solitary peduncles, axillary and a length of 0.8-1.8 cm. Sepal have a length of 1-1.5 cm, which is linear, oblong and having 3-ribs. Sepals have a green colour on its outer surface while on inner surface it can be light yellow, white or red coloured. Petals of Bhimal flowers are generally little shorter than sepals having light yellow or white colour with a distinct claw. Fruit is botanically called as drupe or stone fruit having one to four lobes of about 0.8 cm diameter. Fruits are olive green in colour when immature and turn black after ripening. The ripened fruits can be eaten raw or cooked. Phenology Senescence of old leaves occurs in March-April, renewal of new leaves and flowering occurs in April-May with new leaves. The fruits are developed in the month of June to July and come to their full size by the month of September, ripening of fruit occurs between October and December month.

Silvicultural Characteristics of the Tree

The tree is strong demander of the light and generally requires complete overhead light, its seedlings are generally suppressed by weeds, the tree shows hardiness in frost conditions, coppicing can be easily done, the seedlings and the tree is susceptible to fire and browsing.

Distribution of the Tree

Trees of *Grewia optiva* are found in the Western Himalaya's foothills from J&K to Nepal at 500-2500 m of altitude above mean sea level, hence it can be said that it is a tree of sub-tropical nature. The tree can be grown easily in different type of soil, but sandy loam soil with adequate moisture is a suitable condition for its growth.

Fig. 1 Pictures of Grewia optiva tree retrived from https://efloraofindia.com/

Active Content

Research studies undertaken on the bark of Grewia optiva stem revealed that it had two chemical constituents, Grewialin, and an aromatic compound, Optivanin, β- sitosterol, stigmasterol, and lupeol, which were earlier unreported from this species of plant. (Uddin et al., 2013).

Medicinal & Social Importance

Products from several species belonging to genus Grewia are used as traditional medicine for treating various diseases like, cough, dysentery, diarrhea, small pox, malaria, typhoid, intestine and bladder with irritable conditions, rheumatism and eczema (Chopra et al., 1956). The products made are also Anti- bacterial and Anti-malarial (Grierson & Afolayan, 1999 and Uddin et al., 2013).

Shampoo from this tree: Bhimal bark is used as Shampoo i.e., washing hair. It has saponin and local people use it as an alternative of soap in village of Himalaya region in Uttarakhand. An herbal shampoo product has been developed by mixing it with Amla and Shikakai. The bark of the tree is dried in sunlight or in dryer and ground to a powder, this then mixed with Amla and Shikakai powder in the proportion 35 % Bhimal bark, 40 % Shikakai powder and 25 % Amla powder and packed. This product is a good treatment for dandruff and graying hair. Liquid shampoo can also be prepared with the sap.

Uses in Organic Farming or as a Biofertilizer: Bhimal's leaves are Proteinaceous and good for mulching of several vegetable crops. Large quantity of Organic matter adds to the soil due to the litter (leaves) which falls in winter season. Best response of growing bell peeper using organic manures under widely spaced G. optiva can offer economically more benefit better than sole (Kar et al., 2019).

Fuels, fibre and fodder: Wood obtained from Bhimal generally carries a foul odour with it and hence it is infrequently used as an alternative of the main fuelwood. The fibre obtained from the bark is used for cloth and cordage making. Lopping of the leaves is done for fodder. Several local farmers regard and use leaves of this tree as a key fodder for cattle feed and in some places, it is even preserved at the time of winter season for feeding cows in dairy farms.

As a Checker to the Soil Erosion: In Himalayan states particularly in Uttarakhand, it has been generally grown for checking soil erosion, farmers basically grow them in their field periphery and widely used for checking soil erosions, since it has a very deep tap root system which provides it support and hence it checks the soil. It can be easily seen in 90° slopes where most of the trees don't grow.

Economic Importance of the Tree

The wood obtained from this tree can be used for making axe handles, cat frames, oar-shafts, bows, shoulder poles also at other places where resultant product requires elasticity and strength. The wood is also said to be very suitable for paper making. Baskets can be made from the elastic branches. The bark yields a fibre of inferior quality and used for cordage making.

References

1. Anonymous1. 2021. https://efloraofindia.com/
2. Grierson, D.S., & Afolayan, A. J. (1999). Antibacterial activity of some indigenous plants used for the treatment of wounds in the Eastern Cape, South Africa. Journal of Ethnopharmacology, 66(1); 103–106.
3. Uddin, G., Ullah, W., Siddiqui, B.S. & Shah, S.Q. (2013). Grewialin and optivanin new constituents from the stem bark of Grewia optiva Drummond ex Burret (Tiliaceae), Natural Product Research: Formerly Natural Product Letters, 27(3): 215-220.
4. Chopra, R.N., Nayar, S.L., & Chopra, I.C. (1956). Glossary of Indian medicinal plants. New Delhi: Council of Scientific and Industrial Research.
5. Kar, S., Chandel, A., & Pant, K.S. (2019). Effect of Different Tree Spacings of Grewia optiva and Combined Doses of Poultry Manure and Vermicompost on Growth and Yield of Bell Pepper under Agrisilviculture System. International Journal of Current Microbiology and Applied Sciences, 8(1): 2213-2223.

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Crop Stress

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Introduction

Agriculture is considered as one of the most important sectors for the Indian economy. Although the crop production in India is increasing every year, but various crop stresses resist the rate of increment pf crop production. The consequences of such stresses resist lead to the development of deficiencies symptoms in plant-parts, impairment in crop yields, and even permanent damage or death of plants in case of severe deficiency. There are two types of stresses, which can be categorized as, [a] biotic and [b] abiotic stresses.

Now a days remote sensing is widely used for crop stress monitoring, stress detection and yield estimation. Remote sensing-based methods are non-destructive in nature and they can cover more spatial areas than the ground-based method. However, application of remote sensing techniques in the domain of agriculture requires high resolution imagery.

What is Crop Stress?

Crop stress is any condition in which, growth factors in terms of nutrients, water, temperature, light, etc are not present in their optimum quantity or quality which affects the crop growth. Less amount of these factors may cause deficiency in the crop whereas excess amount leads to toxicity. So, crop stress indicates the deviation of these growth factors from their optimal conditions.

Types of Crop Stress

Plant stress can be divided into two categories namely- abiotic & biotic stresses:

Abiotic stress is imposed on the crop mainly by environmental factors and these may affect the crop growth due to serious environmental circumstances. Any adverse influence of inanimate factors (non-living factors) on plants leads to the deviation from their normal activity which can be described as abiotic stress. Drought or extra water in the crop, high/low temperature, mineral toxicity and good/poor seed quality comes under the examples of abiotic stress in crop.

Figure.1 Abiotic stress in crops

Biotic stress is the negative influence caused by living factors i.e., insect, disease, weed, nematode, etc. on the growth of crop plant and thereby affecting the crop yield. Such stress includes the attack of various organisms such as fungi, bacteria, actinoomycetes, nematodes, herbivores and other organisms. Sometimes it may lead to the premature death of crop plant. These plants are considered as stress susceptible plants. However, several plants like desert plants (Ephemerals) can escape the stress altogether. Diseases caused by these organism's accounts for major yield loss worldwide.

Figure.1 Biotic stress in crops

Remote Sensing for Crop Stress

Remote sensing is drawing attention for crop stress monitoring nowadays. Various government agencies and private institutions have provided a great deal of fundamental information relating spectral reflectance and thermal emittance properties of soils and crops to their agronomic and biophysical characteristics.

This knowledge about the spectral reflectance and thermal emittance properties of soils and crops gives the idea to develop new remote sensing techniques to monitor crop stresses effectively. Various remote sensing methods can assist in non-destructive monitoring of plant growth and development as well as for detecting the environmental stresses which hinder the yield or crop productivity. Remote sensing techniques either from ground or air or space-based platforms have enough potential to provide the detailed spatial and temporal information regarding the plant responses to their local environmental conditions which is very essential for effective stress management of crop plants.

Conclusion

It is clear that abiotic and biotic stresses mainly affect the crop growth and production. Such stresses need to be monitored in proper time for maintaining optimum production level. However real time monitoring of such crop stresses is a major challenge in the agricultural field. Therefore, our review suggests to apply remote sensing techniques for real time crop stress monitoring.

References

1. Audil Gull, Ajaz Ahmad Lone and Noor Ul Islam Wani (October 7th 2019). Biotic and Abiotic Stresses in Plants, Abiotic and Biotic Stress in Plants, Alexandre Bosco de Oliveira, IntechOpen, DOI: 10.5772/intechopen.85832. Available from: https://www.intechopen.com/books/abiotic-and-biotic-stress-in-plants/biotic-and-abiotic-stresses-in-plants
2. Dresselhaus, Thomas, and Ralph Hückelhoven. "Biotic and abiotic stress responses in crop plants." (2018): 267.
3. Kumar, Manu. "Crop plants and abiotic stresses." J. Biomol. Res. Ther 3.1 (2013).
4. Mittler, Ron. "Abiotic stress, the field environment and stress combination." Trends in plant science 11.1 (2006): 15-19.
5. Mosa, Kareem A., Ahmed Ismail, and Mohamed Helmy. "Introduction to plant stresses." Plant Stress Tolerance. Springer, Cham, 2017. 1-19.

Mechanism of Humus – Pesticide Interaction in Soil

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Introduction

The retention of pesticides in soils is mainly due to the adsorption, which is the passage of a solute from an aqueous phase to the surface of a solid adsorbent. The solid adsorbents are the different soil constituents. According to the properties of pesticides and adsorbents, several adsorption mechanisms are possible: hydrogen bonding, ion exchanges, interactions with metallic cations, polar interactions, charge transfers, Van der Waals dispersion forces and hydrophobic effects. As the soil constituents contain polar and ionisable groups, the adsorption of pesticides possessing polar and non-polar groups can involve several of these mechanisms. The reverse process of adsorption is desorption. In general, the desorption is inversely related to adsorption, being small when adsorption is great, and conversely.

Methods of Measurement

Batch experiments: Most of the time, the retention of pesticides is measured with soil suspensions, known as batch experiments. The amounts of adsorbed pesticide in the soil are calculated as the difference between initial pesticide concentration in solution and centrifuged supernatant concentration. This experiment is done at several initial pesticide concentrations to determine the adsorption isotherm of the pesticide (adsorbed amounts as a function of the equilibrium concentration of pesticide). In general, the smaller the concentration, the greater the adsorbed amount per unit mass soil. From this isotherm, distribution coefficients between soil and soil solution can be determined according to the Freundlich (Kf) model (1).

Kf = Qs / Cenf --------------------- (1)

where Qs (mg kg-1) is amount of adsorbed herbicide in soil at equilibrium concentration, Ce (mg L-1) is pesticide concentration in supernatant solution, and nf is an empirical coefficient. When nf = 1, the isotherm is linear and Kf = Kd (L kg-1). As organic carbon is a major adsorbent for pesticides (see 2.3.2.1), the Koc (L kg-1) (2) coefficient is often calculated as:

Koc = (Kd× 100) / Corg ---------------------(2)

where Corg is the percentage of organic carbon content in soil. For a given pesticide, the Koc is generally less variable than the Kd among different soils. However, the intensive shaking of soil-pesticide solution leads to dispersion of the soil structure, resulting in a higher availability of sorption sites. Therefore, batch overestimates the sorption of pesticides.

Centrifugation: The soil sample is prepared at realistic soil moisture, treated with the pesticide, incubated, and then centrifuged to collect the soil solution which is directly analysed for pesticide concentration.

Filters: The volume of the soil solution and the dissolved pesticide retained in the filter are determined. This method could be adapted to undisturbed soil samples.

Soil columns: The soil columns allow the study of retention in dynamic conditions. The column is filled with disturbed (sieved or small aggregates) or undisturbed soil, a solution of pesticide is applied at the top of the column then water flow is imposed through rainfall simulation or pressure head control.

Lysimeters: A lysimeter consists of an undisturbed soil block or cylinder, embedded in an inert container with a bottom permeable to drainage water or leachate. An outstanding feature of lysimeters is the capability to monitor mass fluxes of water and chemicals under field climatic conditions and representative crop practices.

Factors Controlling the Retention of Pesticides in Soils

1. Physico-chemical properties of pesticides: Surface, volume, and branching: In general, the adsorption of pesticides increases with the volume and with the degree of branching which is correlated to the surface area.

2. Electronic structure: The nature of atoms and of functional groups determines the electronic structure of the pesticides (therefore their permanent dipole moment and polarizability) that governs the type of interactions of pesticide with soils.

3. Ionization: It determines the charge of the pesticide and depends on its electronic structure. Strong bases always occur in cationic form in soils, but the ionization of weak bases and weak acids depends on the pH of the soil and on pKa or pKb values of molecules.

4. In general, the sorption of cations is strong on negatively charged surfaces like clays, oxides, hydroxides and humic substances. On the contrary, anions are not adsorbed on these surfaces, but their sorption is high in soils with positive charges, like tropical soils. For example, glyphosate has four pKa so that its sorption increases when the soil pH decreases because the number of negative charges of this herbicide decreases.

5. Hydrophilic / hydrophobic balance: The hydrophilicity of pesticides is defined by their water solubility and the hydrophobicity by their octanol / water partition coefficient. In general, the adsorption of pesticides decreases when their water solubility increases because of their high affinity for the water phase, and conversely, the adsorption increases with the hydrophobicity of pesticides. However, it also depends on the hydrophilic / hydrophobic balance of the soil adsorbents.

Soil Properties

Minerals: The mineral adsorbents involved in the adsorption of pesticides are clays (as silicate minerals), oxides and hydroxides. Their surfaces are mainly hydrophilic because of hydroxyl groups and exchangeable cations. The adsorption of pesticides on clay minerals is likely to occur on external surfaces of clay particles rather than in interlamellar space and increases with the specific surface of clays. Oxides and hydroxides are frequently associated to clays, they have a high surface activity and their charge depends on the soil pH.

Organic matter: Soil organic matter originates from crop residues, microbial biomass and organic amendments. It has very heterogeneous composition and contains both hydrophilic and hydrophobic groups. Even if organic matter only represents few percents of the total dried material in soil, it is a major sorbent of pesticides in soil. This is attributed to its high chemical reactivity towards both mineral surfaces and organic molecules, allowing various types of interaction with pesticides. The sorption capacities of organic matter are not only controlled by their chemical composition, but also by their size, due to a greater number of sorptive sites related to a greater surface area with decreasing particle-size. In general, the adsorption of pesticides increases with organic matter, except for ionic molecules.

Soil pH: The soil pH plays an important role in particular for the adsorption of ionic pesticides like glyphosate or sulcotrione. Depending on the charge of the pesticide, the adsorption will increase (or decrease) with pH. For example, the retention of glyphosate increases when the soil pH decreases because the number of negative charges of the molecule decreases, allowing the adsorption on negatively charged adsorbents like clay or organic matter.

Soil structure: Pesticide movement through aggregated soils is mainly controlled by kinetic sorption and diffusion. In static conditions, the rate of pesticide adsorption decreases when the density of soil aggregates increases. In dynamic conditions, retention depends on transport parameters such as pore water velocity and residence time. Compared to tilled soils, the no tilled or grassland soils are characterized by the presence of bio pores (due to earthworm burrows, roots…) and high content of organic matter in the surface layers. The retention of pesticides is therefore generally higher in these soils.

Effect of Environmental Conditions (Water Content, Temperature)

Water content: The adsorption of pesticides increases with water content as it facilitates pesticide diffusion to sorption sites. As water content increases, the organic matter also becomes more hydrophilic with greater sorption potential for hydrophilic pesticides.

Temperature: In general, the adsorption of pesticides decreases when the temperature increases.

Biodegradation: The degradation of pesticide through microbial metabolic processes is considered to be the primary mechanism of biological transformation. The different groups of microorganisms, mainly the prokaryotic bacteria, actinomycetes and eukaryotic fungi, can mediate an almost infinite number of biochemical transformations. The most numerous organisms in soil are bacteria, whereas fungi form the largest biomass.

Factors Controlling the Degradation of Pesticides in Soils

Physico-chemical properties of pesticides: There is no clear relationship between the chemical properties of pesticides and their rates of degradation because several phenomena are simultaneously involved in the degradation and because of the high variety of structures of pesticides.

Abiotic degradation: Abiotic degradation of pesticides in soil has mainly been studied through laboratory experiments performed under controlled conditions. Identification of the reaction mechanisms and pathways is essentially performed using simplified matrix such as pure or commercial soil components.

Hydrolysis: Hydrolysis may be favoured by metal-ion catalysis, through two mechanisms:

a. Direct polarization, where the metal coordinates the hydrolysable function (eventually through chelate formation) making it more electrophilic and thus more reactive.

b. In situ generation of a reactive metal hydroxo species.

Oxidation: Oxidative mechanisms in soils may be mediated by both oxidative enzymes and abiotic catalysts such as metal oxides. Among them, manganese oxides and hydroxides are major contributors because of their reactivity and frequency in soils.

Reduction: In soils, pesticide reduction happens currently in suboxic and anoxic conditions encountered in poorly drained or groundwater-fed soils, riparian zones, wetlands or flooded areas and sediments. Nature of the reductants includes chemicals or "abiotic" reagents as reduced metal, sulphide ion or natural organic matter. But also, extracellular biochemicals such as metal chelated in porphyrin or corrinoid or as transition metal coenzymes.

Photodegradation: Photochemical reactions, i.e., reactions induced by UV or visible light, may degrade pesticides according to two types of processes, known as direct photolysis and indirect photodegradation. In direct photolysis, the pesticide itself absorbs light energy, becomes excited and, depending on the reaction activation energy, may undergo a transformation reaction. On the opposite, indirect photodegradation is defined as reaction of a ground-state pesticide with another photochemically produced species. This species can transfer energy, undergo an electron or hydrogen transfer, or lead to the formation of reactive entity (singlet oxygen, radical) which reacts with the pesticide. Reaction mechanisms and pathways were extensively reviewed in water and soil.

Conclusion

The fate of pesticides in the environment is mainly regulated by their behaviour in soils, and in particular by their adsorption and biotic and abiotic degradation. The extent of these processes depends on the physico-chemical properties of pesticides (electronic structure, solubility) and on the soil properties (constituents, structure at different scales). They also strongly depend on the environmental conditions like temperature and water content. To improve the understanding of the fate of pesticides in soils, there is a need to better take into account the soils heterogeneity and variability. Studies have to consider relevant integrative parameters describing the soil structure and interfacial properties at various water contents. Depending on the scale, integrative parameters are, in increasing order: hydrophobic structures of organic matter, wettability of clay fraction, soil hydrophobicity, bulk density related to water retention and physical properties like mechanical resistance, hydraulic conductivity and water retention, and spatial repartition of exogenous organic matter. The water content and its distribution in heterogeneous structures should be considered simultaneously. In the perspective of the reduction of pesticide use, the main options are the choice of pesticide and of its commercial formulation, and the improvement of agricultural practices. To evaluate their effects, we propose to use the mesoscopic scale as a link between molecular and field scales, because it allows measurements of coupled processes with any kind of materials, including structured soils. Finally, the effects of wet dry cycles on the fate of pesticides are poorly known and deserve to be studied in view of climate change.

References

1. Albanis, T.A.; Bochicchio, D.; Bufo, S.A.; Cospito, I.; D'Auria, M.; Lekka, M. &Scrano, L. (2002). Surface adsorption and photo-reactivity of sulfonylurea herbicides. International Journal of Environmental Analytical Chemistry, Vol.82, No.8-9, pp.561-569
2. Alletto, L.; Coquet, Y.; Benoit, P. &Bergheaud, V. (2006). Effects of temperature and water content on degradation of isoproturon in three soil profiles. Chemosphere, Vol.64, No.7, pp.1053–1061.
3. Beulke, S.; Brown, C.D.; Fryer, C.J. & van Beinum, W. (2004). Influence of kinetic sorption and diffusion on pesticide movement through aggregated soils. Chemosphere, Vol.57, No.6, pp. 481-490.
4. Menager, M.; Siampiringue, M. &Sarakha, M. (2009). Photochemical behaviour of phenylbenzoquinone at the surface of the clays: kaolinite, bentonite and montmorillonite. Journal of Photochemistry & Photobiology A: Chemistry, Vol.208, No.2-3, pp.159–163.

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Pros and Cons of Genetically Modified Crops

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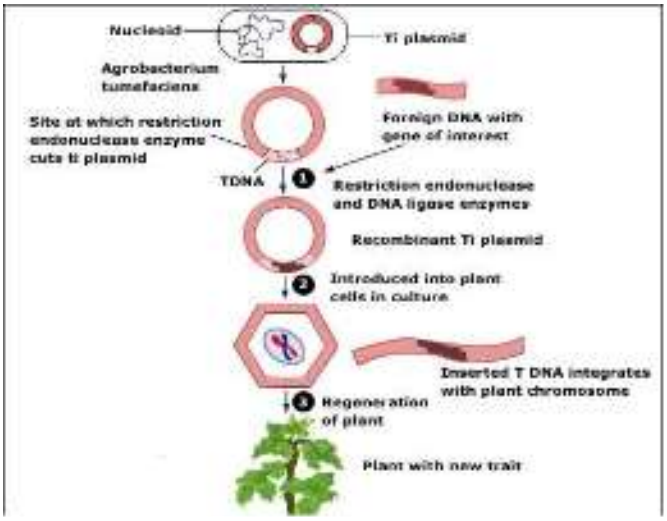
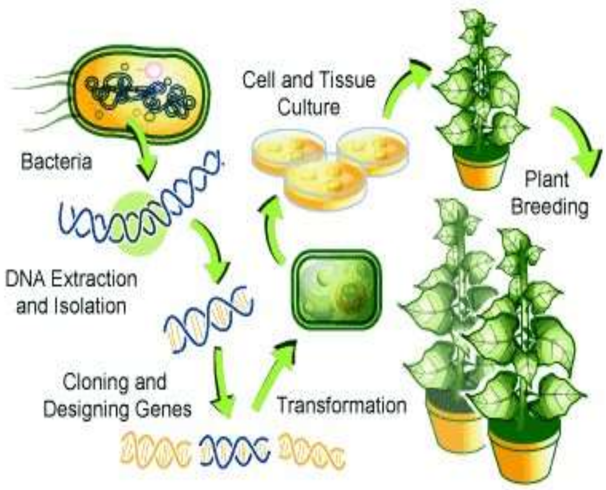
Introduction

According to "World Health Organisation "Genetically modified (GM) foods are foods derived from organisms whose genetic material (DNA) has been modified in a way at does not occur naturally, i.e., through the introduction of a gene from a different organism. Those Crops are described by many different names like Genetically Engineered crops, Transgenic or Biotech crops Genetically Modified Organism. There are different types of GM crops, First-generation crops: They have enhanced input traits, such as herbicide tolerance, better insect resistance and better tolerance to environmental stress. The ensuing crops are not significantly different from the traditionally grown crops in terms of appearance, taste and nutrition. Examples of such crops are herbicide resistant soybean, insect- resistant maize, and herbicide and insect-resistant potato. Second-generation crops. They have new traits to increase their benefits to consumers, such as increased levels of protein modified fat modified carbohydrates, increased flavour or increased micronutrients. Examples of such crops include rice with a higher level of beta- carotene, tomatoes with higher levels of carotenoids, maize with increased vitamin C, soybean with improved amino acid composition, and potatoes with higher calcium content. Third Generation. These GM foods are in the research pipeline.

General GM Food Process: The Process for GM has 8 Steps





What are the Advantages of GM GMOs?

1. GMO crops can be tailored to provide better health benefits.
2. There is the possibility of an increased shelf life.
3. It takes less land to grow more food.
4. Genetically modified crops can conserve energy, soil, and water resources.
5. Simple changes to certain crops can have a major impact.
6. Fewer harmful agents need to be applied to crops
7. It can save core crops from extinction.

8. Farmers can use better ground-care methods.
9. Future GMOs could eliminate food allergies or intolerance issues.
10. GMO crops use less water.
11.There may be a positive environmental impact with GMO crops.
12. GMO foods must meet the same standards as traditional foods.
13. GMOs can even safe beneficial insects.

What are the Disadvantages of GM GMOs?

1. In the US, the FDA does not require GMO labelling.
2. Most core foods have some level of genetic modification.
3. There may be an increased risk of allergies or food intolerance.
4. GMO crops can contaminate other fields.
5. Animal proteins could be affected by GMO crops.
6. Many GMO crops are trademarked, patented, and legally protected.
7. It encourages the use of additional herbicides.
8. GMOs create super weeds.
9. GMOs create super bugs.
10. There are concerns that GMO foods may help to create antibiotic resistance.
11. Genetic engineering doesn't solve everything.

Future of GM FOODS

1. GM advocates are confident that the next generation of GM foods will show even more promising prospects—and may also address many of the problem

2. Australian scientists are adding genes to bananas that will not only provide resistance to Panama disease, a serious fungal disease that can destroy crops but also increase the levels of beta-carotene and other nutrients, including iron.

3. Other GM crops in the pipeline include plants engineered to resist drought, high salinity, nitrogen starvation, and low temperatures.

4. The current techniques that researchers use to introduce genes into plant cells result in random insertions into the genome. New techniques are being devised that will allow genes to be inserted into precise locations in the genome, avoiding some of the potential unknown effects of disrupting aplant's normal genome with random integrations.

5. In the future, GM foods will likely include additional GM animals e.g., a transgenic Atlantic salmon variety is likely to receive marketing approval in the near future.

6. In another project, scientists have introduced a DNA sequence into chickens that protects the birds from spreading avian influenza.

7. Although these and other GM foods show promise for increasing agricultural productivity and decreasing disease, the political pressure from anti-GM critics remains a powerful force.

8. An understanding of the science behind these technologies will help us all to evaluate the future of GM foods.

Conclusion

1. Transgenic crops have potential to solve world's hunger and malnutrition problems.
2. Safety testing and regulations can ensure its superiority.
3. The society should be enlightened about the scientific technology.
4. Newer and faster techniques required to evaluate transgenic products.

References

1. website: www.nuffieldbioethics.org
2. www.btny.purdue.edu/Extension/Weeds/HerbInj2/InjuryHerb1.html
3. Mohamed H. Al-Whaibi. 2010. Plant heat-shock proteins: A mini review, Journal of King Saud University, doi:10.1016/j.jksus.2010.06.022.
4. Pragyakant, Kant, S., Gordon, M., Shaked, R and Barak, S. 2007. Stress response suppressor1 and stress response suppressor2, Two DEAD-Box RNA Helicases That Attenuate Arabidopsis Responses to Multiple Abiotic Stresses. PlantPhysiology.145:814-830.
5. Shankar K. 2010. Development of multiple gene construct and overexpression of multigene cassette for abiotic stress tolerance in plants. MSc Thesis. Department of Crop Physiology, university of agricultural sciences, GKVK, Bangalore.

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Use of Black Water and Grey Water in Agriculture and its Management

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Introduction

Gray water is household or commercial wastewater excluding toilet, urinal, bidet, and kitchen waste. In most cases, gray water comes primarily from the clothes washing machines, showers, baths, lavatories, and other non-sanitary wastewaters. In order to be able to use gray water for irrigation, the household drains must be reconfigured such that black water (from toilets and the kitchen) go directly to the sewer and gray water sources are collected separately and brought to a central location for temporary storage and use in the field. The organic matter content in gray water is actually beneficial for soil structure and most of the microorganisms (viruses, bacteria, protozoans) in gray water are gradually overcome by the vibrant soil microorganism population, although eggs of helminthes (such as tapeworms) tend to survive in soil for a long time. Therefore, it is advisable to minimize direct human exposure to gray water. This can be accomplished with subsurface irrigation, drip irrigation under mulch, or irrigation in areas fenced off from access, especially by children.

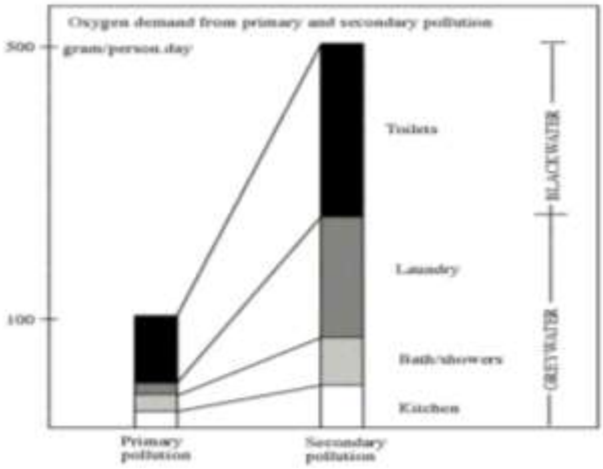
Differences Between Greywater and Blackwater

1. Greywater contains less Nitrogen than blackwater.
2. Blackwater represents a major source for pathogens bacteria, unlike greywater.
3. The normal organic content of greywater decomposes at a much faster rate than of blackwater.

Pollution by Grey and Black Water

Primary pollution: As rivers and lakes started to receive organic pollution from industry, sewers, septic systems, and present day agricultural and livestock-raising practices, these organics decomposed in the water, consuming the oxygen dissolved in it--oxygen crucial for fish and other aquatic animals. This process is known as primary pollution.

Secondary pollution: Concomitants with the primary pollution, algae and other "out -of- balance" plant species start to grow as the result of being fertilized by the surge of nutrients from the above-mentioned sources. These fertilized plants, in turn, die and decompose, further robbing the water of its naturally dissolved oxygen. This phase is called secondary pollution.



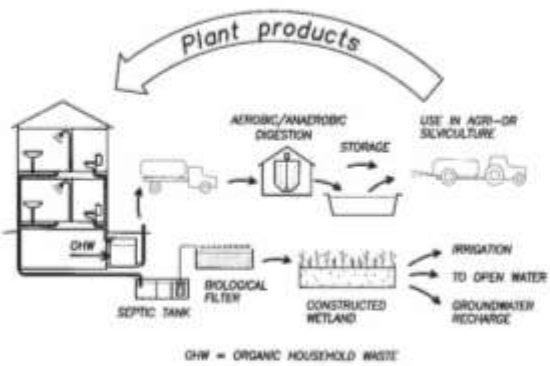


Figure - A complete recycling system based on separate treatment

How much Gray Water can Save Water for Irrigation?

In many households, grey water can be as high as 80 percent of the total wastewater generated. If all of that water can be beneficially used for irrigation, and if the irrigated area does not need supplemental potable water, then significant water savings is accomplished. Thus, it is a combination of the two factors (percent of gray water captured and percentage of irrigated area served) that determines actual water savings at any given location where a grey water system is installed. One extreme is a multiplex, where the gray water generated by a given household is far more than what that household's landscape (or vegetable garden) can possibly use. Another extreme is an estate mansion with a huge garden that needs far more irrigation water than the few residents of the mansion can possibly generate. In between these extremes, there are many situations where the supply of grey water is close to the demand for irrigation water, and that is where irrigation water savings can approach 100 percent. Used in conjunction with rainwater harvesting techniques, the savings can be taken even further.

What are the Applications and Additional Benefits of Grey Water in Agriculture?

Gray water applicability, especially for agricultural irrigation, is limited. A typical farm house's grey water supply can only irrigate a small fraction of the farm's overall area. Small-scale farms, urban farms and gardens, and nurseries may meet with some significant success. California regulations for household use of grey water are in the process of revision and they are expected to become much more permissive and user-friendly, especially for washing machine and single-source residential grey water systems, which will not even require a permit for installation.

Addition to water savings, grey water systems can reduce the load on septic systems and on the community's sewerage systems. Gray water can contain small concentrations of organic matter and some nutrients, beneficial for soils and crops grown with it. The soil's upper (aerobic) layers can decompose and deactivate most of the microbes (and any pathogens) that might be in grey water. Also, the embedded energy in grey water is far less than that in potable water, making its use highly environmentally friendly and sustainable.

Quantity and Relative Pollution in Greywater & Blackwater

Average Pollutants Loading (g/p/d)		
Type	Greywater	Grey + Blackwater combined
BOD5	34	71
SS	18	70
Tot. N	1.6	13.2
Tot P	3.1	4.6

Conclusions

1. Small-scale cultivation experiments with baby rose plants have been carried out, and it is revealed that human excreta (urine and faecal) which has undergone hygienization process, show a good potential to be reused as anthropogenic fertilizer.
2. The urine composition shows that up to 31 kg Nitrogen, 0.4 kg Phosphorous and 1.7 kg Potassium are produced per person annually.
3. The second largest nutrient content is found in faecal matter which produces 4.4 kg Nitrogen, 1.3 kg Phosphorous and 0.5 kg Potassium from one person annually.
4. The vermicomposting experiment on wet faecal matter without toilet paper produces a good quality of compost, which is already compiled with Indonesian National Compost Standard.

Summary

1. The RVFB is a useful addition to GW treatment options, particularly for small-scale decentralized use.
2. The TOC was reduced from the influent value of 161 mg/L to 28.6 mg/l in the permeate with an average reduction rate of 83.4%. In addition, soluble nutrients like ammonia and phosphorous can pass through the UF membrane and remain in the permeate.
3. Long-term irrigation of arid loess soil with greywater may result in accumulation of salts, surfactants and boron in the soil, causing changes in soil properties and toxicity to plants.
4. Increasing the use of insufficiently treated greywater may result in the expansion of water-repellent soil areas, negatively alter soil structure and texture and increase environmental pollution.
5. The nutrients in the greywater that might have been otherwise lost are reclaimed and this maintains fertility of the soil.
6. Human excreta (urine and faecal), i.e., blackwater has undergone Hibernization process, show a good potential to be reused as anthropogenic fertilizer.

References

1. ALBRECHTSEN, H.J., 2002. Microbiological investigations of rainwater and graywater collected for toilet flushing. Water Sci. Technol. 46 (6–7), 311–316.
2. AL-JAYYOUSI, O.R., 2002. Focused environmental analysis for greywater reuse in Jordan. Env. Eng. Policy.
3. GROSS, A., SHMUELI, O., WEIL, A., RONEN, Z., 2005a. Environmental impacts associated with greywater reuse for irrigation in small (isolated) communities. Water Eng. Liquids Irrigat.
4. HALPERIN, R., ALONI, U., 2003. Standards for Treated Wastewater Reuse in the City for Recreation and in Industry. Ministry of Health, Jerusalem, Israel, p. 15.
5. STEER, D., FRASER, D.L., BODDY, J., SEIBERT, B., 2002. Efficiency of small constructed wetlands for subsurface treatment of single-family domestic effluent. Ecol. Eng. 18, 429–440.
6. JEFFERSON, B., LAINE, A., PARSONS, S., STEVENSON, T., JUDD, S., 1999. Technologies for domestic wastewater recycling. Urban Water 1, 285–292.

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Sustainable Farming Systems for Coastal Areas

Article ID: 10285

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Introduction

Coastal ecosystem represents a transition between terrestrial and marine ecosystems. It comprises not only the shoreline ecosystem but also the upland watersheds draining into the sub-littoral eco-systems influenced by the land-based activities. Indian coastline is 7517 km (Area of 10.78 m ha) and population density of 455 persons per sq. km. Coastal India spans from Gulf of Kutch in Gujarat to Sunder bans in coastal east of India (WB). Agriculture is Predominantly rainfed (Mono-cropped with rain-fed rice) Rice, pulses, oilseeds and short duration vegetables are the important crops and it is also important for multi-storied cropping system. About 90% of the farming communities in the coastal region are marginal to small.

Soil and Climate of Coastal Area

1. The regions show tremendous variability in their agro-climatic, soil and water quality.
2. Soils of coastal area mostly laterite (red colored).
3. The soils are rich soil organic carbon.
4. Deficient in available N, K, Ca, Mg, Zn and B.
5. Medium to sufficient in available P, Fe, Mn and Cu.
6. The soils often have poor water holding capacity.
7. Climate is hot and humid (Except the north Gujarat coast)
8. > 1000 to 2500 mm rainfall (excluding Gujarat)
9. The average maximum temperatures are in the range of 25 to 30^{0}C min. temperatures seldom fall below 20^{0}C.

East Coast Plains & Hills Region

This zone covers parts of Orissa, Andhra Pradesh, Pondicherry state and Tamil Nadu. The major crops grown under irrigated conditions are rice, ragi, sugarcane, groundnut, cotton and tobacco. Most of the districts in this zone are coastal and marine fishery is an important occupation to millions of fishing communities. Along the east coast, fruit trees like banana, mangoes and citrus are grown in specified locations. Cashew is the main crop in coastal laterites.

West Coast Plain and Hill Region

The zone comprises of parts of Tamil Nadu, Kerala, Karnataka and Maharashtra state of Goa. This zone is noted for plantation crops such as coffee, tea, rubber, arecanut and spices and condiments such as pepper, cloves, cardamom, ginger and turmeric. Fruits grown are mangoes, banana, pineapple, sapota, papaya and jack fruits.

Among the vegetables, potatoes, tomatoes, and gourds are important. Wide range of plantation crops from coffee, tea, rubber and arecanut to pepper, cloves and cardamom occur in the various subzones.

Reasons for Low Productivity in Coastal Area

1. Soils are poorly developed and sandy to fine loamy.
2. Soils are influenced by tidal waves and periodic inundations.
3. Heavy rainfall and cyclonic weather.
4. Monocropping of rice.
5. Too much brackish water and Lack of fresh water in dry season.
6. Salinity: Salt affected soils in the coastal area is 2.52 m ha.
7. Saline ground water table.
8. Low lying areas subjected to water logging.
9. Impeded drainage.

Ways to Improve the Productivity in Coastal Area

1. Use of organic compost fertilizers.
2. More efficient and precise application of inputs based on soil condition and crop growth cycle (SSNM).
3. Improved rainwater capture and watershed management.
4. Agroforestry.
5. Sustainability through IFS.
6. Crop improvement: Salinity tolerant variety.
7. Reclamation of Soil Salinity: Through Mulching and tillage.
8. Introduction of sustainable cropping system.

So: Sound management of farm resources is necessary to enhance income, productivity, reduce degradation of the environment and to meet the needs of the farmers to improve the quality of life through sustainable production.

Farming system is a resource management strategy to achieve economic and sustained crop and livestock production to meet the diverse requirement of farm house hold while preserving the resource base and maintaining a high level of environment quality.

Components of IFS for Coastal Ecosystem

Crop component Animal component, Agro forestry, Horticulture, Pisciculture, Duck cultivation, Mushroom cultivation, Apiculture, Biogas production.

Multi Storied and Mixed Cropping Systems

Multi storied cropping system for a sustainable land use approach and cropping system management in coastal zone of Andhra Pradesh.

The Coconut based cropping system, i.e Coconut + Cocoa + Banana + Moringa + Pineapple with integrated nutrient management revealed that the cropping system with 75 % NPK + organic recycling with vermicompost recorded highest nut yield of 182 per palm and highest net income (Rs. 1.80 lakhs per ha) and B:C ratio (2.71) compared to monocrop of coconut with recommended NPK + FYM which recorded 150 nuts /palm, Rs. 1.31 lakhs / ha and B:C ratio of 2.00 respectively.

SWOT Analysis of Sustainable Cropping System in Coastal Areas

Strength	Weakness	Opportunity	Threats
Efficient utilization of resources	Climatic and biotic factors	Livelihood approach	Land use policy and programmes
Strong base of ITK's	Non availability of timely inputs	Location specificity	Urbanization and migration
Farmer participatory	Inadequate credit supply	Environmental sustainability	Market price fluctuation
Problem solving	Inadequate market infrastructure	Policy implications	Middleman interference in market
Interdisciplinary	Fragmented holding	Contractual/corporate farming	Wild animal menace
Interactive	Migration	Custom hiring	Energy crisis
Location specific technical solution			

References

1. Channabasavanna, A.S., Biradar, D.P., Prabhudev, K.N and Hegde, M. 2009. Development of profitable integrated farming system model for Sustainable Arecanut based mixed cropping system for coastal zones of Uttar kannada district , Karnataka Journal of Agricultural Sciences, 22 (1): 25-27.
2. Jayanthi, C. 2006. Integrated farming system: A path to sustainable agriculture. 2nd edition, Published by department of Agronomy, Directorate of Soil and Crop management studies, Tamilnadu Agricultural University, Coimbatore, pp. 1.
3. Edwards, P. 1997. Sustainable food production through aquaculture. Aquaculture Asia. Volume 2. School of Environment, Resources and Development, Asian Institute of Technology (AIT), Pathumthani, Thailand.

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Recent Trends in Agriculture: Vertical Farming and Organic Farming

Article ID: 10286

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Introduction

Advancements in the field of science and technology along with the global urbanization are the major factors driving the course and evolution of agricultural research. Rise in per capita income in developing nations, occupational changes and global linkages have changed the food preferences. These trends along with the increase in population pose a challenge to agriculture for producing more & better food. Increase in the productivity of agriculture by employing techniques of conventional (20th century) agriculture is posing a limitation. The threat to environment, due to dependence on chemical fertilizers and pesticides for increasing productivity and pest management respectively is major constraint affecting the global food production. These trends suggest that new innovations in agriculture are inevitably needed and these innovations should be integrated with the main stream agriculture. Vertical farming and organic farming are the research areas to fight these constraints. Vertical farming employs vertical stacking of the farms therefore small land can be utilized for more production. In addition, this technique is well suited for the rapidly growing global urban population as the demands of food supply can be met from within the cities and thus reducing the transportation cost and environment deterioration caused by fuels in the process. Organic farming on the other hand is based on the principles of minimization of the chemical inputs in the agriculture and hence is environment friendly. Thus, these techniques can be utilized for increasing the production and productivity to meet the growing food demands.

Vertical Farming

Concept of vertical farming was given by Professor Despommier, the farm uses conventional farming methods such as hydroponics and aeroponics to produce more yields faster. Vertical farming can be defined generically as a system of commercial farming whereby plants, animals, fungi and other life forms are cultivated for food, fuel, fibre or other products or services by artificially stacking them vertically above each other. Vertical farming is large scale agriculture in urban high-rise structures. The concept foresees the cultivation of fruits, vegetables, medicinal, fuel producing plants and other plant products in the cities.

Vertical Farming Includes Three Types of Farming

1. Phrase vertical farming was used by Gilbert Ellis Bailey in his book "Vertical Farming" in 1915. He discussed the utopian concept of vertical farming. He introduced the concept of underground vertical farming, presently followed in Netherlands.

2. In the second category, Vertical farming is done in open air or in mixed use sky scrapers for climate control and consumption. This is a sustainable type of farming for personal or community use and it may not be for commercial purposes. A modified form of this concept involves cultivation of crops in the periphery of sky scrapers to provide them ambient amount of light.

3. Third category involves cultivation of plant and animals in the sky scrapers in the closed system for large scale cultivation. These systems under trials at various locations (Singapore, Canada, London). A vertical farm of 9300

m^2 (roughly the size of a city block) with 30 stories should provide around 15,000 people with 2000 kcal of nutrition per day.

Advantages of Vertical Farming

1. Increase in production and availability in crops: This farming technology confirms crop production all year-round irrespective of the environmental conditions. According to "The encyclopaedia of earth, 2010" A 30 storey high building with a basal area of 5 acres (2.02ha) has the potential of producing crop yield equivalent to 2,400 acres (971.2ha) of traditional horizontal farming. Expressed in ratio, this means that 1 high-rise farm is equal to 480 traditional horizontal farms.

2. Production of organic crops: Vertical farming will facilitate production of organic crops in large scale production. Further, adoption of this technology will help in reduction in use of chemical pesticides.

3. Conservation and recycling of natural resources: The vertical farming technology includes hydroponics and aeroponics which consumes very less amount of water than utilized in the conventional agriculture. Thus, helps in conservation and recycling of the water resources. Further, urban sewage waste can be used in composted and recycled form in vertical farming, which will further help in recycling of the resources.

4. Environment friendly: Vertical farming will reduce the dependency on land resources and help in regrowth of forests. Further, due to less use of equipment, it will lead to decrease in CO_2 emission, thus help in conservation of the environment.

5. Sustainable urban growth: Vertical farming, applied with a holistic approach in combination with other technologies, will help urban areas to absorb the expected rise in population and yet still remain food sufficient. However, traditional farming will continue because many crops are not suited to indoor farming.

Key Issues Challenging the Adoption of Vertical Farming

1. Uniform practices cannot be adopted for vertical farming due to variable weather conditions in different regions of the world.

2. Lack of crop varieties suitable for the vertical farming. This aspect needs immediate attention from the researchers, as in the absence of suitable varieties adoption of this technique will be difficult.

3. Lack of knowledge and skills required for farming practices in urban populations.

Organic Farming

Organic farming also known as ecological agriculture8 or biodynamic agriculture its works in harmony with nature i.e., the agricultural practices followed in organic agriculture do not cause any harm to the environment. Due to eco-friendly nature of the organic farming, it is considered as a viable alternative in comparison to chemical based farming.

Advantages of Organic Farming

1. Sustainability: Organic agriculture considers the medium- and long-term effect of agricultural interventions on the agro-ecosystem. Production of food is accompanied with establishment of ecological balance to prevent soil sterility or pest problems.

2. Ecological services: The impact of organic agriculture on natural resources favors interactions within the agro-ecosystem and environmental variables. Ecological services derived include soil sequestration, nutrients cycling, predation, pollination and habitats.

3. Biodiversity: Organic farming help in conservation of the environment and hence biodiversity. Lack of use in chemical pesticides, helps in maintain and recolonizing of the beneficial species in the area, including wild flora and fauna.

Challenges Faced in Organic Farming

1. Highly labour intensive.
2. Effective organic inputs are not available in appropriate quantity and time.
3. Lack of adoption in standardized agronomic practices for organic farming.

Conclusion

In conclusion changing demographic trends and technological advancements are delivering new innovations in the field of agriculture. These emerging technologies are required to be used judiciously to meet the growing demands from modern agriculture. Vertical farming and organic farming can be adopted as the viable alternatives for the conventional agriculture to meet the changing demands and needs of mankind. Further, constraints in adoption of such practices should be addressed and linkages between researchers and farmers should be created for suitable measures.

References

1. http://www.fao.org/fileadmin/templates/wsfs/docs/Issues_papers/.
2. www.verticalfarms.com.au
3. Lampkin N. Organic Farming. Old Pond, Ipswich, England; 2002.
4. Stockdale EA, Lampkin NH, Hovi M, et al. Agronomic and environmental implications of organic farming systems. Adv Agron. 2001;70:261–327.
5. Biao X, Wang X, Ding Z, et al. Critical impact assessment of organic agriculture. J Agric Environ Ethics. 2003;16(3):297–311.

Management of Nitrogen Through Precision Farming Tools

Article ID: 10287

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Introduction

Nitrogen is an indispensable element for optimum functioning of crops. The fact that high-yielding varieties of crops possess high yield potential is undoubtedly associated with their tendency to consume high dose of nitrogen but the efficiency of utilization of added nitrogen fertilizer is very low, as applied nitrogen is subjected to various kinds of losses like leaching, volatilization and denitrification. The efficiency of applied N fertilizer not only depends on right quantity but also on right time, method of N application, crops and different genotypes of the same crops. So, the efficiency can be increased by synchronizing crop demand with nutrient supply. The corrective N management methods employ diagnostic tools to assess soil or crop N status during the growing season. Leaf colour chart (LCC), Chlorophyll meter, Site specific nutrient management (SSNM) and Soil test crop response (STCR) are the promising tools developed in recent years for corrective N management in rice crop.

(a) Leaves are yellowish green in the plot, where N fertilizer is not applied.
(b) Leaves of N-deficient plants are light green, narrow, and smaller.
(c) Tillering is reduced where N is deficient.
(d) Tillering is greater where N fertilizer has been applied.

Fig.1 Some of the nitrogen deficiency symptoms in rice field.

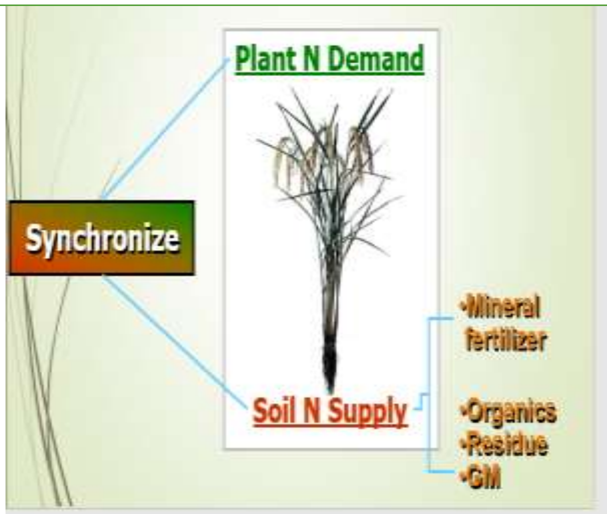

Fig.2 How to Improve N Use Efficiency and Minimize Leakage of N into Environment?

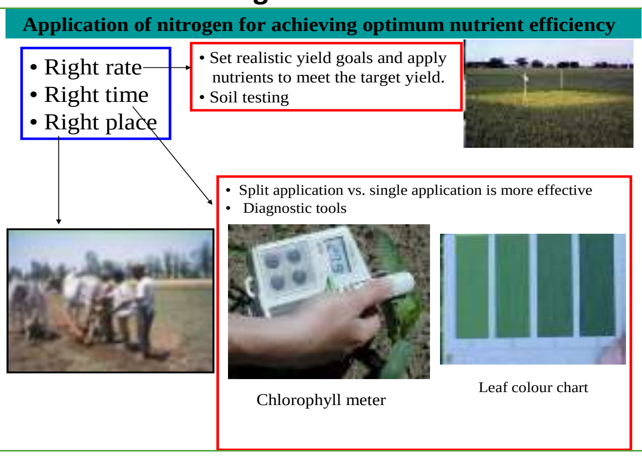

Fig.3 Site-Specific Nutrient Management	Fig.4 Precision Agriculture
Site-specific management can be thought of as a series of layers of information about each field, as depicted in Fig3. Each time a measurement is made (soil tests, scouting reports, yield data, etc.), another layer of information is added. Over time, multiple layers of information are added and become part of the database that can guide future crop management decisions. By geo-referencing each data point to its precise geographic location, these data layers can be "stacked" for analysis to determine the relationship between layers for any point in the field. For example, the relationship between nitrogen rate applied and yield obtained might be determined, and then its variability mapped as an additional "calculated" layer of information.	The systematic implementation of best management practices into a site-specific system provides the best opportunity to develop a truly sustainable agriculture system. Managing the right source at the right rate, right time and in the right place is best accomplished with the right tools. Various technologies are available to help make decisions related to nutrient management, from soil sampling to fertilizer application to yield measurement. These tools enhance the ability to fine-tune nutrient management decisions and develop the site-specific nutrient management plan for each field. Right rate, Right time and Right place are the basic principles one should follow to achieve Synchronization between crop N demand and soil N supply.

Leaf Colour Chart (LCC)

1. For the need-based N application, reliable diagnostic tools are needed to inform farmers how much and how often to apply N fertilizer.
2. Leaf colour chart could help farmers easily to identify the greenness of rice leaves to make their decision on when and how much N fertilizer needed for their crops.
3. The LCC is usually a plastic, ruler shaped strip containing four or more panels that range in colour from yellowish green to dark green.
4. Farmers then apply fertilizer N whenever the leaves are more yellowish green than a threshold LCC value, which corresponds to a critical leaf N content.

How to Use the LCC

Start LCC readings from 14 days after transplanting (DAT) or 21 days after sowing (DAS). Take the last reading when the crop just starts to flower.

1. Randomly select at least 10 disease-free rice plants or hills in a field with uniform plant population. Select the topmost fully expanded leaf from each hill or plant.
2. Place the middle part of the leaf on a chart and compare the leaf colour with LCC shades. When the leaf colour falls between two shades, the mean value is taken as the reading, e.g., 2.5 for colour between 2 and 3. Do not detach or destroy the leaf.
3. Measure the leaf colour under the shade of your body, because direct sunlight affects leaf colour readings.
4. Repeat the process at seven to ten days intervals or at critical growth stages (early tillering, active tillering, panicle initiation and first flowering) and apply N as needed.
5. If more than five out of ten leaves read below a set critical value, apply:
    a. 20-30 kg N/ha for wet season or low-yielding season.
    b. 30-35 kg N/ha for dry season or high-yielding season.

Advantages of LCC

1. The LCC is a cheap.
2. Farmers can easily use the LCC to qualitatively assess foliar N status and adjust N topdressing accordingly.
3. It helps to manage N for large area leading to improved fertilizer N use efficiency.
4. It reduces the risks associated with fertilizer N application.

5. It saves nearly 26% fertilizer N.
6. It helps to synchronize N supply and crop demand.

Measuring SPAD Values in the Field

1. SPAD readings are taken at 7–10-day intervals, starting from 14 DAT for transplanted rice and 21DAS for wet direct seeded rice. Periodic readings continue up to the first (10%) flowering.
2. The youngest fully expanded leaf of a plant is used for SPAD measurement.
3. Readings are taken on one side of the midrib of the leaf blade, midway b/w the Leaf base and tip.
4. A mean of 10-15 readings per field or plot is taken as the measured SPAD value.
5. Whenever SPAD values fall below the set critical values, N fertilizer should be applied immediately to avoid yield losses from N deficiency.

Advantages of Chlorophyll Meter

1. The chlorophyll meter is faster than tissue testing for N.
2. Samples can be taken often and can be repeated if results are questionable.
3. Chlorophyll content can be measured at any time to determine the crop N status.
4. The chlorophyll meter allows "fine tuning" of N management to field condition and reduces risk of under or over fertilizing the rice crop.
5. The Chlorophyll Meter will be most helpful when a producer is unfamiliar with the situation or when conditions are unusual (manure use, excessive rains, high N carryover etc.).
6. The Chlorophyll Meter would also help people who are not highly trained to make N recommendations.

Soil Test Crop Response

1. In this approach, soil contribution and yield level are considered for recommending fertilizer dose.
2. This approach is also called as rationalized fertilizer prescription.
3. The draw backs of STCR approach are that, these equations are not available for different crops and regions.
4. Development of these equations involve high cost and time.
5. These equations are suitable when available N P K are estimated by potassium permanganate, Olsen and ammonium acetate methods respectively.

Conclusion

1. Nitrogen application based on Leaf colour chart at critical value 4 is the optimal N fertilization strategy for rice, since it gives higher grain yield besides saving of N as compared to blanket N recommendation.
2. Nitrogen management using chlorophyll meter at critical value 35 recorded higher grain yield, straw yield and nitrogen use efficiency.
3. The higher grain yield of rice is obtained with SSNM treatment as compared to farmer's practice.
4. STCR helps to generate numerous fertilizer adjustment equations for prescribing rates of N fertilizer application to obtain target yields of rice.

Future Line of Work

1. Need to standardize the LCC critical value for specific varieties of rice predominantly grown in different agro climatic zones.
2. Nitrogen management for problematic soils using LCC as a tool needs to be studied.
3. Pest and disease incidence in relation to nitrogen management through LCC and SPAD Meter need to be studied.
4. There is need to determine specific SPAD threshold values for fine-grain type, aromatic and hybrid rice varieties.

References

1. BALAJI, T. AND JAWAHAR, D., 2007, Comparison of LCC and SPAD methods for assessing nitrogen requirement of rice. Crop Res., 33 (1, 2 & 3): 30-34.
2. BALASUBRAMANIAN, V., 2000, Adaptation of the SPAD technology for real-time N management in rice. Nutr. Cycl. Agroecosyst., 59: 107-110.
3. BUDHAR, M.N., 2005, Leaf colour chart based nitrogen management in direct seeded puddled rice (Oryza sativa L). Fertilizer News. 50 (3): 41-44.
4. CRUZ, R.T. AND MORALES, A.C., 2000, Adaptation of the chlorophyll meter technology for managing nitrogen in rice. Rice Today. 21: 10-13.
5. PATRA, A.K., PATHAK, H. AND CHHONKAR, P.K., 2006, Leaf colour chart - a promising cost effective tool for better N management. Indian Fmg., 55 (12): 20-22.

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Role of Plant Growth Regulators in Mango Flowering

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Introduction

Mango (*Mangifera indica* L.) the "king of fruits" the main fruit of Asia and possessing own importance all over the world has been cultivating in the Indian sub-continent for well over 4000 years (De Candolle, 1904). Flowering, the first step of sexual reproduction is of paramount importance in agriculture, horticulture and plant breeding. Mango occupied a pre-eminent place amongst the fruit crops grown in India because of its great utility. Mango exhibits a wide variation in flowering and fruiting habit due to varietal differences and diversity in agro-climatic conditions. It is highly cross-pollinated crop contains male and hermaphrodite types of flower. The flowering mechanism of mango is very complex process and so many factors like physiological, environmental and different PGR are affecting on it. The present role of PGR in mango flowering are as follows:

1. Role of gibberellins: Gibberellins are considered derivatives of tetracyclic diterpenoid compounds and exhibit wide array of physiological activities. In many perennial fruit species including mango, gibberellins have been shown to suppress floral process (Davenport, 2009; Murti and Upreti, 2000).

The floral inhibitory response of gibberellins depends upon concentrations, growth stage, and climatic conditions of the location. In contrast to delaying inflorescence initiation in cool temperatures, GA did not delay vegetative growth during warm temperatures, thereby revealing that GA prevents initiation of reproductive shoots of mango rather than inhibiting floral induction. Upreti *et al*. (2013) reported that paclobutrazol inhibited gibberellins in mango bud's concomitant with profuse induction in flowering.

2. Role of Auxin: Chacko (1968) found a high level of auxin-like substance in the shoots of 'Dashehari', which were expected to flower. The shoots from 'Dashehari' 'on' year and 'Totapuri Red Small' trees-initiated flower buds & had a higher level of growth promoting substances during the period of flower-bud initiation. Shoots of 'Dashehari' 'off' year trees which remained vegetative.

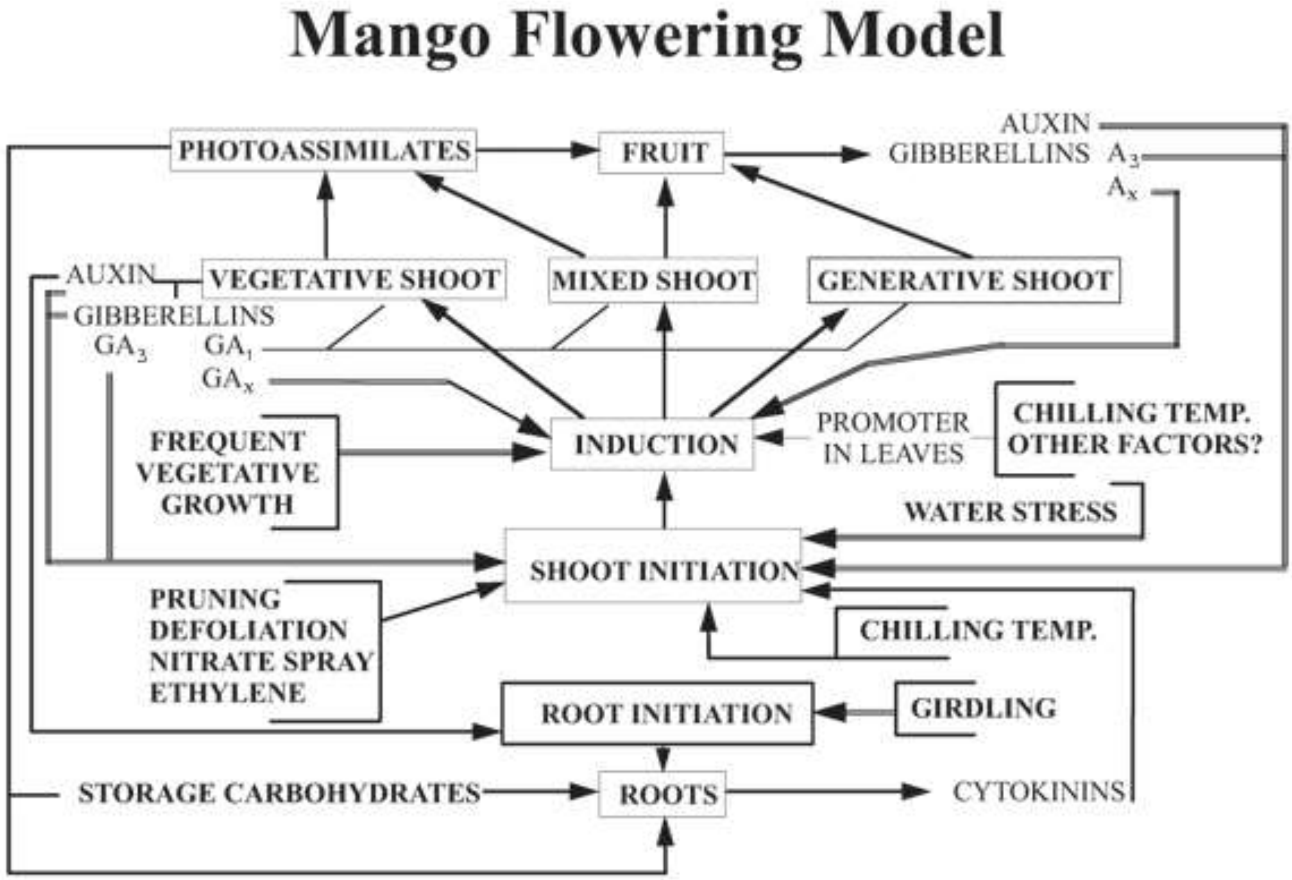
3. Role of Cytokinins: Cytokinins structure resembling adenine which promotes cell division**.** Cytokinin levels in mango stem buds increased during exposure to cool, floral inductive temperatures (Bangerth *et al*., 2004). Cytokinin will occur at time of flower bud differentiation were higher in the 'on' year than in the 'off' year. A well-documented role for cytokinins in higher plants, especially evident *in vitro*, is bud organogenesis (Skoog and Miller, 1957). The primary cytokinins in higher plants are trans zeatin, Dihydrozeatin, isopentenyl adenine and their ribosides.

4. Role of Ethylene: Ethephon effectively promotes flowering of mangoes under specific conditions in the low-latitude tropics (Davenport and Nunez-Elisea, 1997). High ethylene content was observed in Totapuri and Neelum (regular) at flowering stage compared to juvenile Langra (biennial) during flowering (Murti and Upreti, 1996).

Ethylene sprays:

a. Ethephon at the rate of 125-200ppm induced the flowering of 'Carabao' mango in the Philippines within six weeks after treatment (Dutcher, 1972).
b. In India (Ethephon) increaes flowering in Langra and Dashehari ('off' years).
c. It induces earlier production in juvenile plants (Chacko et al., 1974).

5. Role of abscisic acid: Abscisic acid is a sesquiterpene derivative, which typically regulate numerous developmental processes and has an inhibitory effect on cell elongation. It also regulates adaptive stress responses in plants. As stress conditions are required floral morphogenesis, its increased concentrations are expected to facilitate floral growth though stress adaptive mechanism involving osmotic adjustment and synthesis of stress responsive genes. It also has influence on flowering through is effects on sucrose metabolism. Chacko (1968) was first to report the presence of certain inhibitors similar to abscise acid in mango shoots. His findings that the shoots of 'Dashehari as the floral inductive process is high energy consuming metabolic process; the requirement of high soluble sugars for the energy supply for floral development is well justified.



Conceptual flowering model of mango. The model summarizes the proposed roles for various phytohormones in initiation of shoot growth and in defining the vegetative or reproductive outcome of that growth (induction). Single lines in the scheme are promotive and double lines are inhibitory.

Conclusion

The decline in gibberellins with profound increase in cytokinins and abscisic acid in combination with sufficient built-up of carbohydrates in the buds approaching bud burst stage ensure floral inductions in mango. The accumulation of abscisic acid in buds at floral initiation is contributory in optimizing leaf water potential and sap flow besides optimizing carbohydrate availability and cytokinins in sustaining differentiation activity in growing buds.

References

1. Bangerth, F., Naphrom, D., Sruamsiri, P., Hegele, M., Boonplod, N. and Manochai P. 2004. Hormonal changes in various tissues of mango trees during flower induction following cold temperature. Acta Horticulturae. 645:453-457.
2. Chacko, E. K, Kohli, R. R and Randhawa G.S. 1974. Investigations on the use of 2-chloroethylphosphonic acid (Ethephon CEPA) for the control of bienniel bearing in mango. Scientia Horticulturae.; 2:389-398.
3. Chacko, E. K. 1968. Studies on the physiology of flowering and fruit growth in mango. (Mangifera indica L.). Ph.D. thesis submitted to P. G. School of IARI.
4. Chacko, E. K. 1968. Studies on the physiology of flowering and fruit growth in mango. (Mangifera indica L.). Ph.D. thesis submitted to P. G. School of IARI, 1968.
5. Chen W.S. l985. Flower induction in mango (Mangifera indica L.) with plant growth substances. Proc. Natl. Sci. Council Part B, Life Sci. Taipei, Rep. China.; 9:9-12.
6. Davenport T. L, Nunez-Elisea 1997. Reproductive physiology. The Mango: botany, production and uses. Wallingford: CAB International. 69-146.

7. Davenport, T. L. 2009. Reproductive physiology. In: (Ed. R.E.Litz). The Mango: Botany Production and Uses, 2nd edition. CAB International, Wallingford, UK, 97-169.
8. De Candolle. Origin of cultivated plants. Kegan Paul, London, 1904.
9. Dutcher R. D. 1972. Induction of early flowering in 'Carabao' mango in the Philippines by smudging and ethephon application. Hort. Science. 7:343.
10. Murti, G.S.R and Upreti K. K., 1996. Changes in the levels of endogenous hormones in relation to shoot vigour in mango (Mangifera indica L.). Plant Physiol. & Biochem; 25(2):167-171
11. Skoog, F. and Miller C.O. 1957. Chemical regulation of growth and organ formation in plant tissues cultured in vitro. Symp. Soc. Exp. Biol. 11:118-130.
12. Upreti K. K, Reddy Y.T.N, Shivu, P., Bindu G.V., Jayaram, H. L. and Rajan S., 2013. Hormonal changes in response to paclobutrazol induced early flowering in mango cv. Totapuri. Scientia Horticulture,; 150:414-418.

E-Krishi Kendra: An Innovative Frontier for Making Digital Indian Agriculture

Article ID: 10289

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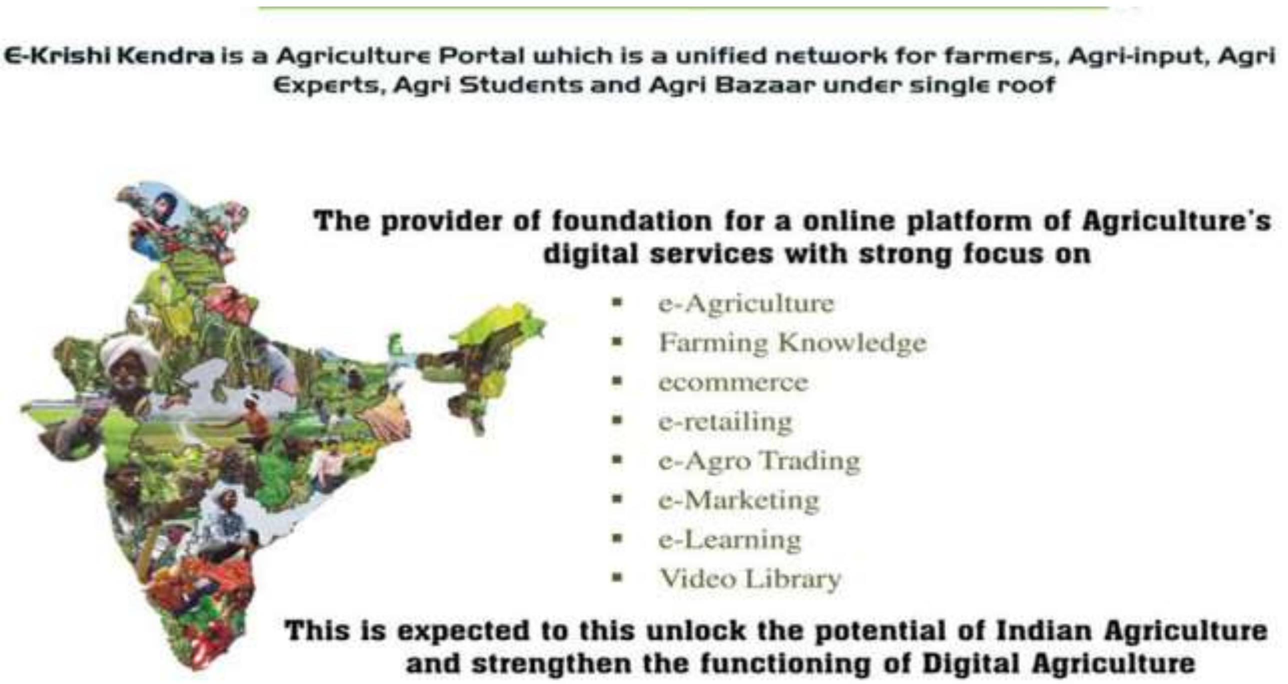
Abstract

E-Krishi Kendra is an open access platform for providing Agriculture’s digital services under a single roof. It’s brought evolution in agriculture with the way of digitalization. It touches the lives of over millions of farmers, clocking a positive growth year to year. Digital revolution changing the face of Agriculture. It is seen as an emerging field focusing on the enhancement of Agriculture and rural development through improve information and communication processes. The digitalization and the spread of mobile telephony and internet in rural areas allow farmers and entrepreneurs to gain access to information, services and markets. The internet, mobile phones, and all the other tools to collect, store, analyses and share information digitally – have spread quickly. Some specific factors such as Age, literacy and education of the target group, farm size, gender, motivation, awareness, information sharing influence the use of the mobile phone and the confidence in the information. E-Krishi Kendra reduce gap by implementing F2B, B2B and B2C platform for agriculture. Development of nation depends upon development of agriculture. By making digitalization in agriculture, we might increase the agriculture’s contribution in GDP of nation.

Keywords: E-Krishi Kendra, E-Agriculture, Digital Agriculture, E-Commerce, Online portal, Agriculture.

Introduction

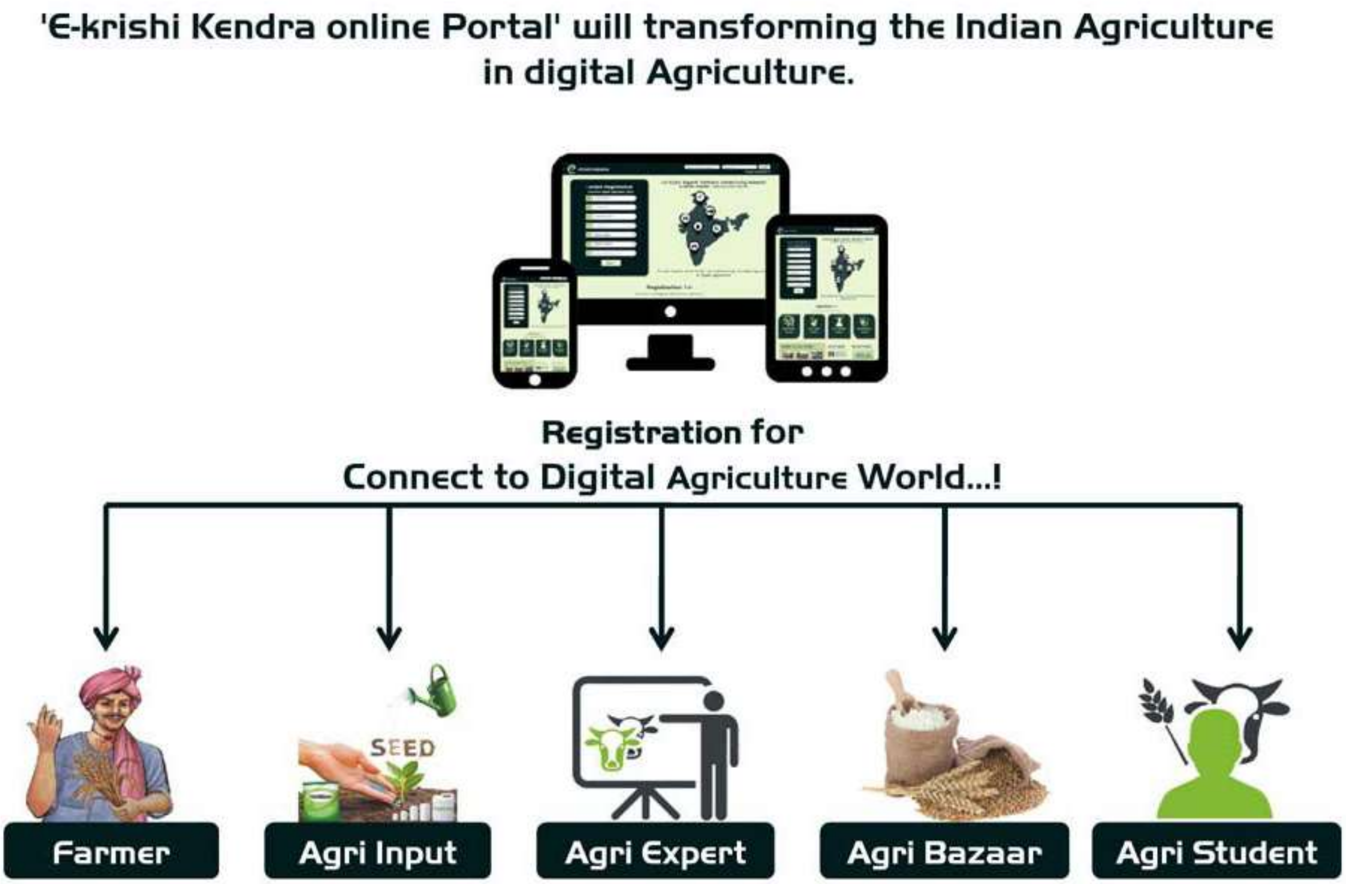


It gives digital infrastructure for implementing of Agriculture portal for Prosperous Indian Agriculture. The Internet and mobile technologies transformed traditional Agriculture in to Digital Agriculture, this transformation is accelerating in profound ways with the use of online Agriculture portal like 'E-Krishi Kendra'.

It has e-commerce platform with agricultural network which digital technologies and analytics are revolutionize agriculture in fundamental way. Portal's Digital Agriculture Service help the Agriculture to fulfil it's potential.

Highlights of e-Krishi Kendra

E-Krishi Kendra is an e-commerce platform for batter tomorrow of Indian Agriculture. It has professional and positive approach to the work in agriculture with digital services. It is committed to ensuring consistent services throughout year. It is a podium for blooming of Agribusiness with e-commerce platform. It offering multidisciplinary agronomic services at one place and an integrated e-education portal for Agriculture students. An initiative to conduct longest serving by integrated distribution services under one roof and framework for e-trading of agriculture produces.



Peculiarity of E-Krishi Kendra

E-Krishi Kendra have content generated by subject matter specialists and provide lower-cost solutions tailored to the specific needs of farmers. Agricultural related news is update on daily basis, and day to day update of central and state government schemes.

Get success stories of progressive farmers on a single platform. Agri experts give guidance on multi-disciplinary agriculture problems. National and International Agricultural Exhibition information available at one click. Through this portal and APP suppliers and buyers connect digitally and can create new business. Actual price discovery of agriculture produces available at one place and integrated agri produce distribution service under one roof. Farmers can create own distribution network.

Working Area of e-Krishi Kendra

E-Krishi Kendra portal is work in five phase which is Farmers, Agri Input, Agri-Experts, Agri Students/professions and Agri-Bazaar.

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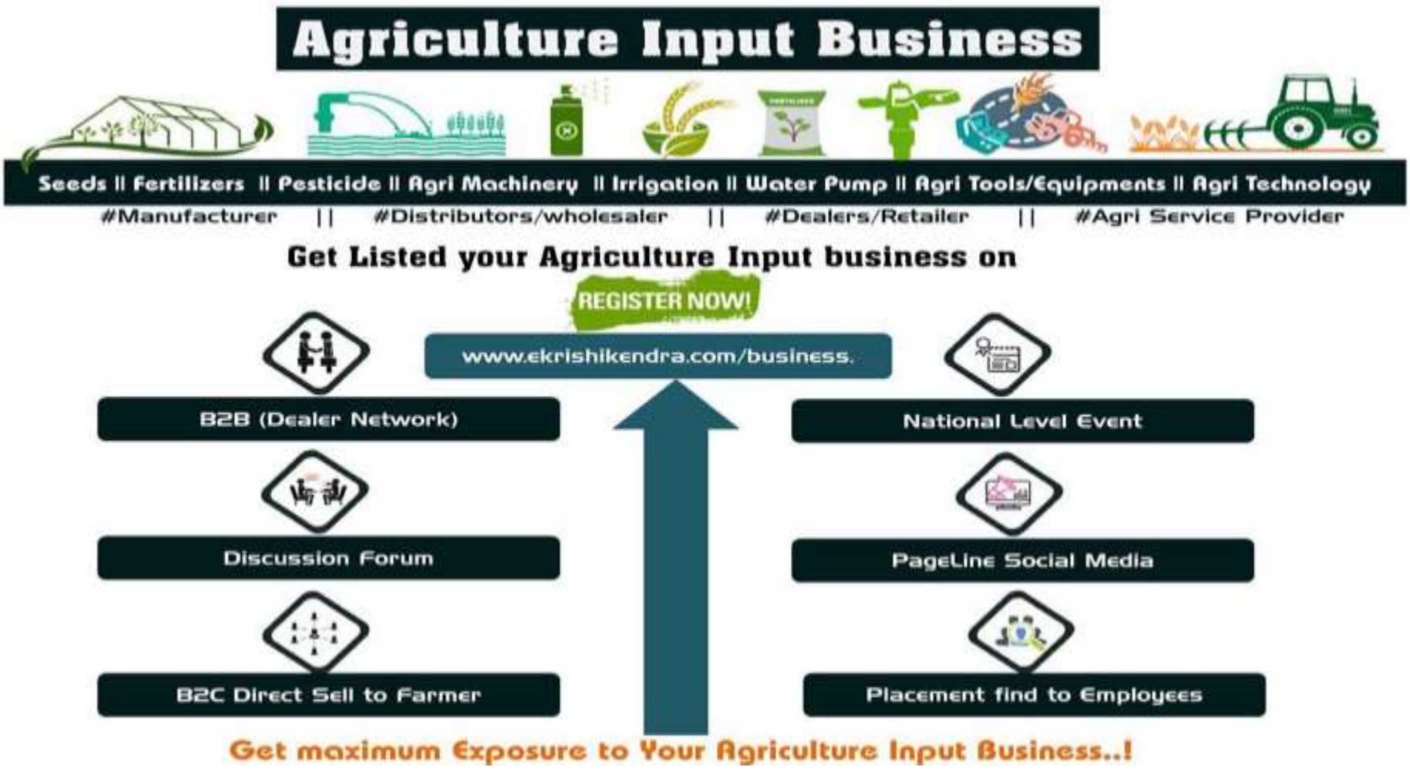
Provide multidisciplinary agronomic services, information to farmers on a variety of issue related to farming, commodity market and government's schemes. Direct Marketing of farm products. The hub for connecting the farmers to the Agri-Experts with a steady stream of information and services improving farming throughout year. E-Krishi Kendra provide Timeline (Social Media Corner), Purchase corner, Government corner, Crop Sell corner, Solution corner, Training corner and Recent Event Corner for farmers.



It offers new ways to connect, collaborate, conduct business and build bridge between people. E- Krishi Kendra is a B2B and B2C online portal which help to grow business. E-Krishi Kendra provide Pageline (Social Media Corner) , Sale corner, Crop purchase corner, Dealer system, Ad corner, Discussion corner and Recent Event corner for Agri Input sector.

E-Krishi Kendra is a platform where farmers connect with buyers, retailers, traders, corporate, industrial users, exporters, etc for selling their agricultural produce through Agri Baazar facility at better and competitive rates. E-Krishi Kendra provide Pageline (Social Media Corner), Farmer Crop (B2C) Corner, B2B (Buy/Sell) Corner, Commodity Update Corner, Discussion corner, Placement Corner, Event Corner for Agri Bazaar.

Agricultural experts can give agricultural information, agricultural knowledge and agricultural problems solutions to farmers through the portal. E-Krishi Kendra provide Live Video Corner, Group line Social Media corner, Advice Corner, Blog Corner, Discussion corner, Training Corner, Student Corner for Agri Expert.

An integrated e-education portal for Agriculture students. Facility of best agriculture organization connection for bright future. E-Krishi Kendra provide Student line (Social Media), Study Corner, Job Corner, Blog Corner, Discussion corner, Training Corner, Event Corner for Agri Student.

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Input Availability at Finger touch, Customized Trading of Agri Commodities, Advisory for all the needs of farmers from experts, and student asset as the future of Indian agriculture, which is digital infrastructure to empower Indian agriculture which is E-Krishi Kendra.

References

1. An Anonymous.An IT revolution in farming retrieved from https://www.agriculturetoday.in/An IT Revolution
2. Bhosage, S. M. (2018). E-Marketing of Agricultural Products, International Journal of Trend in Scientific Research and Development (IJTSRD), conference paper: 70-73.
3. www.ekrishikendra.com

'More Crop Per Drop': Revisiting a Research Paradigm

Article ID: 10290

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Introduction

Feeding a burgeoning world population with healthy diets, while minimizing the impacts on environment, is one of the biggest challenges of the coming decades (Springmann et al., 2018). The population of India has risen by over 235% in the last 60 years (Census of India, 2011) which has coincided with a large increase in food production due to significant improvements in agriculture through Green Revolution. India has the highest national freshwater demand globally and 91% of India's freshwater are used in the agricultural sector. Cereals account for more than 50% of the dietary water footprint in India and represent a potential opportunity for reducing water use in Indian agriculture. The increase in cereal production over last decades had an impact on the local environment, through increased agricultural land area, fertilizer and water use. Groundwater depletion has increased by 23% from 2000 to 2010 (Dalin et al., 2017) and is a major concern for cereal production and self-sufficiency. In this context, the Indian government is dedicated to harmonize the higher preferences to water conservation and water management; therefore, Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) was formulated with a significant vision of expanding the area coverage under irrigation through the concept of 'Har Khet Ko Pani' and improvement of water use efficiency through 'More crop per drop' in a well-focused fashion with end to end solution on source creation, distribution, management, field application and extension activities.

Concept of 'More Crop Per Drop'

1. Indian government has been implementing a centrally sponsored scheme on micro irrigation (drip and sprinkler) as a part of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) to improve water use efficiency in agrarian sector through promotion of suitable technological interventions and encouraging the farmers to engage water conservation practices.

2. 'Per drop more crop', an integral component of PMKSY and categorized into micro irrigation including drip, sprinkler, micro sprinklers etc. and supplementary water management activities (SWMA)/other interventions concentrates upon maximization of WUE at the field level.

3. SWMA involves construction of secondary storage structures at farm level like individual or community water storage, drought proofing structures viz. water harvesting and recharge of underground water, renovation of existing water bodies, enhanced water conveyance efficiency and provision of water lifting devices.

4. Assistance trend/pattern to the beneficiaries will be 55% for small and marginal farmers and 45% for other farmers.

5. Funding pattern is 60% coming from the central government and 40% from the state governments. Besides, in case of North East and Himalayan states, the share of expenditures is 90: 10 from the centre and state and for Union Territories (UTs), the programme is funded 100% by the central government.

6. Four basic water management strategies to promote improved water productivity and achieve real efficiency gains are:

    a. Increase the output per unit of evaporated water.
    b. Reduce losses of water to sinks and evaporation.
    c. Reduce the deterioration of water quality.
    d. Switch from lower value to higher value uses of water.

7. Agriculture has to achieve 'more crop per drop' to increase water efficiency in two ways such as improving the efficiency of rainfed production and modernisation of irrigation technologies. For this reason, there is a need for effective spreading of agronomic knowledge and allowing farmers' access to inputs including good quality seed and crop protection to reduce pre- and post-harvest losses.

8. According to predictions, the demands of water consumption rise an additional of 18% by the year 2050 in developed world and even by 40% in developing world; therefore, it is more important to use water precisely in agriculture.

Realization of 'More Crop Per Drop' through Various Micro Irrigation Techniques

By harnessing rain water through 'Jal Sanchay' and 'Jal Sinchan', water conservation and ground water recharge are nurtured. Micro irrigation is popularized to ensure 'Per drop more crop'. "Different micro irrigation technologies that may realize the concept 'more crops per drop' are mentioned below:

1. Drip irrigation/trickle irrigation is a system of application of the required quantity of water directly to the rhizospheric regions of the crops for optimum growth through drippers/emitters at frequent intervals or water is applied as a fashion of drop by drop or as micro jet on soil surface or in sub-surface soil at a rate lesser than the infiltration rate of the soil.

2. Whereas, sprinkler irrigation is a method of application of water in a manner similar to rainfall which is mostly suitable for majority of row crops as well as field and tree crops and in this improved system of irrigation, the water can be sprayed over the foliage/crop canopy.

3. The sub-surface drip fertigation method associated with conservation agricultural practices utilizes at least 40% less water and requires 20% less nitrogen containing fertilizer to achieve the same quantity of production similar to flood irrigation in a cost-effective manner. This improved method generally involves underground pipelines to deliver the exact or precise amount of irrigation water and nutrients through fertilizers which are directly given to the root zone of crops along with avoidance of soil evaporation. Besides, it may be beneficially suitable for application in rice and wheat without the requirement of adjusting those pipes between rotations thereby saving money and labour.

4. Water requirement in case of drip or sprinkler irrigation is quite less in comparison with other traditional irrigation methods due to the application of irrigation water on a smaller proportion of land, reduced soil evaporation and decreased runoff rate. Submerged condition/water logging usually prevalent in flood irrigation is rarely found in micro irrigation systems as these modern methods permit highly controlled rate of water application, provision of water only when required and minimization/avoidance of losses owing to deep percolation. Drip or sprinkler irrigation may cause reduction in water usage to the tune of 25–40% in contrast with overhead irrigation and 45–60% as compared to surface irrigation methods.

5. Micro irrigation systems can guarantee uniform, consistent and efficient water application thereby providing equal amount of water to all the plants; causing less wastage of water, power and fertilisers and leading to better crop productivity.

6. Moreover, these improved technologies generally help to apply the proper nutrients directly to the root zone at appropriate time through fertigation process which is defined as the application of fertilisers along with irrigation water in order to improve plant growth, development as well as yield thereby leading to the decrease in cumulative quantity of applied fertilisers ultimately saving an average 25–50% of the entire expenditures. Additionally, the herbicides, insecticides as well as fungicides can also be provided through micro irrigation thus improving crop yield.

7. On the other hand, the hazards of excessive weed growth and disease infestation are reduced by these methods as in case of micro irrigation systems, only a limited area is usually irrigated. It gives advantages to commercial crops in terms of yield and quality due to reduced/eliminated growth of harmful weeds which always compete with the main crops for nutrients, moisture and sunlight and also serve as a habitat for different diseases and insect pests.

8. Drip and sprinkler irrigation methods are being promoted in our country through Per drop more crop component of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) where 15% additional assistance is provided to small and marginal farmers to install micro irrigation systems in comparison with other farmers covered under Drought Prone Area Programme (DPAP), Desert Development Programme (DDP) and North Eastern and Himalayan States and 10% for other areas.

9. According to the available information collected from Ministry of Agriculture and Farmers Welfare during the last three years of 2013-14 to 2015-16, approximately 14.3 lakh hectares areas have been covered under drip and sprinkler irrigation systems more specifically under drip irrigation, 9.04 lakh hectares and sprinkler irrigation, almost 5.26 lakh hectares.

10. It is therefore essential:

a. To recognize that agriculture is the sector where potential for water productivity gains is highest,

b. To accept that all sources of water including rain, surface water, groundwater and wastewater are important to achieve food security where water is scarce,

c. To create the right policy, institutions and market incentives to increase water productivity in agriculture,

d. To move from supply to demand driven and service-oriented water management,

e. To realize that rural development may be better served by investments in sectors other than irrigation.

Conclusion

India's agricultural system has achieved a substantial increase in cereal production over the periods of 2005–2014 without consuming more water, through improvements in crop productivity and shifting more production to the Rabi season. As this has led to greater irrigation area, this strategy is of only limited use in solving water crises in India while sustaining crop production. Reducing pressure on freshwater resources, alleviating unsustainable groundwater use and securing cereal production for food security requires different solutions based on growing season. It was suggested by different experts that the properly implemented 'per drop more crop' concept, an integral part of PMKSY can not only help to achieve India's climatic agenda for 2030 but will also provide various other social, economic and environmental co-benefits like SDG1 (reducing poverty), SDG2 (increasing agricultural productivity), SDG 6 (judicious use of water), SDG8 (economic growth) and SDG12 (sustainable production).

References

1. Census of India, (2011). Provisional Population Totals, Paper 1 of 2011, India Series 1. Office of the Registrar General and Census Commissioner, India.
2. Dalin C., Wada Y., Kastner T. and Puma M. J., (2017). Groundwater depletion embedded in international food trade. Nature. 543:700–704.
3. Springmann M., Clark M., Mason-D'Croz D., Wiebe K., Bodirsky B. L., Lassaletta L., de Vries W., Vermeulen S. J., Herrero M., Carlson K. M., Jonell M., Troell M., DeClerck F., Gordon L. J., Zurayk R., Scarborough P., Rayner M., Loken B., Fanzo J., Godfray H. C. J., Tilman D., Rockström J. and Willett W., (2018). Options for keeping the food system within environmental limits. Nature. 562:519.

Protected Agriculture: Farming in Controlled Environment

Article ID: 10291

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Introduction

The adverse effects of green revolution on soil fertility, emergence of new insect pests and diseases and declining level of groundwater table tempted the farmers to consider alternate methods of cultivation which could curb these hazardous impacts and provide an opportunity to grow crops throughout the season or year. Protected cultivation technology was one such alternative which was promising to the farmers. It is defined as the production of crops under protected/controlled environmental conditions such as greenhouses, poly houses, shade nets, shallow and walking tunnels etc. This modern type of farming is gaining significance more specifically in peri-urban areas, ensuring a constant, year-round supply of high-quality vegetables, flowers etc. Protected agriculture embedded with precision farming principles of micro irrigation and fertigation is proved to be an attractive agro-enterprise. India has entered into an era of greenhouse vegetables cultivation more recently and the total area under protected vegetable production is not more than 10000 ha. In recent times, protected agriculture has demonstrated the potential to address the growing concerns of food security with climate change and urbanization (Lawrence et al., 2016).

Advantages of Protected Agriculture

1. The scope of area expansion under cultivation of vegetables and flowers is very little. The only option is vertical expansion through increased productivity and cropping intensity using protected farming.
2. India being a vast country with diverse and extreme agro-climatic conditions, the protected cultivation technology can be utilized for year-round off-season production of high value, low volume vegetables, production of virus free quality seedlings, production of quality hybrid seeds and as well as for disease resistance breeding programmes.
3. Large increases in yield, improvement in produce quality and revenue.
4. High water productivity as significant amount of water is conserved.
5. Significant reduction in pesticide use results in least pesticide residues, lower production cost and healthier produce.
6. Facilitates year-round production, allowing farmers to take advantages of market seasonality and higher prices as well as assured and off-season production.
7. Weed free cultivation and easier plant protection.
8. Can manage vagaries of weather and controlled pollination.
9. Generates self-employment for the educated rural youth in the farm sector.

Constraints for Promotion of Protected Agriculture

1. Environmental constraints:

a. Relatively higher perishability of flowers/vegetables.
b. Scarcity of water for irrigation under poly house and high fluctuating weather conditions.
c. Poor drainage of soil due to continuous irrigation to soil through drip or mist irrigation or water spray.
d. Over-exploitation of nutrients from soil and low soil fertility status.
e. Occurrence of pests and diseases.
f. Loss in production because of occurrence of physiological disorders.
g. Highly erratic weather conditions outside the poly house led to higher care and better management of crops inside the poly house and in turn higher cost of cultivation.

f. Major constraints in production of horticultural crops in India are temperature (hot or cold), sunlight duration and quality, water deficiencies or excesses, atmospheric moisture (relative humidity), weeds, deficiency of nutrients, heavy winds, carbon dioxide and host of diseases and insect pests etc.

2. Technical constraints:

a. Lack of scientific knowledge about crop production under poly house.

b. Non-availability of required quantity and quality planting material at right time.

c. Limited and irregular power supply.

d. Non-availability of quality inputs like pesticides and insecticides at right time at reasonable prices.

e. Non-availability of quality poly house equipment at local market.

f. Lack of technical guidance and relevant literature/ latest information in local language.

g. Production of crops under poly house conditions is highly dependent upon intensive knowledge and technical skill.

h. Package of practices is either limited or requires lot of modification to suit the agro-ecological and socio-economic conditions.

i. Availability of quality seed and planting material of required cultivar is a severe constraint.

j. No specific breeding work has been initiated for development of suitable varieties/hybrids for greenhouse or protected cultivation, even in important vegetables like tomato, cherry tomato, sweet pepper and cucumber etc.

3. Labour related constraints:

a. Poly house cultivation is labour intensive and demands skilled labour throughout the year.

b. Scarcity of labour during peak seasons

c. Migration of rural folk to urban areas in search of better jobs, alternative employment opportunities at the village level and indifferent attitude of youth towards agriculture has led to acute shortage of skilled labour especially in the peak seasons of planting/sowing and harvesting.

d. This has naturally raised the wage rates of skilled labour.

4. Economic constraints:

a. High initial investment in construction of poly house which is beyond the reach of small and medium farmers.

b. High cost of planting materials and plant protection chemicals.

c. Lack of adequate and timely disbursement of loan from financial institutions.

d. High cost of transportation and complexity of loan procedure.

e. Lack of awareness about credit and subsidy facilities and poor accessibility to subsidy.

f. Absence of pricing policy including crop insurance scheme for flowers and vegetables.

g. Seeds of commercial crops and low volume, high value crops were costly because of inclusion of royalty/trait fee in the retail price.

5. Marketing constraints:

a. Fluctuation in market prices and lack of marketing facilities at local place.

b. Farmers fetch good prices from international markets when compared to domestic market.

c. Even in domestic market, farmers fetch good prices during the months of January-April and the season is generally slack during September to December.

d. Lack of exclusive markets for flowers/vegetables grown under poly house.

e. Existence of middle men malpractices and distress sale due to immediate need of money.

f. Lack of specialized supply chain management including cold chain.

g. Difficulty in grading the produce at the production level.

Strategies to Expedite the Rate of Adoption of Protected Agriculture

1. Policy initiatives:

a. Price policy mechanism and regular power supply.

b. Timely availability of quality planting materials locally.

c. Higher subsidy for protected cultivation under poly house.
d. Creation of primary processing facilities at farm gate level.

2. Research and development initiatives:

a. Reducing the high initial investment and the cost of cultivation.
b. Standardization of designs and structure of low-cost poly house for different agro-climatic regions of the country.
c. Development of user-friendly package of practices.
d. Standardization of production technology under poly house.

3. Marketing initiatives:

a. Availability of raw materials of required quality at local markets.
b. Promotion of direct marketing and forward marketing of the produce.
c. Creation of separate cargo flights for national and international markets to export the produce.
d. Creation of specialized brand and market for the produce.

4. Farmer level initiatives:

a. Cluster and cooperative based approach in production and marketing of produce.
b. Appropriate selection of location and site for poly house installation.
c. Installation of rain water harvesting technique to reduce irrigation cost.
d. Use of indigenous technical knowledge for control of temperature and humidity.
e. Reducing poly house instalment cost by using locally made material.

5. Researchers from SAUs/ICAR Institutes:

a. Design and development of low cost and location specific poly house technology.
b. Development of new varieties and hybrids/superior planting materials of flowers and vegetables suitable for protected cultivation.
c. Development of user-friendly package of practices under protected cultivation.
d. Conducting research to reduce the post-harvest losses of the produce under protected cultivation.
e. Increasing the ceiling limits of area under cultivation and amount of subsidy for protected cultivation.
f. Efficient and transparent implementation of loans and subsidies to beneficiary farmers.
g. Creation of world class post-harvest infrastructure including grading, packaging, cold chain management and export facilities.
h. Incentive pricing policy for poly house grown vegetables and flowers.
i. Investment by private sector in development of infrastructure related to market such as storage, grading, packaging and cold chain management.
j. Government initiative for development of infrastructure related to market such as storage, grading, packaging and cold chain management.
k. Promotion of GAP under poly house cultivation among farmers.
l. Improving the accessibility of the quality planting materials, inputs and equipment required for protected cultivation.

Conclusion

Protected agriculture offers technology of varying complexity to suit the immediate needs of the growers, depending on the local climate. It allows high quality and quantity of plant growth during off seasons, or in harsh environments that do not cater to traditional plant production. Work remains to be done in the fields of plant science and engineering as many systems require proper adaptation and improvements.

References

Lawrence J., Simpson L. and Piggott A., (2016). Protected agriculture: A climate change adaptation for food and nutrition security. In Impacts of climate change on food security in small Island developing states, pp. 196-220. Hershey, PA: IGI Global.

Propagation Methods of Black Pepper

Article ID: 10292

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Introduction

Black pepper vines produce three types of shoot, namely:

1. Primary climbing shoot with long internodes having adventitious roots at nodes which cling to the supports/ standards.

2. Runner shoots which originate from the base of the vine and creep on the ground, have long internodes which strike roots at each node.

3. Fruit bearing lateral shoots. Cuttings are raised mainly from runner shoots, though terminal shoots can also be used. Cuttings from lateral branches develop a bushy habit. Rooted lateral branches are used for raising bush pepper. Though seeds (berries) are fully viable, they are not generally used for raising plantations as seedlings will not be genetically uniform.

Different Propagation Methods

1. Traditional method: Runner shoots from high yielding and healthy vines are kept coiled on wooden pegs fixed at the base of the vine to prevent the shoots from coming in contact with soil and striking roots. The runner shoots are separated from the vine during February-March, and after trimming the leaves, cuttings of 2-3 nodes are planted either in nursery beds or in polythene bags filled with potting mixture (soil, sand and farm yard manure in 2:1:1 ratio). Adequate shade has to be provided and the polythene bags are to be irrigated frequently. The cuttings become ready for planting during May-June.

2. Rapid multiplication method: A propagation technique developed in Sri Lanka has been modified for adoption in India for quick and easy multiplication of black pepper vines. In this method, a trench of 45 cm depth, 30 cm width and of convenient length is made. The trench is filled with rooting medium comprising of forest soil, sand and farm yard manure in 1:1:1 ratio.

Split halves of bamboo or split halves of PVC pipes are fixed at 45° angle by keeping split portion facing upward on a strong support on one side of the trench. Rooted cuttings are planted in the trench at the rate of one cutting for each bamboo split. The lower portions of the bamboo splits are filled with rooting medium (preferably weathered coir dust-farm yard manure mixture in 1:1 ratio) and the growing vine is tied to the bamboo split in such a way to keep the nodes pressed to the rooting medium.

Each single nodded cutting with the bunch of roots intact is cut and planted in polythene bags filled with fumigated potting mixture. Trichoderma @ 1g and VAM @ 100 cc/kg of soil can be added to the potting mixture.

The buds start developing in about three weeks and the poly bags can then be removed and kept in shade till main field planting. The advantages of this method of propagation are:

1. Rapid multiplication rate (1:40).
2. Well-developed root system.
3. Higher field establishment.
4. Vigorous growth as a result of better root system.

Bamboo method

PVC pipes method

3. Trench method: A simple, cheap and efficient technique for propagating black pepper from single nodes of runner shoots taken from field grown vines has been developed at the Institute. A pit of 2.0 m × 1.0 m × 0.5 m size is dug under a cool and shaded area.

Single nodes of 8-10 cm length and with their leaf intact are, taken from runner shoots of field grown vines. They are planted in polythene bags (25 cm × 15 cm, 200 gauge) filled with a mixture of sand, soil, coir dust and cow dung in equal proportions with their leaf axil exposed above the potting mixture. After keeping the bags in the pit, the pit should be covered with a polythene sheet. The cuttings should be irrigated at least five times a day with a rose can.

Cuttings in poly bag are drenched 2-3 times with copper oxychloride (2 g/litre). After about 1-month, new shoots start emerging from the leaf axil. The cuttings can be taken out of the pit after two months of planting and kept in a shaded place and watered twice a day. These cuttings will be ready for field planting after about 2 ½ months. By this method 80- 85% success rate can be obtained.

4. Serpentine method: Serpentine layering technique can be used for production of rooted cuttings of black pepper in a cheap and effective manner. In a nursery shed with roofing sheet or shade net, rooted black pepper cuttings are planted in polythene bags holding about 500 g potting mixture, which will serve as mother plants. As the plant grows and produces few nodes small polythene bags (20 ×10 cm) filled with potting mixture may be kept under each node.

The node may be kept gently pressed in to the mixture assuring contact with the potting mixture with the help of a flexible twig such as mid rib of a coconut leaflet. Roots start growing from the nodes and the cuttings keep on growing further. The process of keeping potting mixture filled polythene bags at every node junction to induce rooting at each node is repeated. In three months the first 10 to 12 nodes (from the mother plants) would have rooted profusely and will be ready for harvest.

Each node with the ploythene bag is cut just below the rooted node. The cut end is also buried into the mixture to induce more roots. Polythene bags used are filled with solarised potting mixture fortified with bio control agent. The Potting mixture is prepared by mixing two parts of fertile topsoil, one part of river sand/granite powder and one part of FYM (2:1:1).

The rooted nodes will produce new sprouts in a week time and will be ready for field planting in 2-3 months. The growing vines are to be irrigated every day with a rose can or sprinklers. By this method, on an average, 60 cuttings can be harvested per mother plant in a year (ICAR- Indian Institute of Spices Research, Kozhikode).

	
Trench method	**Serpentine method**

Conclusion

The best method among all the propagation methods is Rapid multiplication method because of its rapid multiplication rate (1:40), well developed root system, higher field establishment and vigorous growth as a result of better root system.

Use of Genetic Engineering for Management of Bacterial Diseases

Article ID: 10293

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Introduction

Plant diseases caused by bacterial pathogens place major constraints on crop production and cause significant annual losses on a global scale. The attainment of consistent effective management of these diseases can be extremely difficult, and management potential is often affected by grower reliance on highly disease-susceptible cultivars because of consumer preferences, and by environmental conditions favoring pathogen development. New and emerging bacterial disease problems (e.g., zebra chip of potato) and established problems in new geographical regions (e.g., bacterial canker of kiwifruit in New Zealand) grab the headlines, but the list of bacterial disease problems with few effective management options is long.

One major facet in the maintenance of the sustainability of crop production systems with predictable yields involves the identification and deployment of sustainable disease management solutions for bacterial diseases.

During the past two decades, much effort has been made to obtain an understanding of the key determinants of plant-pathogenic bacteria–host interactions. The increasing amount of genomic and transcriptomic data from both plants and pathogens, together with the continuous improvements in high throughput sequencing technologies, have resulted in a more complete understanding of the defense mechanisms deployed by plants and how bacterial pathogens subvert such immune responses in order to cause disease.

Use of Genetic Engineering

Improvement of these breeding strategies will require more intensive studies of the mechanisms of action of R genes and of the importance of effector targets to bacterial pathogenesis and the ability of these targets to tolerate mutations. One promising area for genetic manipulation has come through the analysis of transcription activator-like effector (TALE) proteins, secreted by *Xanthomonas spp*. and *R. solanacearum*. These TALEs are imported to the plant nucleus, bind to specific promoter DNA fragments, named effector-binding elements (EBEs), in a nucleotide specific manner and, with the assistance of transcription helper proteins, activate the transcription of the downstream genes required for disease development, termed susceptibility (S) genes.

The development of a comprehensive understanding of the expression and function of executor R genes has definitive promise in the construction of new crop varieties with durable resistance. Potential examples of the modification of TALE–host interactions resulting in resistance include the editing of EBEs to create 'blind' promoters upstream of susceptibility genes and the introduction of synthetic EBEs into the promoter regions of executor genes, creating 'promoter traps' that confer resistance to effectors from multiple pathogens.

As per recent reports six additional EBEs have been introduced in tandem in the promoter region of *Xa*27, an executor gene in rice that confers resistance to *X. oryzae* pv. *oryzae* secreting the effector protein *AvrXa*27. This genetically engineered promoter confers broad-spectrum resistance against bacterial blight and bacterial leaf streak in rice as it contains three EBEs that correspond to three additional effectors from *X. oryzae* pv. *oryzae* and three effectors from *X. oryzae* pv. *oryzicola* (Hummel *et al.,* 2012).

More recently, it was reported that the genetic engineering of the promoter region of *Xa*10, a TALE-dependent R gene that provides narrow-spectrum resistance to only a few strains of *X. oryzae* pv. *oryzae.* The introduction of five EBEs to the *Xa*10 promoter, corresponding to the TAL effectors PthXo1, PthXo6, PthXo7, AvrXa10 and

AvrXa27, has been reported to confer broad-spectrum resistance to 29 *X. oryzae* pv. *oryzae* strains from different geographical origins (Zeng *et al.,* 2015).

Dsbs induce native DNA repair mechanisms, such as non-homologous end joining, an error-prone repair mechanism that introduces variable length insertions or deletions at the breaking point, generally resulting in frame shifts in the target gene, rendering it non-functional. The second mechanism is homology-directed repair that inserts homologous DNA templates at the targeted point, allowing the precise insertion or deletion of nucleotides in a specific locus.

A successful example of genome modification using TALEN to engineer bacterial blight-resistant rice cultivars has been reported. In this study, TALEN technology was employed to target the S gene Os11N3 (OsSWEET14), which encodes a member of the SWEET sucrose efflux transporter family, and is activated by *X. oryzae* pv. *oryzae* through at least four different TALE proteins (AvrXa7, PthXo3, TalC and Tal5) to divert sugar transport and favour pathogen nutrition and proliferation within the host.

Gene Silencing

Gene silencing is the regulation of gene expression in a cell to prevent the expression of a certain gene**.** Gene silencing can occur during either transcription or translation and is often used in research.

Gene silencing is often considered the same as gene knockdown. When genes are silenced, their expression is reduced. In contrast, when genes are knocked out, they are completely erased from the organism's genome and, thus, have no expression. Gene silencing is considered a gene knockdown mechanism since the methods used to silence genes, such as RNAi, CRISPR, or siRNA, generally reduce the expression of a gene by at least 70% but do not completely eliminate it.

The RNAi pathway is found in many eukaryotes, including animals, and is initiated by the enzyme Dicer, which cleaves long double-stranded RNA (dsRNA) molecules into short double-stranded fragments of ~21 nucleotide siRNAs. Each siRNA is unwound into two single-stranded RNAs (ssRNAs), the passenger strand and the guide strand. The passenger strand is degraded and the guide strand is incorporated into the RNA-induced silencing complex (RISC). The most well-studied outcome is post-transcriptional gene silencing, which occurs when the guide strand pairs with a complementary sequence in a messenger RNA molecule and induces cleavage by Argonaute 2 (Ago2), the catalytic component of the RISC. In some organisms, this process spreads systemically, despite the initially limited molar concentrations of siRNA.

It was first time documented that RNAi application for engineering resistance in plant against bacterial pathogen causing crown gall disease. In the particular disease, iaaM and ipt oncogenes are responsible for tumourogensis (gall formation) and a pre-requisite for tumour formation. The management strategy of the disease targets these oncogenes., With the help of RNAi technology, they showed that transgenic plants (*Arabidopsis thaliana* and *Lycopersicon esculentum*) containing modified construct of these two bacterial genes (s) showed resistance against crown gall. The transgenic genes shut down the expression of iaaM and ipt oncogenes of the incoming bacterial pathogen, thereby disturbing the hormonal production and ultimately, tumourogenesis process after infection (Escobar *et al.* 2001).

It was also reported that plants lacking the modified oncogenes were hyper-susceptible to *A. tumefaciens*. Another example is the RNAi-mediated enhanced resistance to *Xanthomonas oryzae*, the leaf blight bacterium due to successful knockdown of a rice homolog of OsSSI2 (Dunoyer *et al.,* 2007).

It was also studied that the function of several miRNA families target genes of plant innate immune receptors (NBS-LRR) in Legumes and Solanaceae, respectively. They gave a new insight into viral and bacterial infection in plants that suppresses miR482- mediated silencing of R genes (Zhai *et al.,* 2011).

Summary and Conclusion

The deployment of specific R genes into agronomically important crop plants has generated positive momentum for disease management in a wide variety of bacterial disease pathosystems. However, in many cases, the resistance is not durable, as mutational modification of effector targets results in the evolution of new pathogen races that can overcome the resistance. Owing to short-term economic pressures, many of these technologies have been deployed without adequate consideration of the likely response of pathogens to the changed selective pressures being imposed. However, there is an increasing realization that the application of evolutionary principles may make sustainable plant disease management systems a reality.

References

1. Dunoyer, P., Cuellar, W. J. and Gazzani, S.2007. Small RNA duplexes function as mobile silencing signals between plant cells. Science 328, 912–916.
2. Escobar, P. S., Tam, W., Sun, L., Chadburn, A., Li, Z., Gomez, M. F., Lund, E. and Dahlberg, J. E. 2001. Accumulation of miR-155 and BIC RNA in human B cell lymphomas. Proceedings of National Academic Sciences USA 102: 3627-3632.
3. Hummel,T., Pallett, D.,Rusholme, R.,Dalmay,T.,and Wang,H. 2012. A simplified method for cloning of short interfering RNAs from Brassica juncea infected with Turnip mosaicpotyvirus and Turnip crinklecarmovirus. Journal of Virological Methods 136: 217–223.
4. Zeng, Y., Wagner, E. J. and Cullen, B. R. 2015. Both natural and designed micro RNAs can inhibit the expression of cognate mRNAs when expressed in human cells. Molecular Cell. 9, 1327-1333..
5. Zhai, J., Jeong, D. H., De Paoli, E., Park, S., Rosen, B. D., Li, Y., Gonzalez, A. J., Yan, Z., Kitto, S. L., Grusak, M. A., Jackson, S. A., Staey, G., Cook, D. R., Green, P. J., Sherrier, D. J., and Meyers, B. C. 2011. MicroRNAs as master regulators of the plant NB-LRR defense gene family via the production of phased, trans-acting siRNAs. Genes Development. 25:2540-2553.

Integrated Disease Management of Chickpea and Lentil

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Introduction

Pulses, an important constituent of food grains, play a vital role in food and nutritional security of millions of down trodden people of the world. Being an important source of protein, poor people mostly depend on pulses for meeting their daily requirements of this essential nutrient. Pulses will form a major source of protein for a huge section of Indian particularly, for the poor, backward classes of the traditionally vegetarian population (Reddy, 2004). But in reality, the net availability of pulses has come down from 61 to 37 gm/day/person and daily per capita consumption has come down from about 74 grams to 23 grams during the period 1960-61 to 2009-10 as against the ICMR norms of 40 gm/day/ person over the period 1950-51 to 2008-2009 in India, although, the World Food Programme (WFP) includes 60 grams of pulses in its typical food basket alongside cereals, oils, sugar and salt due to huge demand-supply gap. India is reckoned as the largest producer and consumer of pulses in the world accounting 25 per cent of that global production, 27 per cent of consumption and 34 per cent of food use (Price et al., 2003). India is the largest producer, consumer and importer of pulses in the world. Pulses are important sources of protein, high in fiber content and provide ample quantity of vitamins and minerals. Keeping in view large benefits of pulses for human health, the United Nations had proclaimed 2016 as the International Year of Pulses.

Chickpea

1. Wilt: Wilt of chickpea a fungal disease caused by *Fuzarium udum*. The pathogen is both soil and seed borne. It can survive in soil up to six years even in absence of host. It is a vascular disease-causing xylem necrosis and wilting of plants. Integration of cultural practices, chemical or biological seed treatment and host plant resistance constitutes integrated management module for effective management for the disease.

IDM practices:

a. Field sanitation and deep ploughing in summer. Avoid chickpea cultivation in heavily infested soil.
b. Select wilt resistance /tolerance varieties like- Avrodhi, JG-315, BG-372 and K-850.etc.
c. Seed treatment with Seed dressing with Metalaxyl 4-6 g/ kg seed or Trichoderma viride @ 6 g/ kg seed.
d. Intercropping with linseed (2:1) or mixed cropping with linseed (1:1).
e. Crop rotation with crop like wheat, barley, linseed, and mustard helps in reduction of wilt.

2. Ascochyta blight: Ascochyta blight is a destructive fungal foliar disease and can cause up to 100% yield loss. The disease is both internal and external seed borne. Cool wet weather favours the disease development. The secondary spread of disease is through conidia and ascospores.

IDM practices:

a. Destruction of diseased plant debris after harvest and deep ploughing during summer.
b. Use healthy seed and Seed treatment with Seed dressing with Metalaxyl 4-6 g/ kg seed or Trichoderma viride @ 6 g/ kg seed.
c. Grow moderately resistant/ tolerant variety like Gaurav, BG 372,Pusa 256.
d. Wide row and plant spacing, late sowing and intercropping with wheat barley and mustard.
e. If cloudy weather prevails, give one protective spray of Mancozeb at 2.5 kg/ha in 800-1000 litres of water. To check the secondary spread of the disease ,repeat the spray at 10-12 days interval.

3. Brotryts gray mold: Botrytis is a very destructive disease in India, Bangladesh, Nepal and Pakistan. Epidimic of this disease was recorded during 1982-83 in North western state of India. The disease appears regularly every year in moderate to severe from depending upon the environmental condition. The pathogen is both externally and internally seed borne and can survive through infected seed, crop debris and other host plants . Since, high level of resistance against this disease is not available.

IDM practices:

a. Late sowing (First fortnight of Nov.)and adaptation of wider row spacing and compact varieties.
b. Avoid excessive vegetative growth and excessive irrigation
c. Used tolerant varieties-Pusa209,SAKI9516 and Sweta.
d. Use healthy seed and Seed treatment with Seed dressing with Metalaxyl 4-6 g/ kg seed or Trichoderma viride @ 6 g/ kg seed
e. To control the secondary spread of the disease, Indofil M-45 @2.5 kg/ha in 800-1000 Litres of water should be sprayed. Depending on weather, spray can be repeated at 10-12 days interval.

Lentil

1. Wilt: Vascular wilt of lentil is of common occurrence wherever lentil crop is grown. It is major disease-causing heavy losses (50-70%) in yield in certain area.

IDM practices:

a. Deep summer ploughing
b. Delayed sowing destruction of diseased plant residue, crop rotation with non-host crops and cultivation of paddy in rainy season and avoidance of lentil sowing in sandy loam soil.
c. Use healthy seed and Seed treatment with Seed dressing with Metalaxyl 4-6 g/ kg seed or Trichoderma viride @ 4g/ kg seed.
d. Two Spray of Saaf (Carbendazim +Mancozeb)@0.2%.has been found more effective.
e. Use of resistant/tolerant varieties such as DPL 15, DPL 62, Pant L77-2 and Pant L-4.

2. Rust: It is a foliar disease usually occurring during the flowering /early podding stage. High humidity and cloudy weather with temperature of 20-220 C favour the disease development .In severe infection the affected plant debris without forming any seeds in pods or with small shrivelled seeds.

IDM practices:

a. Field sanitation and destruction of crop debris.
b. Delayed sowing of crop by 10th November.
c. Seed treatment with Propiconazol (Tilt)@1 ml/kg and two foliar sprays of Tilt@0.1% proved most effective for management of disease .The next best option is seed treatment with Tilt and two spray of Companion(Carbendazim +Mancozeb)@0.2%.
d. Lentil varieties Pant L 406,Pant L639,DPL 15(Priya),DPL-62,HUL-57 are resistant to moderately resistant against rust.

Conclusion

The suitable disease management options that could be Integrated to improve the productivity and reduce the present gap between potential and realized yield of chickpea and lentil crop.

References

1. Reddy, A. (2004). Consumption pattern, trade and production potential of pulses. Economic and Political Weekly. October : 4854-60.
2. Price, G. K. Landes, R. and Govindan, A. (2003). Electronic Outlook report from the Economic Research Service, WRS-03-01, USDA.:18-21.

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e-NAM

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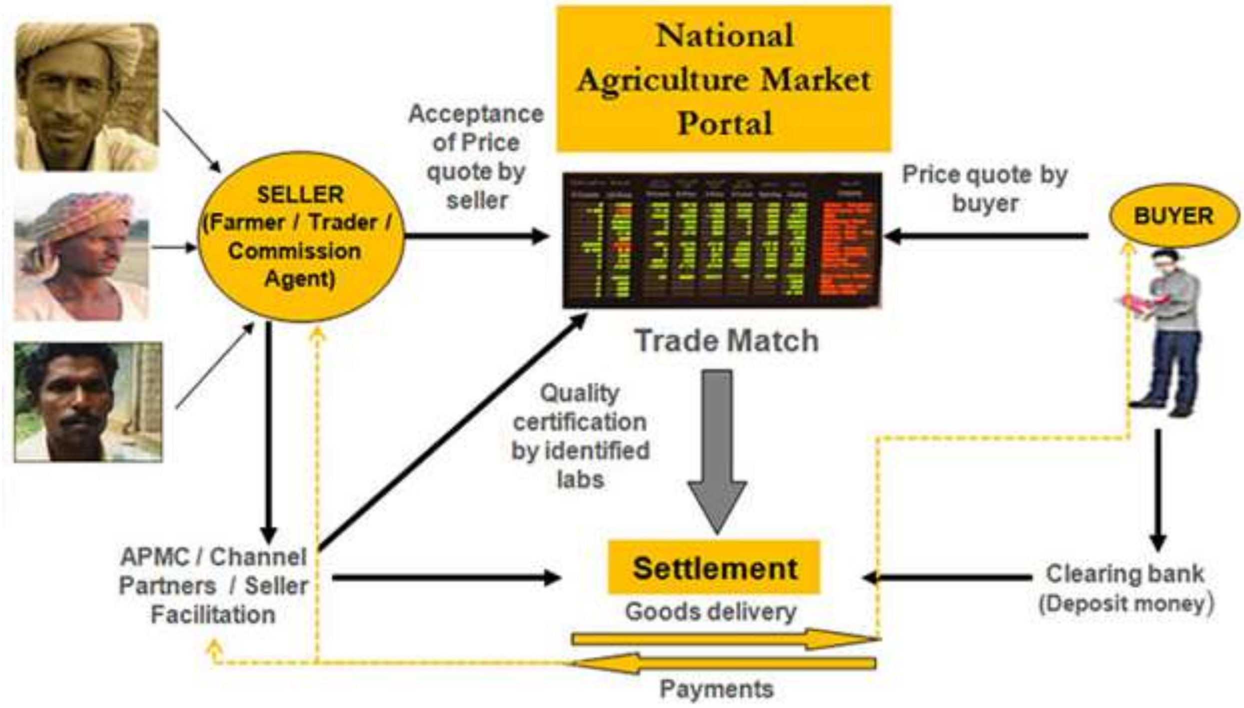
Introduction

National Agriculture Market (eNAM) is an electronic trading portal which networks the existing APMC mandis to create a unified national market for agricultural commodities. Small Farmers Agribusiness Consortium (SFAC) is the lead agency for implementing eNAM under the aegis of Ministry of Agriculture and Farmers' Welfare, Government of India.



Vision

To promote uniformity in agriculture marketing by streamlining of procedures across the integrated markets, removing information asymmetry between buyers and sellers and promoting real time price discovery based on actual demand and supply.

Mission

Integration of APMCs across the country through a common online market platform to facilitate pan-India trade in agriculture commodities, providing better price discovery through transparent auction process based on quality of produce along with timely online payment.

e-NAM and Its Role in the Agriculture Industry

The farmers can benefit if they were to find ways for aggregating produce on their own, bypassing the Arhatiya (business representative) and even the local mandi (Marketplace) in the process.

Features of e-NAM

1. Rs 75 lakhs allotted for every mandi.
2. It provides single window services for all APMC related information and services.
3. The services offered includes commodity arrivals, quality & prices, buy & sell offers & e-payment settlement directly into farmers' account.
4. Liberal licensing of traders / buyers and commission agents by State authorities without any pre-condition of physical presence or possession of shop /premises in the market yard.
5. One license for a trader valid across all markets in the State.
6. Harmonisation of quality standards of agricultural produce and provision for assaying (quality testing) infrastructure in every market to enable informed bidding by buyers.
7. Single point levy of market fees, i.e on the first wholesale purchase from the farmer.
8. Provision of Soil Testing Laboratories in/ or near the selected mandi to facilitate visiting farmers to access this facility in the mandi itself.

Conclusion

In conclusion, e-NAM will turn out beneficial to the farmers when they're receiving a higher price than before on their produce. The intermediaries that are responsible for the claiming charges that result in higher market prices can be put to trial. Larger retail stores can benefit from this and will be attracted to this due to higher profit margins since no intermediaries will be involved. When the local market prices are high, the state government has been seen blocking supplies in order to create an imbalance in Demand and Supply; hence it is critical to ensure that the software being used doesn't have any loopholes.

References

1. Can e-NAM flip Indian farmers' fate?- Business News. www.businesstoday.in.
2. List of Commodities, NAM, 14 April 2016, archived from the original on 19 June 2018, retrieved 29 December 2016.
3. What's in National Agriculture Market?, The Indian Express, 14 April 2016.

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Broccoli: As a Superfood

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Introduction

Broccoli is known to be a hearty and tasty vegetable which is rich in dozens of nutrients. It is said to pack the most nutritional punch of any vegetable. Broccoli is one of the foremost veggies to come in category of green vegetables. It's a staple in just about every produce section. But what's interesting is that broccoli is a fairly new crop in certain parts of the world. Believe it or not, broccoli didn't become widely popular in the United States until the 1920s, and it didn't make its way to England until the 1700s.

This vegetable is native to the Mediterranean, and it was originally cultivated in Italy. It's a cruciferous vegetable that shares ancestry with other flowering plants, including cabbage, cauliflower, Brussels sprouts, and kale. This superfood is loaded with fiber, antioxidants to fight cancer, and vitamin C to aid in iron absorption.

Health Benefits

On top of all the vitamins and minerals it contains, broccoli is chock full of many natural chemicals, chief among these is a sulphur compound called sulforaphane, which may help with certain health conditions. These include:

1. Cancer: Broccoli shares cancer fighting and immune boosting properties with other cruciferous vegetables such as cauliflower, Brussels sprouts and cabbage. Broccoli contains properties that depletes estrogens which usually cause cancer in the body.

It also has indole-3-carbinol, an anti-carcinogen and a potent antioxidant compound known to not only hinder the growth of cervical, breast, and prostate cancer, but also helps to boosts the liver functions.

2. Cardiovascular disease: Broccoli is packed with soluble fibre like many whole foods that excrete cholesterol out of your body. This is because the fibre in broccoli helps bind with bile acids in the digestive tract. This makes draw cholesterol out of our body easy.

According to a research by the Institute of Food Research, a particular variety of broccoli can help reduce the blood LDL-cholesterol levels by 6 per cent.

3. Antiallergic: Research has shown the ability of kaempferol to lessen the impact of allergy-related substances on our body. Broccoli even has significant amounts of omega 3 fatty acids, which are well known as anti-inflammatory.

Along with this, broccoli can also help people suffering from arthritis as broccoli contains sulforaphane, a chemical that blocks the enzymes and can cause joint destruction and hence lead to inflammation.

4. Immunity Booster: Broccoli contains antioxidants that can help the body in a variety of ways. Broccoli is deeply concentrated with vitamin C, making it great for immunity.

Other than this, broccoli also contains flavonoids which help recycle the vitamin C efficiently. It is also enriched with carotenoids lutein, zeaxanthin, beta-carotene and other power packed antioxidants.

5. Osteoarthritis: Broccoli contains high levels of both calcium and vitamin K, both of which are important for bone health and prevention of osteoporosis. Along with calcium, broccoli is also full of other nutrients like magnesium, zinc and phosphorous. Because of these properties, broccoli is extremely suitable for children, elderly and lactating mothers.

6. Heart health: The anti-inflammatory properties of sulforaphane, one of the isothiocyanates (ITCs) in broccoli, may be able to prevent (or even reverse) some of the damage to blood vessel linings that can be caused by inflammation due to chronic blood sugar problems.

Broccoli is great for heart health as it contains fibers, fatty acids and vitamins that help regulating blood pressure in the body. This also helps in reducing bad cholesterol, hence leading to a healthy heart. Broccoli helps protecting blood vessels from damaging as well.

7. Diet aid: Broccoli is a good carb and is high in fibre, which aids in digestion, prevents constipation, maintains low blood sugar, and curbs overeating. Along with this, broccoli is also great for weight loss because it is rich in fibre.

It is an ideal green vegetable to include in your salads and completing your five coloured vegetables every day. In addition to this, broccoli also contains proteins, making it suitable for vegetarians that are otherwise not able to complete their protein requirement.

8. Detoxification: Since broccoli is rich in fibre, it can help get rid of toxins through the digestive tract. Other than this, broccoli is also full of antioxidants that help in overall detoxification of the body. Broccoli includes special phytonutrients that help in the body's detox process.

This means that the body gets rids of unwanted contaminants. Broccoli also contains isothiocyanates, which help in the detox process at the genetic level.

9. Skin care: Skin care not only includes glow, but also its immunity. Since broccoli is a powerhouse of antioxidants and nutrients like vitamin C and minerals such copper and zinc, broccoli helps in maintaining a healthy skin.

This means it also protects the skin from getting infections as well as keep the natural glow of your skin. Broccoli is full of vitamin K, amino acids and folates, making it ideal for maintaining healthy skin immunity.

10. Eye care: Broccoli contains beta-carotene, vitamin A, phosphorous and other vitamins such B complex, vitamin C and E.

All these rich nutrients are great for eye health as these help in protecting the eyes against muscular degeneration, cataract and even repairs damage done by harmful radiations we go through by being constantly on our phones or being in front of a screen.

11. Anti-ageing: Since broccoli is enriched with vitamin C, which has numerous antioxidant properties, it is great for anti-ageing. This is because antioxidants help fight the free radicals responsible for ageing.

These free radicals often damage the skin. Eating broccoli regularly helps in reducing fine lines, wrinkles, skin issues like acne and even pigmentation.

12. Helps with weight loss: Broccoli is also an excellent food for weight loss. Along with being low in calories, this fibre-rich food can help you stay full longer and may curb overeating. It can also improve digestion and help relieve constipation.

13. Anti-pollution properties: Broccoli is a nutrient-rich vegetable with a number of helpful vitamins, minerals. What makes it an effective anti-pollution food is its ability to act down on certain pollutants and toxin. It's not the sprouts themselves but the components found in the stub which are good for the body.

In fact, a study conducted in China found out that broccoli sprouts were particularly helpful in fighting and detoxing away the air pollutants from the root. The phytochemical present in broccoli, called glucoraphanin initiates a chemical reaction that attaches itself to the harmful benzene compound, breaks it down and recharges the body to excrete it faster, before it gets the time to do the damage on the cellular level.

The same mechanism has also been found helpful to get rid of toxins associated with pollution and cigarette smoke. Hence, detoxifying the body by consuming a simple vegetable like fresh broccoli juice or smoothie can alleviate some of the health risks at the ground level.

Conclusion

Use of medicinal plants in medicine is increasing because of their widespread use and for their curing various diseases. Broccoli constituents mediate a variety of physiological functions by acting as antioxidants, regulating enzymes, and controlling apoptosis and cell cycle. This emphasizes the consumption of this vegetable associated to the prevention of disease condition such as cancer, cardiovascular disorders, ulcers and diabetes.

References

1. Valencia Hinguria. (2019). All About Broccoli: Nutrition, Health Benefits, How to Prepare It, and More. Everyday Health.
2. Madhu and Kochher, A. (2013). Role of Nutraceutical Enriched Broccoli in the Management of Lifestyle Diseases. International Journal of Medical Sciences. 6(2):69-76.
3. https://timesofindia.indiatimes.com/life-style/health-fitness/diet/11-health-benefits-of-broccoli/articleshow/30843390.cms.

Azolla: An Improved Feed for Sustainable Livestock and Fish Production for Small and Marginal Farmers for Doubling the Farmers Income

Article ID: 10297

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Abstract

Modern agriculture is a heavily dependent upon chemical fertilizers for increasing crop yield, which gets accumulated slowly in the environment and aquatic bodies and pose a danger to the activity of many beneficial organisms, including human beings. More ever one of the constraints to higher yields is the limited availability and high prices of (N, P & K) fertilizers. Therefore, it is necessary to search for the alternative for chemical fertilizers through renewable natural sources which will not harm the environment and ecology. Azolla is an under exploited multi utility resource, offering socio-economic and environmental benefits in different forms (fresh, dry and compost). It could serve as a potential manure or fertilizer and quality feed stuff for fishes as efficient nutrient recycling in agriculture, livestock, poultry and aquaculture sectors, consequentially curtailing input cost and enhancing farm output for higher economic returns.

Keywords: Azolla, Compost, Fertilizer, Feed, Manure and Mulching.

Introduction

Azolla is an aquatic fern belong to family Azollaceae and genus Azolla. There are nine extent species are identified till date viz: *(A. Caroliniana, A. Filiculoides, A.Maxicana, A. Microphyilla, A. Rubra, A. Pinnata, A. Nilotica, A. Imbricate* and *A. Japonica)*. These different species of Azolla are distributed widely from temperate region to tropical and sub-tropical regions. Whereas Azolla Pinnata is more commonly used in Asia and Indian sub-continent. Azolla is floating fern, small, flat, compact and moss like plant which is floating on water surface in paddy fields, small pounds and cannel surface. Upon close observation, these floating mats are seen to consist of many tiny ferns with multiple pairs of individual overlapping scales like leaves that resemble cedar leaf life appearance. Each plant may have a branching stem with several leaves, only a single dangling roots become dark brownish in colour when exposed to sunlight.

It plays an important role as bio-fertilizer in paddy fields is well known. As manure it improves soil health by adding nutrients (N, P and K), carbon and organic matter into the soil. Unlike traditional mulching materials, Azolla provide additional moisture to the soil, besides conserving soil moisture and checking weed growth in orchards and vegetable fields. Further, it serves as a low-cost protein rich feed resource for animals like cattle, pigs, goat, poultry, ducks and fish for improved health and increased production of milk, eggs, meat and aquatic products. Azolla needs to be exploited by the farming community in such a way that it is cultivated and utilised in maximum possible forms without much cost, labour and extra land requirement for socio-economic and environmental benefits.

Further, it serves as a low-cost protein rich feed resource for animals like cattle, pigs, goat, poultry, ducks and fish for improved health and increased production of milk, eggs, meat and aquatic products. Azolla needs to be exploited by the farming community in such a way that it is cultivated and utilised in maximum possible forms without much cost, labour and extra land requirement for socio-economic and environmental benefits.

Role on Environment & Ecology

As per scientific estimates, available historical fossil records reveal that about 50 million years ago, when earth was a much hotter, *Azolla* mat over the oceans helped in cooling down the planet by sequestering about 10 trillion tons of CO_2 in 1 million years and transformed it from a hot ball to what it is today. *Azolla*'s cosmic potential to sequester CO_2 from the atmospheric is due to its rapid growth in water without any need for a soil-based nitrogen source. The following listed properties make *Azolla* a multiple utility resource, which can be used as potential manure, nutritive feed ingredient and an effective mulching material in different farming systems, including agriculture, livestock, dairy and fisheries, besides alleviating global warming through CO_2 sequestering.

Role as Nutritive Feed

Depending on the environmental conditions (Temperature, pH and Relative Humidity) and nutrient status (Nitrates and Phosphates) of the water. *Azolla* is a good source of quality protein (15-40% on dry matter basis), which also varies with species to species, environmental conditions, culture practices and nutrient availability. Similarly, Lysine and Methionine content in most *Azolla* species has been reported to be higher than many conventional plant protein sources and also contain important micro minerals like viz; calcium, phosphorus, potassium, iron, zinc and manganese. Further, besides absorbing atmospheric N_2, it has immense capacity to sequester carbon dioxide (CO_2) from the air at a faster rate as compared to other plants and; also holds good percentage (%) of water (95 %). Hence, it needs to be integrated with our traditional farming systems in such a way that it could offer all its benefits and help the farmers as a multiple utility resource, without any extra land requirements. *Azolla* culture technology is very simple, requiring two major inputs i.e., organic manure (mostly cow or buffalo dung) and water. Most of the rural households rear dairy animals to fulfil their domestic milk demand, which produces sufficient organic manure within the farm or village. Hence, *Azolla* culture can be adopted without much cost and additional labour requirements.

Table.1 Nutrient Composition (%) of Azolla (Dry Matter basis):

Sl. No	Dry Matter	Crude Protein	Crude Fibre	Total Ash	Ether Extract
1	5.6	26.7	11.2	15.1	4.6
2	--	25.78	15.71	15.76	3.47
3	5-7	19-30	--	14.20	3-6
4	6.7	20.6	15	15.9	3.8
5	--	21.5	16.1	19.2	3.3

Role of Azolla in Horticulture Orchard

Traditionally, a variety of mulching materials, like paddy/wheat husk, wood saw, plastic sheets, cardboards, animal manure, leaves, sugarcane bagasse, grass etc., are used in the orchards or groves to preserve soil moisture and control weed growth, which needs to be arranged from outside the farm.

As a mulching material, *Azolla* holds an edge over the above listed material due to following additional benefits:

1. *Azolla* can be cultured within the orchards itself, without additional land requirement, low transport or procurement.
2. Besides nutrients, *Azolla* also provides moisture to the plants.
3. *Azolla* can be cultured easily throughout the year with simple technological interventions as regular supply.
4. It decomposes fast and adds good amount of nitrogen, phosphorous, carbon and organic matter to the soil helps in soil fertility restoration.
5. It will provide cooling effect through absorption of CO_2 from the surrounding environment.
6. Surplus *Azolla* can be sold out to other farmers (agriculture, livestock, poultry and aquaculture) for additional income leads to enhanced income per unit land holding.

Utilization of Azolla in Orchards

Growing Azolla mats in the pits will continuously absorb N_2 and CO_2 from the air, while harvested Azolla biomass can be utilized in the orchard as manure, mulching material and soil tonic in following two forms:

1. Freshly harvested Azolla can be used as mulching layer around the fruit trees, which will provide moisture, prevent soil moisture evaporation and serve as a potential bio-fertilizer by providing nutrients (N, P & K) and organic carbon to the soil on decomposition. It is very easy to harvest Azolla from the pit or bed with the help of a scoop net or sieve and transfer it directly around the trees.

2. Azolla compost: Surplus Azolla harvest can be filled in earthen pits and left for 4-5 weeks to decompose naturally into high quality compost which needs to be simply reshuffled occasionally with the help of a raker to aerate the decomposing Azolla to accelerate its decomposition process. Once the compost is ready, it is dried and stored to manure the trees, whenever Azolla harvest declines due to environmental extremities.

Utilization of Azolla as Green Manure

The conversion of molecular nitrogen into organic farm by cynobacteria is considered as one of the most direct method of utilization of solar energy and also considered as extremely low-cost bio fertilizers, therefore azolla as is used as efficient green manure.

Multiple Benefits of Azolla

After meeting the farm needs, surplus stock of fresh Azolla and Azolla compost can be utilized for additional income, as given below:

1. Fresh Azolla role in integrated farming: Livestock, poultry and fish farming, can use surplus fresh Azolla for feeding their animals (cows, buffalo, pig, goat, sheep, rabbits and fishes etc), birds (chicken, ducks etc).

2. It will not only save input cost, but also enhance milk, egg and meat production with significant increase in farmer's income. Further, multiple utility of Azolla has attracted the attention of agricultural and livestock farmers in the recent past and they are looking forward to adopt it as a potential manure and feed resource. Hence, Azolla inoculums can also be sold to such aspiring farmers at a higher price. Most recently, Azolla is also gaining popularity among urban people hobby in maintaining terrace gardens, where it is used as decorative filler base with other flowering aquatic plants like lotus, lilies, Pistia and Eichhornia.

3. A suitable market for such hobbyist can also be explored through developing working linkages with hi-tech popular plant nurseries in nearby cities.

Steps in Azolla Culture

Azolla culture in the orchards, earthen pits can be dug out in available land between the trees or portable *Azolla* beds can be installed between the trees. *Azolla* culture in earthen pits involves following steps:

1. Dig 1-1 ½ feet pits of 5 x 2 m (10 m^2) to 8 x 2 m (16 m^2) size.
2. Fix polythene/tarpaulin sheet in the pit.
3. Spread 5 cm soil layer at bottom of the pit.
4. Add cow dung (@1kg per m^2) and DAP (@ 5g per m^2).
5. Add 20-25 cm water and leave for 24 hours.
6. Normally to protect the *Azolla* stock from extreme heat during summers and extreme cold during winters, the pits are covered with 50 % sun shade net. However, it is not required in orchards as the trees protect the pits from extreme temperatures.
7. Add *Azolla* inoculums in the pits to cover about 50 % of water surface so as to prevent algae formation in the pits.
8. *Azolla* will grow and cover the entire water surface within 3-4 days.
9. Once complete *Azolla* mat is formed in the pit, start harvesting ¼ of the stock daily.

10. Keep adding cow dung (@ 1kg per m^2) slurry in the pit after every 7-10 days. In case *Azolla* growth slows down, add DAP solution @3-5 g per m^2.
11. Maintain water level in the pit and replace 25% water with fresh water every 4 weeks.
12. Pit water can be used as liquid manure & drained sludge as solid manure for orchard trees.
13. Renew *Azolla* pits (steps 3-6) after every 5-6 months, after complete drainage and cleaning.

Table. 2 Nutritive value of Azolla Compost:

Sl. No	Nutrient	Percentage (%)
1	Nitrogen	2.5 - 3.0
2	Phosphorus	0.4 - 0.6
3	Potassium	1.0 - 1.25
4	Carbon	28 - 30
5	Carbon : Nitrogen Ratio (C:N ratio)	10 - 12

Table.3 Fresh Azolla feeding for different Livestock Species Including Fish:

Sl. No	Livestock	Daily Feeding Ratio
1	Cattle and Buffalo	1.5 -2.0 kg per animal
2	Pig	1.5 -2.0 kg per pig
3	Chicken	10-100 g per bird
4	Duck	200 g per bird
5	Sheep & Goat	300-500 g per animal
6	Rabbit	100 g per rabbit
7	Fish	5-10 % per fish

Role of Azolla in Socio-Economic Development

***Azolla* compost:** Like vermicompost, surplus *Azolla* compost can also be sold in an attractive packet, with a higher price tag, to urban hobbyists for their home/kitchen gardens. *Azolla* compost also serves as potential manure for aquaculture. *Azolla* compost application @ 20,000 kg/ha/yr was found to enhance fish production (common carp, *Cyprinus* carpio) by 5.31% as compared to traditional manuring with cow dung at the same rate, while combination of *Azolla* compost with cow dung in the ratio of 1:1 and 1:3 enhanced the fish growth by 14.61 and 25.80 per cent, respectively.

Dry *Azolla:* In addition to above listed forms, *Azolla* can also be dried and stored as a promising feed ingredient for fish feed formulation, which has been found to enhance fish biomass production by 28.2% in a carp poly culture system (*Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*) and farmers net profit by 38.64%, when included in the grow out feed @ 10%. Dried *Azolla* can be incorporated in *Labeo fimbriatus* feed up to 40% for rearing fry to fingerling, without compromising fish growth and recorded 24.48% saving on feed cost. Sundried *Azolla* can be incorporated in pig feed up to 30% without any significant adverse effect on growth. Multiple utility options of *Azolla* offer a complete organic package for the farming community to reap maximum economic returns from their farm assets.

References

1. Abduh M Y, Ono J M, Khairani M, Manurung R 2017. The influence of light intensity on the protein content of Azollamicrophylla and pre-treatment with Saccharomyces cerevisiaeto increase protein recovery. J Appl Sci Res 13(8): 16–23.
2. Anitha K C, Rajeshwari Y B, Prasanna S B and Shilpa S J 2016. Nutritive evaluation of Azolla as livestock feed. J Exp Biol Agri Sci 4(6): 670-74.
3. Ansal M D, Kaur K and Kaur V.I 2016. Evaluation of Azollacompost as bio-fertilizer in carp culture water quality and productivity. Indian J. Ani. Nutri 33(2): 191-96.
4. Asadujjaman M and Hossain M A (2016). Fish growth, yield and economics of conventional feed and weed based polyculture in ponds. J Fisher 4(1): 353-60.
5. Chander M (2011). Azolla: A sustainable animal feed. In: Success and failures with animal nutrition practices and technologies in developing countries, FAO Proceedings of Electronic Conference. Animal production and health proceedings. No. 11. 1-30 September 2010, Rome, Italy pp 119-23.

Melia dubia (Malabar Neem): A Miracle Tree

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Introduction

In the past few years, the agricultural crops production and productivity is badly affected due to Abiotic factors like (Temperature, Rainfall, RH & Wind) which impact as environmental problems such as climate change, global warming, uncertainty in rainfall pattern, degradation of fertile land due to soil erosion and reduction of agriculture land with the increase in growing population.

Therefore, to tackle these situations and maintaining sustainability in crop production, changing the cultivation practices is need. The Agroforestry system is the best solution for tackling the adverse effect of climate change over crop production. The raising fast growing forest tree species along with agricultural crops on their fields so that such trees can fulfil several demands like maintaining the soil-health, providing fodder to the livestock and help in regular income generation. In this regard *Melia dubia* based agroforestry system is one of the most potential option to increase the income on a sustainable basis which plays a key role in doubling the farmers income of small and marginal farmers. Many developed and developing countries are involved in planting of trees on large areas to meet current and projected future demand of timber. It has been observed that the timber demand in India is extremely high in the current scenario due to which, the commercial agroforestry is increasing day by day at faster rate. on the other hand, we can be able to conserve our natural resources and generate the income of the farmers. In this regard Melia dubia-based agroforestry is a best option to bridge the gap between demand and supply of timber but also become a better initiative for long term measure for the environmental and ecological sustainability.

Melia dubia Cav. synonym Melia composita, (Family: Meliaceae), is a large deciduous, fast growing tree species native to India. Outside India, it is found in Sri Lanka, Malaysia, Java, China and Australia. In Karnataka state, it is predominantly found in Southern parts and commonly known as Malabar neem. The tree reaches 20 to 25 m height with a straight bole of about 9 to 12 m and nearly 1.5 m in girth at breast height. It grows well on variety of soils, however in deep fertile sandy loam soils it shows optimum growth. The timber is used for packing cases, ceiling planks, building purposes, agricultural implements and match boxes. The tree with the minimum size of 40cm girth is saleable at the minimum rate of Rs 2000 per ton for match, veneer and pulp industry. It is an ideal species for plywood and pulpwood industry apart from being extensively used in afforestation. Considering its fast-growing ability and multipurpose uses, it is also accepted as an ideal agroforestry species. Large scale plantations of *M. dubia* have been raised by various state forest departments and private entrepreneurs in Southern India.

Fruits (drupes) of *M. dubia* are used for propagation. The trees growing in southern part of India produces fruits with hard endocarp, due to which, the germination is inherently low and varies from 14 -34.5% [5-7]. It is an important plantation species with short rotation and multipurpose uses, highly valued as a pulpwood and plywood. It is best suitable for agroforestry system to generate higher and faster income under various Agro-climatic conditions in short tenure. In the recent scenario it has also been observed that this tree species has drawn greater attraction by small and marginal farmers in dryland areas by planting this on the bunds of the farm due to its several characteristics such as fast growth, straight stem, low branching rate and less shade effect over crops etc.

Planting

Melia dubia can grow on a variety of soils; however, well drained, fertile, sandy loam- clay loam soils are best suited for its growth. It grows very faster in initial two years of planting and can achieve the height up to 40 feet (12 m), with very few numbers of branches as compared to other tree species.

The excess side branches are mechanically pruned and harvested. Optimum for good growth can be observed in elevations ranging from 600 to 1,800 m. However, it can be successfully grown in semi-arid region with adequate soil moisture conservation. During planting generally 6-month-old saplings are planted in pits of 30-45 cm3. The spacing of planting under agroforestry is generally varies on the basis of land holding, sort of intercropping, water availability and farmers requirement.

Under agroforestry, optimum spacing of tree-to-tree and row-to-row should be kept 5 m × 5 m while ideal spacing of tree-to-tree and row-to-row is 8 m × 8 m. However, farmers usually plant at a spacing of 3 m × 3 m, 3 m × 4 m and 4 × 5 m respectively.

Agronomic Operations (Package and Practices)

Common Name	Malabar Neem
Botanical Name	*Melia dubia*
Local Name	Kannada: hebbevu, Tamil: malai vembu
Family	Meliaceae
Origin	South East Asia (India)
Distribution	It is distributed all throughout India (with the exception of Jammu & Kashmir, Himachal Pradesh, Sikkim), the Malay Peninsula and tropical Asia. It is present in moist deciduous, evergreen and semi-evergreen forests.
Nursery Management	**Seed Sowing:** It is best to sow seeds during March – April. Cleaned and dried seeds should be sown in the open raised nursery beds, in drilled lines, 5 cm apart. Seeds do not germinate in sand. They have to be sown in soil: farm yard manure medium in the ratio 2:1. A 1:1 ratio can also be adopted. About 6-7 kg of dried drupes containing about 1500 numbers are required for one standard nursery bed. The seeds sown need to be watered regularly, twice a day. At places where daytime temperature is not very high, or where nursery beds are in shade, the bed should be covered with a tarpaulin sheet to retain temperature in the medium. Germination occurs within 90 days. **Vegetative Propagation:** Juvenile stem cuttings and coppice shoots respond well to 1000–2000 ppm IBA. Pencil thick cuttings need to be taken for propagation. Thin shoots are easily susceptible to root rot. The shoots can be placed on sand medium and watered twice a day. A provision for drainage is a must as water logging destroys the shoots.
Land Prepration	Ploughing, Harrowing followed by Planking.
Pitting	30-45 cm3 pits has to open manually or with using machineries.
Interculture Operations	Hoeing is done to remove weeds in and around the planation site.
Irrigation	During initial two years, this tree is irrigated at the interval of 15-20 days by manually. Drip irrigation will be more economic and reduces the wastage of water and increase water use efficiency.
Manures	1-2 kg of well decomposed compost or Vermicompost is mixed with soil before planting. Twice in a year manuring is done for good growth of the trees.
Fertilizers (NPK)	25:30:30 g/plant/Year.

Intercropping	It is a best suited agroforestry tree species which can support a variety of crop growth throughout its phase of cultivation in the field. In the initial three years of planting, intercropping can be done with various annual crops, spices like pepper and Intercrops like groundnut, chilli, turmeric, black gram, papaya, banana, watermelon, sugarcane and leafy vegetables etc are being successfully cultivated. Fourth year onwards the interspace can be utilized for growing of fodder crops like Guinea grass, lemon grass etc.
Planting on the Bunds	Along the field bunds, in a single row about 60 trees can be planted at a spacing of six feet (1.8 m).
Yield	This tree gives good economic returns due to its property of fast growth in nature. It can be used for plywood industries. Under high density plantation 1200 to 1600 trees can be planted with good management in one acre of land and the expected yield would be 30-40 tonnes/acre if harvested the age of 4 years old plantation. Growth rate ranges from 20 to 25 cm per year in intensively managed plantation and in un-managed plantations where the growth rate ranges only from 6 to 8 cm per year. Economics: The tree attains a volume of 15 cu. ft. at the end of 15 years and earns revenue of Rs. 350 per cubic foot from the 5th year onwards. Growth rate ranges from 20-25 cm per year when intensively managed and 6 to 8 cm per year in unmanaged plantations. It is expected to produce 12 to 15 Cu ft. (0.4 - 0.5 cu. m) of timber in 5 years' time. Presently Melia fetches Rs. 7300/- per tonne for billets of girth 50-120 cm girth and above Rs.370 per CFT for trees which have attained a girth > 120 cm.
Uses	Wood obtained from Melia dubia is used in preparing like packing cases, matchbox sticks, pencils, furniture like, cots, stools, benches, wooden racks, sofa sets, dining tables and packing industrial equipment's, wooden tables, interior decoration, cigar boxes, tea powder boxes, musical instruments, splints and building purposes. On other hand It has also a medicinal value, insecticidal property and also used for fodder especially for small ruminants.

Conclusion

It plays a vital role in Integrated farming system in which livestock like sheep, goat and dairy farming is practiced. In this way due to its multiple uses, it can become a most important source of income generating tool among farmers, which play and important key role in doubling the farm income of small and marginal farmers.

Melia dubia Saplings in Nursery

1 Year Plantation of Melia dubia

Legume Intercropping with Melia dubia

Melia dubia Planted on bunds

Harvested Wood of Melia dubia

Fig.1 Pictures of *Melia dubia* based Farming

References

1. Parthiban K.T., Bharathi A.K., Seenivasan R., Kamala K. and Rao M.G. (2009) Asia-Pacific Agroforestery Newsletter, 34, 3-4.
2. Manjunatha, K.B. (2007) My Forest, 43, 455-458.
3. Ansari S.A., Narayanan C., Wali S.A., Kumar R., Shukla N., Rahangdale S.K. (2012) Annals of Forest Research, 55(1), 11-23.
4. Johar V., Dhillon R. S., Bangarwa K.S., Ajit and Handa A.K. (2015) Indian Journal of. Agroforestry, 17(1), 62-67.

Ajowan

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Introduction

The scientific name of ajowan is *Trachypermum ammi* and it belongs to the family Umbelliferae or Apiaceae. It is an annual herbaceous plant grown for its herb and grayish-brown seeds, which constitutes the spice. The trade name ajowan or ajwain based on the Indian name which is derived for adarjawan.

It is known as "Bishop's weed" in English, "Oma" in kannada and ajowain in Bengali and Hindi.

Ajwon is grown for its seeds, the composition of which is as follows:

Moisture	8.9 %
Protein	15.4
Fat	18.1
Crude fibre	11.9
Carbohydrates	38.6
Mineral matter	7.1
Calcium	1.42
Phosphorus	0.3
Iron	14.6mg/100g
Thiamine	0.21 mg
Riboflavin	0.28 mg

Climate

It is a cold loving crop and mainly grown during rabi season in India. In some pockets of the country, it is also grown as kharif crop. Moderately cool and dry climate favour good plant growth and flowering. Avoidance of high humidity especially after flowering is beneficial.

Continuous moist and cloudy weather invites insect – pests and a number of diseases. It needs a temperature between 15-27 0C with relative humidity of 60-70% during its growth period and requires preferably warm weather during seed development.

Soil

Ajwain is well adapted to a wide range of soils but grows well on well drained loamy soils. Organic matter rich clay-loam soil may also be used provided adequate drainage facilities are available. However, the crop does not thrive well in sandy or gravely soils. Owing to high moisture retention, the heavy soils are ideally suited for rainfed cultivation of ajwain. Although the crop is tolerant to salinity but always gives higher yield with better quality of leaves in neutral soils having a PH range from 6.5 to 7.5 .Hence , its cultivation should usually be avoided in problematic soils like saline, alkaline and acidic soils.

Improved Varieties

Ajmer Ajwain -1, Ajmer Ajwain 2, Ajmer Ajwain-93, Pratap Ajwain- 1.
GujaratAjwain-1, Lam selection 1 and Lam selection 2 , R.A. 1-80 and R.A.19-80.

Preparation of Land

The soil should be brought to fine tilth for good germination and growth. The first ploughing should be done by deep soil turning plough followed by 2-3 light ploughing by harrow or cultivator. Each ploughing should be followed by planking to conserve the moisture. In the termite prone areas add 20-25 kg/ha of quinalphos 1.5% or methyl parathion 3% powder at the time of last ploughing. There should be good moisture in the soil for better germination of seed.

Sowing Time

Ajwain is a cold loving crop and is mainly grown during rabi season in India. In some pockets, it is also grown as kharif crop. As a rabi season crop, it is sown in the months of September and October in northern plains, whereas, for kharif season crop, it is sown from July to August. In southern part of India, particularly in Andhra Pradesh, Karnataka and Tamil Nadu, Ajwain is usually sown in the middle of August and harvested around December and January. The early crop of Ajwain is mostly grown as rainfed and is sown during August, whereas the main season crop is sown as rabi season crop during September-October. For realizing yield, it is better to adjusted sowing time in such a way that the seed development and seed maturity phase coincide with a dry and rain free period.

Seed Rate

The quantity of seed required for the sowing of unit area depends on the cropping season for which the crop is sown. In order to sown one hectare area, about 2.5 – 3.0 kg seed of ajwain for rabi season crop and 4-5 kg for kharif crop season is required. The initial soil moisture at the time of sowing should be adequate to ensure satisfactory germination.

Seed Treatment

The use of bioinoculant Azospirillum or Azotobactor as seed treatment before sowing has proved beneficial in getting higher yield. Seed should be treated with bavistin or captan or thiram @ 2.0- 2.5 gm/kg seed for the control of seed and soil borne diseases.

Sowing Method

The seeds are sown by broadcasting method or drilled in rows 45 cm apart under irrigated conditions and 30 cm under rainfed production system. The seed germinates in about 10-12 days. The plant to plant spacing should be maintained to 20-30 cm. Ajwain is generally sown by broadcasting method but to facilitate inter culture operations, line sowing is appropriate. The Ajwain seed is small in size thus depth of seed should be kept around 1.0 to 1.5 cm in the soil for getting good germination. It is better to maintain uniform spread of seed through mixing of seed with dry sand before sowing.

Manures and Fertilizers

In general, for raising good irrigated crop of Ajwain, 10 tons of well decomposed FYM. or compost may be applied and evenly spread in the field before ploughing. At the time of last ploughing 30 kg N, 40 kg P2O5 and 30 kg K2O /ha may be applied in soils. An additional dose of 30 kg nitrogen may be given in two equal splits one at 45 days after sowing and second before flowering. In the rain fed farming area of ajwain 10 ton of well decomposed FYM or compost may be mixed in soil once in 2-3 years. In addition to this 40 kg N, 20 kg P2O5 and 20 kg K2O/ha should be applied at the time of sowing.

Irrigation

Ajwain is cultivated both as rain fed and irrigated crop. In irrigated production system about 4-5 irrigations are required. If initial moisture is less after sowing, a light irrigation is given after 4-5 days to facilitate germination and checking crust formation. Depending on climate and soil type subsequent irrigations are applied at interval of 15-25 days. Application of irrigation at 0.8 IW/CPE ratios has been found better for realizing higher yield.

Weed Management

Initial growth of Ajwain crop is very slow; therefore, it is necessary to keep the field free from weeds. A total of 2-3 manual weedings and hoeings are required, the first weeding should be done after 30 days of sowing accompanied by thinning from rows after maintaining suggested intra row spacing. The subsequent weeding is done at 30 days intervals as per requirement. Weeds can also be controlled by a pre-emergence application of Pendimethalin @ 1 kg /ha after sowing or Oxadiargyl @ 75 g/ha + one hand weeding at 45 DAS is good techniques for weed control in ajwain. Care must be taken that there is sufficient moisture in the soil at the time of application of weedicides for enhancing effectiveness of weedicides.

Plant Protection

Ajwain crop is generally less affected by insect-pests and diseases. However, sporadically crop is harmed by aphids, jassids, seed bug, midge, root rot and powdery mildew. The plant protection measures should include selection of resistant varieties, crop management practices such as time of sowing, balanced nutrition, crop rotation, green manuring etc. for reducing the incidence of diseases and pests and adoption of control measures.

Insect-Pests

Aphids: Some times ajwain crop is infested by aphid. Its colonies the plant at vegetative stages. Affected leaves and tender stem get devitalized and dried later on.

Control: Spray Imidachlorprid (0.005%), Thiomethoxam (0.025%), Dimethoate (0.33%). Repeat second spray after 10-15 days if necessary. Application of resin soap or Neem Seed Kernel Extract (NSKE) 5 %, Neem oil (2%) at early stage of population build up give good result.

Diseases

Root rot *(Rhizoctonia solani)*: This is a soil–borne disease. The symptoms include varying degrees of rotting of the root leading of foliage yellowing generally in 30 – 45 day–old plants. The affected plants later on wither and dry up. It is a serious problem in ajwain growing areas and drastically reduces the yield.

Control:

a. Seed treatment with Thiram or Captan @ 3 g/kg of seed.

b. Soil application of neem cake @ 150 kg/ha and seed pelleting with antagonistic fungi like *Trichoderma viride, T. harzianum* (Talc based formulation @ 6 g/kg of seed) can be used to manage the disease.

Powdery mildew: The disease generally appears late in the season and is of minor importance. The symptoms include the appearance of whitish fungal growth on leaves. The disease becomes serious at temperatures between 150 – 250C and at a relative humidity of above 60%.

Control: Dusting with Sulphur (25 kg/ha) or by spraying wettable Sulphur or Karathane (0.1%) twice at flowering stage at 15 days interval.

Harvesting and yield

The crop matures in 130-180 days depending upon the variety and season. The harvesting is usually done from February to May. At maturity flowering ceases and seed begin to develop and become brown in umbels. The crop is harvested with sickles or manually and stacked for drying, keeping the bundles upside down and then threshed to separate the fruits by beating with sticks. An average yield of 4-6 q under rain fed and 12-15 kg/ha under irrigated conditions could be obtained.

Vegetable Waste Recycling Management

Article ID: 10300

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Introduction

India is one of the largest agriculture-based country, which cultivates large number of fruits and vegetables, with increase in the global population and the rising demand for food and other essentials, there has been a rise in the amount of waste being generated daily by each household.

In vegetable markets, tonnes of wet/organic garbage generated daily, it contributes to waste for market. These waste materials are useless to mankind in their present condition. But by Bioprocessing, in an improved way, these vegetable waste materials can be utilized to produce the economical or commercially viable product i.e., biofuel, biogas and manure and also with other applications as effective solution of waste management without damage to environment.

Kinds of Wastes

1. Solid wastes: Wastes in solid forms. E.g., Plastics, bottles, cans, papers, scrap iron and other trash.

2. Liquid wastes: Wastes in liquid form. E.g., Domestic washings, chemicals, oils, waste water from ponds, manufacturing industries etc.

Types of Waste

Agriculture waste, livestock waste, dairy industry waste, poultry waste, fishery waste, industrial waste, municipal waste and e-waste.

Why so Much Waste in Agricultural?

Production: Lack of food preservation alternatives.

Storage: Lack of adequate cold storage facilities.

Transportation: Loss during handling and transport.

Composition of Municipal Solid Waste in India

In India the biodegradable portion dominates the bulk of Municipal Solid Waste, generally the biodegradable portion is mainly due to food and market yard waste.

Present Status of Waste Management

Storage of waste at source is lacking, domestic waste thrown on streets, trade waste on roads / streets, construction debris left unattended, biomedical waste disposed in municipal waste stream, industrial waste disposed of in open areas, segregation of recyclable waste at source not done, waste processing practiced available in limited places. final disposal done through crude dumping.

Reason for Improper Management of Waste

Lack of planning for waste management while planning townships, lack of proper institutional set up for waste management, planning and designing in urban local bodies, lack of technically trained manpower, lack of community involvement, lack of expertise and exposure to city waste management using modern techniques / best practices, lack of awareness creation mechanism and lack of funds.

Recommended Approaches to Waste Management

Waste minimization, material sorting and recycling, compost preparation: Aerobic/ anaerobic/ Vermicomposting, energy generation: fuel production, palletisation, biogas production and sanitary land filling: limited land availability is a constraint in metro cities.

The Ministry of Environment has Adopted the "5 R's" as Guiding Factor in its Approach to Waste Management

1. Reduction.
2. Reuse.
3. Recycling.
4. Recovery.
5. Residual management.

Processing / Treatment should be

Technically sound, financially viable, eco-friendly / environmentally friendly, easy to operate and maintain by local community and long-term sustainability.

What is Vegetable Waste?

It is a biodegradable material generated in large quantities, much of which is dumped on land to rot in the open, which not only emits a foul odour, but also creates a big nuisance by attracting birds, rats and pigs-vector of various diseases. Vegetable waste include rotten peels, shells, scraped portions of vegetables slurries

What is Recycling?

It means turning waste into something useful.

Characterization of Vegetable Waste

1. Vegetable and fruit waste are special group of biomasses that needs to be characterized to understand its nature for application as row material and to propose the best methodology for its proper utilization.
2. Characterization of waste can be done physically, chemically or biologically.
3. Physical characterization of solid wastes include estimation of weight, volume, moisture, ash, total solid, volatile solid, colour, odour, temperature etc.; while dissolved and suspended solids are estimated for liquid waste.
4. Chemical studies include the measurement of cellulose, hemicellulose, starch, reducing sugar, protein, total organic carbon, phosphorus, nitrogen, BOD, COD, pH, halogens, toxic metals.
5. Biologic characterization indicates the presence of pathogens and organisms which are indicator of pollution.

Vegetable Waste Recycling Done by Composting, Vermicomposting, Biogas Technology

1. Composting: It is the natural process of rotting or decomposition of organic matter by microorganisms under controlled conditions. Compost is a key ingredient in organic farming. It is organic matter that has been decomposed and recycled as a fertilizer and soil amendment.

Raw organic materials for composting: Kitchen wastes, crop residues, animal wastes, food garbage, some municipal waste, suitable wastes for agriculture processing industries

Why composting: Vegetable wastes are purely organic. organic waste can cause problems of smell, leachate, gas and stray animals in landfills. recycling at source is most economic and environment friendly method of waste management. compost is valuable resource for farmers. composting at source keeps inorganic waste clean and makes it easier for recycling.

Benefits of Composting: Improving soil structure, increase in nutrient content, Water retention and Wading off plant's diseases.

Mechanism of composting: Composting is a biochemical process in which aerobic and anaerobic microorganism decomposes organic matter into valuable manure called as compost.

Material required for Composting:

Kitchen refuses: Vegetable wastes.
Animal dung: Cow dung, Buffalo dung and Poultry dung.
Town refuse: Night soil, Street refuse and Municipal fuse.

Methods of preparation of compost:

Indore Method: This method was developed by A. Howard & Y. D. Wad at the institute of plant industry, Indore, India

Bangalore method: This method was worked out by L. N. Acharya at Indian Institute of Science, Bangalore

NADEP method: This method was developed by N. D. Pandhari pandey. Demonstration of this method at large scale was initiated at J. N. K. V. V., Indore campus.

2. Vermocomposting: Vermicompost is an organic manure (bio-fertilizer) produced as the vermicast by earth worm feeding on biological waste material. Vermicast are popularly called as 'Black gold'

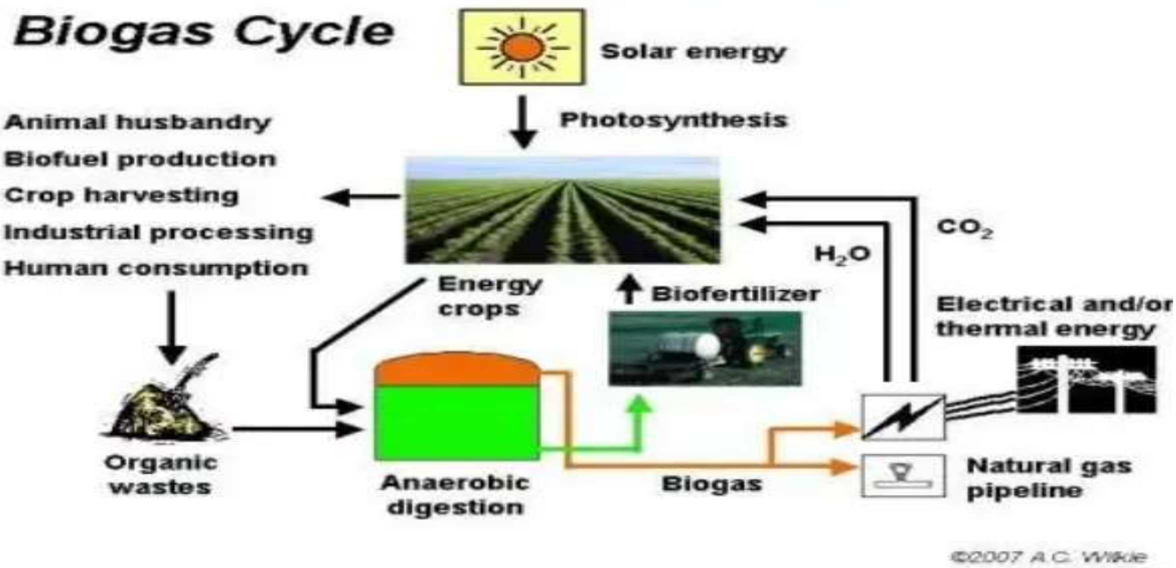
Benefits of vermicompost: Helps better plant growth and crop yield, improve physical structure of soil. enriches soil with micro-organism, attracts deep-burrowing earthworm already present in the soil which, indirectly improves fertility of soil, increase water holding capacity of soil, enhances germination, plant growth and crop yield, improves root growth of plants, enriches soil with plant hormones such as auxins and gibberellins and it is helpful in elimination of biowastes.

Earthworms: Commonly following varieties are used for vermicompsting *Eisenia foetida*, *Eudrilus eugeniae and Perionux excavates.*

Vermicompost can be produced by two methods:

Pit method: It is commonly used for small scale production of vermicompost.
Windrows method: This method is widely used for large scale production of vermicompost.

3. Biogas technology:



What is biogas: Biogas is a methane rich flammable gas that results from the decomposition of organic waste material. it is produced by anaerobic digestion or fermentation of biodegradable materials such as biomass, manure, sewage, municipal waste, green waste, plant material and energy crops. withered vegetable and flower wastes are being considered as a potential feed stock.

Advantages of biogas: Production of large amount of methane gas, production of free-flowing thick sludge, odourless sludge, sludge can be used as fertilizer and soil conditioner, sanitary way for human and animal waste disposal and conservation of scare resources like wood.

Disadvantage of Biogas

Explosion chances, high capital cost, incorrect handling of liquid sludge causes pollution, require control and maintenance, needs proper condition.

Process of Biogas Production

1. Waste collection.
2. Pre-treatment.
3. Mixing/Homogenising Tank.
4. Waste feeding into anaerobic tanks.
5. Anaerbic digestion: Biogas production or sludge production.

Conclusion

India cultivates large number of fruits and vegetables, there has been a rise in the amount of waste being generated daily by each household. In vegetable markets, tonnes of wet/organic garbage generated daily. These waste materials can be utilised by Bioprocessing to produce the economical or commercially viable product i.e., biofuel, biogas and manure and also with other applications as effective solution of waste management without damage to environment.

References

1. Nagarajan, G., Rajakumar, S and Ayyasamy, P. M. (2014). Vegetable waste : An alternative resource for biogas and biocompost production through lab scale process. Int. J. Curr. Microbiol. App. Sci. 3(10): 379-387.
2. Singh, A., Kuila, A., Adak, S., Bishai, M. and Banerjee, R. (2012). Utilization of vegetable wastes for bioenergy generation. Agric. Res. 1(3): 213-222.
3. Tayade, S. D., Marathe, A. B., Sapkal, V. S. and Sapkal, R. S. (2017). Sustainable solution for vegetable waste generated at district agriculture produce marketing centre. IARJSET. 4(3): 148-151.

Fly Ash as Soil Amendment for Remediation of Heavy Metal Contaminated Soil

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Abstract

Globally environmental pollution particularly soil contamination by heavy metals has become serious issue and big concern for human kind. The presence of non- biodegradable nature of heavy metal in soil and their associated risk to human health through food chain contamination as well as a decrease in crop productivity warranted a statutory requirement to remediate contaminated soil. Historically, various remediation methods were applied to contaminated soil; among them, heavy metals fixation by the organic or inorganic amendments has been emerged as a promising technology. Fly ash is a by-product from thermal power plants has several chemical constituents and physical properties which can be beneficially utilized for improving soil physical and chemical environment, improving supply of some plant nutrients as well as enhancing fertilizer use efficiency and also for remediation of heavy metal contaminated soil.

Introduction

Environmental pollution and particularly heavy metal contamination are the biggest menace the industrialized world faces today. Mine tailings, disposal of heavy metal wastes in improperly landfills, soil application of fertilizers, animal manures, bio-solids, compost, pesticides and atmospheric deposition through emission from industrial area are some of the major contributor to soil pollution (Zhang et al. 2010). Among the pollutants causing soil degradation due to above activities, heavy metals soil contamination is important and poses several serious environmental problems because of the non-biodegradable properties and toxicity to almost all kind of organisms (Zhang et al., 2010). The presence of non- biodegradable nature of heavy metal in soil and their associated risk to human health through food chain contamination as well as a decrease in crop productivity (Rooney et al. 2007) warranted a statutory requirement to remediate contaminated soil.

Remediation of Heavy Metal Contaminated Soil

As the heavy metals are highly persistent in soil and have adverse effect on soil microbes, animal, plant and human health. In general, toxic effects of heavy metals on living organisms, plant, animal and human occurs when the tissue concentration of heavy metals as a result of accumulation or uptake exceeds certain concentration level (toxic level). Also, some heavy metals are being subjected to bioaccumulation and may pose a risk to human health when transferred to the food chain (Zhou, 2003). Hence, remediation of such contaminated soil through immobilization or removal of heavy metals from soil is essential to protect ecosystem from potential harmful effect. Remediation technologies to counter the toxicity can be grouped into engineering (soil flushing and washing, excavation and removal), chemical (organic and inorganic soil amendment, electrochemical method) and biological approaches (phytoremediation and bioremediation) (Salt et al., 1995).

Most of the chemical approaches particularly heavy metal stabilization technique aim at reducing labile pool and free ion activity of the metals in soil solution so that their uptake by plant and toxicity to organisms can be reduced to a greater extent. Among the chemical method, heavy metals contaminants stabilization by the addition of organic or inorganic material as soil amendments has been emerged as a promising technology (Kumpiene et al., 2008).

Potential Soil Amendments for Remediation Purpose

Several soil amendments both organic and inorganic materials have been employed by various researchers in remediation of heavy metal contaminated soil. Mostly the inorganic amendment that has been used for remediation of heavy metal contaminated soil was industrial waste by-products. The use of such waste materials will not only solve the problem of waste disposal but may also provide a beneficial market for the substance as a valuable product. In literature, different inorganic amendments like red gypsum, phosphogypsum, goethite, ferrous sulphate, red mud, liming material, Fe/Mn oxyhydroxides, zeolites, steel slag, fly ash and beringite has been employed to immobilize heavy metals in a contaminated site (Vangronsveld and Cunningham 1998). On the other hand, addition of organic matter through various organic source has been practiced for several centuries to soil fertility improvement and revegetation purpose. In addition to these age-old practices of organic matter addition for crop production, heavy metal immobilization and decreasing plant availability of toxic metals in a contaminated soil through organic matter addition has proved to be economically viable and environmentally friendly technology. The organic amendments addition to contaminated soils can alter the heavy metal bioavailability by changing them from easily available forms to the organic matter or metal oxides or carbonates associated fractions form thereby reducing its bioavailability in soil (Walker et al., 2004). Among the organic amendments that have been used for the remediation of contaminated soil, the potential sources include cow manures, plant residues, municipal biosolids, charcoal, biochar, compost, sawdust, and wood ash.

Fly Ash Generation Scenario in India

Fly ash is a by-product from thermal power plants has several chemical constituents and physical properties which can be beneficially utilized for improving soil physical and chemical environment, improving supply of some plant nutrients as well as enhancing fertilizer use efficiency. In India, as per the Central Electricity authority of India, currently more than 185 million tonnes of fly ash are being generated annually. Out of the total generated fly ash, about 67% of the generated fly ash was utilized by various sectors and about 65 million tons were being dumped annually in ash ponds near thermal power plants occupying 65000 acres of land. Hence, due to its limited utilization in manufacturing bricks, cements and other civil utilization activities, safe disposal of such huge quantity of ash produced by the thermal power plants of India is a huge concern.

Fly Ash Utilization for Remediation of Contaminated Soil

Fly ash contains considerable amount of plant available nutrients like K, Ca, Mg, S and P and therefore has been proposed for its potential utilization for agriculture purpose (Singh et al., 1997). Recently, fly ash has also been used for remediation of contaminated soil by reducing bioavailability of heavy metals in soils; however, remediation capacity of fly ash is low due to low adsorption capacity for metals. As the application of fly ash as potential adsorbent are limited which reorients the research into the fly ash surface structure modification using acid and alkali (Chowdhury and Saha, 2011), so that its adsorption properties can be improved. To increase the efficiency of heavy adsorption or removal by fly ash from contaminated soil and water, the fly ash material has been modified either physically or chemically. The powdered form of fly ash material will increase the surface contact area with soil colloids containing heavy metals thereby reducing the bioavailability of heavy metals in soil. Further the fly ash materials have been activated by the strong alkali and acid so as to improve CEC through process of synthesis of zeolite or zeolite like intermediate product for heavy metal adsorption or retention on the surface. Querol et al. (2006) also studied on synthesis of zeolite like compound from fly ash and have been used as soil amendment for heavy metal removal and immobilization in soil. Further, the fly ash chemical composition and physical characterization makes it an attractive amendment for the inactivation of heavy metals in a contaminated soil (Mohapatra and Rao, 2001). Mohapatra and Rao (2001) also stated that fly ash chemical composition makes them attractive for inactivation of trace metals in soil. The thermal power plant by-product, fly ash has also been used for other purposes in addition to heavy metal immobilization like phosphorus retention, mitigation of acid mine drainage and reclamation of mine site.

Conclusion

Fly ash contains considerable amount of plant available nutrients like K, Ca, Mg, S and P and has been used as a potential source for agriculture purpose. Fly ash has also been used for remediation of contaminated soil by reducing bioavailability of heavy metals in soils. To increase the efficiency of heavy adsorption or removal by fly ash from contaminated soil and water, the fly ash material has been modified either physically or chemically. Synthesis of zeolite like compound from fly ash and the modified fly ash material have been used successfully as soil amendment for heavy metal removal and immobilization in soil.

References

1. Chowdhury S. and Saha P., (2011). Adsorption thermodynamics and kinetics of malachite green onto Ca(OH)2-treated fly ash. Journal of Environmental Engineering, ASCE. 137: 388–397.
2. Kumpiene J., Lagerkvist A. and Maurice C., (2008). Stabilization of As, Cr, Cu, Pb and Zn insoil using amendments – A review. Waste Management. 28(1): 215-225.
3. Mohapatra R. and Rao J. R., (2001). Some aspects of characterisation, utilisation and environmental effects of fly ash (a Review). Journal of Chemical Technology and Biotechnology. 76(1): 9-26.
4. Querol X., Alastuey A., Moreno N., Alvarez-Ayuso E., García-Sánchez A., Cama J. and Simón M., (2006). Immobilization of heavy metals in polluted soils by the addition of zeolitic material synthesized from coal fly ash. Chemosphere. 62(2): 171–180.
5. Rooney C. P., Zhao F. and McGrath S. P., (2007). Phytotoxicity of nickel in a range of European soils: influence of soil properties, Ni solubility and speciation. Environmental Pollution. 145: 596–605.
6. Salt D. E., Blaylock M., Kumar N. P., Dushenkov V., Ensley B. D., Chet, I. and Raskin, I., (1995). Phytoremediation: a novel strategy for the removal of toxic metals from the environment using plants. Biotechnology. 13(5): 468-474.
7. Singh S. N., Kulshreshtha K. and Ahmad, K. J., (1997). Impact of fly ash soil amendment on seed germination, seedling growth and metal composition of Vicia faba. L. Ecological engineering. 9: 203-208.
8. Vangronsveld J. and Cunningham S. D., (1998). Introduction to the concepts. In Metal Contaminated Soils: in situ Inactivation and Phytorestoration. Eds. J Vangronsveld and S D Cunningham. pp. 1–15. Springer, New York.
9. Walker D. J., Clemente R. and Bernal M. P., (2004). Contrasting effects of manure and compost on soil pH, heavy metal availability and growth of Chenopodium album L. in a soil contaminated by pyritic mine waste. Chemosphere. 57: 215–224.
10. Zhang M. K., Liu Z. Y. and Wang H., (2010). Use of single extraction methods to predict bioavailability of heavy metals in polluted soils to rice. Communications in Soil Science and Plant Analysis. 41(7): 820-831.
11. Zhou Q. X., (2003). Interaction between heavy metals and nitrogen fertilizers applied in soil-vegetable system. Bulletin of Environmental Contamination and Toxicology. 71: 338-344.

Bacillus thuringiensis, Mode of Action and Impact on Pest Management

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Introduction

1. In recent years the more important bacteria used in bio control belongs to this group.
2. The currently best-known crystal bearing bacterium is *Bacillus thuringiensis*, which was first isolated in 1911 by Berliner in Germany from the diseased larvae of Mediterranean flour moth.
3. *Bacillus thuringiensis* is an aerobic or anaerobic, facultative and sporulating bacterium.
4. Bt is present in soil, insects and their habitats, plants, forests and in aquatic environment.
5. This bacterium is different from other bacteria as it has parasporal inclusion body (crystal) of protein origin formed during sporulation.
6. This crystal is composed of cry proteins which are encoded by cry genes.
7. These cry proteins (Delta- endotoxin) exhibit toxic effects to the target organisms.
8. These proteins are highly specific to the target organisms and harmless to the plants, humans, vertebrates and completely biodegradable.
9. Therefore, Bt is a viable and important agent that controls insect pests in agriculture.

Taxonomy of *Bacillus thuringiensis*

1. The taxonomy of this species is difficult as different varieties of it.
2. It has been isolated from different species of caterpillars and were given different specific names but 37 were found to be the varieties of same *Bacillus thuringiensis* (Hmipel. 1967), has grouped all crystal bearing bacteria as variety of *B. thuringiensis*.
3. There are presently 24 serotypes of *Bacillus thuringiensis*, most of which have primary activity against lepidopterous larvae.
4. The most recently discovered serotype. H-14 *(Bacillus thuringiensis israelensis*), is primarily active against mosquito larvae and blackfly larvae.

Mode of Action

1. Many lepidopterous larvae are susceptible to Bacillus thuringiensis.
2. Susceptible host ingested by the Bt, the endospore germinates inside the gut region.
3. The bacterial cells are migrating in to the haemocoel where they can multiply rapidly and invade in to the certain tissues and cause disintegration.
4. This state of infection is called as "Septicemia".
5. Many lepidopteran larvae are susceptible to toxic action of the crystal alone, while others are susceptible only to the combined action of the spores and the crystals, a few lepidopterous larvae and several phytophagous hymenopterous larvae are susceptible to the action of B. thuringiensis spores alone.
6. Lepidoptera that are susceptible to the crystals alone are divided into types I and II, based on their response to the ingestion of crystals.
7. Type I and II insects both suffer from mid gut paralysis a few minutes after ingesting the crystals.
8. Type I insects, consisting of only a few insect species, develop a general paralysis and die after 1-7 hrs.
9. Type II insects do not develop a general paralysis and die 2-4 hours after ingestion of crystal.
10. Type I insects, consisting of only a few insect species, develop a general paralysis and die after 1-7 hrs.
11. Type II insects do not develop a general paralysis and die 2-4 hours after ingestion of crystal.

12. Most susceptible insects are in the Type II category.
13. After ingestion of spore the first symptom in both Type I and Type II is, “cessation of feeding”.
14. The activity of the crystal is dependent on the pH of the larval foregut and the action of the proteolytic enzymes within the gut.
15. Larvae that have a strongly alkaline gut pH (Above 8.9) and enzyme system with selective proteolytic activity in an alkaline medium are Susceptible to the crystal.
16. The crystal itself is a pretoxin, activated by the enzymatic hydrolysis that liberates soluble proteins which are in turn directly toxic.
17. These alkaline contents with the toxic material leak into the haemocoel.
18. In some insects the toxic material directly causes degeneration of mid gut epithelium.
19. This toxin has been found to be nontoxic to higher animals probably because of low pH in mammalian gut.
20. The crystal has long durability, the spore preparations retaining toxicity for 10-25 years outside the host body (Steinhaus, 1960).
21. The number of insects susceptible to only spore-crystal combinations or spore alone is relatively small when compared to the number of susceptible to toxic crystal alone.
22. It appears that while crystal is the active toxic principle responsible for paralysis, the Bacillus plays additional invasive by invaliding the tissue in body cavity of insects and thus accelerating the lethal process.

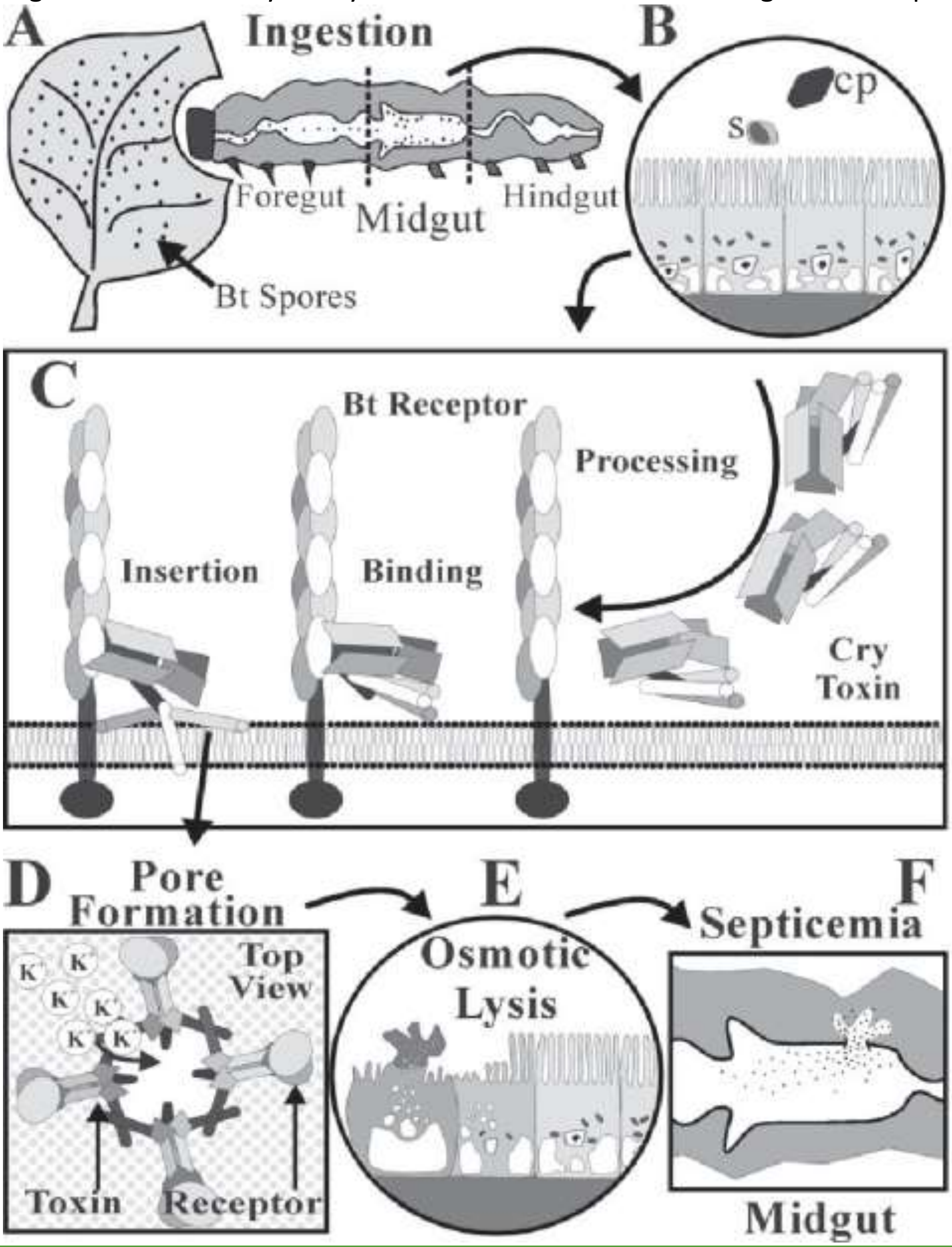

Fig:

A: Ingestion of spores or recombinant protein by phytophagous larva.

B: In the midgut, endotoxins are solubilized from Bt spores(s) and inclusions of crystallized protein. (cp).

C: Crytoxins are proteolytically processed to active toxins in the midgut. Active toxin binds receptors on the surface of columnar epithelial cells. Bound toxin inserts into the cellular membrane.

D: Cry toxins aggregate to form pores in the membrane.

E: Pore formation leads to osmotic lysis.

F: Heavy damage to midgut membranes leads to starvation or septicemia.

Bt. Impact on Pest Management

1. Bt. reduces pest damage and insecticide use.
2. It helps in enabling biological control.
3. Potential reduction in the cost of cultivation (depending on seed cost versus insecticide cost)
4. It promotes eco-friendly cultivation and allows multiplication of beneficial insects.
5. Bt. Proteins can also be introduced into the crop themselves through genetic engineering.

Bibliography

1. Gill, S. S., Cowles, E. A., & Pietrantonio, P. V. (1992). The mode of action of Bacillus thuringiensis endotoxins. Annual review of entomology, 37(1), 615-634.
2. Bravo, A., Gill, S. S., & Soberón, M. (2007). Mode of action of Bacillus thuringiensis Cry and Cyt toxins and their potential for insect control. Toxicon, 49(4), 423-435.
3. Pardo-Lopez, L., Soberon, M., & Bravo, A. (2013). Bacillus thuringiensis insecticidal three-domain Cry toxins: mode of action, insect resistance and consequences for crop protection. FEMS microbiology reviews, 37(1), 3-22.

The Possible Approaches for Herbicide Tolerance

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Introduction

Herbicide tolerance is the first trait incorporated in genetically modified crops. Excessive application of herbicide in the field raised the need to create herbicide-tolerant crops. Herbicides act by inhibiting the essential metabolic pathways of plants such as the aromatic amino acid pathway, aliphatic amino acid pathway, carotenoid biosynthesis pathway, cell division, and cell wall synthesis. Therefore developing a herbicide-tolerant crop is the need of an hour.

Table 1. Shows the list of herbicides targeting different metabolic pathways in plants:

Sr. No.	Herbicide	Inhibition of metabolic pathway
1	Atrazine	Photosynthesis at photosystem II
2	Bromoxynil	Photosynthesis at photosystem II
3	Paraquat	Photosynthesis at photosystem I
4	Glyphosate	Branched-chain amino acid synthesis
5	Glufosinate	Ammonia assimilation

Approaches for Developing Herbicide Tolerance

1. Target protein over-expression.
2. Creating a mutation in the target protein.
3. Detoxification of herbicide.

Target Protein Over-Expression

Herbicide tolerance can be introduced in the plant by nullifying the effect of herbicide through the over-expression of the target protein. Overexpression of a gene can be achieved by the use of a strong promoter or enhancer.

E.g., Overexpression of plant 5-enoyl pyruvyl shikimate-3-phosphate synthase (EPSPS). This enzyme is involved in the production of branched-chain amino acids in plants.

Glyphosate is a broad-spectrum herbicide that targets EPSPS enzyme, affecting protein synthesis and other important metabolic pathways which require branched-chain amino acids e.g., for secondary metabolite production. EPSPS should be expressed in plastids. Therefore, transgene sequence should contain its transit peptide.

Creating a Mutation in a Target Protein

Herbicides act as the competitive inhibitor of the enzyme involved in important metabolic pathways. These herbicides are showing structural similarity with the substrate of the enzyme. Therefore, any change in the amino acid sequence of these enzymes can weaken the interaction of herbicide with the enzyme. In this way, it can help in providing herbicide tolerance traits.

Eg. Mutant EPSPS gene. The mutant EPSPS has a lesser affinity for glyphosate. This methodology is used by Monsanto company to produce Roundup Ready crops (cotton, soybean, and rapeseed) that are resistant to glyphosate.

Detoxification of Herbicide

Detoxification of herbicide can be achieved either by expressing a gene from a foreign source or by enhancing the plant's endogenous detoxification.

E.g., the Glyphosate oxidase (GOX) gene isolated from soil microorganisms, *Achrobactrum anthropi* strain LBAA (Sahora et al., 1998). GOX degrades glyphosate to form aminomethyl phosphonic acid and glyoxylate which can be utilized by plants as metabolites. Another gene glyphosate acetyltransferase (GAT) isolated from *Bacillus licheniformis* which detoxify glyphosate by acetylation.

Plant has endogenous mechanisms of detoxification such as hydroxylation, conjugation, and transport processes. Hydroxylation of herbicide involves enzyme cytochromeP450 monooxygenases. Conjugation to glutathione involves the enzyme2 glutathione S-transferase (GST). This conjugate is transferred to the vacuole.

Table 2. List of herbicide-resistant gene:

Herbicide	Target protein	Transgene	Crop
Glyphosate (Roundup)	EPSPS	*Agrobacterium* CP4-resistant gene	Cotton, soybean, wheat, rapeseed.
Phosphinothricin (Liberty)	Glutamine synthase	Bar gene; PAT detoxification	Maize, rice, wheat, cotton.
Chlorsulphuron	Acetolactate synthase	Mutant plant acetolactate synthase	Maize, rice, tomato, sugarbeet.
Atrazine	Plastoquinone binding protein in photosystem II	Mutant plant chloroplast *psbA* gene.	Soybean.

References

1. Saroha, M. K., Sridhar, P., & Malik, V. S. (1998). Glyphosate-tolerant crops: genes and enzymes. Journal of Plant Biochemistry and Biotechnology, 7(2), 65-72.
2. Adrian Slater, Nigel W. Scott, and Mark R. Fowler. (2008). Plant Biotechnology: The Genetic Manipulation of Plants. Oxford University.

Antibiotics in Manure and Soil

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Introduction

Growth promoting properties of antibiotics in farm animals were first discovered in the late 1940's in chickens and pigs. Feeding of sub therapeutic doses of antimicrobials to the farm animals was readily adopted and it has now become an integral part of the farm animal/fish production systems.
1. Use of antibiotics as growth promoter is loosely defined as administration of antibiotics to healthy animals at concentrations below 200 ppm in feed for more than 14 days.
2. In terms of animal body weight it will be around 200 mg per 100 kg, which work out to a concentration of 2 ppm in animals.
3. Therapeutic and prophylactic antibiotic use: 20 ppm in animals, generally administered in water.

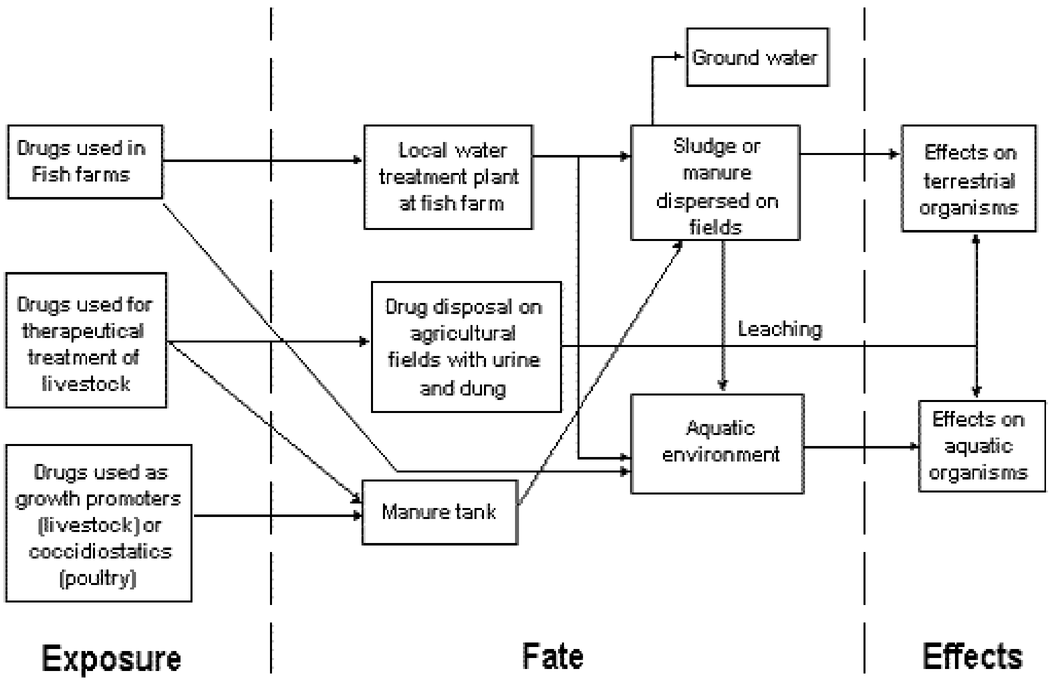
Antibiotics in Soil Environment and Food Chain

A major portion i.e., 30- 80 percent of antibiotic dose fed to the animals as growth promoters may be excreted as waste because of poor absorption. Antibiotic-laden manure used to fertilize crop lands, may get into the soil and eventually end up in streams, lakes or rivers.

Antibiotics Enter the Environment by Two Ways

1. Directly when using the drugs i.e., the unabsorbed as waste.
2. Subsequent excretion of absorbed antibiotic residues and their metabolites through urine and faeces of the animal.

Persistence



Effects of some soil properties on the persistence of anti-biotics in soil

1. Antibiotics like ciprofloxacin, ofloxacin, and virginiamycin degrade very slowly and may persist in soil in its original form up to 30-80 days.
2. Bambermycin, tylosin, and erythromycin completely degrade in a period of one month at temperatures ranging from 20-30 ^{0}C.
3. Persistence of an antibiotic in the terrestrial environment is the key factor determining its environmental impact.
4. Most of the antibiotic residues in manure generally remain stable during manure storage until its application to agriculture fields.

Effect of Soil pH

1. Tetracycline group: amphoteric in nature and are stable under acid conditions. These compounds can form chelates with divalent metal ions.
2. Sulfonamides: have two pKa values, they behave as weak acids and form salts both under acid and basic conditions
3. Amino-glycosides: being polar compounds move easily with the percolating water and can contaminate the ground water resources. But they are photodegradable therefore, easily decompose when subjected to sun-light.
4. Penicillin: belongs to ß-lactam class of antibiotics. It is stable under a wide range of pH values from strong acid to strong alkali conditions.
5. Fluoroquinolones: resist break down through hydrolysis and therefore are highly stable in soil.

Adsorption Reactions

1. Distribution coefficient (Kd).
2. Antibiotics with higher Kd value are strongly bound with the soil and are less mobile. Strongly bound antibiotics can be transported mainly to surface waters with the sediments during run off losses of soil.
3. Compounds with less Kd value are less strongly bound and more mobile in the soil. These group of antibiotics can be easily transported to contaminate the ground as well as surface waters.
4. Sulfonamides have little adsorption tendency and do not form immobile complexes in soil. Therefore, sulfonamides are strong contaminators of ground and surface waters while tetracycline is likely to contaminate mainly the surface water bodies.

Effect of Soil Texture

1. Ciprofloxacin was mineralized to CO_2 less than 1% in all the three soils in 80 days of incubation. Strong binding of this antibiotic was cited as the reason for its slow degradation.
2. Half-life of ceftiofur was more than 49 days in sand and only 22 days in clay loam.
3. Half-life of oxytetracycline in marine sediments at a depth of 5 to 7 cm was more than 300 days as compared to 87 to 173 days for virginiamycin in sandy soil.
4. This shows that antibiotic persistence in soil is determined by not only the soil type but also soil depth.

Effect of Type of Clay Minerals

1. In soils dominated by montmorillonite or illite or kaolinite, clay mineral reacts with the first two groups (strongly basic and amphoteric) of antibiotics to form complexes.
2. But acidic and neutral antibiotics are adsorbed only in soil that dominantly contains montmorillonite type of clay mineral; still the tenacity of adsorption is relatively weak.

Effect of Soil Temperature

1. As the temperature decreases from the normal range of 25-30 ^{0}C, persistence of antibiotics increases.

2. At 30 ^{0}C, 44% of chlortetracycline and 23% of bacitracin remained in the soil after 30 days of their application. However, when temperature decreased to 20^{0}C, 88% of chlortetracycline, 33% of bacitracin, 25% of erythrocin remained in soil.

Conclusion

There is an urgent need to gather precise information on the use of antibiotics in the animal husbandry in the country and its potential reservoir in soil and water. There is need for constant monitoring by compound livestock feed manufacturers association (CLFMA), ICAR, Drug controlling agencies for production and distribution of antibiotics for non-therapeutic uses. Health and hygiene should be the key to success without AGP's.

Physical and Financial Progress of Kisan Credit Card in India as Well as Assam

Article ID: 10305

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Introduction

Agriculture is the mainstay of our economy and about 70 per cent of the population of India is dependent upon agriculture for their livelihood (India at a glance, 2018). So, accelerated progress of agriculture is essential for food and nutritional security. For enhancing the growth and development of Agriculture it is necessary to use the new technology in agriculture along with modern infrastructural facilities. However modern agriculture is capital intensive, so timely availability of credit is crucial for economic growth. Due to increase in the prices of agricultural inputs they are unable to invest on high-cost technology in crop field from their own farm income and external finance is a must for any new investment proposal (Bordoloi and Das, 2015). Institutional credit plays a pivotal role in increasing agricultural production and also in improving the level of living standard of the rural households. The introduction of 'Kisan Credit Card' (KCC) in 1998-99 with the aim to provide financial assistance to farmers to meet their credit needs in relation to production as well as consumption need is a step in this direction. Keeping this point in view the topic has been selected with the objective to know the progress of Kisan Credit Card scheme in India and Assam.

Progress of KCC in India Before Revised

Table 1 explains that the mean value of number of cards issued by all the banks throughout the country was 85.72 and mean value of amount sanctioned was Rs. 44,909.33 crore. The number of cards issued was 7.84 lakh in the year 1998-99 which increased to 129.82 lakh in the year 2012-13 but in 2002, 2005 and 2007 it showed a decreasing rate and from 2008 it has been showing a positive growth rate. The reason behind the fact is that during 1990 the first major debt waiver scheme i.e., the Agricultural Rural Debt Relief Scheme was introduced, which might be creating misconception to the farmer that their interest and loan amount will be waived off which slowed down the repayment of loan as a result cause decline in issue of card. The amount sanctioned under the Kisan credit card scheme was Rs. 2310 crore in the year 1998-99 which increased to Rs. 126280 crores in the year 2012-13. During the period in 2003 and 2006 it showed a decreasing rate and from 2007 it has been showing a positive growth rate. The reason might be the introduction of Agricultural Rural Debt Relief Scheme which led to decline in flow of credit to agriculture sector. Apart from the negative mind set, there were a number of procedural hassles and conceptual issues which caused decline in flow of agricultural credit.

Table 2 explains that during the period 1998-99 to 2012-13, the mean value of number of cards issued under Kisan credit card scheme in India was the highest in commercial banks (41.99 lakh) followed by co-operative banks (30.90 lakh) and RRBs (12.82 lakh). The reason might be due to the fact that commercial bank issues short term credit and also commercial bank has many branches in different location, so it is easily accessible and as a result preferred by farmer.

Table 3 reveals that average amount sanctioned was highest in commercial banks (Rs. 26798.33 crore) followed by co-operative banks (Rs. 11921.20 crore) and RRBs (Rs. 6168.46 crore).

Table 1: Period wise progress of Kisan Credit Card scheme in India before revised:

Year	No. of Cards Issued (In lac)	Amount Sanctioned (Rs. in crore)
1998-99	7.84	2310
1999-00	51.34	7548

2000-01	86.52	16427
2001-02	93.41	25858
2002-03	82.43	26277
2003-04	92.47	21785
2004-05	96.80	34186
2005-06	80.12	47601
2006-07	85.11	46729
2007-08	84.70	49987
2008-09	85.92	46669
2009-10	90.05	57678
2010-11	101.69	72625
2011-12	117.60	91680
2012-13	129.82	126280
MEAN	85.72	44909.33

Source: Study on Implementation of Kisan Credit Card Scheme: Occasional paper 64, NABARD.

Table 2: Agency-wise number of Kisan Credit Card issued in India before revised (in lakh):

Year	Commercial Banks	RRBs	Co-operative Banks
1998-99	6.22	0.06	1.55
1999-00	13.66	1.73	35.95
2000-01	23.90	6.48	56.14
2001-02	30.71	8.34	54.36
2002-03	27	9.64	45.79
2003-04	30.94	12.73	48.78
2004-05	43.96	17.29	35.56
2005-06	41.65	12.49	25.98
2006-07	48.08	14.09	22.98
2007-08	46.06	17.73	20.91
2008-09	58.34	14.14	13.44
2009-10	53.13	19.49	17.43
2010-11	55.83	17.74	28.12
2011-12	68.04	19.95	29.61
2012-13	82.43	20.48	26.91
Mean	41.99	12.82	30.90

Source: Progress of Kisan Credit Card Scheme in India.

Table 3: Agency-wise amount sanctioned under KCC in India before revised (in crore):

Year	Commercial Banks	RRBs	Co-operative Banks
1998-99	1473	11	826
1999-00	3537	405	3306
2000-01	5615	1400	9412
2001-02	7524	2382	15952
2002-03	7481	2955	15841
2003-04	9331	2599	9855
2004-05	14756	3833	15597
2005-06	18779	8483	20339
2006-07	26215	7373	13141
2007-08	20421	9074	20492

2008-09	25865	7632	13172
2009-10	39940	10132	7606
2010-11	50438	11468	10719
2011-12	69510	11520	10640
2012-13	101090	13260	11920
Mean	26798.33	6168.46	11921.20

Source: Progress of Kisan Credit Card Scheme in India.

Progress of Kisan Credit Card in India After Revised

Table 4 depicts that after revision, Kisan Credit Card has issued average 1326.87 lakh cards with an amount of 587421.77 crore. In case of number of cards issued, during 2014-15 and 2015-16 it showed a decreasing rate. But from 2016-17, it has been showing an upward direction. In case of amount sanctioned also it has been showing the same result. During 2014-15 and 2015-16, amount sanctioned was reduced but from 2016-17 it has been showing an upward direction. Table 5 indicates after revision of KCC Commercial bank has issued highest number of cards i.e., average 663.96 lakh with an amount of Rs.354880.50 crore. Co-operative bank is in second position both in case of card issued and amount sanctioned. Co-operative bank has issued 458.76 lakh of cards with an amount of Rs.123897.49 crore. However, in case of RRB it has issued lowest number of cards i.e., 211.12 lakh with an amount of Rs. 99494.10 crore.

Table 4: Period wise progress of Kisan Credit Card scheme in India after revised:

Year	No. of Cards Issued (In lakh)	Amount Sanctioned (Rs. in crore)
2013-14	1203.37	617232.33
2014-15	1010.94	572614.17
2015-16	740.94	520307.27
2016-17	1504.61	530034.58
2017-18	1734.73	598159.36
2018-19	1766.68	686182.94
Mean	1326.87	587421.77

Source: India Agristat database.

Table 5: Agency wise progress of KCC in India after revised:

Year	Commercial Banks		RRBs		Co-operative Banks	
	Card issued (in lakh)	Amount sanctioned (Crore)	Card issued (in lakh)	Amount sanctioned (Crore)	Card issued (in lakh)	Amount sanctioned (Crore)
2013-14	547.49	353144.82	192.39	90210.35	463.49	173877
2014-15	547.49	333714.68	117.34	72351	387.93	111881
2015-16	225.24	334496.85	123.42	75892.95	392.26	109687.10
2016-17	815.66	333253.43	268.60	87652.87	420.36	109128.28
2017-18	920.89	383539.16	275.49	102416.74	538.36	112203.46
2018-19	926.99	391134.08	289.49	168440.72	550.21	126608.14
Mean	663.96	354880.50	211.12	99494.10	458.76	123897.49

Source: India Agristat database.

Progress of KCC in Assam After Revised

Table 6 indicates that in case of Assam number of cards issued has been showing a decreasing trend during 2014-15 and 2017-18. And average 11.10 lakh of cards has been issued from 2013-14 to 2018-19. For amount sanctioned, it has been showing a decreasing trend during 2014-15, 2016-17 and 2017-18 with an average amount of Rs. 3743.56 crore during the period 2013-14 to 2018-19.

Table 7 depicts the agency wise progress of KCC in Assam for revised KCC. From the table it is found that Commercial bank is in 1st rank in terms of number of cards issued and amount sanctioned. Commercial Bank has issued average 8.09 lakh of cards with an average amount of Rs. 2445.53 crore from the period 2013-14 to 2018-19. In case of RRB it is in 2nd position both in terms of card issued and amount sanctioned. It has issued average 4.85 lakh of card with an amount of Rs. 1257.86 crore. For Co-operative Bank, it has issued average 0.15 lakh of cards with an amount of Rs. 40.16 crore.

Table 6: Period wise progress of KCC in Assam after revised:

Year	No. of card issued (in lakh)	Amount sanctioned (in crore)
2013-14	10.24	2911.72
2014-15	0.31	2413.65
2015-16	10.74	4577.15
2016-17	18.26	4399.78
2017-18	17.30	3746.71
2018-19	21.76	4412.35
Mean	13.10	3743.56

Source: India Agristat database.

Table 7: Agency wise progress of KCC in Assam after revised:

Year	Commercial Banks		RRBs		Co-operative Banks	
	Card issued (in lakh)	Amount (crore)	Card issued (in lakh)	Amount (crore)	Card issued (in lakh)	Amount (crore)
2013-14	6.37	1617.55	3.60	1173.86	0.26	120.31
2014-15	0.28	1476.54	0.03	908.32	0.02	28.79
2015-16	5.90	2718.97	4.56	1824.75	0.27	33.43
2016-17	11.01	2719.49	6.95	1647.39	0.31	32.90
2017-18	10.77	2746.55	6.49	988.56	0.04	11.60
2018-19	14.25	3394.09	7.47	1004.32	0.04	13.94
Mean	8.09	2445.53	4.85	1257.86	0.15	40.16

Source: India Agristat database.

Conclusion

In case of both India and Assam the trend in growth of number of cards issued and amount sanctioned has been fluctuating over the years because of non-repayment of loan by the beneficiary which ultimately led to decline in flow of credit to agriculture sector. Introduction of Agricultural Rural Debt Relief Scheme has created misconception to the farmer that their interest and loan amount will be waived off, as a result of which they misutilise the credit and fails to repay the amount. Apart from the negative mind set, there were a number of procedural hassles and conceptual issues which caused decline in flow of agricultural credit. Among the different agency responsible for distributing KCC, commercial bank issues highest number of cards and sanctions larger credit in compared to other banks as it issues short term credit and also has many branches in different location, so it is easily accessible and as a result preferred by farmer.

References

1. Anonymous. India Agristat database. Retrived from https://www.indiaagristat.com/
2. Anonymous. (2018). India at a glance, FAO. Retrived from http://www.fao.org/india/fao-in-india/india-at-a-glance/en/
3. Bordoloi J. and Das A.K., (2015). Impact of Credit on Agricultural Production with Special, Reference to Crop Loan and KCC Scheme - An Empirical Study in Assam, Study no.-145, Agro-Economic Research Centre for North-East India, Assam Agricultural University, Jorhat -785 013, Assam.
4. Mani G., (2016). Study on Implementation of Kisan Credit Card Scheme: Occasional paper 64. Department of economic analysis and research, NABARD, Mumbai.
5. Kaur H. and Dhaliwal N. K., (2018). Progress of Kisan Credit Card Scheme in India. Amity. Journal of Agribusiness. 3 (1):26-36.

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Agro-Techniques for Seed Production in Garden Pea

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Introduction

Botanical Name: *Pisum sativum l.*
Family: Leguminosae.
Chromosome no: 2n=14.
Origin: Ethiopia.

Note: Pea is very predominantly a self-pollinated crop though in some varieties very little cross pollination may occur. Peas are very sensitive to drought. However, it can tolerate frost at early stage of growth.

Uses

1. Pea is highly nutritive containing high percentage of digestible protein (very valuable for the vegetarians) along with carbohydrates and vitamins A and C.
2. It is also very rich in minerals Ca and P.
3. It is an excellent food for human consumption taken either as a vegetable or in soup.
4. Large proportion is processed (canned, frozen or dehydrated) for consumption in the off-season.
5. Being N fixing legume, it is recognized as a soil building crop.
6. Pea is being used in a growing snack market.

Climate

Pea is a cool season crop and requires frost-free weather particularly at flowering and pod formation stage though vegetative growth is not affected by the frost. The optimum temperature for its germination is about 22°C and that for better growth and yield is 13-19°C. High temperature reduces the pod quality as sugars in the seed's changes to hemicellulose and starch. Temperature above 27°C shortens the growing period and adversely affects pollination.

Land Requirement

The land should be free of volunteer plants. The soil of selected fields should be well drained and aerated. The highly organic soils are unsuitable for pea as their moisture reserve leads to excessive vegetative growth and poor pod formation.

Field Inspection

A minimum of three inspections should be made, the first before flowering, the second at flowering and the third at edible pod stages.

Field Standards

1. General requirements:

Isolation: pea seed fields shall be isolated from the contaminants shown in column 1 of the table below by the distance specified in columns 2 and 3 of the said table:

Contaminants	Minimum distance (meters)	
	Foundation	**Certified**

Fields of other varieties	10	5
Fields of the same variety not conforming to varietal purity requirements for certification	10	5

2. Specific Requirements:

Factor	Maximum permitted (%)	
	Foundation	**Certified**
Off types	0.10	0.50
Plants affected by mosaic	0.50	1.0

3. Seed Standards:

Factor	Standards for each class	
	Foundation	**Certified**
Pure seed (minimum)	98.0%	98.)%
Inert matter (maximum)	2.0%	2.0%
Other crops seeds (maximum)	None	5/kg
Weed seeds (maximum)	None	None
Other Distinguishable varieties (maximum)	5/kg	10/kg
Germination including hard seeds (minimum)	75%	75%
Moisture (maximum)	9.0%	9.0%
Forvapour-proof containers (maximum)	8.0%	8.0%

Brief Cultural Practices

1. Time of sowing:

Plains: October-Mid of November
Hills: Mid of March to End of May
Darjeeling: June to August
North India: March- April, August-September & November-December.

2. Preparation of land: Prepare the field to a good tilth by ploughing two to three harrowing followed by levelling.

3. Source of seeds: Obtained nucleus/breeders/foundation seed from source approved by a seed certification agency.

4. Seed rate: Early Varieties – 100 - 120kg/ha.
Mid late varieties - 80-90kg/ha.

5. Methods of sowing: Seeds can be sown on flat or raised beds either by broadcasting or behind deshi plough in furrows, which are covered usual planking. Some farmers drill the seed through pora (tube) attached to deshi plough and there is no need of planking. A depth of 5-7.5cm is optimum.

6. Spacing: 22.5-30cm x 3.75-5cm.

7. Fertilization: FYM- 80-100q/ha at 15 days before sowing the seeds.
NPK- 30:50:25kg/ha this should be given at the time of sowing of seed as basal dose.

8. Irrigation: Irrigation should be provided as and when needed. Abundant water supply during flowering should be ensured. Late irrigation during warm weather should be avoided which may cause sunscalding of plants as also plants may tend to lodged and some rotting of vines may occur if the soil is kept too wet.

9. Interculture: Land should be kept clean by weeding and mulching. Lasso@0.75kg a.i./ha pre-emergence spray of tribunal@ 1.5kg a.i./ha. Pre emergence or Basalin @2kg a.i./ha pre plant incorporation along with one hand weeding at 45 days after sowing should be used.

10. Roguing: Roguing of offtype and diseased plants before flowering, during flowering and edible pod stage should be done on the basis of the growth habit of the plant, colour of foliage, pod size, shape, colour and maturity period.

11. Harvesting and Threshing: Maturity of seed crops take about 130-140 days. To test the maturity a common practice is to squeeze the seed between fingers. If the cotyledons break away from each other and free moisture is not visible, the crop may be considered mature enough for harvest. Vines along with the pod are harvested from the field and dried in the threshing floor under sunshine. Threshing is done by beating with stick when sufficiently dry.

12. Storage: Threshed seeds are cleaned by winnowing, dry to reduce seed moisture content to 12% for temporary storage. For longer storage pea seed should be stored in sealed containers at 10% moisture content and in air cooled rooms.

13. Seed Yield: 10-20 qt/ha.

14. Disease management:

a. Powdery mildew *(Erysiphe pisi)*: First symptoms appear on the upper surface of the leaves as very small and discoloured spots which soon give rise to enlarge white powdery areas on the leaf, stem and pod. Multiple infection may cover the whole plant.

Management:

i. Grow resistant varieties like Palam Priya.

ii. Spray Dinocap or Bitertanol or Hexaconzole @ 0.05% as the initial symptoms appear on the leaves.

b. Fusarium wilt (*Fusarium oxysporum* f.sp. pisi): Near wilt attacks young plants. The affected plants shoe yellow-orange internal discolouration in the lower internodes.

c. Root rot *(Fusarium solani)*: The vascular tissue shows red discolouration extending upward 1-3 nodes above soil surface. Diseased plants appear unthrifty, variously dwarfed depending upon the severity of infection, and may wilt and die.

Management: Fusarium wilt and root rot can be controlled by using following treatments:

i. Seed treatment with Bavistin @ 3g/kg of seed.

ii. Soil drenching with Bavistin @ 0.01% or Captan or Brassicol reduces the disease.

iii. Follow long crop rotation.

d. Bacterial blight: Lesions appear on all above ground parts of the plant. They begin as small, water soaked, oval spots. Multiple lesions often appear together which may cover large portions of infected plants and give blighted appearance.

Management: Slurry treatment of seed with streptomycine sulphate (2.5 g/kg of seed) or soaking seeds in streptomycine solution for 2 hours.

15. Insect-pest management:

1. Pea aphid: It attacks young vine sucking the juice from growing tip, later covering the whole plant. It causes curling of the leaves and pods.

Management: Spray Dimethoate @ 0.01% or spray of 0.06% nicotine sulphate.

2. Pod borer: The young caterpillars first feed on the surface of the pods, bore into them and feed the seeds.

Management: Spray Malathion or Cypermitherin @ 0.01%

3. Leaf minor: The greenish larvae make serpentine tunnel in the leaves and feed on it. The infested leaves wither and dry. Flowering and pod formation is drastically affected.

Management: Spray Cypermethrin or Fenitrothion or Fenthion @ 0.01%.

16. Cultivars are grouped on the basis of various characters:

a. According to seed:

i. Round or smooth seeded cultivars.
ii. Wrinkled seeded cultivars.

b. According to height of plant:

i. Bush or dwarf types.
ii. Medium tall types.
iii. Tall types.

c. According to maturity period:

i. Early (65-80 days).
ii. Medium (90-100 days).
iii. Main season (110-120 days).

d. According to use of pods:

i. Fresh market.
ii. Freezing types.
iii. Canning types.
iv. Dehydration types.

Varieties Recommended for Different Regions

1.	Early Wrinkle Seeded:-	Arkel, Pusa pragati, Azad P3, Pant Sabzi matar-3(PSM-3), Matar ageta 6, VL ageti matar 7(VL-7), Vivek matar-10, Kashi nandini (VRP-5), Kashi uday (VRP-6), Palam triloki
2.	Main season wrinkled seede varieties:-	Bonneville, Lincoln, Azad P-1, Punjab-89, Palam priya, Vivek matar-6, Vivek matar-8, Vivek matar-9, Arka ajit
3.	Edible Seeded peas:-	Sylvia, Punjab mithi phali, Arka sampoorna

Water Footprint

Article ID: 10307

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Water Footprint

The water footprint is a measure of the amount of water used to produce each of the goods and services we use. It tells us how much water is being consumed by a particular country – or globally – in a specific river basin or from an aquifer. The water footprint is a measure of humanity's appropriation of fresh water in volumes of water consumed and/or polluted.

The water footprint helps to answer a broad range of questions such as:
1. Where is the water dependence in a company's operations or supply chain?
2. How well are regulations protecting the water resources?
3. How secure are the food or energy supplies?
4. Can we do something to reduce our own water footprint and help us manage water for both people and nature?

The water footprint can be measured in cubic meters per tones of production, per hectare of cropland, per unit of currency and in other functional units.

It helps us understand for what purposes our limited freshwater resources are being consumed and polluted. The impact it has depends on where the water is taken from and when. If it comes from a place where water is already scarce, the consequences can be significant and require action.

Components of Water Footprint

The water footprint has three components: green, blue and grey. Together, these components provide a comprehensive picture of water use by delineating the source of water consumed, either as rainfall/soil moisture or surface/groundwater, and the volume of fresh water required for assimilation of pollutants.

Green Water Footprint

Green water footprint is water from precipitation that is stored in the root zone of the soil and evaporated, transpired or incorporated by plants. It is particularly relevant for agricultural, horticultural and forestry products.

Blue Water Footprint

Blue water footprint is water that has been sourced from surface or groundwater resources and is either evaporated, incorporated into a product or taken from one body of water and returned to another, or returned at a different time. Irrigated agriculture, industry and domestic water use can each have a blue water footprint.

Grey Water Footprint

Grey water footprint is the amount of fresh water required to assimilate pollutants to meet specific water quality standards. The grey water footprint considers point-source pollution discharged to a freshwater resource directly through a pipe or indirectly through runoff or leaching from the soil, impervious surfaces, or other diffuse sources.

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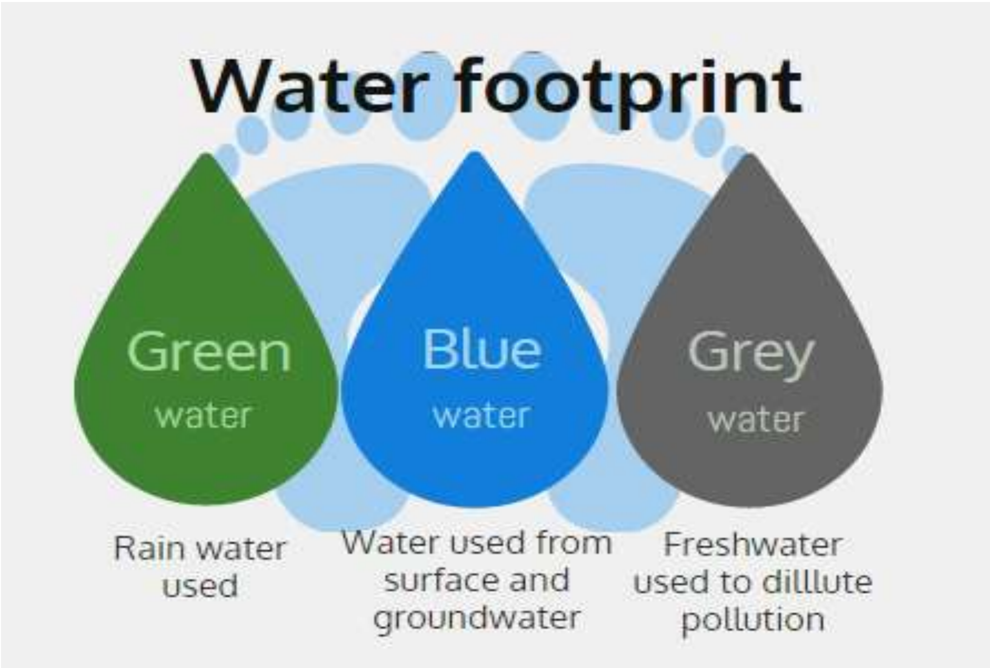

Direct and Indirect Water Footprint

The water footprint looks at both direct and indirect water use of a process, product, company or sector and includes water consumption and pollution throughout the full production cycle from the supply chain to the end-user.

It is also possible to use the water footprint to measure the amount of water required to produce all the goods and services consumed by the individual or community, a nation or all of humanity. This also includes the direct water footprint, which is the water used directly by the individual(s) and the indirect water footprint – the summation of the water footprints of all the products consumed.

Conclusion

The global water footprint of humanity in the period 1996-2005 was 9087 billion of cubic meters per year (74% green, 11% blue, 15% grey). Agricultural production contributes 92% to this total footprint (Mekonnen and Hoekstra, 2011). With the water scarcity affecting over 2.7 billion people for at least one month each year, it necessary to find out steps to reduce the water footprint to the extent possible.

References

1. Water footprint network. 2021. https://waterfootprint.org/en/
2. Mekonnen, M.M. and Hoekstra, A.Y. 2011. National water footprint accounts: The green, blue and grey water footprint of production and consumption. Value of water research report series no. 50. UNESCO-IHE Institute of Water Education. PP. 50.

Quality Protein Maize: Birth, Genetics and Routes to its Improvement

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Introduction

The nutritional well-being and health of all people are vital pre-requisites for the development of societies. Though significant advances have been made in agricultural research and technological developments, malnutrition remains a widespread problem. It contributes to global burden of disease, and loss in annual gross domestic product (GDP) in Asia and Africa is to the extent of 11%, and poses severe socio-economic loss to the countries. Kwashiorkar and Marsmus two major manifestations of protein energy malnutrition (PEM) accounts highest number of deaths worldwide in 2016. (Hossain et al., 2019).

Humans require 0.66g protein/kg body weight to a day to meet the requirement for proper growth and development. Cereals such as rice, wheat and maize supply more than half of the dietary protein to human being. Maize is a major cereal crop for both livestock feed and human nutrition, worldwide and acquired a good reputation as 'poor man's nutricera'.

Cereal proteins, however, have poor nutritional value for monogastric animals, including humans, because of reduced content of essential aminoacids such as lysine and tryptophan. Cereal proteins contain on an average about 2% lysine, which is less than one-half of the concentration recommended for human nutrition by the Food and Agriculture Organization (FAO) of the United Nations. Therefore, it is valuable to adopt a genetic enhancement strategy in which essential amino acids are either incorporated or increased in grain proteins.

Storage Proteins in Maize

The maize kernel, like that of other cereal grains, includes pericarp (6%), endosperm (82%) and germ or embryo (12%). The main structural component of the endosperm is starch, a complex carbohydrate that constitutes on an average 71% of the grain and is a source of concentrated energy. In normal maize, proportions of various endosperm storage protein fractions, on an average, are; albumins (3%), globulins (3%), zeins (60%) and glutelins (34%). Zeins – α, β, γ and δ aggregate in a distinctive spatial pattern within protein body, which gives hard texture phenotype in the mature maize grain. Significantly all fractions other than zeins are balanced in amino acid content and are quite rich in lysine and tryptophan. Suppression of lysine-deficient zein fraction without drastically altering the contribution of other fractions could be, thus, seen as feasible approach to bring about improvements in the amino acid balance in maize grain (Gibbon and Larkins, 2005).

Birth of Quality Protein Maize (QPM)

In 1963, Mertz and coworkers discovered the nutritional significance of opaque-2 (o2), which doubles the lysine and tryptophan level in maize kernels than the normal maize. This was soon followed by the discovery of another mutation, floury-2 (fl2) that also has the ability to alter endosperm nutritional quality. These mutations, derive their names from soft, floury/opaque endosperm. Due to undesirable effects associated with fl2 its use was slowed down and discontinued. For almost decade, the major emphasis in most breeding programmes was on conversion of normal genotypes to o2 mutant versions.

The direct utilization of o2 mutant soon tampered in breeding programmes due to pleiotropic effects of this mutation namely, a soft endosperm that results in damaged kernels, an increased susceptibility to pests and fungal diseases, inferior food processing and generally reduced yields, were not easily overcome. In developing countries where farmers are accustomed to growing hard flints and dents, the kernel phenotype or appearance of the opaques was a major barrier to their acceptance (Vasal, 2000).

The researchers identified ‘o2 endosperm modifier genes’ that alter the phenotype of o2 mutants, giving them a normal hard (vitreous) appearance instead of a soft, chalky nature. By comibining the nutritional advantages associated with the o2 mutation with the o2 modifiers that contribute to the genetically complex endosperm modification trait, CIMMYT researchers developed agronomically superior QPM genotypes and donor stocks.

Modified backcrossing cum recurrent selection method was used to convert non-QPM genotypes to QPM versions. Large amount of QPM germplam was developed which include different maturities, grain colour and grain texture. They further made efforts towards merging, consolidation and reorganization of valuable germplasm. An initiative on QPM hybrid breeding at CIMMYT was made in 1985, as the QPM hybrids offered several advantages in relation to (a) exploitation of heterosis; (b) ease in maintaining seed purity in contrast to open pollinated QPM cultivars; (c) uniformity and stability in kernel modification in hybrids, and (d) requirement for minimum protein quality monitoring as long as the purity of parental lines is ensured (Prasanna et al., 2001).

Genetics of Quality Protein Maize

The development of high lysine/tryptophan maize involves manipulating three distinct genetic systems (Gibbon and Larkins, 2005).

1. The recessive allele of the opaque-2 gene (o2o2).
2. o2 modifying genes (mo2).
3. Enhancer of o2o2.

The Recessive Allele of the Opaque-2 Gene

Increased lysine: The O2 regulates the expression of the 22-kDa α-zeins and several other genes, including lysine ketogluterate reductase (LKR). An o2 mutant typically shows a marked increase in non-zein proteins, which in association with the decrease in lysine-poor α-zein proteins, leads to a greater percentage of lysine and tryptophan. Furthermore, the loss of LKR activity results in increased levels of free lysine.

Opaque endosperm: Two research groups reported the knockdown of 22-kDa and 19-kDa α-zeins by RNA interference (RNAi). It is noteworthy that the 22-kDa α-zein RNAi lines showed a more pronounced opaque phenotype than the 19-kDa α-zein RNAi lines. The 22-kDa α-zeins interact more strongly than the 19-kDa α-zeins with the γ- and β-zeins, which coat the exterior surface of protein bodies. Therefore, the absence of the 22-kDa α-zeins could perturb the insertion of 19-kDa α-zeins into the centre of protein bodies, or might enable more direct contact of the 19-kDa α-zeins with the γ- and β-zeins. Such abnormal associations could disrupt protein body formation, leading to the opaque endosperm phenotype.

o2 Modifying Genes (mo2)

Although QPM genotypes have reduced levels of 22-kDa α-zeins, typical of o2 mutants, contain approximately twice as much 27-kDa γ-zein. The 27-kD γ-zein appears to initiate and facilitate the formation of more protein bodies. Because the 27-kD γ-zein becomes cross linked by disulfide bonds during kernel desiccation. The scientist suggested that it, along with other cysteine-rich proteins, contributes to the formation of a covalently-linked proteinaceous network around the starch grains. Thus, the level of 27-kD γ-zein could be an important component of endosperm modification by mo2 in QPM.

Relationship between starch structure and endosperm modification: The starch from QPM is, in fact, different from its wild type and o2 counterparts. Increased amount of granule-bound starch synthase I reflected in the form of a change in starch structure, which was manifested as shorter amylopectin branches and increase swelling of starch granules. The QPM genotypes has extensive contacts between adjacent starch granules and the spaces between them are completely filled in vitreous areas of the kernel. This gives hard endosperm phenotype to the maize kernels.

Enhancer of o2o2

The presence of the o2 allele in the recessive condition (o2o2) alone does not ensure high lysine and tryptophan levels, but only predisposes maize to have them. The presence of another set of genes that enhance the level of lysine and tryptophan is required to confer higher levels of amino acids. Genes are mapped on chromosome no. 2, 4 and 7. eEF1A (7L), eEF1A (4S), eEF1A (2S), FAA(4L).

Routes to Improvement of Quality Protein Maize

1. Marker Assisted Selection (MAS): MAS accelerate the breeding programmed and enhance the selection efficiency in developing cultivars with higher quality and yield potential. Marker-assisted backcross breeding (MABB) involves two steps: (1) foreground selection: targeting gene through marker, and (2) background selection: targeting uniformly distributed markers throughout the genome for recovering recurrent parental genome (RPG). This is an efficient way of transferring specific gene(s) to an otherwise superior parental lines or variety. Availability of PCR-based and gene-liked markers has made MAS an effective option. The *o2* gene-linked SSR markers, *phi057, phi112* and *umc1066* led to effective distinction of the dominant (O2) and recessive (o2) alleles. It offers significant advantages in conversion of non-QPM lines into QPM.

In India, Vivek Hybrid-9, an early maturing single cross normal hybrid was converted to QPM using MAS, and improved hybrid 'Vivek QPM-9' was released (Gupta *et al.,* 2013). It has similar yield potential with the original hybrid, possesses 41% and 30% more tryptophan and lysine over the original hybrid, respectively. Hossain *et al.* (2018) developed QPM hybrids, 'Pusa HM-4 Improved', 'Pusa HM-8 Improved' and 'Pusa HM-9 Improved' using MAS. These hybrids have significant enhanced lysine (48-74%) and tryptophan (55-100%) with similar yield potential of the original hybrids.

2. Marker-assisted introgression of *o16:* A recessive *opaque16* (*o16*) mutant located on chromosome 8 and isolated from Robertson's Mutator (Mu) stock was found to be associated with higher nutritional value in maize. Further, genotypes with *o16o16* possessed nearly twofold more tryptophan (0.072%) and lysine (0.247%) compared to normal maize (tryptophan 0.035% and lysine 0.125%). *o16* alone can be as good as *o2* for improving the nutritional quality of maize and provides a significant advantage to the breeders since *o16* possesses vitreous endosperm with equivalent grain hardness to wild line. The availability of linked SSR markers to *o16 (umc1141* and *umc1149)* offers additional advantage of adopting marker-assisted breeding along with *o2* in maize breeding programmes.

Sarika *et al.* (2018) successfully pyramided *o2* and *o16* genes through MABB by targeting the parental inbred lines of four *o2*-based QPM commercial hybrids viz., HQPM-1, HQPM-4, HQPM-5 and HQPM-7. The reconstituted hybrids possess an average of 0.13% tryptophan and 0.50% lysine compared to 0.08% and 0.37% in original hybrids, with an average enhancement was 60% and 49%, respectively.

3. Enhancing QPM with micronutrients: Normal maize including QPM contains very low proA (1-2 ppm) compared to target level of 15 ppm. Muthusamy et al. (2014) developed 'Pusa Vivek QPM-9 Improved' by introgression of favourable allele of crtRB1, the hybrid possessed significantly higher level of proA (8.15 ppm). Further efforts on enrichment of vitamin E by introgression of VET4 favourable allele, iron and zinc in QPM genetic background have also been reported.

Conclusion

Evolution of QPM assumes significance, as it not only signifies a breeding achievement of enhancing grain protein quality in maize, but also highlights the spirit of scientific enquiry through painstaking research, sustained and focused efforts. Considering the pace of technological developments in genome research, molecular breeding is likely to be the leading option in future for stacking a range of nutritionally important speciality traits in QPM as it offers significant benefits to poor and vulnerable. The multinutrient rich high yielding QPM hybrids could be efficiently utilized in biofortification programmes of maize across the globe and hold great promise for nutritional security in a holistic manner.

References

1. Gibbon B.C. and Larkins B.A., (2005), Molecular genetic approaches to developing quality protein maize. Trends in Genet. 21(4):227-232.
2. Gupta H.S., Agrawal P.K., Mahajan V., Bisht G.S., Kumar A., Verma P., Srivastava A., Saha S., Babu R., Pant M.C. and Mani V.P., (2009), Quality protein maize for nutritional security: rapid development of short duration hybrids through molecular marker assisted breeding. Curr. Sci. 96(2):230-237.
3. Hossain F., Muthusamy V., Pandey N., Ashish K., Vishwakarma, Baveja A., Zunjare R.U., Thirunavukkarasu N., Saha S., Manjaiah K.M., Prasanna B.M. and Gupta H.S., (2018), Marker-assisted introgression of opaque2 allele for rapid conversion of elite hybrids into quality protein maize. J. Genet. https://doi.org/10.1007/s12041-018-0914-z
4. Hossain F., Sarika K., Muthusamy V., Zunjare R.U. and Gupta H.S., (2019), Quality protein maize for nutritional security. Nature. 20:217-231.
5. Muthusamy V., Hossain F., Thirunavukkarasu N., Choudhary M., Saha S. and Bhat J.S., (2014), Development of β-carotene rich maize hybrids through marker-assisted introgression of β-carotene hydroxylase allele. PLoS One. 9:1–22.
6. Prasanna B.M., Vasal S.K., Kassahun B. and Singh N.N., (2001), Quality protein maize. Curr. Sci. 81(10):1308-1319.
7. Sarika K., Hossain F., Muthusamy V., Zunjare R.U., Baveja A., Goswami R., Bhat J.S., Saha S. and Gupta H.S., (2018), Marker-assisted pyramiding of opaque2 and novel opaque16 genes for further enrichment of lysine and tryptophan in sub-tropical maize. Plant Sci. 272:142-152.
8. Vasal S.K., (2000), The quality protein maize story. Food and Nutrition Bull. No. 21, The United Nations University.

Revolution of ICT in Indian Agriculture

Article ID: 10309

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Introduction

Information Communication Technology (ICT) is a vital function in spreading data to farmers empowering them to settle on the cropping pattern, utilization of high-yielding seeds, manures and fertilizer application, bug the board, showcasing, and so forth Generally, Indian farmers have been following indigenous creation strategies and depend upon companions, family members, individual farmers and information sellers to get data with respect to farming. With headway of farming science furthermore, innovation, numerous choices to get to present day advancements have opened up. It is apparent from the substitution of indigenous assortments of seeds by high-yielding varieties and conventional hardware and practices by power-tillers, farm tractors and others machines.

Information Communication Technology

ICT is utilized as an overall term joining all methods of transmission like electronic gadgets, organizations, mobiles, administrations and applications which help to spread data with the assistance of innovation. In recent years, ICT has end up being amazingly beneficial for farmers including small land holders, minimized and helpless farmers, and caused them in advertising, accuracy cultivating and improved profits. Through ICT, farmers have been enabled to trade their feelings, encounters and thoughts. It has given farmers more introduction and permitted them to utilize science that takes a gander at agribusiness from a coordinated viewpoint. Additionally, e-Agriculture is one of the activity lines identified in the assertion and strategy of the World Summit on the Information Society. E-agriculture can possibly put India on the higher platform of 'Second Green Revolution' by making Indian agricultural area self-sufficient.

Advantages of ICT

1. It will give frameworks and instruments to make sure about food detectability and dependableness that has been a rising issue with respect to cultivate item since genuine defilement like chicken infectious sickness was identified.
2. It will encourage rural activities and supply gentler and safe country existence with equal administrations to those inside the metropolitan territories, similar to arrangement of distance training, telemedicine, far off open administrations, far off redirection and so on
3. It will uphold political and investigations on ideal farm creation, disaster management, agro natural resources the executives and so on, exploitation devices like geographic Information system (GIS).
4. It will improve farm management and cultivating innovations by efficient farming, risk management, powerful information or data move etc., acknowledging serious and property cultivating with safe product.

Conclusion

India has at least two-decade long experience of using ICT in agriculture. ICTs have experienced various stages and a large number of these will keep on developing because of changing innovation and business climate in agriculture just as in light of arising difficulties in agriculture. ICT can assume basic part in reinforcing the limits of farmers as well as for the field level functionaries and mediators. Building up the privilege or applicable substance at the proper level has consistently been a test and more endeavours are required toward this direction.


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An Overview of Repayment Behaviour of KCC Beneficiaries

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Introduction

The smooth functioning of any source of finance depends upon the recovery of loan (Bala, 2015). Disbursement and recovery are the main element of any credit scheme. A good recovery of loan will make smooth flow of credit which will in turn helps the farmer in increasing agricultural productivity leading to economic growth. From different literature it is found that the NPA (Non-performing Assets) Accounts of the majority of bank branches are from KCC holders. Farmers are using a big chunk of loans for consumption and not productive purposes as money comes cheap under the Kisan Credit Card scheme (Unnikrishnan, 2013). The main motto of central government behind this scheme is to strengthen the economic position of farmers in the country and also to make them able to live a good life. But sometimes their decision like waiving off the interest amount or loan amount as was done in 2007 has creating misconception to the farmer that their interest and loan amount will be waived off, as a result of which they misutilise the credit (Kothari, 2015). Thus, it is important to review the repayment performance of the borrower. Some of the findings regarding repayment behaviour of beneficiaries are:

A study conducted by Bala (2015) at Haryana found that 40 per cent of the borrowers have repaid 25 to 50 per cent of the loan. Moreover 20 per cent of the borrowers have repaid 2.5 per cent, 17.5 have repaid 50 - 75 per cent and 5 per cent of borrowers have repaid 75 per cent of the borrowed amount. Rests 17.5 per cent of borrowers were found to be defaulters due to improper use of credit in non-income generating activities which increase their over dues.

Godara, et *al*. (2014) in their study on “Agriculture Credit in India: An Analytical Study” observed that the progress of the implementation of this scheme in the North-Eastern States is very much poor. From the study they found that 30% small farmers, 53% marginal farmers and 47% large farmers misutilised the loan on purchasing assets, consumption, construction of houses and in paying old debt. Around 50% farmers misutilised the loan in payment of old debt. Among the defaulters 30%, 20% and 17% were large, medium and small farmers respectively. Among the non-willful defaulters 80% were small farmers, 67% medium farmers and 56% large farmers. The reason among non-willful defaulters were: Minimum support price, mounting input costs and inadequate formal credit, crops failure etc. In case of willful defaulters 46%, 33% and 20% of the farmers were large, medium and small farm category.

Bordoloi and Das (2015) in their study on “Impact of Credit on Agricultural Production with Special Reference to Crop Loan and KCC Scheme- An empirical study in Assam” observed that-

83.33 per cent of sample households were found to fall under the head of "NPAs". At overall level, nearly 71.67 per cent of the respondents were wilful defaulters. They had a wrong notion that the loan might finally be waived off by the banks/Government. For 9.58 per cent of the loanees crop failure due to natural calamities was the reason for non-repayment of loan. The rest 90.42 per cent did not have any experience of facing any natural calamities. About, 39.17 per cent of the respondents reported that they had the problem of repayment as the educational expenditure for their children increased quite a lot over time. Apart from these, the intensity of problems of non-repayment of loan was very high because of continuous price hike of the essential commodities; it hampers the adoption of desired technological application as the farmers usually divert a part of this short-term credit for capital expenditure.

A study conducted by Thakur and Barman (2013) in Assam" observed that though KCC is a good source of credit instruments for farmers, but its disbursement and recoveries of loan provided through the KCC were not effective in Assam. In case of recovery of loan, it was found that lack of awareness of farmers on utilization of the loan and its recovery, casual approach of follow-up of banks etc., were some of the major reasons for poor recovery of loans.

Reasons for Poor Recovery

There are many reasons for poor recovery of KCC loan. Some of the common reasons found in different literature are listed below:

1. Commission agents: Commission agents play the role of middleman between bank and borrowers. So, for taking the help of commission agent in the process of obtaining loan, the farmer gives an amount of the loan to the commission agent and likewise he starts to misutilise the credit.

2. Poor awareness: Due to their poor literacy, the farmers are not aware of how to repay, when to repay and how much to repay to the bank and hence they become defaulters.

3. Lack of follow up by bank official: Due to lack of follow up by the bank official as well as lack of visits by the loanee farmers to the bank branch after withdrawing his loan amount, a gap is created between the bank official and the borrower due to which the recovery becomes irregular.

4. Natural calamity: Natural calamity and disaster plays a crucial role in poor recovery of KCC loans like in case of Assam every year flood damages the crop fields of many farmers and they lost their crops at the time of harvest. As a result, farmer fails to repay their dues.

5. Misutilization of loan: It has been found in different literature that many KCC borrowers do not utilize their loan in productive purpose which results in poor repayment of loan amount.

6. Misconception: Villagers have certain misconception in their mind regarding waiving off of KCC loans. In some states including Assam, KCC loans were once waived off. So many of the loanee farmers think that they do not have to repay the loan amount.

Recommendations for Improving Recovery Status of the Beneficiaries

Major reason for low recovery	Suggestions
Commission agents	In order to remove commission agent, frequent visit by the bank official to the borrower is necessary so that they can help the beneficiaries in understanding about KCC.
Poor awareness	Dept. of agriculture should provide extension activities and organised regular group meeting and awareness programme in the village.
Misutilization of loan	Agriculture department should be given responsibilities for regular supervision and monitoring in order to ensure proper utilization of loan obtained against the KCC.
Natural calamity	Introduction of resistant varieties, use of improve farm technology can help the farmers from losing their production in such natural hazards thereby making them better off to repay the loaned amount at regular interval.
Lower yield	Extensive capacity building programme are to be launched to make the farmers aware of the modern technology and Soil Health Card may be linked to KCC loan so that they can judiciously use soil nutrients in the crop field to raise the level of production and productivity.

Conclusion

For enhancing the repayment of KCC loan a group approach will be best solution as it will create a peer group pressure to the defaulter and ultimately the farmers will repay the loan. Nowadays, most of the banks are forming farmers' club in collaboration with NABARD by selecting some farmers from the villages. Farmers' club is a good medium to reach the customers, so banks can take the help of farmers club in disbursement as well as recovery of KCC loans.

References

1. Bala K., (2015). An Analysis of Agricultural Loan Repayment Performance of Regional Rural Bank: A case study of District Sirsa, India. International Research Journal of Social Sciences. 4(6): 89-92.
2. Bordoloi J. and Das A.K., (2015). Impact of Credit on Agricultural Production with Special Reference to Crop Loan and KCC Scheme - An Empirical Study in Assam, Study no.-145, Agro-Economic Research Centre for North-East India, Assam Agricultural University, Jorhat -785013, Assam.
3. Godara R.L., Singh P. and Singla S., (2014). Agriculture Credit in India: An Analytical Study. International Journal of Latest Trends in Engineering and Technology. 3(3).
4. Kothari P., (2015). A Study on Execution of Kisan Credit Card Scheme in Agricultural Finance with Special Referecnce to Sbi Mandsaur. Global Journal for Research Analysis. 4(4): 2277 – 8160.
5. Thakur A. and Barman U., (2013). Reasons for poor performance of disbursement of Kishan Credit Card and A qualitative study recovery of loan under the scheme in Assam. Journal of Academia and Industrial Research. 2(1): 2278-5213.
6. Unnikrishnan D., (2013). Kisan Credit Cards: Bad loan bubble waiting to burst?
7. https://www.livemint.com/Industry/ph30HumD1FPAGaBj0XCOyH/Kisan-Credit-Cards-Bad-loan-bubble-waiting-to-burst.html.

Agroforestry Recommendations in Madhya Pradesh

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Agroforestry is a merger of agriculture/ horticultural crops and/or livestock with tree components on a unit piece of land with deliberately special arrangement of time and space. In Madhya Pradesh, agroforestry is being practiced in nearly every region of the state in the form of traditional agroforestry since time-immemorial. However, the extension of agroforestry practices is slow in most of the regions. Traditionally, trees like babul, neem, shisham, teak, bamboo, palash, mahuwa, jamun, aonla, mango, guava, etc. are deliberately retained by farmers on their farm. However, some new entrants such as subabool (*Leucaena leucocephala*), Eucalyptus and khamair (*Gmelina arborea*) have also been adopted under agroforestry. Farmers were seen frequently growing paddy with babul (Acacia nilotica) under traditional agroforestry system. The preference for babul is due to its robust nature, market accessibility, multiple products and services. MP presently has 25.14% of forest and tree cover, fairly better than other states of India. However, for attaining 33% forest cover according to the Forest Policy 1988, it is imperative to promote trees outside forests (TOF) under agroforestry, farm forestry and social forestry. The total population of MP is 42.63 million, of which 72.37% is rural, including 21.09% tribal population, whose potential can be harnessed for promotion of tree farming as a major economic activity to achieve the Sustainable Development Goals. Similarly, significant livestock population of the state can be properly managed through adoption of different silvipastoral and hortipastoral systems. With the increasing gap in demand and supply of forest produce in India from territorial forests, the role of agroforestry seems to be noteworthy in filling the gap.

As far as agriculture in MP is concerned, it occupies a unique position with 11 agro-climatic regions and five cropping zones that grow all kinds of crops and a variety of cereals, pulses, oilseeds, fruits and vegetables. The state also occupies a special place for agricultural produce in the country. The farming sector in MP forms the mainstay of its economy and the primary source of employment for over 70% of its population. It contributes almost one-fourth of the gross state domestic product (GSDP) and about 60–75% of rural income.

The State is divided in 11 Agro-climatic regions and 5 crop zones.

District-wise classification along with soil type and normal rainfall range is as below:

S. No.	Agro climatic region	Soil Type	Rainfall (Range in m. m.)	Districts covered	Details of partly covered districts
1.	Chhattisgarh plains	Red & Yellow (Medium)	1200 to 1600	Balaghat	-
2.	Northern Hill Region of Chhattisgarh	Red & Yellow Medium black & skeltal (Medium/light)	1200 to 1600	Shahdol, Mandla, Dindori, Anuppur, Sidhi (Partly), Umaria	Singroli Tehsil (Bedhan)
3.	Kymore Plateau & Satpura Hills	Mixed red and black soils (Medium)	1000 to 1400	Rewa, Satna, Panna, Jabalpur, Seoni, Katni, Sidhi (except Singroli tehsil)	-
4.	Central Narmada Valley	Deep black (deep)	1200 to 1600	Narsinghpur, Hoshangabad Sehore	Sehore -Budni Tehsil, Raisen -Bareli Tehsil.

				(Partly), Raisen (Partly)	
5.	Vindhya Plateau	Medium black & deep black (Medium/ Heavy)	1200 to 1400	Bhopal, Sagar, Damoh, Vidisha, Raisen (except Bareli Teh.), Sehore (except Budni Teh.), Guna (Partly)	Guna -Chanchoda, Raghogarh & Aron Tehsils
6.	Gird Region	Alluvial (Light)	800 to 1000	Gwalior, Bhind, Morena, Sheopur-Kala, Shivpuri, (except Pichore, Karera, Narwar, Khania- dana Teh.), Guna (except Aron, Raghogarh, Chachoda Tehsil) Ashoknagar	-
7.	Bundelkhand	Mixed red and black (Medium)	800 to 1400	Chhattarpur, Datia, Tikamgarh, Shivpuri (Partly)	Shivpuri -Karera, Pichhore, Narwar & Khaniadhana Tehsils
8.	Satpura Plateau	Shallow black (Medium)	1000 to 1200	Betul & Chhindwara	-
9.	Malwa Plateau	Medium black (Medium)	800 to 1200	Mandsaur, Neemuch, Ratlam, Ujjain, Dewas, Indore, Shajapur, Rajgarh & Dhar (Partly) Jhabua (Partly)	Dhar -Dhar, Badnawar & Sardarpur Tehsils. Jhabua -Petlawad Tehsil
10.	Nimar Plains	Medium black (Medium)	800 to 1000	Khandwa, Burhanpur, Khargone, Barwani, Harda, Dhar (Partly) District.	Dhar -Manawar, Dharampuri & Gandhawani Tehsil
11.	Jhabua Hills	Medium blackskeletal (Light/Medium)	800 to1000	Jhabua District (except Petlawad Tehsil) & Dhar (Partly)	Dhar - Only Kukshi Tehsil)

Major forest trees, fruit trees, agricultural crops, agroforestry system and common agroforestry combinations under various Agro-Climatic Regions in M.P.

S. No.	Agroclimatic zones	Major forest trees in agroforestry	Major fruit trees in agroforestry	Major agricultural crops in agroforestry	Agroforestry system	Common agroforestry combinations
1.	Chhattisgarh plains	Babul, Palash, Mahua, Teak, Khair, Arjun, Subabul,	Mango, Ber, Aonla, Guava, Jackfruit,	Paddy, wheat, kodo, kutaki, gram, ginger, masoor	Agrisilviculture, Agrihorticulture	Wheat/ paddy + babul, wheat +

		Shisham, behada, Bamboo	Chiku, Papaya, Banana, Lemon, Drumstick, Custard apple.			mango, gram/ wheat + custard apple, aonla + wheat
2.	Northern Hill region of Chhattisgarh	Babul, Khamer, Subabul, Shisham, Karanj	Jamun, Guava, Mango, Drumstick, Aonla, Custard Lemon, Litchi, Jackfruit	Paddy, wheat, maize, arhar, moong, urad, soybean	Agrisilviculture, Agrihorticulture	Teak + wheat/ paddy, teak + soybean, paddy/ wheat + babul, wheat + guava, wheat + mango, paddy + babul
3.	Kymore Plateau and Satpura Hills	Babul, Khamer Karanj, Teak, Arjun, Mahua, Palash, Shisham, Sirish, Subabul, Eucalyptus, Bamboo	Mango, Jamun, Aonla, Guava, Jackfruit, Lemon, Ber	Wheat, paddy, gram, maize, arhar, moong, urad, masoor	Agrisilviculture, Agrihorticulture	Paddy/ wheat + babul, teak + wheat/ paddy, wheat + guava, wheat + khamer, wheat + mango, gram/wheat + custard apple, paddy + shisham, eucalyptus + wheat, subabul + wheat
4.	Central Narmada Valley	Shisham, Khamer, Palash, Bamboo, Mahua, Babul, Subabul, Bamboo	Mango, Jamun, Ber, Guava, Pomegranate, Aonla, Ber, Lemon, Mandarin, Papaya	Wheat, paddy, gram, soybean, sugarcane, pea, moong, urad, arhar	Agrisilviculture, Agrihorticulture	Subabul + wheat, sugarcane + babul, wheat + khamer, soybean + bamboo
5.	Vindhya Plateau	Babul, Shisham, Neem, Khamer, Mahua, Siris,	Guava, Ber, Lemon, Aonla, Mosambi,	Paddy, wheat, sugarcane, maize, arhar, gram, jowar	Agrisilviculture, Agrihorticulture	Paddy + babul, shisham + maize,

		Subabul, Bamboo	Mango, Chiku, Papaya			guava + wheat, guava + paddy, babul + soybean
6.	Gird Region	Babul, Siris, Shisham, Paalas, Neem, Khejri, Anjan, Tendu	Ber, Karonda, Custard Apple, Pomegranate, Bael, Aonla, Guava	Jowar, bajra, mung, urad, sessome, mustard, arhar, cotton	Agrisilviculture, Agrihorticulture	Babul + jowar, mango + mustard, shisham + gram
7.	Bundelkhand Region	Neem, Palash, Shisham, Khair, Karanj, Mahua, Subabul	Pomegranate, Custard apple, Aonla, Ber, Guava, Orange, Chiku, Mango, Mosambi, Lime, Kraounda	Jowar, maize, mung, gram, til, mustard, wheat, arhar, masoor	Agrisilviculture, Agrihorticulture, Silvipasture	Neem + wheat, shisam + wheat, palash + mustard, custard apple + wheat
8.	Satpura Plateau	Teak, Shisham, Sal, Neem, Mahua, Babul	Pomegranate, Orange, Papaya, Mosambi, Guava, Ber, Jamun, Custard Apple, Lemon, Mango, Karonda	Wheat, paddy, jowar, bajara, potato, urad, gram, aarhar, moong, soyabean	Agrisilviculture, Agrihorticulture	Teak + wheat, shisham + wheat, orange + agriculture crops
9.	Malwa Plateau	Suababul, Babul, Neem, Khamer, Shisham, Siris	Lemon, Orange, Aonla, Papaya, Pomegranate, Guava, Banana, Mosambi, Chiku, Grape, Ber	Wheat, cotton, arhar, moong, urad, jowar, bajra	Agrisilviculture, Agrihorticulture	Wheat + khamer, wheat + babul, cotton + neem
10.	Nimar Plains	Shisham, Siris, Babul, Subabul, Mahua,	Guava, Aonla, Lime, Banana, Papaya, Pomegranate,	Wheat, arhar, gram, cotton, soybean, moong, urad	Agrisilviculture, Agrihorticulture	Wheat + mahua, shisham + wheat

		Palash, Khamer	Mango, Grape, Chiku			
11.	Jhabua Hills	Mahua, Palash, Siris, Babul, tadi, Subabul, Neem, Khejri, Shisham	Aonla, Guava, Ber, Pomegranate, Mango, Karaunda	Wheat, maize, urad, gram, sarson, groundnut, moong, mustard	Agrisilviculture, Agrihorticulture	Wheat + babul, wheat + tadi, neem + wheat

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Green Nanotechnology in Agriculture

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Abstract

The study and the application of extremely small size particles of range 1 to 100 nanometres in length can be used in all the fields of science under the branch nanoscience and nanotechnology. The use of synthetic nanotechnology derived products is reduced nowadays in the field of medicine due to their risk and side effect, same goes for the agriculture also.

Therefore, scientist nowadays have started using plant source or green route for the manufacturing of nanoparticles. Several plants have several properties with them which help them to fight against several other bioties and possess other properties. Extraction and using those plant part for the formation of nanoparticles is a form of green nanotechnology.

So, green nanotechnology is a kind of nanotechnology using plant derived source for the nanoparticle formation to enhance the sustainability of the environment by reducing the environmental risks and minimizing costs. Green nanotechnology provides an innovation to improve the nutrient use efficiency through production of nanoscale pesticide, nanoscale fertilizer, nanoscale sensors for sensing nutrients, water purification, agronomic fortification and target nutrient delivery.

Besides this it helps in investigation of disease and pest preservation of foodstuff, removal of food contaminants from water bodies and soil, improving the shelf life of flowers and vegetables, regeneration of soil fertility. So, green nanotechnology is a developing science and technology so more and more research work is required to know more about the depth of this particular technique.

Keywords: green nanotechnology, nanotechnology, plant-derived product, agriculture.

Introduction

Nanotechnology is the technology conducted at the nanoscale and applied in science, engineering and technology with size ranging from 1 to 100 nanometres. The study and the application of such extremely small particles can be used in all the fields of science under the branch nanoscience and nanotechnology. The beauty of nanomaterials comes from its size dependent functions and properties with different magnetic, electrical and optical properties and size at nanoscale size.

The present-day agricultural world is facing a lot of challenges like decrease in land for arable purpose because of rapid urbanization, decrease in organic matter and low nutrient use efficiency etc. So, nanotechnology provides a platform for improving and meeting these demands with new tools for disease detection, more ability to stand in any abiotic condition and also make them more able to absorb the essential nutrients.

So, the nanotechnology derived products are being used in several purpose in agriculture like, nanoscale pesticide, nanoscale fertilizer, nanoscale sensors for sensing nutrients, water purification, agronomic fortification and target nutrient delivery.

But the synthetic form of nanoparticles has left some environmentally harsh by-products. So, the use of synthetic nanotechnology derived product is reduced nowadays in the field of medicine due to their risk and side effect, same goes for the agriculture also. Therefore, scientist nowadays have started using plant source or green route for the manufacturing of nanoparticles.

So, green nanotechnology is a kind of nanotechnology using plant derived source for the nanoparticle formation to enhance the sustainability of the environment by reducing the environmental risks and minimizing costs.

Thus, green nanotechnology uses new effort to reduce the environmental as well as human health risks by replacing the existing one with the plant derived nanoparticles which is more environmentally friendly than the synthetic one (Nasrollahzadeh et al., 2015).

Green Nanotechnology in Agriculture

As it is mentioned before that the use of synthetic nanoparticle leads to traces of some toxic chemical absorbed on the surface so green synthesis is more innovative over chemical and physical systems. So, several plants are being tested and use for the production of nanoparticles which will be further used for several purposes in agriculture (Gholami-Shabani et al. 2013)

Some of the important plants which is used for the production of green nanoparticle are given in the table below:

Table-1 : Synthesis of nanoparticles using plant extract:

Plant source	Plant part or extract	Metal NPS	Pharmacological applications	Reference
Abelmoschus esculentus	Seed extract	gold	Antifungala activity	Jayaseelan et al., (2013)
Acacia auriculiformis	Pods extract	Silver	Antibacterial activity	Nalawade et al. (2014)
Adhathoda vasica	Leaf extract	Silver	Antimicrobial activity	Bhumi et al. (2015)
Artocarpus heterophyllus Lam.	seed extract	Silver	Antibacterial activity	Jagtap and Bapat (2013)
Ananas comosus (Pineapple)	Fruit extract	Gold	Antimicrobial activity	Asavegowda et al. (2013)
Apple	Fruit extract	Silver	Antimicrobial	Ali et al. (2016)
Azadirachta indica	Leaf extract	Zinc oxide	Antibacterial and photocatalytic	Bhuyan et al. (2015)
Black pepper	Leaf extract	Silver	Antibacterial activity	Augustine et al. (2014)
Catharanthus roseus Linn	Leaf extract	Silver	Antibacterial activity	Kotakadi et al. (2013)
Cassia fistula	Leaf extract	Zinc oxide	Antibacterial activity	Suresh et al. (2015)
Chenopodium album	Leaf extract	Gold and silver	Not determine	Dwivedi and Gopal (2010)
Citrus sinensis	Fruit extract	Silver	Antibacterial activity	Kaviya et al. (2011)
Cocos nucifera	Coir extract	Silver	Larvicidal activity	Roopan et al. (2013)
Cocos nucifera	Inflorescences	Silver	Antibacterial activity	Mariselvam et al. (2014)
Datura metel	Leaf extract	Silver	Anax Immaculifrons, Anopheles Stephensi	Murugan et al. (2015)
Dendrophthoe falcata	Leaf extract	Silver	Anticancer activity	Sathishkumar et al. (2014)
Diospyros kaki (persimmon)	Leaf extract	bimetallic gold/silver	Antibacterial, anticancer activity	Kuppusamy et al. (2016)

Dalbergia spinosa	Leaf extract	Silve	Antibacterial activity	Muniyappan and Nagarajan (2014)
Euphorbia condylocarpa M. bieb	Root extract	Au/Pd	Not determine	Nasrollahzadeh et al. (2014)
Euphorbia condylocarpa M. bieb	Root extract	Pd/Fe O3	Not determine	Nasrollahzadeh et al. (2015a)
Eucalyptus leucoxylon	Leaf extract	Silver	Antioxidant activities	Rahimi-Nasrabadi et al. (2014)
Garcinia kola	Leaf extract	Silver	Antibacterial activity	Hassan et al. (2016)
Gloriosa superba	Leaf extract	CuO	Antibacterial activity	Naika et al. (2015)
Ipomoea aquatica	Leaf extract	Silver	Antibacterial activity	Sivaraman et al. (2013)
Leptadenia reticulata	Leaf extract	Silver	Antibacterial, antioxidant, cytotoxic activity	Swamy et al. (2015)
Melia dubia	Leaf extract	Silver	Anticancer activity	Kathiravan et al. (2014)
Mimusops elengi	Seed extract	Silver	Antibactrial and antioxidant activities	Kumar et al. (2014c, d)
Moringa oleifera	Bark extract	Silver	Anticancer activity	Vasanth et al. (2014)
Ocimum sanctum (Tulsi) 4–30 Spherical Benth. 50 Hexagona ND 90 Spherical	Leaf extract	Silver	Antibacterial activity	Singhal et al. (2011)
Olive	Leaf extract	Silver	Cytotoxic activity	Rashidipour and Heydari (2014)
Ocimum basilicum L. var. purpurascens	Leaf extract	Zinc oxide	Antibacterial activity	Salam et al. (2014)
Piper longum	Fruit extract	Silver	Antioxidant, antibacterial and cytotoxic activity	Reddy et al. (2014)
Eclipta prostrata	-	TiO_2	Heterocyclic compounds such as flavones	-
Santalum album	Leaf extract	Silver	Antimicrobial activity	Swamy and Prasad (2012)
Solanum tricobatum	Fruit extract	Silver	Antibacterial, anticancer activity	Ramar et al. (2015)
Saraca indica	Bark extract	Gold	Catalytic reduction	Dash et al. (2014)
Solanum lycopersicum	Fruit extract	Silver	Insecticidal activity	Bhattacharyya et al. (2016)
Terminalia chebula	Fruit extract	Silver	Antibacterial activity	Kumar et al. (2012)

Zingiber officinale	Root extract	Silver, gold	Antibacterial activity	Velmurugan et al. (2014)

Some Important Nanoparticles and its Uses

Application of TiO_2 NPs has adverse effect on the growth and development of plant. It was also found that exogenous application of helps a plant to get better under abiotic stress condition because it allows to plant to produce more shoot growth and better production of photosynthetic activity. The use of TiO_2 NPs was done in plants like spinach, safflower. (Mahmoodzadeh et al. 2013).

Fe_3O_4 nanoparticle when grown with plant in aqueous solution, the plants are able to absorb other nutrients more efficiently, and able to translocate and also accumulate the particles in plant tissue (Wang et al. (2011).

Zinc oxide nanoparticle treated plants were found showing more tolerant potential under stress condition and can be considered as anti-stress agent in crop fabrication. It was found in the tomato plant where the plant is showing different degree of salinity tolerance to different concentration of zinc oxide (Alharby et al., 2016).

Adhikari et al. (2016) when studying the maize plant with copper nanoparticles was found that copper can enter inside the plant cell and help in the growth of the plant growth. He was studying on the solution culture having copper nanoparticle and check the effect of it on the growth and enzymatic activity of the plant, and it was found that copper nanoparticles can enter the plant cell through roots and leaves.

Some of the nanoparticles can also be used as a delivery mechanism in the plants. A successful use of nanoparticles as delivery system in plants is by using silica nanoparticles. Silica nanoparticle can be used to deliver DNA into the protoplast of tobacco by covering the nanoparticle with plasmid DNA which were again coded for Green Fluorescent Protein (Torney et al., 2007).

Magnetic nanoparticles like carbon-coated iron nanoparticles are also used to transfer materials in the plant and their magnetic characterization can be used to guide carriage and localization (González-Melendi et al., 2008).

Conclusion

The application of green nanotechnology in the field of agricultural sciences is less than few decades. Since we know that the application of green nanotechnology will help in bringing a healthy sustainable agriculture goal, so encouraging the use of plant-derived nanoparticles should be done as the synthetic one leaves harmful residuals. Nanotechnology is still a developing science and technology; its new technology keeps on coming and new ideas keep on revealing (Prasad et al. 2017). So, nanotechnology in agriculture may have taken few more years to move from research laboratory to land. Sustained funding on the part of policy planners should go hand in hand with science administrators, along with reasonable expectations, would be desirable and crucial for this new field to blossom.

Reference

1. Alharby, H.F., Metwali, EM., Fuller, MP, Aldhebiani, A.Y., (2016). Impact of application of zinc oxide nanoparticles on callus induction, plant regeneration, element content and antioxidant enzyme activity in tomato (Solanum lycopersicum Mill.) under salt stress. Arch Biol Sci 00:17. doi:10.2298/ABS151105017A
2. Ali, Z.A., Yahya, R, Sekaran, S,D., Puteh, R. (2016). Green synthesis of silver nanoparticles using apple extract and its antibacterial properties. Adv Mater Sci Eng:1–6. doi:10.1155/2016/4102196
3. Asavegowda, N., Sobczak-Kupiec, A., Malina, D., Yathirajan ,H.S., Keerthi, V.R., Chandrashekar, N., Liny, P. (2013). Plant mediated synthesis of gold nanoparticles using fruit extracts of Ananas comosus (L.) (pineapple) and evaluation of biological activities. Adv Mater Lett 4:332–337
4. Augustine, R., Kalarikkal, N., Thomas, S. (2014). A facile and rapid method for the black pepper leaf mediated green synthesis of silver nanoparticles and the antimicrobial study. Appl Nanosci 4:809–818. doi:10.1007/s13204-013-0260-7
5. Bhattacharyya, A., Prasad, R., Buhroo, A.A., Duraisamy, P., Yousuf, I., Umadevi, M., Bindhu, MR, Govindarajan, M., Khanday, A.L. (2016). One-pot fabrication and characterization of silver nanoparticles using Solanum lycopersicum: an eco-friendly and potent control tool against Rose Aphid, Macrosiphum rosae. J Nanosci:4679410. 7 p. http://dx.doi.org/10.1155/2016/ 4679410
6. Bhumi, G., Rao, M.L., Savithramma, N. (2015). Green synthesis of silver nanoparticles from the leaf extract of Adhatoda vasica nees. and assessment of its antibacterial activity. Asian J Pharm Clin Res 8:62–67

7. Bhuyan, T., Mishra, K., Khanuja, M., Prasad, R., Varma, A. (2015). Biosynthesis of zinc oxide nanoparticles from Azadirachta indica for antibacterial and photocatalytic applications. Mater Sci Semicond Process 32:55–61
8. Dash, S.S., Majumdar, R., Sikder, A.K., Bag, B.G., Patra, B.K. (2014). Saraca indica bark extract mediated green synthesis of polyshaped gold nanoparticles and its application in catalytic reduction. Appl Nanosci 4:485–490. doi:10.1007/s13204-013-0223-z
9. Dwivedi, A.D., Gopal, K. (2010). Biosynthesis of silver and gold nanoparticles using Chenopodium Album leaf extract. Colloid Surf A: Physicochem Engin Asp 369:27–33. doi:10.1016/j. colsurfa.2010.07.020
10. Gholami-Shabani, M.H., Akbarzadeh, A., Mortazavi, M., Emadzadeh, M.K. (2013). Evaluation of the antibacterial properties of silver nanoparticles synthesized with Fusarium oxysporum and Escherichia coli. Int J Lifesc Bt Pharm Res 2:342–348
11. González-Melendi, P., Fernández-Pacheco, R., Coronado, M.J., Corredor, E., Testillano, P.S., Risueño, M.C., Marquina, C., Ibarra, M.R., Rubiales, D., Pérez-de-Luque, A. (2008). Nanoparticles as smart treatment-delivery systems in plants: assessment of different techniques of microscopy for their visualization in plant tissues. Ann Bot 101:187–195. doi:10.1093/aob/mcm283
12. Hassan, L.A., Elijah, A.T., Ojiefoh, O.C., Joseph, O., Sunday, B.O., Olugbenga, D.E., Anuoluwapo, A.A. (2016). Biosynthesis of silver nanoparticles using Garcinia kola and its antimicrobial potential. Afr J Pure Appl Chem 10:1–7. doi:10.5897/ajpac2015.0650
13. Jagtap, U.B., Bapat, V.A. (2013). Green synthesis of silver nanoparticles using Artocarpus heterophyllus Lam. seed extract and its antibacterial activity. Ind Crop Prod 46:132–137
14. Jayaseelan, C., Ramkumar, R., Rahuman, A.A., Perumal, P. (2013). Green synthesis of gold nanoparticles using seed aqueous extract of Abelmoschus esculentus and its antifungal activity. Ind Crop Prod 45:423–429. doi:10.1016/j.indcrop.2012.12.019
15. Kaviya, S., Santhanalakshmi, J., Viswanathan, B., Muthumary, J., Srinivasan, K. (2011) .Biosynthesis of silver nanoparticles using Citrus sinensis peel extract and its antibacterial activity. Spectrochim Acta Mol Biomol Spectrosc 79:594–598. doi:10.1016/j.saa.2011.03.040
16. Kotakadi, V.S., Rao, Y.S., Gaddam, S.A., Prasad ,T.N.V.K.V, Reddy, A.V, Gopal, D.,S (2013) Simple and rapid biosynthesis of stable silver nanoparticles using dried leaves of Catharanthus roseus. Linn. G. Donn and its antimicrobial activity. Colloids Surf B: Biointerfaces 105:194–198. doi:10.1016/j.colsurfb.2013.01.003
17. Kumar, K.M, Sinha, M., Mandal, B.K, Ghosh, A.R, Kumar, K.S, Reddy, P.S (2012). Green synthesis of silver nanoparticles using Terminalia chebula extract at room temperature and their antimicrobial studies. Spectrochim Acta Part A: Mol Biomol Spectrosc 91:228–233
18. Kumar, H.A., Mandal, B.K., Kumar, K.M., Babu, Maddinedi. S, Kumar, T.S, Madhiyazhagan ,P, Ghosh, AR (2014c). Antimicrobial and antioxidant activities of Mimusops elengi seed extract mediated isotropic silver nanoparticles. Spectrochimica Acta Part A: Molecul Biomolecul Spectroscopy 130:13–18. doi:10.1016/j.saa.2014.03.024
19. Kumar, P.V, Pammi, S.V.N, Kollu, P., Satyanarayana, K.V.V., Shameem, U. (2014d) .Green synthesis and characterization of silver nanoparticles using Boerhaavia diffusa plant extract and their antibacterial activity. Ind Crop Prod 52:562–566. doi:10.1016/j.indcrop.2013.10.050
20. Kuppusamy, P., Yusoff, M.M, Maniam,. GP, Govindan N (2016). Biosynthesis of metallic nanoparticles using plant derivatives and their new avenues in pharmacological applications–an updated report. Saudi Pharm J 24:473–484. doi:10.1016/j.jsps.2014.11.013
21. Mariselvam,, R, Ranjitsingh A.J.A, Nanthini, A.U.R, Kalirajan, K, Padmalatha .C, Selvakumar, PM (2014). Green synthesis of silver nanoparticles from the extract of the inflorescence of Cocos nucifera (family: Arecaceae) for enhanced antibacterial activity. Spectrochim Acta A Mol Biomol Spectrosc 129:537–541. doi:10.1016/j.saa.2014.03.066
22. Muniyappan, N, Nagarajan, N.S (2014.) Green synthesis of silver nanoparticles with Dalbergia spinosa leaves and their applications in biological and catalytic activities. Process Biochem 49:1054–1061. doi:10.1016/j.procbio.2014.03.015
23. Murugan, K, Dinesh, D, Kumar, P.,J, Panneerselvam C, Subramaniam, J, Madhiyazhagan, P, Suresh, U, Nicoletti. M, Alarfaj ,A.A, Munusamy, M.A, Higuch,i A. (2015). Datura metel-synthesized silver nanoparticles magnify predation of dragonfly nymphs against the malaria vector Anopheles stephensi. Parasitol Res 114:4645–4654. doi:10.1007/s00436-015-4710-x
24. Naika, H.R, Lingaraju, K., Manjunath, K, Kumar, D, Nagaraju G, Suresh D, Nagabhushana H (2015) Green synthesis of CuO nanoparticles using Gloriosa superba L. extract and their antibacterial activity. J Taibah University Sci 9:7–12. doi:10.1016/j.jtusci.2014.04.006
25. Nasrollahzadeh M, Sajadi SM, Rostami-Vartooni A, Khalaj M (2014) Journey on greener pathways: use of Euphorbia condylocarpa M. bieb as reductant and stabilizer for green synthesis of Au/Pd bimetallic nanoparticles as reusable catalysts in the Suzuki and Heck coupling reactions in water. RSC Adv 4:43477–43484. doi:10.1039/c4ra07173e
26. Nasrollahzadeh, M, Sajadi, S.M, Rostami-Vartooni, A., Khalaj, M .2015a). Green synthesis of Pd/ Fe3O4 nanoparticles using Euphorbia condylocarpa M. bieb root extract and their catalytic applications as magnetically recoverable and stable recyclable catalysts for the phosphine-free Sonogashira and Suzuki coupling reactions. J Molecul Catal A: Chem 396:31–39. doi:10.1016/j. molcata.2014.09.029
27. Prasad, R, Bhattacharyya, A, Nguyen, Q.D (2017). Nanotechnology in sustainable agriculture: recent developments, challenges, and perspectives. Front Microbiol 8:1014. doi:10.3389/ fmicb.2017.01014
28. Rahimi-Nasrabadi, M, Pourmortazavi, S.M, Shandiz, S.A, Ahmadi ,F, Batooli. H. (2014) .Green synthesis of silver nanoparticles using Eucalyptus leucoxylon leaves extract and evaluating the antioxidant activities of extract. Nat Prod Res 28:1964–1969
29. Reddy, N.J., Vali, D.N., Rani, M., Rani, S.S .(2014). Evaluation of antioxidant, antibacterial and cytotoxic effects of green synthesized silver nanoparticles by Piper longum fruit. Mat Sci Engin: C 34:115–122. doi:10.1016/j.msec.2013.08.039
30. Roopan, S.M, Madhumitha. G, Rahuman. A,A, Kamaraj, C, Bharathi, A., Surendra, T.V .(2013). Lowcost and eco-friendly phyto-synthesis of silver nanoparticles using Cocos nucifera coir extract and its larvicidal activity. Ind Crop Prod 43:631–635. doi:10.1016/j.indcrop.2012.08.013
31. Salam, H.A, Sivaraj, R, Venckatesh, R (2014). Green synthesis and characterization of zinc oxide nanoparticles from Ocimum basilicum L. var. purpurascens Benth.-Lamiaceae leaf extract. Mater Lett 131:16–18. doi:10.1016/j.matlet.2014.05.033
32. Sathishkumar, G, Gobinath, C, Wilson. A, Sivaramakrishnan, S (2014) .Dendrophthoe falcata (Lf) Ettingsh (Neem mistletoe): a potent bioresource to fabricate silver nanoparticles for anticancer effect against human breast cancer cells (MCF-7). Spectrochim Acta A Mol Biomol Spectrosc 128:285–290. doi:10.1016/j.saa.2014.02.096
33. Saware, K, Sawle, B, Salimath, B, Jayanthi, K, Abbaraju, V (2014). Biosynthesis and characterization of silver nanoparticles using Ficus benghalensis leaf extract. Int J Res Eng Technol 3:867–874. doi:10.1007/s10876-014-0697-1
34. Swamy, V.S, Prasad, R (2012). Green synthesis of silver nanoparticles from the leaf extract of Santalum album and its antimicrobial activity. J Optoelectron Biomed Mater 4(3):53–59

35. Swamy, M.K, Sudipta, K.M, Jayanta, K, Balasubramanya,. S (2015) The green synthesis, characterization, and evaluation of the biological activities of silver nanoparticles synthesized from Leptadenia reticulata leaf extract. Appl Nanosci 5:73–81. doi:10.1007/s13204-014-0293-6
36. Singhal, G, Bhavesh. R, Kasariya,. K, Sharma A.R, Singh, R..P (2011) Biosynthesis of silver nanoparticles using Ocimum sanctum (Tulsi) leaf extract and screening its antimicrobial activity. J Nanopart Res 13:2981–2988. doi:10.1007/s11051-010-0193-y
37. Torney, F, Trewyn, B.G, Lin, V.,S, Wang, K. (2007) .Mesoporous silica nanoparticles deliver DNA and chemicals into plants. Nat Nanotechnol 2:295–300. doi:10.1038/nnano.2007.108
38. Vasanth, K., Ilango, K., MohanKumar, R.,, Agrawal. A, Dubey.. G.P (2014)., Anticancer activity of Moringa oleifera mediated silver nanoparticles on human cervical carcinoma cells by apoptosis induction. Colloid Surfaces B: Biointer 117:354–359. doi:10.1016/j.colsurfb.2014.02.052
39. Wang, H., Kou, X.,, Pei Z., Xiao, .JQ, Shan,, X, Xing B (2011). Physiological effects of magnetite (Fe3O4) nanoparticles on perennial ryegrass (Lolium perenne L.) and pumpkin (Cucurbita mixta) plants. Nanotoxicology 5:30–42. doi:10.3109/17435390.2010.489206.

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Climate Resilient Agriculture for Ensuring Food Security

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Introduction

Climate change poses many challenges to growth and development in South Asia. The Indian agriculture production system faces the daunting task of feeding 17.5% of the global population with only 2.4% of land and 4% of water resources at its disposal. India is more vulnerable to climate change in view of the dependence of huge population on agriculture, excessive pressure on natural resources, and relatively weak coping mechanisms.

The warming trend in India over the past 100 years has indicated an increase of 0.6°C, which is likely to impact many crops, negatively impacting food and livelihood security of millions of farmers.

During the past decade, frequency of droughts, cyclone, and hailstorms increased, with 2002, 2004, 2009, 2012, and 2014 being severe droughts. Frequent cyclones and severe hailstorms in drought prone areas have become common. Eastern part of the country is affected by seawater intrusion.

Reduced food grain productivity, loss to vegetable and fruit crops, fodder scarcity, shortage of drinking water to animals during summer, forced migration of animals, severe loss to poultry and fishery sectors were registered, threatening the livelihoods of rural poor. Enhancing agricultural productivity, therefore, is critical for ensuring food and nutritional security for all, particularly the resource-poor, small, and marginal farmers who would be the most affected. In the absence of planned adaptation, the consequences of long-term climate change on the livelihood security of the poor could be severe. In India, the estimated countrywide agricultural loss in 2030 is expected to be over $7 billion that will severely affect the income of at least 10% of the population.

However, this could be reduced by 80%, if cost-effective climate resilient measures are implemented.

Climate Resilient Agriculture

The climate-resilient agriculture (CRA) concept reflects an ambition to improve the integration of agriculture development and climate responsiveness. It aims to achieve food security and broader development goals under a changing climate and increasing food demand.

Similarly, climate smart agriculture is an integrative approach to address the interlinked challenges of food security and climate change that explicitly aims for three objectives:
1. Sustainably increasing agricultural productivity to support equitable increases in farm incomes, food security, and human development
2. Adapting and building resilience of agricultural and food security systems to climate change at multiple levels
3. Reducing greenhouse gas (GHG) emissions from agriculture (including crops, livestock, and fisheries) to the extent possible (FAO, 2013).

It also requires planning to address trade-offs and synergies between these three pillars:
1. Productivity.
2. Adaptation.
3. Mitigation.

The priorities of different countries and stakeholders are reflected to achieve more efficient, effective, and equitable food systems that address challenges in environmental, social, and economic dimensions across productive landscapes.

Items	Production (million tons)	Demand of food (million tons)
	2015	*2020*
Rice	104.80	122.1
Wheat	88.94	102.8
Coarse grains	41.75	40.9
Total cereals	235.49	265.8

Source: Commodity Board, 2016.

CRA also consists of elements of preparedness such as documentation of aberrant weather conditions, weather-based agroadvisory, awareness about the impacts of weather, etc. In case of water, resilient practices consist of aquifer and groundwater recharge, in situ moisture conservation, farm ponds, efficient application system, etc.

Some of the crop-based practices consist of drought- and flood-tolerant varieties, intercropping systems, etc. and interventions related to carbon, fertilizer, and institutions in the village which are similar to the climate smart interventions indicated by Scherr et al. (2012) and Aryal et al. (2015).

Government Policy and Support

India, as a developing country, has reasons to be more concerned about the adverse impact of impending climate change on its economy and particularly on agriculture sector for food security. An India is a party to the United Nations Framework Convention on Climate Change. It has established the National Clean Development Mechanism Authority in 2003. A council has also been set up under the Chairmanship of the Prime Minister of India in 2007 to coordinate national action for assessment, adaptation, and mitigation of climate change.

The National Action Plan on Climate Change (NAPCC) was launched in 2008 to address climate change concerns and promote sustainable development. There are eight National Missions including that on sustainable agriculture, which form the core of the NAPCC, representing "multipronged, long term and integrated strategies for achieving key goals in the context of climate change."

The National Mission on Sustainable Agriculture (NMSA) aims to support climate adaptation in agriculture through the development of climate-resilient crops, expansion of weather insurance mechanisms, and agricultural practices. All Indian states are also developing State Action Plans on Climate Change (SAPCC) in line with the NAPCC to define how they will integrate adaptation and mitigation of climate change into their ongoing government schemes and practical actions.

Insurance Scheme	Year of launch	Region	Crops	Risks covered
PCIS	1979	Implemented in 13 states.	Cereals, millets, cotton, potato, pea etc.	Non-preventable risks including natural fire and lightning, storm, hailstorm, cyclone, flood, drought, pest and diseases.
CCIS	1999-2000	Implemented in 15 states	Food crops and oilseeds.	Non-preventable risks including natural fire and

		and 2 union territories.		lightning, storm, hailstorm, cyclone, flood, drought, pest and diseases.
Rainfall Insurance	2005	Voluntary for all classes of cultivators	All food crops, oilseeds, annual horticulture /commercial crops	Crop failure due to erratic rainfall
NCIP	2013–14	Entire country	All food crops, oilseeds, annual horticultural/ commercial crops	Nonpreventable risks including natural fire and lightning, storm, hailstorm, cyclone, flood, inundation, landslide, drought, pests and diseases, including planting risk and postharvest losses
PMCIS	2016	Entire country	All food crops	Multiple localized risks including postharvest losses, prevented sowing due to adverse weather conditions; less premium (1.5–5% depending on the crop and season); timely settlements

Conclusion

A resilient agriculture that eliminates hunger, provides development opportunities, and maintains the supply of natural capital and a diversity of ecosystem services is a basic condition for the persistence and prosperity of human society. Achieving this goal will require developing an agriculture that is persistent, adaptive, and transformative.

We have many successes in stabilizing agriculture in the short term and in building efficiency; however, this very success has interfered with our ability to allow agricultural systems to adapt to the rising rate of environmental change and to be transformed when needs and opportunities arise. There will be costs to allowing transformation and maintaining a resilient agriculture, but these will be compensated by the capacity to maintain human well-being in the long run.

Reference

1. Ch. Srinivasa Rao , K.A. Gopinath, J.V.N.S. Prasad, Prasannakumar, A.K. Singh,2016," Climate Resilient Villages for Sustainable Food Security in Tropical India: Concept, Process, Technologies, Institutions, and Impacts", ICAR-Central Research Institute for Dryland Agriculture, Hyderabad, Telangana, India, AdvancesinAgronomy, Volume 140 ISSN 0065-2113.
2. Food and Agriculture Organization of the United Nations (FAO), 2010. "Climate-Smart" Agriculture. Policies, practices and financing for food security, adaptation and mitigation. Rome: FAO.
3. Scherr S. J, Shames. S, Friedmann.R, 2012,"From climate smart agriculture to climate smart landscapes, Agri food security 1(12),15.
4. Elena Bennett , SR Carpenter, LJ Gordon, N Ramankutty, P Balvanera, B Campbell, W Cramer, J Foley, C Folke, L Karlberg, J Liu, H Lotze-Campen, ND Mueller, GD Peterson, S Polasky, J Rockström, RJ Scholes, M Spierenburg ,2014,"Toward a More Resilient Agriculture", Volume 5, Issue 5, Page 65-75, Oct 2014.

Conservation Agriculture – Prospects and Constraints in India

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Conservation agriculture (CA) is a management system that maintains a soil cover through surface retention of crop residues with no till/zero and reduced tillage. CA is described by FAO (http://www.fao.org.ag/ca) as a concept for resource saving agricultural crop production which is based on enhancing the natural and biological processes above and below the ground. As per FAO definition CA is to:

1. Achieve acceptable profits.
2. High and sustained production levels.
3. Conserve the environment.

It can also be referred to as resource efficient or resource effective agriculture.

Chief Distinguishing Parameters of Conventional and Conservation Agriculture Systems

Conventional Agriculture	Conservation Agriculture
Cultivating land using science and technology to dominate nature.	Least interference with natural processes
Excessive mechanical tillage and soil erosion.	No-till or drastically reduced tillage (biological tillage).
High wind and soil erosion	Low wind and soil erosion
Residue burning or removal (bare surface)	Surface retention of residues (permanently covered)
Water infiltration is low	Infiltration rate of water is high
Use of ex-situ FYM/composts	Use of in-situ organics/composts
Green manuring (incorporated	Brown manuring/cover crops (surface retention)
Kills established weeds but also stimulates more weed seeds to germinate	Weeds are a problem in the early stages of adoption but decrease with time
Free-wheeling of farm machinery, increased soil compaction	Controlled traffic, compaction in tramline, no compaction in crop area.

Sharma et al., 2012

Principles of Conservation Agriculture

Conservation agriculture basically relies on 3 principles, which are linked and must be considered together for appropriate design, planning and implementation processes.

These are:

1. Minimal mechanical soil disturbance: The soil biological activity produces very stable soil aggregates as well as various sizes of pores, allowing air and water infiltration. This process can be called "biological tillage" and it is not compatible with mechanical tillage.

2. Permanent organic soil cover: In turn it improves soil aggregation, soil biological activity and soil biodiversity and carbon sequestration.

3. Diversified crop rotations: Cropping sequence and rotations involving legumes helps in minimal rates of build-up of population of pest species, through life cycle disruption, biological nitrogen fixation, control of off-site pollution and enhancing biodiversity.

Prospects of Conservation Agriculture

The promotion of CA under Indian context has the following prospects:

1. Reduction in cost of production: Cost reduction is attributed to savings on account of diesel, labour and input costs, particularly herbicides.

2. Reduced incidence of weeds: Most studies tend to indicate reduced incidence of Phalaris minor, a major weed in wheat, when zero-tillage is adopted resulting in reduced in use of herbicides.

3. Saving in water and nutrients: Higher soil water content under no-till than under conventional tillage indicated the reduced water evaporation during the preceding period.

4. Increased yields: CA has been reported to enhance the yield level of crops due to associated effects like prevention of soil degradation, improved soil fertility, improved soil moisture regime (due to increased rain water infiltration, water holding capacity and reduced evaporation loss) and crop rotational benefits.

5. Environmental benefits: Conservation agriculture involving zero-till and surface managed crop residue systems are an excellent opportunity to eliminate burning of crop residue which contribute to large amounts of greenhouse gases like CO_2, CH_4 and N_2O.

6. Crop diversification opportunities: Adopting Conservation Agriculture systems offers opportunities for crop diversification.

7. Resource improvement: Surface residues acting as mulch, moderate soil temperatures, reduce evaporation, and improve biological activity.

Constraints for Adoption of Conservation Agriculture

A mental change of farmers, technicians, extensionists and researchers away from soil degrading tillage operations towards sustainable production systems like no tillage is necessary to obtain changes in attitudes of farmers.

1. Lack of appropriate seeders especially for small and medium scale farmers.
2. The wide spread use of crop residues for livestock feed and fuel.
3. Burning of crop residues.
4. Lack of knowledge about the potential of CA to agriculture leaders, extension agents and farmers.
5. Skilled and scientific manpower.

Conservation agriculture offers a new paradigm for agricultural research and development different from the conventional one, which mainly aimed at achieving specific food grains production targets in India. A shift in paradigm has become a necessity in view of widespread problems of resource degradation, which accompanied the past strategies to enhance production with little concern for resource integrity. Conservation agriculture offers an opportunity for arresting and reversing the downward spiral of resource degradation, decreasing cultivation costs and making agriculture more resource – use-efficient, competitive and sustainable. “Conserving resources – enhancing productivity” has to be the new mission.

Reference

1. Bhan, S and Behera, U.K. Conservation agriculture in India – Problems, pro2014. spects and policy issues. International Soil and Water Conservation Research, Vol. 2, No. 4, pp. 1-12.
2. FAO. (2012). Food and Agriculture Organization of the United Nations, 2012. Available online at http://www.fao.org/ag/ca/6c.html.
3. Sharma, A. R., Jat, M. L., Saharawat, Y.S., Singh, V. P. and Singh, R. (2012). Conservation agriculture for improving productivity and resource-use efficiency: prospects and research needs in Indian context. Indian Journal of Agronomy, 57 (IAC Special Issue), 131-140.

Production Technology of Jack Bean

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Botanical Name: *Canavalia ensiformis.*
Chromosome No: 2n= 22.
Family: Fabaceae.

Introduction

Jack bean *(Canavalia ensiformis)* is commonly grown for young pods and immature seeds which are used as food for human and animals. It is also cultivated for forage or for green manure. It is a minor legume vegetable and work on this crop is very scanty.

The nutritional characteristics and food potentials of jack bean *(Canavalia ensiformis)* have been reviewed. The bean is a good source of protein, 23% to 34%, and carbohydrate 55%. It is also a good source of Ca, Zn, P, Mg, Cu and Ni. Jack bean protein is adequate in most essential amino acids with the exception of methionine and cystine which may be nutritionally limiting. Antinutritional and toxic factors including trypsin inhibitors, hemagglutinins, cyanogen glucosides, oligosaccharides and others are present in jack bean.

In Philippines, the mature seeds are primarily used for'ginisa' (salted) dishes while immature pods and immature leaves are used as vegetable dishes like salad 'pinakbet', 'lumpia', 'ginataan'.

The Jack bean is reported to be the native of West Indies (Anon.,1950). Then it was distributed to Central and South America. It is also cultivated to a limited scale.

Composition

The immature pods and seeds contain about 75.2% water, 6.9% protein, 0.5% fat, 13.3% carbohydrate, 3.3% fibre and 0.8% ash (Indira and Peter, 1988). Mendoza et al. (1986) extensively investigated composition of jack bean and reported that green pods are rich source of protein (28.31%) and seeds contain carbohydrate (44.56%) with a fairly digestible protein. The foliage and the seed contain growth inhibiting growth substances, canavalin and concanavalin A (conA) and the amino acid, canavanine. The concentration of these growth inhibiting substances. Increases age and maturity of plant tissue. Hence, only tender foliage and pods are edible.

Morphology

Annual or short-lived perennial climber with a deep root system, bushy, twining or prostrate. Leaves alternate, 3 foliolate; petiole 11-17 cm. Flowers mauve to purple, or sometimes white, borne on an axillary raceme with swollen nodes. The cultivated plant may reach from 60 to 120 cm in height. The leaves are cordate, green and large. The pods are large from 20 to 24 cm in length, flat broad, sword shaped, hooked, there are 8 to 18 seeds in each pod. They are yellowish in colour. The seeds are large, kidney shaped or oval elongated, 1 to 2 cm in diameter.

Soil and Climate

The crop is successfully cultivated on various tropical soils. It prefers a pH range of 5.0 to 7.0. Humus is necessary for vigorous plant growth and better seed quality. It is a typical short-day plant. The seeds germinate at 25 to 27^{o}C and jack bean seeds consume much water up to 200%.

Propagation and Planting

Jack bean is propagated by seed in a range of densities from 1m. and 75 cm, 40 and 30 cm. Sowing at the start of the wet season is preferred in regions with about 1000 mm annual rainfall, but in more humid environments sowing should be delayed until the end of the wet season.

As a pulse, jack bean may be grown with other crops such as maize or cassava. Although the grain yield of jack bean is then likely to be reduced, sometimes by as much as 50%, the total productivity of the system is improved.

Interculture

Two to three weeding at 3 week’s intervals with first weeding after one month of sowing are done.

Harvesting

The marketable pods, are available from 68 to 74 days in case of early type whereas 110 days for pole type.

Yield

2.67 to 3.14 kg green pod/plant. 2.92 to 3.50 kg green pod/plant in case of pole type.

Disease and Pests

Serious pests and diseases have not been observed in jack bean, being hardy plant not much attention much attention is required.

However, hairy caterpillar (Anisecta sp.) creates problems during early stage of plant, which can be controlled by spraying quinalphos @2ml/l.

Reference

1. A.B.I. Udedibe, Nutritional evaluation of Jack bean (Canavalia ensiformis) for the Nigerian Poultry Industry. AMB 1019(8), 1990, 361-365.
2. United State Department of Agriculture (USDA), (Canavalia ensiformis (L) DC. Germplasm Resources Information Network, 2005.

Physiology of Growth and Development of Orchids

Article ID: 10316

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An orchid includes some of world's most important floricultural, ornamental plants, pharmacological interest. It is estimated that 186 genera and 1141 species of orchids are found in India which constitutes almost 10% of world orchid flora.

Physiology

Plant physiology is the science concerned with processes and function, the response of plants to change in environment and the growth and development that results from the responses. A thorough understanding of all these processes is essential to improve crop yield. Use of similar approach to improve orchid cultivation by studying the various physiological processes affecting orchid growth.

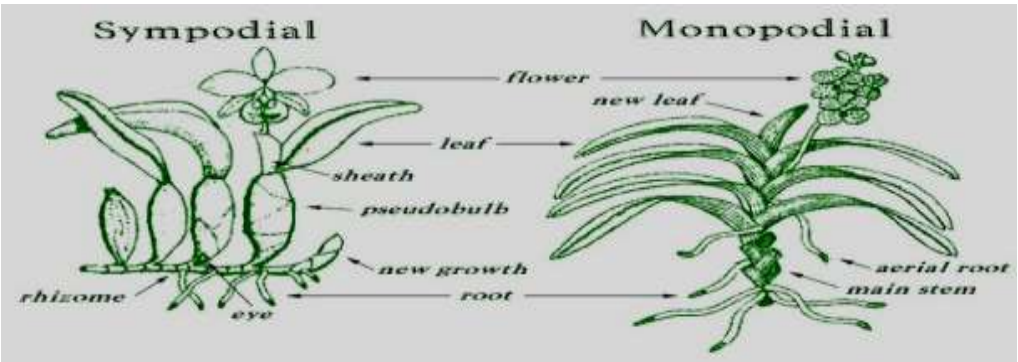
Physiological Issues Affecting the Orchid Industry

1. Orchid Seed: Nature's tiny treasure. Orchid seeds have no endosperm; no cotyledons, and no root initials, 80% terrestrials are symbiotic. Longevity of orchid seeds may vary from two months to 18 years. Orchid species are mycoheterotrophic. Mycobionts can enhance the accumulation of P, N and Ca in symbiotic seedlings of *Goodyera repens and Dactylorhiza purpurella.*

Orchid Leaves: Epiphytes generally have smaller stomata than terrestrial species. Usually, mature leaves are photosynthetically active. Leaves are sites for reduction of transpiration, water storage organs, retention of rain or condensed water and absorption of water as liquid or vapour. Thick leaves show Crassulacean Acid Metabolism (CAM), a very important adaptation to water stress. All thin orchid leaves show C3 photosynthesis. Small and narrow leaves are better adapted to exposure than larger ones because they lose heat more efficiently by convection. Deciduousness occurring in sympodial orchids helps to avoid water stress during the dry season by shedding their leaves and entering a dormancy period.

Pseudo-bulbs: Pseudo-bulbs of *Oncidium* 'Goldiana' maintain relatively high-water contents of 90-95% throughout development. In *Cymbidium sinense*, pseudo-bulbs are able to retain about 64% of their water content after 42 days of water stress conditions (Zengh *et al,* 1992).

Growth Habit



The plant produces a series of adjacent shoots which grow to a certain size, bloom and then stop growing, to be then replaced, pseudobulb contains nutrients and water for drier periods, e.g., *Cymbidium, Cattleya,* *Dendrobium.* The stems grow from a single bud, leaves are added from the apex each year and the stem grow longer accordingly e.g., *Vanda , Phalaenopsis, Arachins, Vanilla.*

Pollination

Pollination induces chlorophyll synthesis in gynostemia or perianth segments. A marked increase in respiration following pollination has been observed in orchids. Activities of a number of enzymes like catalase, peroxidase, polyphenol oxidase, ascorbic acid oxidase and glycolic acid oxidase increased following pollination. Activity of polyphenol oxidase in orchids is reportedly highest in the columns followed by aerial roots, tips, petals and leaves. A dramatic increase in catalase activity is observed in columns and petals of *Cymbidium lowianum* and *Dendrobium nobile* after pollination. The sharp rise in peroxidase activity in aging orchid flowers is caused by an increase in ethylene production during senescence.

Photosynthesis

During photosynthesis, carbon dioxide is fixed and reduced to carbohydrate. Green plants can be divided into three groups with respect to their patterns and biochemistry of CO_2 fixation C_3 –Photosynthesis. All thin leaved orchids fix CO_2 via C_3 pathway. The thin leaved orchids have fewer layers of smaller mesophyll cells and a larger number of stomata than thick leaved species. Thin-leaved orchids fix carbon in the light. They have high CO_2 points, prominent post-illumination CO_2 outbursts and active glycolic acid activity all of which are characteristics of plants with high photorespiration - e.g., *Habenaria platyphylla, Coelogyne masangeana, Cymbidium cynense, Oncidium spp, Vanda tessellata, Eulophia keithii, and Spathoglottis plicata.*

The C3 Photosynthetic Carbon Reduction Cycle

1. Carboxylation, during which CO2 is covalently linked to a carbon skeleton.
2. Reduction, during which carbohydrate is formed at the expense of the photochemically derived ATP and reducing equivalents, NADPH.
3. Regeneration, during which the CO2-acceptor molecule, ribulose 1,5-bisphosphate is re-formed.

C4-Photosynthesis

Plants which fix carbon *via* the C4 pathway grow best under high light intensities and warm climates. They use water efficiently, have high photosynthetic ratios and may tolerate arid conditions. PEP is the initial C-acceptor and the product is oxaloacetate, which is readily converted to malate or aspartate. The malate is then decarboxylated to yield CO2 which is refixed by RUBP carboxylase. *e.g, Arundina graminifolia.* (Malate was detected as an early product of photosynthesis in young leaves of *Arundina graminifolia* and this has led to the suggestion that young leaves of *Arundina graminifolia* may photosynthesise in part through the C4 pathway in contrast to the mature leaves).

Crassulacean Acid Metabolism (CAM)

The majority of plants in the Orchid family use CAM photosynthesis to fixate carbon dioxide. In these plans for dark fixation is phosphoenolpyruvate carboxylase (PEPCase). PEPCase has a high affinity for the CO2 molecule. Plants open their stomata during the cooler and more humid night-time hours, permitting the uptake of carbon dioxide with minimum water loss. During the day, they close their stomata and concentrate CO2 around the enzyme RuBisCO increasing its efficiency, e.g., *Vanilla, Cattleya, Thunia marshiliana, Coelogyne cristata, Laelia spp, Dendrobium, Calanthe vestita, Bulbophyllum, Aerides odoratum, Phalaenopsis, and Aranda.*

Photosynthesis of Non-Foliar Green Organs

There are numerous non-foliar green organs in leafy orchids such as pseudo-bulbs, flowers, fruit capsules and roots that can potentially contribute to the overall carbon balances For non-foliar organs involved in regenerative photosynthesis, nitrogen investment is low but high in water use efficiency.

Pseudo-Bulbs

CO_2 evolution can be detected in darkness after the partial removal of cuticle (2 cm by 2 cm) from each side of the pseudo-bulb. Using the same pseudo-bulb, there is a gradual decrease in CO_2 evolution when exposed to light indicating that there is some degree of CO_2 fixation by the pseudo-bulb tissue. The chlorophyll content in *Oncidium* pseudo-bulbs is only 4–6% when compared to the leaves. During the day, the CAM pseudo-bulbs act as a CO_2 releasing organ for carbon fixation.

Flowers and Fruit Capsules

Stomata in orchid flowers are generally non-functional and it is unlikely that gas exchange. Green Cymbidium flowers are able to photosynthesis and more C is fixed in light than in darkness. However, their rates of CO_2 fixation are comparatively lower than other organs such as roots, stems and leaves. Fruit capsules are formed from flowers after fertilization. The decrease in CAM activity is attributed to the increasing resistance to CO_2 diffusion as the fruit capsules mature.

CO2 Enrichment and Orchid Growth

CO_2 enrichment generally causes plants to develop more extensive root systems to exploit additional pockets of water and nutrients and to enhance the activity of bacteria and other organisms that break nutrients out of the soil, which the plants can then exploit**.** In C3 photosynthesis, the carboxylating enzyme Rubisco has a relatively low affinity for CO_2 molecule and therefore an increase in CO_2 concentration will increase the rate of CO_2 fixation. An increase in CO_2 concentration will also inhibit the rate of photorespiration. An orchid leaf will have greater rates of photosynthesis at higher levels of atmospheric CO_2 concentration. This in turn will generate more carbohydrate available for growth and development. For C3 orchids (thin-leaved orchids like *Oncidium 'Goldiana', Spathoglottis plicata*), CO_2 enrichment should commence at sunrise or when photoperiod begins, and refrain during darkness hours. The average CO_2 level that is recommended is 700 to 1500 ppm. For CAM orchids (thick-leaved orchids, like *Dendrobium and Phalaenopsis*), CO_2 enrichment should commence at three to four hours before sunset, continue through darkness hours and stop when photoperiod begins.

Respiration

Respiration generally refers to the processes of "dark respiration" that may occur in the light and darkness. The whole process of respiration involves the catabolism of sugar or some other substrates, the production of CO_2 and the consumption of O_2. Two important products are produced as a result of respiration: Reduced nucleotides (NADH and $FADH_2$) and ATP.

Respiration, in its essence, transforms the substrates derived from photosynthesis into important intermediates and useful energy necessary for growth and maintenance of living tissues. Aerobic respiration in plants is strongly inhibited by certain negative ions such as cyanide and azide. In some plant tissues, the poisoning of cytochrome oxidase by such inhibitors has only minimal effects on respiration. The respiration that continues in this situation is said to be cyanide-resistant respiration.

Cyanide-resistant respiration is also known as alternative respiration. Cyanide-resistant respiration in mature flowers is induced by ethylene. There is a shift from cyanide-resistant respiration in the tight buds to cyanide sensitive respiration in the fully opened flowers of Aranda. Cyanide-resistant respiration in mature flowers is induced by ethylene. There is a close relationship between ethylene production and respiration in developing Aranda flowers.

Seeds and Proto-Corms

Germinating orchid seed may respire anaerobically at some stage in its development. This is based on the depletion of oxygen in proto-corms growing in an enclosed culture system. *Dendrobium* proto-corms and calli, the respiration rates are higher when grown in medium with fructose.

Leaves

Oxygen uptake continues at a fairly steady rate in the dark when organic acids are formed. Photorespiration is present in the leaves of C3 orchids.

Flower

All young flowers generally respire at higher rates than older ones. Arundina flower has the highest respiration rate, and the shortest life span. In Cattleya cut flowers, the respiration rate decreases with age. Tight buds have the highest rates of respiration, which declines after the opening of bud. All young flowers respire at higher rates than the older ones.

Roots

In Cattleya roots, the highest rate of respiration is detected at the root tip and the respiratory rate decreased sharply in the first 4 cm behind the tip. Respiration of Aranda roots increases with increasing temperature from 15°C–35°C. Net CO_2 fixation in roots is observed only at 15°C and 350 ppm of CO_2.

Mineral Nutrients

The epiphytic orchids grow on the canopies of trees in the tropical rain forest and this presents a unique problem regarding water and nutrient supply. A general account for mineral nutrition of orchids has been reviewed. Level of elemental content varies with the different plant parts and stages of plant development. There exists a relationship between plant growth (or yield) and the mineral content of plant tissue. Table 1.0 Take a longer time to show mineral deficiency:

Elements	Concentration in dry matter	
	umole g-1	Ppm or %
Micro-elements		
Molybdenum	0.001	0.1
Copper	0.10	6
Zinc	0.30	20
Macro-elements		
Sulphur	30	0.1%
Phosphorus	60	0.2

Factors Affecting Flower Induction

1. Juvenility of Orchids: Juvenility refers to the early phase of plant growth during which flowering cannot be induced by any treatment. It is an important phase that controls the changes from vegetative to reproductive growth. Four to seven years required for orchid to flower from seed (Goh and Arditti 1985), but many commercial important hybrids flower within 36 months. (Hew and Yong, 1997).

2. Vernalization: The terminal inflorescence of *Dendrobium crumenatum* produces flower buds that develop until the anther is almost fully grown and all other segments are formed. This flower buds then undergo dormancy. Development resumes in the dormant flower buds after a sudden drop in temperature of 5°C. Hybrids of Cymbidium require a period of cool night and warm days for flower induction.

3. Photoperiodism: *Cattleya* species and hybrids flower induction occurred only when plants were placed under photoperiods of nine hours (nine hours of light per day) at 13°C, while flowering was inhibited under 16 hours of light per day at 55°F (Rotor, 1959). *Dendrobium*, plants exposed to a constant 13°C produced flowers regardless of the day length, whereas plants placed at 18°C remained vegetative and did not flower. *Phalaenopsis* uniform spiking can be obtained when plants are grown at day/ night temperatures of either 25/20°C or (20/15°C) for four to five weeks. Short days enhance spiking and long days promote vegetative growth or the development of keikis in Phalaenopsis.

Partitioning of Assimilates

Assimilate partitioning between sources (net producers of assimilates, e.g., leaves) and sinks (net importers of assimilates, e.g., flowers) is essential for increasing the harvestable component of economically important plants. A thorough understanding on how assimilates are allocated among flowers, storage organs (e.g., pseudo-bulbs) and leaves is useful for the maximisation of harvestable yield in orchids. Orchids have a highly integrated pattern of assimilate partitioning in which both major sinks (inflorescence and vegetative apex) and minor sinks (leaves, stems and roots) receive 14C-assimilates from nearby and distant leaves. The relatively unrestricted assimilate movement between sources and sinks within an orchid suggests the high potential in diverting additional assimilates for inflorescence growth. Inflorescence growth of orchids is primarily source-limited and larger inflorescences could be obtained by increasing source capacity through the usage of elevated CO_2 treatments, removal of competing sinks or possibly, by selecting a specific cultivar with additional source leaves. Improvements in the harvestable yield of orchids grown for its cut-flowers should adopt a two-pronged approach which seeks to increase both the photosynthetic capacity of the source leaves and the ability of the inflorescence sink to import assimilates.

Flower Senescence

Orchid flowers are particularly sensitive to ethylene. The injury caused by ethylene to most orchid flowers is characterized by the progressive drying and fading of sepals. Ethylene is produced by orchid flowers and its production is enhanced following pollination or emasculation (removal of pollinia). When an inflorescence is excised from the plant, a number of physiological processes are affected. These include the supply of water, depletion of respiratory substrates and ethylene production.

Conclusion

Careful and well-planned usage of elevated carbon dioxide, coupled with the other physiological ‘tools’ such as plant hormones and the appropriate fertilizer, should allow the growers to ‘speed-up’ vegetative growth or to extend the flowering period in tandem with market demands. To induce flowering, plants need to be grown at cooler temperatures. Without the information, growers are not able to produce a flowering crop when demand — and likely profit — is greatest.

Reference

1. Hew, C.S. and J. W. H. Yong. 1997. The physiology of tropical orchids in relation to the industry. World Scientific, Singapore.
2. Goh, C. J. and J. Arditti.1985 Orchidaceae, p. 309-336. In: A. H. Halevy (ed.). Hand book of flowering. Vol. I. CRC Press, Boca Raton, Fla.
3. Rotor, G.B.1959. The photoperiodic and temperature responses of orchids, p. 397-416. In: C.L. Withner (ed). The orchids. Ronald press, New York.
4. Zeng, X. N.,Wen, Z. Q. & Hew, C. S. 1992. Response of Cymbidium sinensis to drought stress. J. Horti. Sci., 67: 295-299.

Watershed Development Approach for Holistic Agricultural Planning

Article ID: 10317

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Abstract

In our country now further increase in land area for food production is not being visualized and therefore greater emphasis will have to be laid on increasing the productivity. For enhancing the food productivity, a regionally differentiated strategy based on agro-climatic regional planning which takes into account agronomic, environmental and socio-economic conditions will have to be adopted to realize the full potential of growth in every region. Therefore, the thrust should be on sustainable use of basic resources such as land, water and vegetation in such a way that it serves the objectives of accelerated growth, employment, social justice and ecosystem protection. Strategy should involve optimum utilization of soil and water resources and suitable production inputs for maintaining soil health and adoption of cropping patterns in line with the farming system's approach whereby appropriate productivity increase is obtained in agricultural crops, livestock, fisheries and horticulture sector, which are equally important in the national context. Emphasis should be given for utilizing soil, water and fertilizers/ manures as productive resources with the higher level of efficiency. Forest cover must be preserved to keep off climatic disturbances and to plan future strategies to evolve a progressively more efficient and sustainable food and nutritional security system. These goals can be achieved through creating awareness amongst farming community and all those who are directly or indirectly involved in agriculture. Achievement of all these goals is possible through holistic agricultural planning following the Watershed Development Approach.

Keywords: Watershed, Holistic Planning, constraints to productivity, black clay soils, Malwa region.

Introduction

Fragmented or piece meal approaches do not lead to sustainable and long-lasting impacts. Permanent solution for attaining water prosperity, food productivity and overall profitability lies only in WS based Approach. The Definition /Meaning of WS are known to us for about Last 200 Years but the advantages and Impact of WS Management Approach could attract our attention only during Second Half of 20th Century. Integrated watershed management is considered an effective unit for overall development of agriculture for obvious reasons as it is the most rational approach in preventing deterioration of ecosystem, restoration of degraded lands, efficient water harvesting and improving the overall productivity of the rain-fed areas. Last 3/ 4 decades years have witnessed a marked increase in the level of interest among R&D organizations, administrators and policy makers, and there has been a significant increase in commitment towards this approach. Besides the schemes launched by the Ministries of Agriculture, Rural Development, and Environment and Forestry, committed local leadership and voluntary agencies are coming forward to help implementation of watershed development programmes by motivating and involving peoples' participation. The success stories of Sukhomajri and Nada (Haryana) and Ralegaon Siddi (Maharashtra) watersheds are inspiring examples, which should spread like eco-development movement across the country. It is through watershed approach only, we can make grey areas green, since 68% area is still rainfed and requires appropriate technological backstopping for sustained production so critical for the "Second Green Revolution".

At present, there is an extreme inadequacy of basic data for preparation of scientifically sound watershed plans. Wide array of data required for this purpose cannot be acquired and analysed with traditional tools and procedures. Increasing use has to be made of modern technologies like, satellite imageries, simulation models, systems research, informatics, etc. for which expertise is now emerging in the ICAR institutes, specialized government departments and SAUs. There is also need to establish proper linkages with NRSA and ISRO, and to establish documentation centres, where basic data on a variety of parameters for land, water and environment can be collected, stored, retrieved and analysed for preparation of watershed development plans.

What is a Watershed?

A watershed is the entire area, which contributes runoff water to a given location on a stream below and therefore, to manage this water, a watershed is the most appropriate unit. The runoff water can be fully quantified for the watershed and taken care of. Also, the management of water has to be thought of right at the point it starts flowing, and this is where watershed originates. Thus, the management practices can be adopted starting from the ridge and extended to area downwards in the direction of water flow, with time. At first, a micro-watershed, then the others of a mini watershed can be selected for development. Thus, watershed approach is very appropriate whereby the land is developed sub watershed by sub watershed.

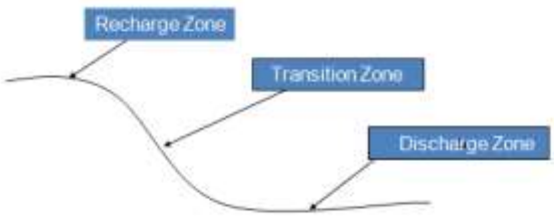
In physical terms, a watershed refers to the area lying above a given drainage point. It may cover less than one hectare or more than thousands of hectares depending upon the point of reference. Each watershed may have distinct characteristics called watershed attributes, such as shape, size, orientation, topography, geology, climate, surface conditions, land use, ground water and socio- economic aspects. The development programmes involve many of these attributes and also include components such as special crop management, soil and water conservation, water harvesting and recycling, alternate land use etc. Clearly these factors are interrelated and often have an effect on the social environment as well.

Classification of Watersheds

A WS comprise of three zones namely:

1. A Catchment area (Recharge Zone).
2. A Command area (Transition Zone).
3. A Delta area (Discharge Zone).

Based on the catchment area and convenience of operation 5 main classes as (1) Macro watershed (> 50,000 ha), (2) Sub-watershed (10,000 to 50,000 ha), (3) Milli-watershed (1000 to10000 ha), (4) Micro watershed (100 to 1000 ha), and (5) Mini watershed (1-100 ha).



Watershed Management Approach?

Watershed management means management of resources such as land, soil and rain-water on a watershed basis. Improving the productivity of dryland is the central theme in the watershed approach. The watershed development programme may have the following specific objectives:

1. To manage land and water resources of the watershed for their most optimum utilization.
2. To manage land to manage rainwater to control the problems of soil erosion, inadequate drainage, maintenance of fertility and conservation of water.
3. To obtain optimum upland treatments (conservation practices) consistent with efficient land use and high income per unit area.
4. To make a substantial contribution towards flood prevention.
5. To increase productivity and income from drylands through introduction of improved technologies with respect to components of watershed programme.

6. To conserve soil resource for achieving sustained productivity.
7. To improve collection of runoffs through appropriate water harvesting systems.
8. To generate increased employment potential at village level by introducing such labour-intensive technologies particularly during the ‘ lean’ period.
9. To enhance the productivity of community lands through programme like social forestry, pasture development etc.

Various steps for effective implementation of watershed management programmes include identification and demarcation of the watershed and divide it into mini/ micro watersheds, identification of the problems of the micro/mini watersheds, collection of data on resources (resource inventory), assessment of available technology to solve the problems identified, preparation of development plans, execution of the plans, and monitoring and evaluation of the impact of the development programmes.

Constraints to Management and Productivity of Black Clay Soils

Dominance of montmorillonite clay in black soils leads to high degree of swelling on wetting and shrinkage on desiccation due to which arise the problems of poor infiltration, high runoff, soil erosion and nutrient losses during rainy season and enhanced evaporative water losses due to development of shrinkage cracks during prolonged dry spell in rainy season and post rainy season. Areas having dependable rainfall (more than 750 mm annual rainfall) coupled with high intensity and erratic temporal and spatial distribution frequently results in waterlogging on flat lands and runoff and severe soil erosion on sloppy lands.

The major factors contributing to severity of soil erosion are land slope, runoff, and traditional systems of cultivation particularly the practice of rainy season fallowing. The extent of runoff emphasizes the strong need for scientific water management along with soil erosion control measures. In view of poor infiltrability of these soils, widely occurring undulating topography, monsoonic nature of rainfall and fallowing of land in many areas for obvious reasons, runoff is inevitable in the black soils’ regions. Runoff water, a precious natural resource, not only erodes the soils, washes away plant nutrients and limits the productivity in these areas but also creates the flood problems and damages the crops in lower reaches.

Soil erosion is the serious problem in black soils with land slope greater than 0-8 per cent while on flat lands sheet erosion as well as waterlogging are the serious problems. The major constraints to high productivity of black clay soils arise due to their peculiar physical-chemical characteristics. These constraints can be grouped into three categories namely; (1) physical, (2) chemical and (3) biological constraints.

1. Physical constraints: These are:

a. Low infiltration and poor internal drainage.
b. Narrow workable moisture range of these soils.
c. Poor crop stand.
d. Evaporation from soil surface and shrinkage cracks.
e. Runoff and associated soil erosion and nutrients losses.
f. Salinity and alkalinity hazards.
g. Non availability of drainage design criteria etc.

2. Chemical constraints: Chemical constraints are:

a. High values of soil reaction i.e., high soil pH, which adversely affects the availability of plants nutrients such as P, Fe, Mn and Zn.
b. Calcareous nature of soils which enhances volatilization losses of N following surface application of ammonium and ammonium forming fertilizers (Goswami and Sahrawat, 1982).
c. Soils are low in organic carbon and loss of N from urea and ammonical fertilizers further aggravate the situation.
d. Wide spread deficiency of P in Indian soils (Tandon, 1987). High P fixing capacity of black clay soils limits the desired response of applied fertilizer P.
e. Very little attention paid to K management.

f. Widespread S deficiency in many areas.

g. deficiency of certain micronutrients particularly of zinc and iron.

3. Biological Constraints: As far as biological constraints are concerned, potential for maximizing biological N fixation is underutilized. Further, the importance of biological N fixation has been suppressed by fertilizer N in intensive and high input agriculture (App et al., 1980). App et al.(1980) have listed four biological constraints for underutilization of biological N fixation. These are:

a. Fertilizer N has been relatively less expensive and is far easier to manage than biological N2 fixation.

b. Yield of grain legumes are generally low and they usually have not responded to high level of management.

c. Grain legumes are generally grown on marginal lands where appropriate technology for legume-based farming systems is not available.

d. there is general lack of understanding about the potential for symbiotic nitrogen fixation.

Watershed Development Programme

Concept of planning as understood in Industrial ventures may not be applicable in a biological system because unlike industrial project, the conditions vary from location to location and even within the same agro- ecological region. Instead of centralized planning, the watershed has to be planned from below so as to consider the needs and capability of the participants. Apart from this the norms laid down by the funding agencies such as Department of Agriculture and Rural Development and Banks have also to be confirmed with so that the financial discipline is maintained throughout the life of the project.

Preparation of Master Plan

The preparation of master plan is a pre-requisite and is useful document encompassing not only the site characteristics, socio- economic situations, existing cropping schemes and land uses, available technologies ready for transfer; infrastructures available and even the mode of monitoring the progress and inter agency coordination.

1. General description of watershed physio-graphy: Basic information, viz., location size, shape slope, climate, major type of vegetation, village statistics and infrastructure facilities etc.

2. Analysis of problems and needs: Field problems which directly influence the productivity are spelt out viz. land use pattern, soil and water management, crops and participation of farmers etc.

3. Resource evaluation: Surveys for resources.

4. Proven technology adoption: The research findings earlier verified under the farmers' fields through adaptive trials, demonstrations etc. in the region should be identified for each component such as soil and water, crops, pasture, forestry etc. Based on the available information the work plan is formulated for the effective implementation of the project to be described in the following major parts.

a. Proposed soil and water conservation measures:

i. Mechanical measures including overall area treatments with land levelling, grading, bunding/ terracing; water disposal treatment, water harvesting structures and other erosion control structures as per need of the area.

ii. Agronomic measures, viz., contour cultivation, strip cropping, conservation tillage, mulching and land configuration.

b. Proposed land use and cultural practices: The land use appropriate to the land capability class should be identified and various operations viz., sowing, fertilizer management, cropping pattern and plant protection measures etc.

c. The animal husbandry programme should appropriately be included.

d. Cost benefit analysis: A detailed estimation of benefit and cost from each improved technology should be given to serve as a basis of calculating the budget and also to justify the investment.

e. Coordination and monitoring: Since the watershed development is a multidisciplinary / multi-institutional effort, it is essential to have coordination committees to ensure and oversee the efforts of various agencies. It is envisaged to have committees for smooth running of the project and farmers should be involved from the very beginning of the project.

f. Evaluation: Overall assessment of project effects and their impact involves comparison and requires information even from outside the project. Fully treated watershed is a rare exception in India; therefore, an evaluation can be made on different degree of coverage of works. Following the evaluation during construction (in phases), operation and maintenance stages, the impact effect of various practices are evaluated before continuing the development when expected results are not obtained, changes are proposed which can involve new designs and implementation methods.

Watershed Development Technology

The technology for the watershed development should consists of land and water management practices, and Crop husbandry practices.

Land and water management practices: Land and water management practices would depend upon whether the erosion or water logging/ water stagnation or both are the problems. Practices of controlling soil erosion aim at slowing down the velocity of runoff water, allowing most of it to soak into the soil or to drain off slowly to the natural streams.

Various activities are: (1) stabilization of slopes > 6% with shallow soil by vegetative cover, (2) bench terracing on land with slope > 6% and with deep soil, (3) water diversion bunds, (4) grassed waterways, (5) mechanical structures for stabilization of waterways, Use of Gabions, Loose boulder structures etc, (6) graded bunds / planting appropriate vegetation on a grade, (7) waste-weirs, (8) gully reclamation works, and (9) Water harvesting works. Practices that control water logging and water stagnation are; water diversion bunds, grassed waterways, graded drainage channels, and Stabilization works for waterways and drainage channels, vegetative barriers etc.

Watershed approach envisages the scientific land use planning in such a way that maximum productivity and profits are realized by the farming community and other beneficiaries on one hand and the natural resource, LAND is also maintained in good a health. Suitable soil and water conservation practices and cropping systems according to soil category of Malwa and Nimar conditions have been given in Tables 1 and 2 respectively.

Table 1: Soil and water conservation practices (SWCP) under different land categories:

Land slope %	Type of land.	SWCP	Example.
0 to 2	Arable land, no crop limitation	Cultural Practices	Furrow-bed system, mulching intercropping, contour strip cropping.
2 to 3- 12	arable and, some limitation on crops, if mechanized	Major	Contour bunding on slopes less than 6% and rainfall lass than 500 mm.
12 to 20-25	Mostly suitable for pasture, reforestation.	SWCP	Graded bunding, grass water- ways drops structures.
Greater than 20-25	Pasture, woodlots. ravines, gullies	Major SWCP	Bench terracing on permanent grass or forest land, graded ditching.

Table 2: Different suitable cropping systems for different land conditions:

Soil category	Cropping system
Shallow black soils (depth <40cm)	Only kharif crops of short duration.
Medium black soils (depth 40-90 cm)	Single cropping in rainy season, soybean based inter- cropping systems e.g., soybean + pigeon pea /maize, sorghum, cotton.
Deep black soils (soil depth > 90 cm)	Inter-cropping system as above, soybean based sequential cropping i.e., short duration soybean followed by chickpea, linseed, wheat and safflower.

Crop Husbandry Practices

The basic principle is to use land according to its capability, taking into consideration the type of land, its slope, and the depth of soil. Also, to achieve maximum moisture use efficiency; the land is to be cropped during the period in which most of the rain received. Various activities are:

1. Afforestation of bare hillocks.
2. Planting grass on sloppy lands with shallow soil.
3. Short duration crops/varieties on moderately or less sloppy land with shallow soil.
4. Intercropping on medium deep soil.
5. Sequential cropping on deep soil after providing crop drainage in rainy season.
6. Growing more remunerative crops / varieties.

Conservation Practices

Cost effective conservation practices include:

1. Sowing crop against the slope on sloppy land.
2. Planting on grade rather than on graded broad ridges.
3. Providing surface drains / graded furrows on flat land (between crop rows).
4. Opening of dead furrows at an appropriate interval in standing crops.
5. Planting of crops and cropping systems on appropriate land configurations e.g., Ridge and Furrows, Broad bed and Furrows, Broad bed and tied Furrows, and Raised - sunken beds.

Improved Package of Practices

Once sound planning is done then crops must be grown using recommended package of practices for realizing the highest productivity. Main practices are:

1. Appropriate land management and seedbed preparation.
2. Selection of crop/varieties.
3. Seed grading /treatment.
4. Early but safe planting.
5. Judicious use of fertilizers.
6. Control of weeds.
7. Control of pests and diseases.
8. Harvest at physiological maturity.
9. Post-harvest technology and value addition etc.

Inspiring Examples of WS Based Development Approach in India

The recent examples of WS based approach of natural resources management seeking peoples' participation in India are:

1. Jamburdi-Hapsi, Rinjalai-Nainod WS (M.P.,1974-75) by Dr. G. P. Verma & Team.
2. Raley-Gaon-Siddhi WS (M.S., 1975): by Sh Anna Hazare.
3. Sukhomanjari WS (Haryana, 1977) by Dr P. R. Mishra &Team.
4. Tarun Bharat Sangh (Rajsthan, 1985) by Sh. Rajendra Singh.
5. Adarsh Watershed, Kothapalli (ICRISAT, A.P., 1999) by Dr. S. P. Wani & Team.
6. Hingonia-Piplyatapha, Ringnodia, Jaitpura, Gawali-Palasiya WS (M.P.) by Dr R. A. Sharma and Team.

Ralegaon Siddhi in Mharashtra [Sh. Anna Hazare]

A village in Parner Taluka of Ahmednagar District, Maharashtra state has an area of 982.31 ha (1991). It is considered a model of environmental conservation. The village has carried out programs like tree planting, terracing to reduce soil erosion and digging canals to retain rainwater. For energy, the village uses solar power, biogas (some generated from the community toilets) and a windmill. The project is heralded as a sustainable model of a village republic. The village's biggest accomplishment is in its use of non-conventional energy. For example, all the village street lights each have separate solar panels. The village is headed by a Sarpanch who is the chief of the Gram Panchayat (village panchayat). In 1975 the village was afflicted by drought, poverty prevailed, and trade in illicit liquor was widespread. The village tank could not hold water as the embankment dam wall leaked. Work began with the percolation tank construction. Sh. Anna Hazare encouraged the villagers to donate their labour to repair the embankment. Once this was fixed, the seven wells below filled with water in the summer for the first time in memory. Now the village has water year-round, as well as a grain bank, a milk bank, and a school. There is no longer any poverty. The World Bank Group has concluded that the village of Ralegan Siddhi was transformed from a highly degraded village ecosystem in a semi-arid region of extreme poverty to one of the richest in the country.

Sukhomajri WS in Haryana [P. R. Mishra & Team]

Sukhomajri is a village in the erosion prone Shivalik hills near Chandigarh in north Indian state of Haryana where there was a severe problem of erosion in the upstream catchment area leading to silting up of the downstream Sukhna Lake. In 1977, under the guidance of PR Mishra four tanks were built to conserve rainwater. This increased water storage and provided protective irrigation to the rain-fed crops, increasing yields. This became an incentive to the villagers to stop grazing and initiate afforestation and watershed protection in the catchment, to reduce erosion and prevent sedimentation of their tanks. The project gave increased yields in agriculture, protected forest cover, and reduced erosion. The dam and catchment management were undertaken by Hill Resource Management Societies (HRMS).

Tarun Bharat Sangh [Sh. Rajendra Singh]

Rajendra Singh is a well-known water conservationist from Alwar district, Rajasthan in India. Also known as "waterman of India", he won the Ramon Magsaysay Award for community leadership in 2001 for his pioneering work in community-based efforts in water harvesting and water management. He runs an NGO called “Tarun Bharat Sangh” (TBS), which was founded in 1975. Since 1985 Rajendra Singh has directed Tarun Bharat Sangh, an NGO which promotes access to water. The organization has been recognized for its success in revitalizing rivers, renewing groundwater supplies, and granting access to clean water to people who formerly had no access. In the coming years, rivers like Ruparel, Sarsa, Bhagani and Jahajwali were also revived after remaining dry for decades. Abandoned villages in the areas got populated and farming activities could be resumed once again, in hundreds of drought-prone villages in neighboring districts of Jaipur, Dausa, Sawai Madhopur, Bharatpur and Karauli, where work of TBS gradually spread. By 2001, TBS had built 4,500 earthen check dams, or johads, to collect rainwater in 850 villages in 11 districts of Rajasthan. He has also been organizing Pani Pachayat or Water Parliament in distant villages in Rajasthan to make people aware of the traditional water conservation wisdom, the urgency of groundwater recharge for maintaining underground aquifers and advocating community control over natural resources. Rajendra Singh is recipient of (1) Magsaysay Award for Community Leadership in the year 2001, (2) Jamnalal Bajaj Award in 2005 for his notable contributions.

Kothapally Watershed, A.P. [Dr S. P. Wani and Team]

ICRISAT started its work in the Adarsha watershed in Kothapally village, Ranga Reddy district in undivided Andhra Pradesh, India in 1999. The initial phase consisted of (i) a detailed and systematic baseline characterization of the natural resource base and the socio-economic condition of the local population, and (ii) The formation of a consortium including local and national research institutions as well as government authorities to provide technical support. In close collaboration with the community, ICRISAT accordingly tested, evaluated and further developed a wide range of management styles and agricultural innovations to improve the living conditions of the people in Kothapally, and to prove that scientific backstopping, participation of the rural population and the collaboration of various institutions in multi-disciplinary consortia can make a difference. Today, the community manages the watershed independently; the project has proven to be sustainable. The watershed project resulted in impacts on the livelihoods of the community and on the natural resource base.

Jamburdi-Hapsi, Hingonia-Piplyatapha, Ringnodia and Gauli-Palasiya Watersheds in M. P. [Dr. G. P. Verma, R. A. Sharma and Team]

Watershed approach-based works were started in 1970s in Madhya Pradesh seeking peoples' participation. The scientific land use planning was done and practiced in such a way that maximum productivity and profits are realized by the farming community and other beneficiaries on one hand and the natural resource, land is also maintained in good a health. Suitable soil and water conservation practices and cropping systems according to soil category of Malwa and Nimar conditions were tested which could be popularized in farming community on a large scale.

Reference

1. Anonymous (1977 -98). Annual Report. AICRPDA, JNKVV, College of Agriculture, Indore, M. P., India.
2. Goswani, N.N. and Sahrawat, K.L. (1982). Review of Soil Research in India, New Delhi, 21, 127, Indian Soc. Soil. Sci.
3. Paroda, R. S. (1998). Natural Resource Management for Sustainable Agriculture: A New Paradigm. Plenary Lecture delivered inFirst International Agronomy Congress, 24 November, 1998, Organized by ISA and ICAR, New Delhi.
4. Yadav, J.S.P. and Singh, G.B. (Eds.) (2000). Natural Resource Management for Agricultural Production in India. Published by Secretary General, International Conference on Managing Natural Resources for Sustainable Agricultural Production in the 21st Century. PP. 1022.
5. Sharma, R. A., Raghu, J. S. and Thakur, H. S. (2005). Rainfed Farming Technology for Black Clay Soils. Tech. Bulletin, AICRPDA, JNKVV, Campus, College of Agriculture, Indore, PP. 1- 128.
6. Sharma, R. A. and Patidar Kamlesh (2019). Impact of integrated approach of land, water and nutrient management practices on agricultural productivity in Malwa region of Madhya Pradesh. Int. J. Chem. Stud. 2019; 7(1), Part-D: 179-183.
7. Sharma, R. A. and Nilesh Sharma (2019). Strategies for mitigation of drought effects through resources management practices including indigenous rural technologies with special reference to Madhya Pradesh: A review. Int. J. Chem. Stud. 2019; 7(2): 137-149.

Soil Fertility and Nutrient Management Practices for Different Crops Grown on Black Clay Soils of Madhya Pradesh- A Research Review

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Abstract

A lot of studies have been carried out during second half of 20th Century, aiming at optimization of fertilizer nutrient amount for mono-cropping, double cropping and foliar application of nutrients for different crops. These studies included different sources of nutrients including chemical fertilizers, organic sources i.e., FYM, compost, green biomass, crop residue application as mulch and its incorporation in soil in subsequent seasons, application of decomposed residues, gliricidia green lopping and other green biomass, different bio-fertilizers and their combinations etc. The important conclusions which have been emanated from these long-term studies have been reviewed and summarized in the present paper.

Keywords: Soil fertility, nutrient management, organic and inorganic sources, black clay soils.

Fertilizer Use in Single / Mono-Cropping

Based on the results of adequate studies made to work out the fertilizer needs for different crops under rain-fed conditions, various recommendations of nutrients have emerged for different crops. These recommendations were revised from time to time and latest recommendations of fertilizer nutrients N, P and S have been summarized in Table 1. Initially, no recommendations were made for potash and S. Further, use of organics also could not find place in fertilizer schedules on large scale. The recommendations of nutrients for normal weather situation have been depicted in Table 1.

Table 1: Nutrient recommendations for rain-fed crops of Malwa region of Madhya Pradesh:

Crop	Nutrient (kg/ha)			Application information
	N	P_2O_5	S	
Soybean, Pigeon-pea, Groundnut.	30	60	40- 60	All basal at sowing time below the seed.
Blackgram Greengram	20	50	40- 60	- do-
Cotton	60	30	40- 60	All P as basal N in two splits i.e., 1/2 + 1/2 as basal at DAS 30.
Sorghum Hybrids	80	50	-	All P as basal, N in 2 splits i.e., 1/2 at sowing + 1/2 DAS 25 - 30
Sorghum varieties	50	25	-	-do-
Maize Hybrid	80	50	-	- do-
Maize varieties	50	25	-	-do-
Wheat, Safflower and Sunflower.	40	40	40- 60	All as basal application
Gram	20	40	-	do
Linseed	30	30	-	do

Fertilization of Double Cropping Systems

Results of experiments conducted at All India Coordinated Research Project on Dryland Agriculture (AICRPDA), Indore during 1971-80 led to the conclusions that recommended dose of N and P should be given to Kharif crops, and sequential crops should be grown without fertilizer as they are grown on residual moisture. Such intensive cropping for three years had shown no deterioration in soil fertility provided Kharif crops are adequately fertilized. If rains are received prior to sowing or if there is provision for pre-sowing irrigation, application of rational dose of N (20 kg/ha) to wheat and safflower crops has been found most remunerative.

Foliar Application of Nitrogen

In all the studies conducted on foliar application for N to different Kharif and Rabi crops, basal application of N proved much better than its foliar application. No response to foliar application of N was obtained in dry wheat, sunflower, safflower and gram. Also, no significant response to foliar application of P to gram crop was observed. There were indications that N and P requirement of sunflower and safflower could significantly be reduced by smearing of seeds before sowing with dilute solution of macro elements (NH4)2 NO3 + KH2PO4 +Gum) in water.

Rain-Fed Crop Responses to Fertilizer N and P

The results of studies carried out to evaluate the responses of various rain-fed crops to fertilizer N, P and combined use of farmyard manure on different crops grown in sequence and in intercropping systems have been summarized in Table 2. Responses in terms of grain yield of different crops to P application in black clay soils of Indore have been presented in Table 3. The responses of rain-fed hybrid maize and sorghum have been observed to be around 3.1 and 7.6 kg grain per kg of P2O5 applied through single superphosphate at 100 and 50 kg P_2O_5/ha application rate, respectively. Although, the grain yield of sorghum was increased gradually by 15.7, 23.4 and 33.6 % respectively over control (Table 3) due to application of 100, 150, and 200 kg P_2O_5/ha but the response per kg of applied P_2O_5 was only about 4.3 kg grain. In another study still higher doses of P ranging from 110 to 330 kg P_2O_5/ha (Table 5 and 6) although resulted in 18 to 25% increase in sorghum yield but the response decreased from 5.53 kg to 2.47 kg grain/ kg of applied P_2O_5 at 110 and 330 kg P_2O_5/ha application rate. Responses of yellow soybean grown on vertisols of Indore have been recorded to be fairly good varying from 7.2 to 4.2 kg seed/ kg of fertilizer P_2O_5 at 20 to 80 kg P_2O_5 application rate. Soybean grain yield of 7.2 and 5.6 kg/ha of applied P_2O_5 were obtained at 20 and 40 kg P_2O_5/ha (Table 2) applied through single superphosphate. Higher application rate of P_2O_5 (80 kg P_2O_5/ha) although gave 8.33 % additional grain yield of soybean as compared with 40 kg P_2O_5/ha but the yield response declined to 4.2 kg.

The responses of rain-fed wheat, chickpea and safflower grown on vertisols of Indore at 40 kg P_2O_5/ha fertilizer application rate have been observed to be 2.5, 3.2 and 1.25 kg grain/kg of applied P2O5. Very low responses of these post rainy season crop to applied P was due to inadequate soil moisture supply particularly during reproductive phase of crop growth

Table 2. Response of some rainfed crops to fertilizer N and P at Indore, Madhya Pradesh:

Crop sequence / Varieties	Nutrient application (kg/ha)	Grain yield (kg/ha)	Incremental response (kg grain /kg fertilizer nutrient)
Maize (Ganga-5)	N @ 0, 25, 50, 75, 100 at P= 22.	480,932,1532, 2291, 2548.	18.1, 24.0, 30.4, 10.3.
Gram (Ujjain 24) (1983-85)	Residual N At (N=20 P = 17.5 to gram)	687,759,815, 875, 921.	2.9, 2.2, 2.4, 1.8.
Soybean (JS 72-44) (1983-87)	N @ 0, 7,10,20,10 + FYM at P = 17.5	1131, 1432, 1517, 1628, 1913.	43.0, 28.3, 11.1, 28.5.
Safflower (JSF 1) (1983-94,85-96, 87- 88)	N @ 0,13,20,40,20+ FYM at P= 17.5	695,822,955, 1132, 1692.	9.8, 19.0, 8.8, 28.0.
Soybean (JS 71-05) (1987)	N @ 0,20,40, at P=17.5	1298,1462,1839.	8.2,18.8.
Safflower (JSF 1)(1987-88)	Residual N and P	1555,1709,2131.	7.7,21.1.

Sorghum (CSH 5) (1981-83)	P @ 0, 22, 22+ 4 t FYM, 44, 66, 88 at N = 100.	2770, 3149, 4013, 3206, 3420, 3700.	17.2, 56.5, 2.6, 9.7, 12.7.
Soybean (JS 72-44) (1984-87)	P @ 0, 8.7, 17.5, 35, at N= 20.	1135, 1279, 1357, 1470.	16.6,8.9,6.5.
Gram (Ujjain-21) (1982-83)	P @ 0, 8.7, 17.5 at N= Nil. , P @ 0, 8.7, 17.5 at N = 16.	1108,1118,1204. 1186,1290,1350.	1.1, 9.8. 12.0,3.4.
Safflower (JSF-1)(1985-88)	P @ 0, 17.5 at N=0.	833, 920.	5.0.
Soybean + Pigeon-pea (JS-71-05+AS-71-37) (1988)	P @ 0, 13, 26, at N = 20.	4096,4651, 4985, (S.E.Y.)	42.7,25.7, (S.E.Y.)
Soybean + Pigeon-pea (JS 72 - 44 + AS 71-37) (2:1 row ratio) (1984-87).	P @ 0, 8.7, 17.5,35 at N = 20.	1406, 1528, 1754, 1918 (S.EY.).	14.0, 25.7, 9.4 (S.EY.).
Note: S.E.Y. refers to soybean equivalent yield.grain/kg of P2O5 applied through fertilizer			

Interactions of P with Other Nutrients

The experimental results presented in Tables 7- 9 provide ample evidences of positive interactive effects of N, Zn and Mn with P applied in vertisols under rain-fed conditions. Application of 20 kg N coupled with 40 kg P_2O_5/ha has resulted in 13.78 % additional grain yield of soybean as compared with the same rate of P_2O_5 applied along with 10 kg N/ha. Application of Zn at the rate of 20 kg $ZnSO_4$/ ha enhanced the grain yield of soybean only by 1.11% (Table 8). The data presented in Table 9 indicate the influence of Zn and Mn on the production of rain-fed sorghum although the responses were of quite low magnitude. Application of 10 kg N/ha along with 40 kg P_2O_5/ha increased mean yield of safflower, grown on residual moisture after soybean by 8.48% and WUE by 11.28% as compared with the same level of P but without fertilizer N (Table 7).

Organic Manures Application

The data presented in Tables 4, 5 , 6 and 10 clearly indicate that conjunctive use of organic manures and chemical fertilizers proves to be the best in increasing the rain-fed crop production and P use efficiency. It appears from distribution of different fractions of inorganic P that most of the applied P gets converted into fixed form (Table 11). Application of FYM equivalent to 20 kg N per ha was most effective in raising the organic P content of soil. The distribution of various forms of inorganic P in soil was of the order of Ca - P > Fe- P> Al-P. Increase in organic P fraction in soil due to application of FYM is probably due to depletion of $Ca_3 (P0_4)_2$ and thus increasing the availability of P.

Application of FYM alone @ 4 t/ha has been found to enhance yield as well as of P_2O_5 from soil by 27.5 and 141.12% respectively over control (Table 3). Conjunctive use of FYM @ of 3.5 and 4 t/ha along with 110 and 50 kg P_2O_5/ha through chemical fertilizer resulted in 11.84 and 27.30 % additional Sorghum yield, and 35.62 and 74.20 % respectively more recovery of P_2O_5 from soil as compared with respective levels of P applied through fertilizer but without FYM (Table 4, 5, 6 and 7). The application of FYM @ 5 t/ha along with P fertilizer not only resulted in a tremendous increase in production of rain-fed soybean - safflower grown in sequence on vertisols of western Madhya Pradesh but also stabilized the productivity (Table 10) as compared to P fertilizer alone with the same level of nutrients applied through fertilizer alone.

Response of P in Intercropping System

Studies on P fertilization of intercrops of Soybean (cv JS 72-44) and Pigeon-pea (cv AS 71-37) planted at 45 cm row spacing in 2:1 row ratio was conducted at AICRPDA, Indore. The results (Table 12) on the influence of different levels of fertilizer P applied on yield of component crops, total productivity and land use efficiency (land equivalent ratio) indicated that increasing levels of P fertilization in the range of zero to 80 kg P_2O_5/ha increased the LER from 1.38 in control to 1.63 in 80 kg P_2O_5/ha in fertilized plots, and total productivity of soybean + pigeon-pea intercropping system by 36.4 percent.

Water Use Efficiency in Relation to P

Efficient utilization of soil moisture holds key for making any breakthrough in crop production from dry farming. The application of P is known to improve WUE of crops due to its favourable effects on crop growth, and extensive and deeper root development. Deeper root system enables the crop to extract soil moisture from deeper soil layers during the stress period and helps in alleviating the drought effects on crop grown on vertisols. It is apparent from data (Table 13) that application of fertilizer P at the rate of 50 kg P2O5/ha increased water use efficiency of rain-fed sorghum by 13.6 % which was further significantly enhanced by 45% due to conjunctive use of FYM at the rate of 4 t/ha along with fertilizer P. Application of P at the rate of 40 kg P2O5/ha improved the WUE of rain-fed crops by about 5 to 20% in soybean, 10% in chickpea and 20% in safflower grown on black clay soils. The chickpea and safflower were taken in sequence after maize and soybean respectively under rain-fed conditions i.e., on residual moisture. Soybean plus pigeon-pea intercropping system showed a significant response to applied P in which WUE was increased from 9% to 36.7% with increasing levels of P2O5 from 20 to 80 kg/ha (Table 13).

Table 3: Response of rain-fed crops to applied phosphorus in vertisols of Indore, Madhya Pradesh (Figures in parentheses indicate the response in kg grain per kg of nutrient applied):

Crops/Location	N (kg/ha)	Fertilizer P_2O_5 (kg/ha)	Grain yield (kg/ha)	C.D 5%
Maize (1980-81)	100	0,50,100	2560,2570(0.2), 2870 (3.1)	N.S.
Sorghum (1981-83)	100	0,50,100,150,200	2770,3150(7.6), 3210(4.4), 3420, (4.3), 3700 (4.6)	293
Black soybean (1982)	20	80, 160,240,320	1176,1237,1499,1519	68
Soybean (1984-87)	20	0, 20, 40, 80	1135,1279(7.2), 1357 (5.5), 1470 (4.2)	205
Wheat (1980-82)	40	0,40	1580, 1680(2.5)	NS
Safflower (1982-83)	40	0, 20, 40	1470, 1520(2.5), 1520(1.25)	NS
Chickpea (1982-83)	16	0, 20, 40	1190,1290(5.0),1320(3.2)	93

Table 4: Grain yield of rain-fed sorghum (CSH 5) and total uptake of phosphorus as influenced by fertilizer P and farmyard manure:

Treatments	Grain yield (kg/ ha)				Increase in yield (%)	Response (kg grain /kg P2O5)	Uptake (kg/ ha) of P2O5
	1981	1982	1983	Mean			
Control	2375	3420	2515	2770	-	-	7.93
P_2O_5 @ 50 kg/ha.	2690	3767	2989	3148	13.6	7.6	3.06
FYM @ 4 t/ha.	2561	4172	3860	3531	27.5		19.12
P_2O_5 @ 50 kg + 4 t FYM/ha	2990	4693	4355	4012	44.8	6.9	22.75
P_2O_5 @ 100 kg/ha.	2643	3890	3087	3206	15.7	4.4	14.62
P_2O_5 @ 150 kg/ha.	2774	4028	3452	3418	23.4	4.3	15.99
P_2O_5 @ 200 kg/ha.	2903	4317	3880	3700	33.6	4.6	20.41
C.D. (0.05)	485	398	347	293	-	-	1.22

Table 5: Response of rainfed sorghum to applied phosphorus grown on vertisols of Indore, M.P:

Levels of P_2O_5 (kg/ ha)	Grain yield (kg/ha)					Increase in Yield (%) over check	Response in kg grain per kg of P_2O_5
	1979	1980	1981	1982	Mean		
Control	3866	3408	3029	2801	3276	-	-
110	4111	4332	3547	3546	3884	18.56	5.53
220	4389	4235	3609	3801	4008	22.34	3.33
330	4977	4292	3223	3875	4092	24.91	2.47
110+ 3.5 t/ha FYM	4412	4331	3883	4750	4344	32.60	9.71

C.D.(0.05)	359	635	706	380	-	-	-

Table 6: Uptake of P by rain-fed sorghum in relation to different levels of fertilizer P and FYM:

Levels of P2O5 (kg/ ha)	Total uptake of P2O5 (kg/ha)			Increase in recovery of P2O5 (%)	Relative recovery of P2O5
	1981	1982	Mean		
Control	9.44	7.13	8.28	-	1.00
110	14.64	13.20	13.92	68.12	1.68
220	16.86	16.92	16.89	103.99	2.04
330	17.18	16.54	16.86	103.62	2.04
110 + 3.5 t/ha FYM	18.13	19.63	18.88	128.02	2.28
C.D. (0.05)	3.50	4.82	-	-	-

Table 7: Influence of N and P on yield and water use efficiency of rainfed safflower (JSF 1) grown on residual moisture after soybean:

Nutrient levels (kg/ha)		Seed yield (kg/ha)			Water use efficiency (kg/ha.mm)		
N	P_2O_5	1985-86	1987-88	Mean	1985-86	1987-88	Mean
0	0	729	937	833	7.03	3.30	5.17
0	40	855	985	920	8.54	3.33	5.94
10	40	949	1047	998	9.15	4.06	6.61

Table 8: Interaction of N, P and Zn in soybean (JS 72-44) production grown on vertisols of Indore under rain-fed conditions:

Nutrient levels (kg/ha)		Seed yield (kg/ha)	Increase in yield over control (%)
N	P_2O_5		
0	0	1178	-
10	40	1654	40.40
20	40	1882	59.76
20	40 + Zn (25 kg ZnSO4/ha)	1903	61.54
C.D. (0.05)		94	-

Table 9: Interaction of P, Zn and Mn in rain-fed sorghum (CSH 5) production on vertisols of Indore:

Treatments*	Sorghum grain yield (kg/ha)**				
	1979	1980	1981	1982	Mean
1 Base P	4389	4235	3609	3801	4008.50
1 Base P+$ZnSO_4$ @ 25 kg/ha	4815(+9.7)	4377(+3.4)	3484(-3.5)	3759(-1.1)	4108.75(+2.5)
1 Base P+ $ZnSO_4$ @ 25 kg/ha+0.2% $MnSO_4$ spray at 15and 20 days	3991(-9.1)	4507(+6.4)	3978(+10.2)	3879(+2.0)	4088.75(+2.0)
* Base P refers to 220 kg P2O5/ha, ** Figures in parentheses refer % change in yield over base P alone.					

Table 10: Effect of conjunctive use of fertilizers and FYM on seed yield of soybean (1983-1987) and safflower (1983-1988) grown in sequence under rain-fed conditions of Indore, M.P.:

Treatments		Soybean		Safflower	
Soybean	Safflower	Seed yield (kg/ha)	Increase (%)	Seed yield (kg/ha)	Increase (%)
N0P0*	N0P0	1131	-	695	-
N10 P40	N20 P40	1517	34.13	955	37.41
N20 P40	N40 P40	1628	43.94	1132	62.87
N0 P40+6 t/ha FYM.	N0 P40	1808	59.85	1539	121.43
N10 P40 +6 t/ha FYM	N20 P40	1913	69.14	1692	143.45
* N and P refer to fertilizer N and P2O5 and numbers in subscripts refer to dose kg/ha respectively.					

Table 11: Different P fractions in a vertisol (at 80 and 320 kg P2O5/ha application rate) after black soybean as influenced by FYM and fertilizer use.:

Treatments	Forms of P2O5 (ppm)			
	Ca-P	Fe-P	Al-P	Organic P
Control	161 – 171	19 – 23	11 – 10	19 - 25
Urea N @ 20 kg/ha	161 – 171	20 – 24	11 – 14	21 - 24
FYM @ 20 kg N/ha	151 – 154	19 – 18	10 – 11	23 - 26
C.D. (0.05)	0.61	0.71	N.S.	0.55

Table 12: Influence of different levels of P on production of soybean and pigeonpea Inter-cropping systems (1984-87) under rain-fed conditions of Indore, M.P.:

Levels of P_2O_5(kg/ha)	Yield of Crops (kg/ha)		Soybean equivalent yield (SEY kg/ha)	LER	Response in kg SEY per kg of P2O5
	Soybean	Pigeon-pea			
Control	692	507	1406 (-)	1.38	-
20	788	564	1528 (8.7%)	1.40	6.10
40	833	673	1754 (24.7%)	1.57	8.70
80	1024	717	1918 (36.4%)	1.63	6.40

Table 13: Influence of different levels of fertilizer P on water use efficiency of different Rain-fed crops grown on vertisols of Indore, Madhya Pradesh:

Crops	Fertilizer N (kg/ha.mm)	Fertilizer P_2O_5 (kg/ha)	Grain yield (kg/ha)	Water use efficiency (kg/ha..mm)
Sorghum(CSH 5) (1981-83)	100	0,50,100,50 + 4t / ha FYM	2770, 3149 , 3206, 4013	4.20, 4.77 (13.6), 4.87 (15.9), 6.09 (45.0).
Soybean (JS72-44), (1986)	20	0, 40	1308,1366	2.37 2.48(4.6).
Soybean (JS 72-44) (1984-87)	20	0, 20,40,80	1135, 1279, 1357, 1470	2.74, 3.09 (12.8), 3.28 (19.7), 3.55 (29.6)
Soybean + Pigeonpea Intercrops (1984-85)	20	0,20,40,80	1406,1528,1754, 1918 (SE)	3.00, 3.27(9.0), 3.75 (25.0), 4.10 (36.7).
Chickpea (Ujjain 21) (1982-83).	0	0,20,40	1108,1118,1204	6.0, 6.6 (10.0), 6.6(10.0).
	16	0,20,40	1186,1290,1320.	6.2, 6.5(4.8), 6.7(8.1)
Safflower (JSF 1)	0	0, 40	729, 855.	7.03, 8.53 (21.3).
Note: Figures in parentheses indicate increase in WUE over control, "SEY" is soybean equivalent yield.				

Response of Sulphur

Experimental results summarized in Table 14 indicate that the application of S up to 60 kg/ha through agricultural grade pyrites improved soybean grain yield and water use efficiency significantly. Soil application of S at 0, 20, 40, 60, 80 and 100 kg/ha to soybean produced 8.7, 18.1, 29.8, 34.0, and 33.6 per cent additional grain yield. Residual effect on safflower grown in sequence was 4.9, 8.0, 10.4, 16.0, and 16.6% additional grain yield. The corresponding incremental response to S was of the order of 5.6, 5.9, 7.5, 2.7 and -0.2 kg soybean grain and 4.0, 2.6, 2.0, 4.7, and 0.5 kg safflower seed per kilogram of S applied to preceding crop of soybean. Although the highest WUE of 3.00 kg/ha.mm and 5.58 kg/ha.mm of safflower was observed at 100 kg S per hectare but levels of 60 and 80 kg S/ha were almost equally effective in this respect. In another study on soybean plus pigeon-pea intercropping, soybean equivalent yield (SEY) of 4378, 4718, 4940 and 5096 kg/ha were recorded due to S application at the rate of 20, 40, 60 and 80 kg/ha respectively (Table 16). The effect of S on the response of soybean based intercropping system was more pronounced than on sole soybean as also reflected by the WUE values of 6.80, 7.33, 7.67 and 7.91 kg SEY per hectare per mm of water compared to WUE values of soybean alone at corresponding levels of S application.

Table 14: Influence of S application on seed yield and water use efficiency of rain-fed crops grown on black clay soils at Indore:

Crops	Nutrient application (kg/ha)	Seed yield (kg/ha)	CD 5%	Water use efficiency (kg/ha.mm)
Soybean (JS 71-05) (1987)	S @ 0, 20, 40, 60, 80, 100 at P = 17.5, N = 20)**.	1270, 1381, 1500, 1649, 1702, 1697 (5.6, 5.9, 7.5, 2.7, -0.2)*	77	2.24, 2.44, 2.65, 2.91, 3.00, 3.00 (8.9, 18.3, 29.9, 33.9, 13.9)**
Safflower (JSF 1) Sequence (1987-88)	Residual S, P, and N.	1645, 1725, 1776, 1816, 1909, 1918 (4.0, 2.6, 2.0, 4.7, 0.5)*.	72	4.78, 5.02, 5.16, 5.28, 5.55, 5.58 (5.0, 7.9, 10.5, 16.1, 16.7)**.
Soybean+ Pigeon-pea (JS71-05+AS71-37) (4: 2 row ratio). (1988)	S @ 0, 20, 40, 60, 80 at N=20	3755, 4378, 4718, 4940, 5096 (SE). (31.2, 17.0, 11.1, 7.8)*.	148	5.83, 6.80, 7.33, 7.67, 7.91, (16.6, 25.7, 31.6, 35.7)**.
()* refer to incremental response in kg grain per kg of nutrient applied. ()** refer to percent increase in WUE over control, "SEY" refers to soybean equivalent yield.				

Conjunctive Use of Organics, Bio-Fertilizers and Fertilizer Nutrients

Long term studies were carried out to evaluate the influence of different levels and sources of N and P applied through fertilizers, FYM and crop residues applied singly and in conjunction with recommended level of nutrients, and half of the recommended level of fertilizer nutrients. The mean values of long-range data have been summarized in Table 13 and 16. Table 17 presents the data on grain yield and nutrient uptake by soybean and chickpea grown in sequence as influenced by different indigenous sources of nutrients viz; pyrites (PY), rock phosphate (RP), equivalent to 25 kg P/ha, single superphosphate, FYM (5t/ha) and phosphorus solubilizing bacterial culture (PSB) @ 1.5 kg/ha in different combinations. The treatments (Table 17) were given to soybean crop and chickpea grown on residual moisture and nutrients.

Table 15: Influence of different levels of N, FYM and crop residues on yield of soybean and safflower grown in sequence and changes in soil fertility after 9 years (1983-91):

Treatments	Yield (kg/ha)		Sustainability index for yield		Available Nutrient status (kg/ha)				
	Soybean	Safflower	Soybean	Safflower	O.C.%	N	P	K	S
N0 P0	1104	748	0.30	0.19	0.30	142.5	4.40	481.0	7.50
N20/40-40	1770	1241	0.44	0.29	0.46	08.5	12.67	481.0	0.37
N10/20-20	1653	1070	0.40	0.25	0.44	98.0	12.62	81.0	8.70
FYM 6 t	1972	1647	0.52	0.37	1.15	45.0	60.60	1295.4	0.17
FYM 6 t+ N10/20	2089	1814	0.55	0.39	1.20	355.8	59.20	1247.4	9.54
N20/40-40 + Zn	1805	1158	0.44	0.30	0.48	14.5	13.34	59.0	7.84
Residues + N10/20-20	1573	1146	0.31	0.21	0.64	238.8	15.20	24.0	8.67
Note: Safflower could be taken in 5 seasons only i.e. 1983-84, 1985-86, 1987-88, 1988-89, and 1991.									

Table 16: Influence of different levels of N and P, FYM, crop residues and their conjunctive use on yield, WUE of soybean and safflower sequence (mean 1982-85):

Treatments	Seed Yield (kg/ha)		W.U.E. (kg/ha.mm)		Average nutrient uptake (kg/ha)			
	Soybean	**Safflower**	**Soybean**	**Safflower**	**Soybean**		**Safflower**	
					N	P	N	P
N0 P0	1684	637	4.25	2.98	113.8	4.9	32.8	2.2
N20 P13	2012	952	4.84	4.39	137.8	7.5	47.2	3.8

N30 P20	2235	1225	5.56	6.34	151.2	8.7	58.3	4.6
N40 P26	2387	1392	5.95	7.13	165.5	9.2	64.5	5.5
N60 P35	2432	1460	5.91	7.40	167.5	10.1	68.4	5.9
FYM 6 t + N20 P13	2429	1701	5.83	11.21	170.0	11.1	81.1	6.7
Residues 5 t+ N20P13	2139	1329	5.13	8.03	146.1	8.4	55.6	4.4
FYM 6 t	2294	1616	5.88	10.49	161.3	9.2	62.4	4.9
Residues 5 t	2042	966	4.88	5.32	138.6	8.4	46.6	3.6
Note: Safflower could be taken during 1993-94, and 1995-96 only.								

Table 17: Influence of indigenous sources of nutrients, organics and bio-fertilizers on seed yield and nutrient uptake by soybean (JS 71-05) and gram Ujjain-21):

Treatments	Seed yield (kg/ha)		Yield Increase (%)		Nutrient uptake by soybean (kg/ha)			
	Soybean	Safflower	Soybean	Gram	N	P	K	S
P0	1389	397	-	-	78.8	4.04	18.50	7.08
P0 + PY	1516	409	9.1	3.0	89.5	5.50	27.60	8.37
P0 + FYM	1508	453	8.6	14.1	99.6	4.58	29.71	9.17
P0 + PSB	1389	417	0.0	5.0	96.1	4.66	21.03	9.00
P0 + PSB + FYM	1476	379	6.3	-4.5	106.4	5.17	24.64	10.76
P0+PSB+FYM+PY	1608	413	15.8	4.0	114.7	6.25	26.83	10.77
RP25	1620	91	16.6	-77.0	124.3	5.12	30.27	12.74
RP25 + PY	1394	369	0.4	- 7.1	99.5	7.57	20.33	10.68
RP25 + FYM	1600	369	15.2	- 7.1	133.7	6.70	24.81	10.33
RP25 + PSB	1415	349	1.9	-12.1	97.5	5.83	21.27	10.59
RP25 + FYM + PSB	1666	385	19.9	- 3.0	134.2	4.58	29.54	14.44
RP25+FYM + PSB + PY	1690	452	21.7	13.8	150.7	6.93	31.95	14.09
SSP25	1516	405	9.1	2.0	113.5	6.57	17.58	9.30
SSP25 + FYM	1746	365	25.7	- 8.1	155.8	7.02	29.51	14.20
SSP25 + PSB	1733	401	24.8	1.0	133.0	7.15	28.61	12.91
SSP25 + PSB +FYM	1810	409	30.3	3.0	166.7	8.18	26.37	14.71

Conclusions

The results of long term studies lead to conclude that; (1) Conjunctive use of farmyard manure (about 6 t/ha) and chemical fertilizer N and P at the rate of 20 kg N/ha and 13 kg P /ha improve yield and water use efficiency of rain-fed soybean and safflower crops grown in sequence, (2) Application of FYM (6 t/ha) for rain-fed soybean-safflower cropping sequence improves the recovery of N, P, K, and S from black clay soils and moisture availability and thus alleviates the adverse effect of aberrations, (3) A dose of 40 kg N/ha along with 26 kg P/ha is optimum for soybean, (4) Economy in fertilizer N and P can be affected through conjunctive use of FYM and crop residues applied at the rate of 5 t/ha as surface mulch and subsequently its incorporation in surface soil in the following season, (5) Response of post rainy season crop of safflower grown after soybean depends upon soil moisture conditions and winter rains. However, treatment involving FYM and crop residues prove better over other treatments, and (5) A combination of PSB and FYM applied in conjunction with single superphosphate and rock phosphate (equivalent to 25 kg P/ha) improve grain yield of rain-fed soybean.

Reference

1. Anonymous (1971 -2000). Annual Progress Reports. All India Coordinated Research Project for Dryland Agriculture, College of Agriculture, Indore, M.P., India.
2. Sharma, R. A. (1987). Effect of phosphorus application on rainfed sorghum in vertisol of Indore. J. Indian Soc. Soil Sci. 35 (1), 158 160.
3. Sharma, R. A. and Dixit, B. K. (1987). Effect of nutrient application on rainfed soybean. J. Indian Soc. Soil Sci. 35(3), 452 455.
4. Sharma, R. A. (1990). Land and water use efficiency of different rainfed crops in relation to nutrients application. Crop Res. 3 (2), 129 136.

5. Upadhyay, M. S.; Sharma, R. A. and Gupta, R. K. (1991). Response of soybean and pigeonpea intercropping system to phosphorus fertilization in vertisols under unirrigated conditions. J. Nat. Con. 3 (2), 197 203.
6. Sharma, R. A. (1992). Influence of integrated fertility management on productivity and water use efficiency of rainfed soybean. Crop Res. 5 (Suppl. 1992), 55 – 58, P. 193-198.
7. Sharma, R. A. (1993). Response of safflower to integrated fertility management practices in black clay soils under dryland conditions. Proc.Third Intl. Safflower Conference. June 14 18, 1993, Beijing, China, Beijing Botanical Garden, Institute of Botany, Chinese Academy of Sciences. P. 661 – 669.
8. Sharma, R. A. (1999). Management of crop residue and farmyard manure for sustainable productivity of rainfed soybean and safflower and soil health under rainfed conditions. Crop Res. 18 (3), 370-372.
9. Sharma, R. A. and Gupta, R.K. (1993). Fertility management for soybean - safflower cropping sequence on rainfed vertisol. Recent Advances in Dryland Agriculture (Ed L.L. Somani 1983). Scientific Publishers Jodhpur, Rajasthan, India. P. 4111 - 420.
10. Sharma, R. A., Raghu, J. S. and Thakur, H. S. (2005). Rainfed Farming Technology for Black Clay Soils. Tech. Bulletin, AICRPDA, JNKVV, Campus, College of Agriculture, Indore, PP. 1- 128.
11. Sharma, R.A. and Raghu, J. S. (2003). Evaluation of sustainable nutrient management practices based on land degradation and rainfall effects on soybean yield and organic carbon and available N content in rain-fed vertisols. Annales UMCS, Sec. E, 2003 58, 205-221.
12. Raghu, J.S. and Sharma, R. A. (2003). Influence of integrated fertility management practices on productivity and fertility of black clay soils of central India. In.“Practical Solutions for Managing Optimum C and N Content in Agricultural Soils II.”(Ed. K. Vorisek, 2003), Research Institute of Crop Production, Praha 6-Ruzyne, Martinn-Luther-University Halle-Wittenberg, UFZ-Centre for Environmental Research, Leipzig Hall, International Working Group of Soil Fertility in the IUSS. P. 154-168.
13. Srinivasrao, C., Venkateswarlu, B., Lal, R., Singh, A.K., Kundu, S., Vittal, K.P.R., Sharma, S.K., Sharma, R. A., Jain, M.P., and Chari, C. (2012c). Sustaining agronomic productivity and quality of a vertisolic soil (Vertisol) under soybean- safflower cropping system in semi-arid central India. Canadian Journal of Soil Science, 92, 771-785.
14. Sharma, R. A. and Patidar Kamlesh (2019). Impact of integrated approach of land, water and nutrient management practices on agricultural productivity in Malwa region of Madhya Pradesh. Int. J. Chem. Stud. 2019; 7(1), Part-D: 179-183.
15. Sharma, R. A. (2020). Management of Organic Matter in Soil for Enhancing Hydro-physical Characteristics and Productivity of Crops. (Article No. 31557). Agriculture & Food: e-News letterwww.agrifoodmagazine.co.in (ISSN-2581 -8317) Volume 2(9),P. 460-465. September 2020.

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Cultivation Technique of Quinoa

Article ID: 10319

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Introduction of Quinoa *(Chenopodium quinoa)*

Family: Amaranthaceae/ Chenopodiaceae

Common Names of Quinoa

Quiuna, Kinova Parka, Dawe, Chuppah and Kinwa.

1. Quinoa is a grain crop that is grown for its edible seeds
2. It is an annual dicotyledonous plant and grows about 1 to 1.5 meter in height or 4 to 6 feet.
3. Quinoa seeds are highly nutritional and have high percent of protein compared to other cereals.
4. The main colours of quinoa are green, purple and red that change in different colour shades during maturation period.
5. In India, quinoa farming has bright future due to its high protein content andless carbohydrates compared to rice.
6. The challenge for Indian farmers is to get the seeds. Once, seed production of quinoa starts, the commercial farming of quinoa will be successful in India.
7. It is used in eating like wheat, rice and Semolina (Sujee).

Health Benefits of Quinoa

1. Quinoa is incredibly nutritious and healthy.
2. Quinoa is gluten free and good for people with gluten intolerance.
3. Quinoa is a good source of protein.
4. Quinoa is fully loaded with antioxidants.
5. Quinoa has a low glycemic index (GI) and excellent for diabetic people.
6. Quinoa has very high fiber content when compared to other grains.
7. Quinoa is a good source of minerals like magnesium.
8. Quinoa is good for metabolic health.
9. Quinoa helps in weight management.

Soil and Climate Requirement for Quinoa Farming

1. This grain can be grown in poor soils as well. However, the most suited soil for quinoa farming is sandy loam.
2. Avoid heavy clay soils as they are not suitable.
3. It is usually grown on soils pH 5.0 to 9.0
4. It is tolerant of a big range of climates, depending on the variety.
5. The ideal temperature for Quinoa is between 15 ° C and 20 ° C, although the plant can withstand temperatures of -4 ° C to 38 ° C.
5. Frost can be tolerated after the established plant and before the flowering plant.
6. Full sun is desirable for good crop stand.

Propagation in Quinoa Farming

Propagation is done through seeds.

Land Preparation

1. Land should be weed free and fine tilth stage
2. The soil should be deep ploughed 2-3 times.
3. Before the last ploughing should be mixed with organic manure (Compost) at the rate of 5,6 tonnes per hectare.
4. Arranged the proper drainage if needed.

Sowing in Quinoa Farming

1. Sowing time- October to November
2. Seeds can be directly sown in the main field or transplanted.
3. The most appropriate plant density in quinoa farming ranges from 150 to 500 plants per sq. meter area.

4. The row spacing depends on many factors. However, the most common row spacing is 50 cm or25 cm or 12.5 cm and recommended depth of sowing is 1 to 3 cm.
5. Generally, seed rate in quinoa farming is about 2 to 3 kg per hectare area.
6. Usually seed germination occurs within 24 hours after planting when adequate moisture is present in the soil, and seedlings emerge in 3 to 5 days.

Manures and Fertilizers in Quinoa Farming

Supplement the field with 20 to 30 tonnes of well rotten farm yard manure to improve the soil with organic matter during land preparation.

Quinoa crop responds well to nitrogen fertilizer. This crop requires chemical fertilizers of N:P:K in the ratio of 120 kg: 50 kg: 50 kg per 1 hectare land.

Irrigation and Weed Management

It should be irrigated immediately after sowing; its plant requires very little water; it is sufficient to give 2 to 3 irrigation from planting to harvesting. When the plants are small, the weeds should be removed.

Insect and Disease

Quinoa plant has a great ability to fight pests and diseases, as well as can tolerate frost and drought. So far, no information of any type of diseases has been found on this.

Harvesting and Threshing

Quinoa crop is ready in 90-100 days. it can be cut like mustard and removed easily in a thresher machine. A few days of sun drying is required Production per hectare ranges from 30 to 40 quintals per hectare.

Nutritional Value

Quinoa Nutritional value per 100 g	
Energy	1,539 kJ (368 kcal)
Carbohydrates	64.2 g
Dietary fibre	7.0 g
Fat	6.1 g
Monounsaturated	1.6 g
Polyunsaturated	3.3 g
Protein	14.1 g
Vitamins	**Quantity**
Vitamin A equiv.	1 µg
Thiamine (B1)	0.36 mg
Riboflavin (B2)	0.32 mg
Niacin (B3)	1.52 mg
Vitamin B6	0.49 mg
Folate (B9)	184 µg
Choline	70 mg
Vitamin C	0 mg
Vitamin E	2.4 mg
Minerals	**Quantity**
Calcium	47 mg
Copper	0.590 mg
Iron	4.6 mg
Magnesium	197 mg

Manganese	2.0 mg
Phosphorus	457 mg
Potassium	563 mg
Sodium	5 mg
Zinc	3.1 mg
Other constituents	**Quantity**
Water	13.3 g

Food Products of Quinoa

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Flipsides of An Ant – Friends or Faze?

Article ID: 10320

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Ants belong to a single family, the Formicidae (largest family of insects), within the order Hymenoptera. Ants are successful social insects exhibiting task allocation. A queen and her colony can live to be 30 years old. Worker ants can live for one to three years; but male ants live for only a few weeks. These generalist feed on a combination of live prey, dead animals, seeds and plant exudates, with specialized behaviours such as fungus cultivation and pollen consumption. The utility of ants in India in medicine, cuisine and culture is listed in this article.

Cuisine

Many species of ants are rich food and all stages (eggs, larvae, pupa and adult) are a good source of protein and mineral nutrition for human. In some parts of India, indigenous communities consume ants in both raw and cooked form. Nutritive values of ants also depend on method of preparation. Common method is frying them with mustard oil. It was studied by Butler in 1985 that indigenous people from Kanara district (south India) consumed red ants and used them as smelling salt.

South central tribals of Bastar (Chhattisgarh) used *Oecophylla smaragdina* worker ants in making curries, also practiced in parts of Nagaland and Orissa. It was believed to help overcome fatigue and sun's heat. The Muria tribals of Chattisgarh roast these ants in the leaf nests and prepare a sauce. They also sun-dry and powder them for later use. Chutney, Chaprah is made out of red ants and their eggs in Bastar (Neelkamal 2011; Veeresh 2019). The Karbi community people bake eggs and pupae of ants with banana or turmeric leaf and consume. Some people fry or cook them along with dried fish and vegetables to make it a good appetizer (Sabina *et.al.* 2017).

Medicinal Value

In ants there is well evolved immune system, disease resistant abilities and antimicrobial chemicals against pathogens. These chemicals can be extracted and used for treating human diseases (Neelkamal, 2011). The common black ant and *Dorylus labiatus* (driver ants) are consumed by lethargic patients to strengthen the nervous system and is believed to restore immune health.

Sushrutha, the father of Ayurveda used ants to tie the wounds of intestine by making the ants bite the cut ends. The antiseptic formaline secretions of the ants help in healing the wounds besides acting as stitches. Paniyan (Kerala and Tamil Nadu) tribes use the mud from the interior of the ant hill to rub against the infected area of scabies. Locally the ethnic tribes of Hrangkhols and Khasi Pnars (from north- east India) boil or fry the weaver ants (both adults and eggs) to treat children suffering from cold and cough. In adults it is used to treat malaria (Sabina L *et.al.* 2017). Formic acid derived from ants is used in treating varicose veins, polypi, and catarrh in homeopathy (Manchanda *et.al.* 2016).

Fire ant inject venom into the blood stream and causes pain, swelling, nausea etc. if not treated it results in the swelling of throat and causes difficulty in breathing. Ant bites need to be avoided as they are reported to be vectors for disease caused by salmonella bacteria. Rearing ants as a livestock to increase their source of pharmaceutical values is of late realized. Weaver ants are dipped in oil and used for the treatment of rheumatism, stomach infections, gout, ringworm, and for their aphrodisiac properties. Ants are also used to treat gout and joint pain, weakness resulting from prolonged fever due to typhoid. Formic acid is used for the prevention of gastritis.

According to the recent studies the natural silk fibres produced by weaver ants serve as cell matrix for cell adhesion. It also has application in tissue engineering and wound healing (Neelkamal, 2011). Ants produce antibiotics by the paired metapleural glands. This is secreted externally and this secretion covers the entire surface of the body and protects them from fungal and bacterial infections. This evolution of antibiotics (immune proteins) in ants is due to the pressure of pathogens over a period of time. Proteome investigation of bacteria *Blochmannia floridanus* (obligate intracellular endosymbiotic bacteria) found in the gut of carpenter ants may lead to new production of antibiotics targeting Gram-negative bacteria (Neelkamal, 2011).

In Agri-Horticulture

Each hectare of soil contains in excess of 8 million ants. Ants tend to loosen the soil which helps in the better aeriation in the soil which in turn increases the chances of survival of other soil insects and species. They also feed on dead organisms which improve the soil nutrient levels. The weaver ants build nests on the canopies of trees and shrubs. These ants act as pest control in the surrounding agricultural lands. Weaver ants are used as pest control for orchids.

To increase the production of oranges in the plantation the Dimasa and Khasi Pnar (Assam and Nagaland states) farmers introduce weaver ants' nest on the orange trees. They also use weaver ants and their larvae to feed fish and chicken (Sabina *et.al.* 2017). Few species of red ants feed on pestiferous butterfly and moth eggs. Ants are poor pollinators but few ants like weaver and common white footed ants are known to be effective pollinators. The most effective pollinator of *Syzygium occidentale* was common white footed ant and weaver ants (Giby *et.al.* 2018).

We can measure the reformation of nature by knowing the population of ants and its colonies as they act as the ecological disturbance indicators. Recent studies showed that actinomycetes (fungi) in association with ants is highly diverse and rarely specific in their inhibition to other microbes. Ants can a negative reputation wherin they aid in spread and survival of sucking pests like mealy bugs, scales, aphids produce honey dew for tending ants which in turn protect them from their natural enemies and help in dispersal (Mahimasanthi et.al. 2014).

Cultural Value

The weaver ants have a cultural value among Dimasa people as it is used to annoy the groom's party at the gate and sprinkle hand full of weaver ants and enjoy watching them getting rid of them (Sabina et.al. 2017).

Commercial Uses

Commercial harvesting and selling edible ants have been reported in many rural markets of Thailand, Indonesia, China and Mexico. The value of ants varies depending on their productivity and nutrient value. Ant medicines like wines, syrups, powdered products and capsules are sold in China and the products containing *P. dives* are exported from China to other South-east Asian countries.

About 2 decades ago China amounted about approximately $100 million in annual sale of ant foods for human consumption. The recent socio-economic studies on *O. smargdina* shows that by collection and marketing of these ants gives them $12 in Thailand. The collection of this species of ants alone yields $620,000 per year. Thus, ant's species like *O. smaragdina* which has high economic value has more multiple benefits like pest suppression and it converts pests into protein rich food. It also contributes in commercial bussiness (Neelkamal, 2011).

Ants provide numerous ecosystem services (benefits people obtain from ecosystems) including provisioning-food and drugs, supporting-soil modification, regulating-pollination, seed dispersal, herbivore suppression and cultural services-artistic, religious and spiritual services to mankind (Neelkamal, 2011).

Reference

1. Giby K, Palatty A S & K.R Shivanna 2018. Ant Pollination of Syzygium occidentale, an endemic tree species of tropical rain forests of Western Ghats, India. Arthropod – Plant interactions 12: 647 – 655
2. Mahimasanthi, N. Sakthivel, R. Nalini and S. Rajavel 2014. Association of ants with pink hibiscus mealybug, Maconellicoccus hirsutus (Green) and its influence on predatory fauna in mulberry ecosystem. Journal of Biopesticide. 7(1):47-51

3. Manchanda R, Gupta J, Chakraborty P, Singh P, Nyan S S, Singh J P, Pradhan P K, Ramteke S, Das K C, Prasad P, Gupta P, Rakshit G, Nayak C 2016. Formic Acid: A multicentric observational homoeopathic clinical verification trial. Indian Journal of Research in Homoeopathy.10:249 – 257
4. Neelkamal R 2011. Provisioning services from ants: Food and Phamaceuticals. Asian Myrmecology. 4: 103 – 120.
5. Sabina L and Robindra T and Ajit K T. 2017. Weaver ants (Oecophylla smaragdina): a multi – utility natural resource in Dima Hasao District, Assam. International Journal of Applied Environmenatal Science 12(4)709-715.
6. Surgical Supremacy in Ancient India – todaysclinician
7. Veeresh G.K 2019. Pest Ants of India. Applied Myrmecology, A World Perspective:15- 24.
8. Wilsanand V, Preema V and Rajitha P 2007. Therapeutics of insects and insect products in South Indian traditional medicine. Indian Journal of Traditional Knowledge. 6(4):563 – 568.

Drip Fertigation Techniques

Article ID: 10321

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Introduction

Use of conventional irrigation methods not only results in considerable loss of water but is also responsible for development of wide spread salinity, water logging and leaching of nutrients from the rhizosphere. Fertilizers supplied under traditional methods of irrigation are not effectively utilized by the crops. As an alternative, fertigation is gaining popularity all over the world. Once installation on drip irrigation is made it is very easy to achieve the full benefits through the next ultimate step called as fertigation.

Fertigation is a coined term to irrigate and give fertilizers along with it. In other words, fertigation is addition of fertilizers to irrigation water and application via drip or similar micro irrigation system.

Fertigation provides Nitrogen, Phosphorus and Potassium as well as the essential trace elements directly to the active root zone, thus minimizing the loss of expensive nutrients, which ultimately helps in improving productivity and quality of farm produce. Nutrients are delivered to the restricted root zone (wetted soil) in a readily available form and frequent delivery of water and nutrients replenish the small volume of soil in the active root zone, nourishing the crop throughout the entire growing season.

One of the major factors to promote modern fertigation is the development of Micro Irrigation Systems (MIS), which includes drip, jets and micro sprinklers. Field experiments in Israel in the early 1960's showed that when only part of the field area is irrigated, as in MIS, the use of standard broadcast application of fertilizers is ineffective.

The limited root zone and the reduced amount of mineralization in the restricted wetted zone are the main reasons for the reduced nutrient availability to the plant. Recognition of these facts led to the installation of fertigation facilities with almost all applications of MIS. Fertigation is by far the most common, and in some cases the only method of fertilizing the green houses, orchard, vegetables and drip irrigated field crops. The fertilizer use efficiency for various application methods is given in Table 1.

Table 1. Fertilizer use efficiency under various application methods:

Nutrient	Fertiliser use efficiency (%)	
	Soil application	Fertigation
Nitrogen	30 - 50	95
Phosphorus	20	45
Potassium	50	80

Fertilisers for Fertigation

Water in which fertilizers are to be dissolved should have pH levels between 5.8 and 7.8. The fertilizers commonly administered in fertigation are Ammonium nitrate, Ammonium sulphate, Urea, Monoammonium phosphate, Diammonium phosphate, Potassium chloride, Potassium nitrate, Potassium sulphate, Mono potassium phosphate and Phosphoric acid.

Special Water-Soluble Fertilisers

Water soluble specialty fertilizers specifically meant for fertigation are available at present and most of them are imported in India and marketed by Irrigation Systems and Fertilizer Dealers. Some of the special water-soluble fertilizers suitable for fertigation are Poly feed, MAP, Multi – K, MKP and SOP.

Fertigation Equipment

Ventury: Very simple and low-cost device. A partial vacuum is created in the ventury which allows suction of the fertilizer solution into the irrigation system through ventury action. The vacuum is created by diverting a small portion of water flow from the main and pass it through a constriction which increases the velocity of flow thus creating a drop in pressure. When the pressure drops the fertilizer, solution is sucked into the ventury through a suction pipe from the tank and from there enters into irrigation stream.

Fertilizer Tank: In the fertilizer tank portion of irrigation water is diverted from the main line of flow through a tank containing the fertilizer in a fluid form, before returning to the main line, the pressure in the tank and the main line is the same but a slight drop in pressure is created between the off take and return pipes for the tank by means of a pressure reducing valve. This causes water from main line to flow through the tank causing dilution and flow of the diluted fertilizer into the irrigation stream. With this system the concentration of the fertilizer entering the irrigation water charges continuously with the time, starting at high concentration.

Fertilizer Injector Pump: Fertilizer injector pumps are piston or diaphragm pumps which are driven by the water pressure of the irrigation system and such as the injection rate is proportional to the flow of water in the system. A high degree of control over the fertilizer injection rate is possible. If the flow of water stops, fertilizer injection also automatically stops.

Merits of Fertigation

1. Fertigation ensures uniform and regular flow of both water and nutrients, resulting in increased growth, yield and quality of crops.
2. Through fertigation the three major nutrients are supplied in one solution to the active root zone resulting greater absorption.
3. Small quantities of fertilisers can be applied at close intervals.

4. The system enables accurate and uniform distribution of nutrients in the root zone.
5. Each irrigated plant receives the same proportion of nutrients.
6. When combined with proper management, fertigation can reduce nutrient losses from leaching, volatilization and / or fixation.
7. Large savings on labour and energy in nutrient application.
8. Increases the availability and uptake of nutrients.
9. Maximizes water and nutrient productivity.
10. Micronutrients can be effectively applied by fertigation.

Conclusion

"Fertigation technique" is the need of the hour. By fertigation, due to interaction and combination of water and nutrient leads to an efficient use of both by the plant and will improve soil health. Based on the past research activities, it was found that adoption of fertigation improves the yield and the quality of produce. It is also highly beneficial to the farming community in reducing the cost of cultivation. Further it helps in sustaining the soil health for better productivity and reducing environmental hazards. Hence efficient use of irrigation water and fertilizer through fertigation needs to be adopted on a large scale by the farmers.

Reference

1. Bar Yosef, B. (1999). Advances in fertigation. Advances in Agronomy, 65: 1–77.
2. Technical bulletin on Fertigation. National Committee on Plasticulture Applications in Horticulture (NCPAH) Ministry of Agriculture, GOI, New Delhi.

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Principles of Conservation Agriculture

Article ID: 10322

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Conservation Agriculture (CA)

“A concept for resource-saving agricultural crop production that strives to achieve acceptable profits together with high and sustained production levels while concurrently conserving the environment” given by FAO.

Conservation is the use of resources in a manner that safely maintains a resource that can be used by humans.

Principles in Conservation Agriculture

The Food and Agriculture Organization of the United Nations (FAO) has determined that CA has three key principles that producers (farmers) can proceed through in the process of CA.

1. Minimum tillage.
2. Permanent soil cover.
3. Crop rotation.

Minimum Tillage

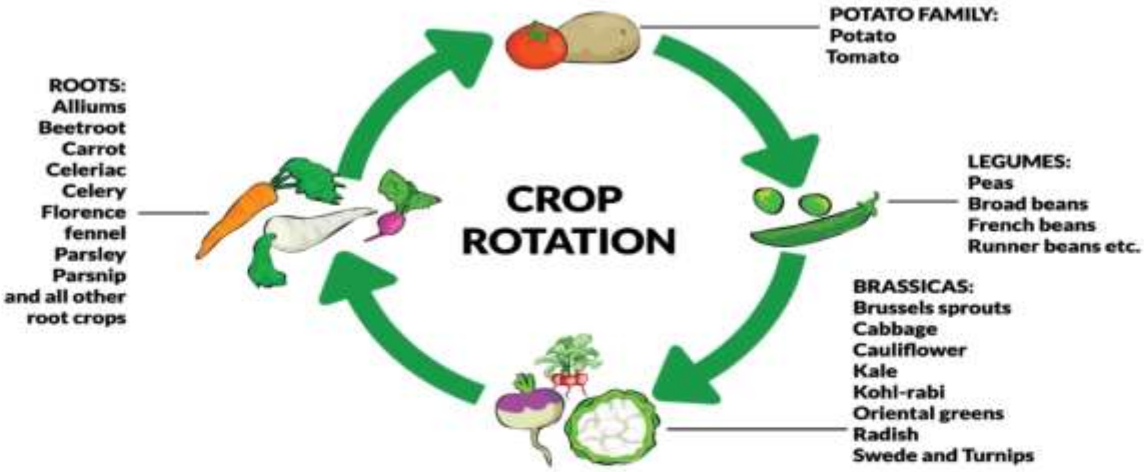
The first key principle in CA (Conservation Agriculture) is practicing minimum soil disturbance which is essential to maintaining minerals within the soil, stopping erosion, and preventing water loss from occurring within the soil. In the past agriculture has looked at soil tillage as a main process in the introduction of new crops to an area. It was believed that tilling the soil would increase fertility within the soil through mineralization that takes place in the soil. Also tilling of soil can cause severe erosion and crusting which leads to a decrease in soil fertility. Today tillage is seen as destroying organic matter that can be found within the soil cover. No-till farming has caught on as a process that can save soil organic levels for a longer period and still allow the soil to be productive for longer periods (FAO 2007). Additionally, the process of tilling can increase time and labor for producing that crop. Minimum soil disturbance also reduces destruction of soil micro and macro-organism habitats that is common in conventional ploughing practices.

Permanent Soil Cover

The second key principle in CA is much like the first in dealing with protecting the soil. The principle of managing the top soil to create a permanent organic soil cover can allow for growth of organisms within the soil structure. This growth will break down the mulch that is left on the soil surface. The breaking down of this mulch will produce a high organic matter level which will act as a fertilizer for the soil surface. If CA practices were used done for many years and enough organic matter was being built up at the surface, then a layer of mulch would start to form. This layer helps prevent soil erosion from taking place and ruining the soil's profile or layout. The presence of mulching also reduces the velocity of runoff and the impact of rain drops thus reducing soil erosion and runoff.

Crop Rotation

The third principle is the practicing diverse crop rotations or crop interactions.



According to an article published in the Physiological Transactions of the Royal Society, "Crop rotation can be used best as a disease control against other preferred crops. This process will not allow pests such as insects and weeds to be set into a rotation with specific crops. Rotational crops will act as a natural insecticide and herbicide against specific crops. Not allowing insects or weeds to establish a pattern will help to eliminate problems with yield reduction and infestations within fields. Crop rotation can also help build up soil infrastructure. Establishing crops in a rotation allows for an extensive build-up of rooting zones which will allow for better water infiltration. Organic molecules in the soil break down into phosphates, nitrates and other beneficial elements which are thus better absorbed by plants. Ploughing increases the amount of oxygen in the soil and increases the aerobic processes, hastening the breakdown of organic material. Thus, more nutrients are available for the next crop but, at the same time, the soil is depleted more quickly of its nutrient reserves.

Benefits

The FAO believes that there are three major benefits from Conservation Agriculture:
1. Within fields that are controlled by CA the producer will see an increase in organic matter.
2. Increase in water conservation due to the layer of organic matter and ground cover to help eliminate transportation and access runoff.
3. Improvement of soil structure and rooting zone.

Nature and Causes of Post-Harvest Losses in Fruits and Vegetables

Article ID: 10323

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Introduction

India is the second largest producer of fruits and vegetables in the world, next only to China. Though India produces large quantity of horticultural produce in the world, per capita consumption is very low for us over a billion population. Major portion is being wasted at various stages of from production till it reaches end-user and its mainly due to inadequate facilities for processing.

Extending the PH life of horticultural produce requires knowledge of all the factors that can lead to loss of quality or generation of unsalable material. The field of study that adds to and uses this knowledge in order to develop affordable and effective technologies that minimizes the rate of deterioration is known as postharvest technology. Losses occur after harvesting is known as post-harvest losses.

It starts first from the field, after harvest, in grading and packing areas, in storage, during transportation and in the wholesale and retail markets. Several losses occur because of poor facilities, lack of know-how, poor management, market dysfunction or simply the carelessness of farmers.

Extent of Post-Harvest Loss

The wastage during post-harvest handling accounts for 20-30% of the losses at different stages of storage, grading, packing, transport and finally marketing as a fresh produce or in the processed form. According to Chadha, India loses about 35-45% of the harvested fruits and vegetables during handling, storage, transportation etc. leading to the loss of Rs. 40,000 crores per year.

Important Sites of Post-Harvest Losses

Farmer's field (15-20%), Packaging (15-20%), Transportation (30-40%), Marketing (30-40%).

Estimated Loss of Fruits

Papaya 40-100%, Grapes 27%, Banana 20-28%, Citrus 20-95%, Avocado 43%, Apple 14%.

Crop Rotation

The third principle is the practicing diverse crop rotations or crop interactions.

> **Estimated loss of Vegetables:** Onion 25-40%, Garlic 08-22%, Potato 30-40%, Tomato 5-34.7%, Cabbage & cauliflower 7.08-25%, Chili 4-35%, Radish 3-5%, Carrot 5-9%.

Causes of Post-Harvest Losses

Horticultural crops not only provide nutritional and healthy foods to human beings, but also generate a considerable cash income for growers. However, horticultural crops typically have high moisture content, tender texture and high perishability. If not handled properly, a high value nutritious product can deteriorate and rot in a matter of days or hours. The causes of postharvest losses can be divided into different categories.

1. Metabolic: All fresh horticultural crops are live organs. The natural process of respiration involves the breakdown of food reserves and the aging of these organs.

2. Mechanical: Owing to their tender texture and high moisture content, fresh fruits and vegetables are very susceptible to mechanical injury. Poor handling, unsuitable containers, improper packaging and transportation can easily cause bruising, cutting, breaking, impact wounding and other forms of injury.

3. Developmental: These include sprouting, rooting, seed germination, which lead to deterioration in quality and nutritional value.

4. Parasitic diseases: High post-harvest losses are caused by the invasion of fungi, bacteria, insects and other organisms. Micro-organisms attack fresh produce easily and spread quickly, because the produce does not have much of a natural defence mechanism and has plenty of nutrients and moisture to support microbial growth.

5. Physiological deterioration: Fruits and vegetable cells are still alive after harvest and continue their physiological activity. Physiological disorders may occur due to mineral deficiency, low or high temperature injury or undesirable atmospheric conditions, such as high humidity, physiological deterioration can also occur spontaneously by enzymatic action leading to over-ripeness and senescence, a simple aging phenomenon.

6. Lack of market demand: Poor planning, inaccurate production and market information may lead to over production of certain fruits or vegetables which can't be sold in time. This situation occurs most frequently in areas where transportation and storage facilities are inadequate. Produce may lie rotting in production areas, if farmers are unable to transport it to people who need it in distant locations.

7. Consumption: These losses can be due to inadequate preservation methods at home, methods of cooking and preparation such as peeling, consumption styles etc.

8. Others:

a. Lack of clear concept of packing house operations.
b. Lack of awareness among the growers, contractors and even the policy makers.
c. Lack of infrastructure.
d. Late realization of its importance,
e. Inadequate technical support.
f. Wide gap in technologies available and in vogue.
g. Inadequate post-harvest quality control.
h. Unorganized marketing.
i. Absence of pre-cooling and cold storage.
j. Inadequate market facilities, market intelligence and market information service (MIS)
k. Poor storage facilities.

Impact of Post-Harvest Losses

Post-harvest losses of horticultural crops affect both the nutritious status of the population and economy of the country.

Nutrition: Fruits and vegetables are rich source of vitamins and minerals essential for human nutrition. These are wasted in transit from harvest to consumer represent a loss in the quantity of a valuable food. This is important not only in quantitative terms, but also from the point of view of quality nutrition.

Economy: Careless harvesting and rough handling of perishable bruise and scar the skin, thus reducing quality and market price. Such damaged produce also fails to attract the international buyers, and bring the exporting country less profit and bad name. This ultimately results in huge economic losses to the country.

For improving the situation, it is essential to create awareness among growers, farm workers, manager's traders and exporters about the extent of losses being incurred and their economic consequences. These groups of people involved in the fruit industry also need to learn the basic principles of fruit handling and storage.

In addition, the government needs to provide basic infra-structure like storage, handling, grading, packing, transport and marketing facilities and technical expertise. This could be carried out by the public and private sectors.

Technologies for Minimizing the Losses

Fruits and vegetables are perishable in nature. Scientific harvesting and handling are the practical way to reduce the losses due to physical damage, spoilages, due to insect damages and microbial growth. Various protocols are standardized and available for adoption to get the best result, which will give economic benefits. Similarly, proper storage conditions, with suitable temperature and humidity are needed to lengthen the storage life and maintain quality once the crop has been cooled to the optimum storage tempera Lure. Greater emphasis needs to be given on the training of farmers, creation of infrastructure for cold chain with common facilities for sorting, grading, packing and post-harvest treatments in all major markets.

Postharvest Handling of Fruits and Vegetables: Reduce Wastage

Article ID: 10324

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Introduction

Being living organs, fruits and vegetables continue to respire even after harvesting when they have a limited source of food reserves. In addition to degradation of respiratory substrates, a number of changes in taste, color, flavor, texture and appearance take place in the harvested commodities which make them unacceptable for consumption by the consumers if these are not handled properly.

The improper temperatures may lead to the disturbance in the normal metabolism of the harvested organs. The higher temperatures may increase manifolds the rate of metabolic activities thereby, reducing the shelf-life, while much lower temperatures may lead to the freezing or chilling injury in the harvested commodities. Mechanically damaged fruits and vegetables during harvesting are very much prone for fungal decay during the course of storage.

Already infected fruits or vegetables may spread the disease to the adjacent stored commodity if not sorted out prior to the storage. It is well established that the quality of the harvested commodities cannot be improved further but it can be retained till their consumption if the rate of metabolic activities is reduced by adopting the appropriate postharvest handling operations.

Precooling

Precooling (prompt cooling after harvest) is important for most of the fruits and vegetables because they may deteriorate as much in one hour at 32°C (90°F) as they do in one day at 10°C (50°F) or in one week at 0°C (32°F). In addition to removal of field heat from commodities, precooling also reduces bruise damage from vibration during transit.

Cooling requirement for a crop vary with the air temperature during harvesting, stage of maturity and nature of crop. There are many methods of precooling *viz.* Cold air (room cooling, forced air cooling), cold water (hydro cooling), direct contact with ice (contact icing), evaporation of water from the produce (evaporative cooling, vacuum cooling) and combination of vacuum and hydro cooling (hydrovac cooling).

Some chemicals (nutrients/ growth regulators/fungicides) can also be mixed with the water used in hydro cooling to prolong the shelf life by improving nutrient status of crop and preventing the spread of postharvest diseases.

Washing, Cleaning and Trimming

Before fresh fruits and vegetables are marketed, various amounts of cleaning are necessary which typically involves the removal of soil dust, adhering debris, insects and spray residues. Chlorine in fresh water is often used as disinfectant to wash the commodity. Some fungicides like Diphenylamine (0.10 - 0.25%) or ethoxyquin (0.20 – 0.50%) may be used as postharvest dip to control an important disorder of apple known as superficial scald. For cleaning of some fruit type vegetables (melons, brinjals, tomatoes, cucumber) they should be wiped with damp cloth. Many vegetables need trimming, cutting and removal of unsightly leaves or other vegetative parts.

Sorting, Grading and Sizing

Sorting is done by hand to remove the fruits which are unsuitable to market or store due to damage by insects, diseases or mechanical injuries and malformations. The crop is then separated into various grades based on the surface colour, shape or visible defects. After sorting and grading, sizing is done either by hand or machine sizers which work on the principle of weight and diameter. Sizing on the basis of fruit shape and weight is most effective for spherical (Oranges, tomato, certain apple cultivars) fruits and the elongated fruits (pears) are graded based on size.

Curing

Curing is an effective operation to reduce the water loss during storage from hardy vegetables viz. onion, garlic, sweet potato and other tropical root vegetables. The curing methods employed for root crops are entirely different than that from the bulbous crops (onions and garlic).

The curing of root and tuber crops helps to develop periderm over the cut, broken or skinned surfaces. It helps in the healing of harvest injuries, reduces loss of water and prevents the infection by decay pathogens. Onions and garlic are cured to dry the necks and outer scales. For the curing of onion and garlic, the bulbs are left in the field after harvesting under shade for a few days until the green tops, outer skins and roots are fully dried.

The Optimum Conditions for Curing of Some Vegetables

Commodity	Temperature (oC)	RH	Curing time (days)
Sweet Potato	13-17	>85	7-15
Yam	27-33	>90	5-7
Cassava	30-35	>80	4-7
Onion and garlic	35-45	60-75	½ to 1 day with warm forced air

Chemical Treatment

Various types of compounds like nutrients, growth regulators, ethylene, ethylene inhibitors, anti-microbial agents, etc. are used to treat the fruits and vegetables with the purpose to enhance quality, avoid physiological disorders, extend storage life, promote ripening etc.

Waxing

Application of waxes on the surface of fruits helps to create modified atmosphere that has been used to supplement temperature control and extend the postharvest shelf life of fruit by reducing respiration and transpiration rates and delaying senescence.

Other chemicals such as fungicides, growth regulators, preservatives can also be incorporated specially for reducing microbial spoilage, sprout inhibition, etc. Various quality contributing factors are affected by wax application which includes reduction in the physiological loss in weight (PLW), delay in respiration rate, reduction in postharvest spoilage and maintenance of improved quality of commodity to increase the shelf life.

The principal disadvantage of wax coating is the development of off-flavour if not applied properly. Adverse flavour changes have been attributed to inhibition of O_2 and CO_2 exchange thus, resulting in anaerobic respiration and elevated ethanol and acetaldehyde contents.

Packaging

Proper or scientific packaging of fresh fruits and vegetables reduces the wastage of commodities by protecting them from mechanical damage, pilferage, dirt, moisture loss and other undesirable physiological changes and pathological deterioration during the course of storage, transportation and subsequent marketing.

Packaging helps to protect the produce against the hazards of transportation. The gunny bags, grasses and stem leaves used so far for packaging are now being replaced by a variety of containers such as wooden boxes, baskets woven from bamboo or twigs, hessian sack/ jute bags, plastic punnets and corrugated fibre board (CFB) boxes, plastic trays, pulp trays, stretch wrapping, modified atmosphere packaging etc.

Storage

A number of storage techniques (ground storage, ambient storage, refrigerated storage, air cooled storage, zero emery storage, modified atmospheric storage, hypobaric storage, controlled atmospheric storage etc.) are being used for fruits and vegetables depending upon the nature of the commodity and the storage period intended.

Post-Harvest Handling Operations of Fruits

Harvesting, Precooling, Sorting, Washing, Waxing/ Chemical treatments, Sizing, Packaging, Storage, Transportation, Wholesaler, Restoring, Resizing and Repacking, Transportation, Retailer and Consumer.

Post-Harvest Handling Operations of Vegetables

Harvesting, Precooling, Cleaning, Trimming, Grading, Sorting, Curing, Sizing, Waxing, Packaging, Storage, Transportation, Wholesaler, Transportation, Retailer and Consumer.

Methylotrophs: A Microbial Community Provides Multiple Benefits to Plants

Article ID: 10325

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The global necessity to develop an eco-friendly and efficient technique to increase agricultural production from a decreasing land resource has placed considerable concern on the fragile agro-ecosystems. The use of plant growth promoting microorganisms in an agricultural production system is considered the greatest approach to improve crop growth and health.

The plant system is habitually influenced by numerous microorganisms during the life cycle and the effects on plant growth may vary from neutral, negative to positive. The soil and plant microbiomes are indeed considered vital for maintaining the sustainability of agriculture production. Methylotrophs are one among the beneficial microbial community that improves plant growth and health by providing plentiful benefits to plants *viz*., nitrogen fixation, phosphate solubilization, phytohormones production, and ACC deaminase production.

Besides, it also improves plant defence against various biotic and abiotic stresses (Kumar *et al*., 2016). Methylotrophic bacteria are a unique group of microorganisms able to utilize methanol, methylamine, and other C1 carbon compounds as a sole source of carbon and energy. The methylotrophic bacterial communities belong to classes of proteobacteria, which inhabiting in different parts of plants as phyllospheric (*Methylobacterium phyllosphaerae*, *M*. *phyllostachyos*, *M*. *cerastii*, *M*. *gossipiicola*, *M*. *thuringiense,* and *M*. *trifolii*), rhizospheric (*M*. *soli*, *M*. *goesingense*, *M*. *variabile*, *M*. *aminovorans,* and *Methylopila capsulata*) and endophytic (*M*. *nodulans* and *M*. *populi*).

Other than the plants, it also colonizes soil, sediment particles, and water as well as on extreme habitats of high/ low temperature, salinity, drought, and acidic and alkaline soil (Kumar *et al*., 2019). Methylotrophic bacteria are applied on crops either by seed treatment or foliar spray and both.

Plant Growth Promoting (PGP) Mechanisms of Methylotrophs

The plant associated methylotrophs perform diverse functions for enhancement of plant growth and health viz., nitrogen-fixation, mineral solubilization (P, K and Zn), Fe-chelating compounds production, PGP hormones (gibberellic acids, auxin, and cytokinins) production, and ACC deaminase enzyme production.

Moreover, the methylotrophic microbe's act as biocontrol agents against diverse plant pathogenic microbes through indirect PGP attributes of siderophores, ammonia, HCN, and diverse groups of secondary metabolites including extracellular hydrolytic enzymes and antagonistic substances, which inhibits the growth of different plant pathogen.

Plants inoculated with methylotrophic bacteria also improves plant defence to various abiotic stress by improving ACC deaminase activities, phytohormones production, and antioxidants activity. The methylotrophic microbes associated with crops may promote plant growth in terms of increase in germination rates, chlorophyll content, leaf area, nitrogen, and phosphorus content, Fe and Zn content, biomass production, hydraulic activity, protein content, roots and shoot length, yield, and tolerance to biotic and abiotic stresses (Kumar et al., 2019).

N_2 Fixation by Methylotrophs

Nitrogen is the major limiting factor for plant growth, the application of N_2-fixing microbes as one of the most efficient and environmentally sustainable methods for increasing the growth and yield of crop plants. Plant associated methylotrophic bacteria can fix atmospheric nitrogen, makes it available to the host plants. The methylotroph, *Methylobacterium nodulans* is a facultative methylotroph capable of nodulating and fixing nitrogen in symbiosis with Crotalaria legumes (Sy et al. 2001).

Moreover, a variety of methylotrophic bacteria associated with the rhizosphere of different crops contribute to nitrogen fixation, which includes *M. mesophilicum* and *M. organophilum* (Kumar *et al*., 2019).

Phosphorus Solubilization by Methylotrophs

Phosphorus (P) is an essential macronutrient required for plant growth and development. Methylotrophs have the capabilities to solubilize the inorganic form of soil P and make it available to the host plants, results in increasing crop production.

Some of the P-solubilizing methylotrophs such as *Methylobacterium extorquens*, *M. lusitanum*, *M. mesophilicum*, *M. radiotolerans*, *M. komagatae*, *Methylobacillus arboreus*, *Methylopila musalis,* and *Methylovorus menthalis* (Kumar *et al*., 2019).

Plant Growth Hormones Production by Methylotrophs

Plant growth and development are positively affected by plant hormones, making plants responsive to their environments. Phytohormones such as auxins and cytokinins stimulate cell division or plant elongation and lower the accumulation of ethylene in the plant system by the activity of 1-aminocyclopropane-1-carboxylate (ACC) deaminase.

Plant-associated Methylobacteria is known to produce indole-3- acetic acid (IAA), indole-3-butyric acid (IBA), and cytokinins, gibberellin as well as ACC deaminase. Phytohormones are produced by several methylotrophic bacteria includes *Methylobacterium extorquens*, *M. mesophilicum*, *M. phyllosphaerae*, *M. radiotolerans* and *M. zatmanii* (Kumar *et al*., 2019).

Fe-Chelating Compounds

Iron is recognized as an essential micronutrient required for some important physiological activities, chlorophyll biosynthesis, and redox reactions in the plant. Siderophores are defined as low molecular weight ion chelating agents synthesized by many bacteria, which transfer the iron to the plant for growth and development.

Also, bacteria produced siderophore plays an important role in the biological control against certain phytopathogens, which bind with the iron strongly and make it unavailable for the plant pathogens, therefore inhibiting the growth of phytopathogens.

Methylobacterium is capable of producing iron chelating compounds, such as hydroxamate-type siderophores. Siderophores producing methylotrophic bacteria comprises *Methylobacterium extorquens*, *M. mesophilicum*, *M. phyllosphaerae*, *M. radiotolerans* (Kumar *et al*., 2019).

ACC Deaminase Activity

Ethylene is one of the most important plant hormones, controlling various activities at low concentrations such as growth, cellular metabolism, and even senescence. Increased production of ethylene under stress conditions leads to an inhibitory effect on plant growth.

The methylotrophic bacteria synthesis an enzyme called 1-aminocyclopropane-1-carboxylate (ACC) deaminase which converts ACC, the immediate precursor of ethylene to α-ketobutyrate and ammonium, thus lowering the concentration of the ethylene during the stress conditions and stimulating the growth of the plants. Some of the ACC deaminase producing methylotrophs like *Methylobacterium fujisawaense*, *M. mesophilicum*, *M. oryzae*, *M. phyllosphaerae*, *M. populi*, and *Methylobacterium radiotolerans* (Kumar *et al*., 2019).

Methylotrophs in Crops Diseases Management

Methylotrophs are known to possess antagonistic activities, which can be used to improve plant health by protecting plants from pathogens. Several methylotrophs support PGP indirectly, via the production of ammonia, HCN, siderophores, secondary metabolites, extracellular hydrolytic enzymes, and antagonistic substances, which inhibit the growth of different plant pathogen.

Methylotrophic bacteria are reported to inhibit plant pathogens including *Aspergillus niger, Colletotrichum capsici*, *Sclerotium rolfsii*, *Fusarium oxysporum*, *Cercospora capsici*, and *Xanthomonas campestris* (Kumar *et al*., 2019). Furthermore, Methylobacterium also induces plant defense responses against several phytopathogens including *Ralstonia solanacearum* (Yim *et al*. 2013).

Abiotic Stress Management by Methylotrophs

Methylotrophic bacteria adapt to survive and promote plant growth under stress conditions like salt stress, drought stress, heat stress, *etc*., by producing biofilm, aggregate formation and producing ultraviolet (UV)-protecting compounds. Under stress conditions, plants produce higher amounts of ethylene and reactive oxygen species causes an increase in membrane damages, which leads to yield loss.

Additionally, Methylotrophic bacteria produce an enzyme called 1-aminocyclopropane-1-carboxylate (ACC) deaminase and induce the production of antioxidant metabolites as well as osmolytes and phytohormones in plants, which helps in mitigating stress (Krishnamoorthy *et al*., 2021).

Pink pigmented facultative methylotrophs (PPFMs) are one of the important groups of Methylobacterium advocated for the protection of crops in heat and drought stress conditions. Some methylotrophs like *Methylobacterium mesophilicum*, *M*. *extorquens*, *M*. *oryzae*, and *Methylocella tundra* are reported to induce tolerance in plant cells by triggering several protecting metabolic machineries.

Effects of Co-Inoculation of Methylotrophic Bacteria on Plant Growth

The plant growth promoting (PGP) methylotrophs are applied as a single bioinoculants or co-inoculated with other phosphate-solubilizing and nitrogen-fixing bacteria (*Arthrobacter*, *Bacillus*, *Pseudomonas*, *Rhizobium*, *Burkholderia, Serratia*, *Azotobacter*, and *Azospirillum*) as a microbial consortium for enhancing the crops production and soil fertility for sustainable agriculture.

Co-inoculation of *Methylobacterium oryzae* with *Azospirillum* and *Bradyrhizobium japonicum* significantly increases urease activity, plant growth parameters, nutrient uptake, and soybean yields (Madhaiyan *et al*. 2010).

Conclusion

Rhizospheric and non-rhizospheric methylotrophs associated with plant growth can be exploited for eco-friendly and cost-effective practices to promote sustainable agriculture. Methylotrophs employ multiple mechanisms viz., phytohormones production, plant growth promotion, nodulation, nitrogen fixation, and nutrient acquisition, which makes them a suitable and promising candidate for use in sustainable agriculture.

The application of methylotrophs as bioinoculants and in microbial sprays to crops is common, and their use as alternatives to chemical fertilizers is also increasing.

Additionally, it also improves plant tolerance to diverse unfavourable environmental conditions. These beneficial methylotrophs can play a significant role in sustainable agriculture.

References

1. Krishnamoorthy R, Anandham R, Senthilkumar M, Venkatramanan V (2021) Adaptation Mechanism of Methylotrophic Bacteria to Drought Condition and Its Strategies in Mitigating Plant Stress Caused by Climate Change. In Exploring Synergies and Trade-offs between Climate Change and the Sustainable Development Goals. Springer 145-158.
2. Kumar M, Tomar RS, Lade H, Paul D (2016) Methylotrophic bacteria in sustainable agriculture. World Journal of Microbiology and Biotechnology 32:120.
3. Kumar M, Kour D, Yadav AN, Saxena R, Rai PK, Jyoti A, Tomar RS (2019) Biodiversity of methylotrophic microbial communities and their potential role in mitigation of abiotic stresses in plants. Biologia 74:287-308.

4. Madhaiyan M, Poonguzhali S, Kang B-G, Lee YJ, Chung JB, Sa TM (2010) Effect of co-inoculation of methylotrophic *Methylobacterium oryzae* with *Azospirillum brasilense* and *Burkholderia pyrrocinia* on the growth and nutrient uptake of tomato, red pepper and rice. Plant Soil 328:71–82
5. Sy A, Giraud E, Jourand P, Garcia N, Willems A, De Lajudie P, Prin Y, Neyra M, Gillis M, Boivin-Masson C (2001) Methylotrophic *Methylobacterium* bacteria nodulate and fix nitrogen in symbiosis with legumes. Journal of bacteriology 183:214-220.
6. Yim W, Seshadri S, Kim K, Lee G, Sa T (2013) Ethylene emission and PR protein synthesis in ACC deaminase producing *Methylobacterium* spp. inoculated tomato plants (*Lycopersicon esculentum* Mill.) challenged with *Ralstonia solanacearum* under greenhouse conditions. Plant Physiol Biochem 67:95–104.

Novel Solutions for Indian Agriculture Conundrum

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When world thinks and act on Artificial Intelligence, it is inevitable for Indian brains to think like minded. Indian Agriculture is no exception to such high profile thinking. It is high time for Indian farmers to be saved from the clutches of debts, suicides, and umpteen worries. For this, there should be a shift from conventional farming to high value crop farming. The Ashok Dalwai Committee on Doubling Farmer's Income has given seven-point strategy as the following:

1. Increase in production.
2. Effective use of input cost.
3. Reduction of post-harvest losses.
4. Value Addition.
5. Reforms in Agriculture Marketing.
6. Risk, Security and Assistance.
7. Allied Activities.

The rhetoric on high value farming gets interrogated due to plethora of factors specific to Indian farm and farming conditions. In spite of the idea being questioned there are some novel ways which can be advocated for doubling farmer's income. The novel ways which dovetail with seven-point strategy by which farming can be made profitable are:

1. Shift to Nonconventional crops (Horticulture, Ornamental, Medicinal guaranteed by crop insurance etc.).
2. Use of Information Networking (in Production, Marketing).
3. Practicing of Secondary Agriculture(Processing, value addition).
4. Promotion of Farmer Producer Organizations or promoting farming on pooled lands (in effectively using the factors of production).

Shift to Nonconventional Crops

The mundane cultivation of conventional crops won't be remunerative for the farming community. A shift to high value crops is inevitable for transforming agrarian sector. The conventional agriculture is often subsistence, if commercial then the farmers often land in distress sale. Area specific crops should be selected and promoted by Krishi Vigyan Kendra. High Value Crops include horticulture, floriculture, medicinal and ornamental crops. High Value crops along with precision agriculture will prove to be remunerative for farmers. The main rationale for focusing on fruits and vegetables according to CGIAR System priority 3A, Challenge Program:

1. Fruits and vegetables generate high economic returns per unit of land; thus, the production of fruits and vegetables has a comparative advantage under conditions where arable land is scarce.

2. Fruits and vegetables have high export potential, fruits such as mango, orange, apple, papaya, guava etc. Whereas vegetables such as tomato, onion, potato (T,O,P) can fetch domestic and international markets if marketed efficiently.

3. The production of fruits and vegetables tends to require more labour input compared to other crops, so the horticulture sector can contribute to poverty reduction by providing employment and wages to laborers.

There is immense potential in ornamental, medicinal and aromatic crop cultivation. The role of KVK is pertinent in identifying aforesaid crops specific to specific regions. For example, in Rajasthan, Chlorophytum spp. (Safed Musli) can be widely grown but due to improper cultivation practices, the crop is disease prone and due to indulgence of middleman farmers often sell the crops at very low prices. Some medicinal crops/trees are the least focused. For instance, in Telangana, *Butea monosperma* is an under exploited tree. Natural colour can be extracted from the flowers. The gum extracted from the tree are used in Ayurvedic preparations too. Since it is a forest tree, the same can be raised along fences and barren land for additional income.

Use of Information Networking

Information communication networking can work both for homophilous and heterophilous populace of farmers. For instance, in developing nations, larger chunk of farming population is small and marginal while in developed nations the same is dominated by large farmers. The penetrative power of ICT is such that it can cater to former and latter. Several works conducted in the arena gave cognizance of the fact that multi-dimensionality of ICT should be applied in Agriculture. There is a plethora of potential areas where ICT can be applied to increase the efficacy of Agricultural production system. In Indian scenario, farmers being marginal and small create intensified agricultural practices unpragmatic. But the situation can be approached in different angle. Information Communication Networking is one such tool that can be employed so as to put domain knowledge in user's language. Efficient accessing and distribution of content are two advantages of the ICN approach. Albeit several efforts have been unleashed by GOI and other private agencies to digitally aid farmers such as several mobile applications, e-NAM, kiosks, e-choupals etc, lot more to be done.

Nevertheless, the use of drones and satellite-based technology in Agriculture have been gaining momentum. The incorporation of Remote Sensing in Pradhan Mantri Fasal Bheema Yojana for gauging crop loss is a welcome step. Innovative satellite-based technologies such as navigation systems, GIS, and telematics combined with automation control systems, sensor networks, and ICT can pave the way towards sustainable and efficient agricultural production systems (Dionysis Bochtis, 2013). Innovative satellite technology can be used in right from the initial stages of crop production. As far as India is concerned, Indian Regional Navigation Satellite System (NAVIC) can aid in the process.

Practicing of Secondary Agriculture and Entrepreneurship

Conventional farming has not catered to farmers necessities. Farming should be seen as an enterprise for augmenting income. In reality, the farm sizes are very less hence a farmer is not able to see his farm as an enterprise. Thus, grass root agricultural organizations such as KVK, ATMA should mobilize farmers to pool their lands for greater returns. Farmers should also be organized to process and value add their produce. For instance, in Bihar, Litchi is grown widely but there is a lacunae in its processing and value addition. Hence litchi farmers are not getting remunerative prices for their produce. But when we see international market, litchi has huge demand. It is used in the confectionary, juice, chocolates etc. But in India the market potential is not exploited. Even farmers should practice secondary activities related to the crop he/she is cultivating. Market information on the same should be disseminated for the following. Kissan Call Centres like centres can be established for proper market information dissemination. The same will augment the activity of electronic National Agriculture Market.

Promotion of Farmer Producer Organizations

What is lacking in Indian Agriculture is group led farm ventures. On one hand Indian farms are getting fragmented and still farmers not motivated for group farming. We have many successful examples of group led farm initiatives Mahagrapes, Mahamango etc. Such initiatives should be promoted pan- India. Farmer producer organization is one such initiative gaining momentum. In rural agrarian scenario, this has to be advocated as farmers are burdened with high input costs and water scarcity. If farmers are organized, they can reap a good profit unlike the previous years. Contract farming and cooperative farming are better options but in the former, there are many cases of farmers being cheated. Government should when aimed at doubling farmer's income should ponders on options which they can rope in for real transformation. Public private partnership has its meager presence in India. PPP can cater to input needs, information delivery to remote farm lands, and can offer plethora of needs of farmers.

Glimpse of Case Study to Analyse the Prevailing Agrarian Scenario

India is a diverse country; farm situations vary from region to region. A perusal of the study conducted during field experience training as well as professional attachment training during ARS probationary period in three different states: Three states, Telangana, Rajasthan and Kerala throw light on how to move forward with the aim of doubling farmers' income under diverse agro-climatic regions of the country. The contrasting agro-climatic regions necessitate the need for region specific action than a pan-India approach. For the same three villages were selected purposively.

1. Telangana (Madhurapoor Village): The village is having a rich cultural and agricultural diversity. The population of Madhurapoor is heterogeneous. They are in constant touch with extension agency too. As a result, they are following scientific cultivation practices. The farmers are using ICT tools for accessing agricultural information. The problems plaguing the famers here are, salinity in soil, in marketing of agricultural produce and absence of better post-harvest management practices. 60% of the youth are engaged in non-agricultural vocation.

2. Rajasthan (Malpur Village): The village is having a rich cultural but less agricultural diversity. The population of Malpur is slightly heterogeneous i.e., Rajputs and tribals. The farmers are using ICT tools but not for accessing agricultural information. Plethoras of problems are plaguing the farmers. Such as:

a. Less or no extension agency contact.
b. Defunct Large Sized Adivasi Multipurpose Society (LAMPS).
c. Non-judicious use of fertilizers.
d. Absence of timely insurance and inaccessibility to Banking Financial Institutions.
e. High disease and pest incidences.
f. Ignorance on quality planting material/seeds and pesticides.
g. Water Scarcity.
h. Exploitation by middleman.

80 % of the youth are engaged in non-agricultural vocation. Agricultural growth is showing a declining trend in this village.

3. Kerala (Madakkattara Village, Thrissur District): The village is having a rich cultural, social and agricultural diversity. The population of Madakkattara is heterogeneous. They are in constant touch with extension agency. They are following scientific cultivation practices. The farmers are using modern ICT tools for accessing agricultural information.20% of the farmers are progressive farmers. The problems plaguing the famers here are inability to capture better market for their marketable surplus, disease and pest incidences. Share of youth practicing agriculture is abysmally low here.

Conclusion

Diverse agro-climatic regions demand different agro-approaches. Some villages need a total revamp, while some need exposure to modern and scientific agricultural practices. Policies should also dovetail with the current situations of the Indian village.

References

1. Pilaiwan Phupattanasin and Sheau-Ru Tong, 2013. Applying Information-Centric Networking in Today's Agriculture: APCBEE Procedia (184 – 188).
2. Dionysis Bochtis, 2013. Satellite based technologies as key enablers for sustainable ICT-based.
3. agricultural production systems: Procedia Technology (4 – 8).
4. Vijayan Bhagya, 2020. Access to Agricultural Information and use of Modern Technology, the Real Game Changer for Doubling Farmer's Income: Agriculture & food e-Newsletter, vol 2 (8) (271-272).

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Urban Horticulture: The Need of 21st Century

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What is Urban Horticulture in India?

Interconnecting Plants and Urban Environment’s art and science is nothing but Urban Horticulture. For urban areas where there are fewer canopies, it encourages the growth of horticultural plants. Ornamental crops, horticultural plants, fruit plants, and other plants are included in this urban horticulture. This new concept has taken on a huge role in Concrete Jungles with the increase in pollution and temperature. We wrote about the benefits of urban horticulture earlier. We’re going to let you know about the Urban Horticulture Forms in India in this article now.

Value of Urban Horticulture and Urban Gardening

These are days of increasing demand and interest in this new concept. The magnitude of their situation has been understood by the people living in urban areas. The pollution, the rising temperature, makes the government take steps to support this Indian Urban Gardening. When Urban Horticulture continues to have the same range and significance, we may also see greenery in the cities and towns. Urban horticulture has many forms. In the section below, we presented the List of Urban Gardening in India. You can take a look at the details below.

List of Urban Horticulture Types in India

Not many people know that there are many other branches of Urban Horticulture. That’s why we’ve got all the types in the list below.

Terrace Gardening

Terrace Gardening is nothing about growing vegetable and ornamental plants on the Terrace. In the towns, where individual families are showing a lot of interest, this type of terrace gardening is growing. Roof Gardening is also Terrace Gardening’s famous name.

Vegetable Gardening

Another name for Vegetable Garden is Kitchen Garden and Backyard Gardening. This is just like the gardening of the terrace. The only difference is that you are going to grow plants in your backyard or any other available space. In addition, you're not going to grow plants in Terrace in this style.

Balcony Gardening

The City Apartments have very little space. Balcony Gardening grows on the balcony with plants. This will serve the purpose of leisure. Ornamental plants such as roses, vegetable plants such as tomatoes, etc. may grow.

Green Parks

Green Parks is another part of this latest technology. We are all familiar with parks. But the number of parks in the cities is increasing these days. Therefore, to aspire for a better environment, we must bring them back.

Guerilla Gardening

Growing plants are called Guerilla Gardening in the form of buses in areas that are of no interest. These are beneficial in growing the metropolitan area's greenery.

Community Gardens

This is pretty much similar to the Allotment Gardens. A huge piece of land is being used for this Allotment Gardens and they are growing vegetables and fruit crops. This Community Garden is being raised by both communities and NGOs.

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Organic Farming in 21st Century

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Summary

Organic farming is a production management system which involves crop rotation, residue management, organic biological inputs, management of weeds and pests by better management practices, physical and cultural means. Organic management must be adapted to local conditions, ecology, culture and scale. Organic farming effectively addresses soil management.

Introduction

More than 24 million hectares of land is farmed organically - over 40 percent of this is in Oceania and almost a quarter respectively in Latin America and Europe. However, more than half or the area farmed organically world-wide is concentrated in just three countries - Australia, Argentina and Italy - that account for the lion's share of the respective continent. In Australia alone, a share of around ten million hectares is accounted for by extensive pastureland, just like the almost three million hectares in Argentina. Owing to this high share of pastureland, less than half of the area farmed organically world-wide is cultivated arable land. Among the countries of the South, the European champions are followed by Ecuador (3.1%), Argentina (1.7%), Chile (1.5%), Uganda (1.39%), Belize (1.3%) and Bolivia (1%). Thus, they are all well above the share of organically farmed land in the USA, which is just 0.23%. Currently, organic agriculture is commercially practiced in 120 countries, representing 31 million ha of certified croplands and pastures (0.7 percent of global agricultural lands and an average of 4 percent in the European Union) and 62 million ha of certified wild lands for organic collection of bamboo shoots, wild berries, mushrooms and nuts (Willer and Youssefi, 2007).

Components of Organic Farming

Organic farming approach involves steps like:

1. Conversion of land from conventional management to organic management.
2. Management of the entire surr sustainability of the system.
3. Crop production with the use of alternative sources of nutrients such as crop rotation, residue management.
4. Organic management of weeds and pests by better management practices, physical and cultural means and by biological control system.
5. Maintenance of livestock in tandem with organic concept and make them an integral part of the entire system.

Principal of Organic Farming

These are the four principles of organic farming are mentioned below:

1. Principle of health: Organic agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible. Healthy soils produce healthy crops that foster the health of animals and people. Health is the wholeness and integrity of living systems.

2. Principle of ecology: Organic agriculture should be based on living ecological system and cycles, work with them, emulate them and help sustain them. These principal roots organic agriculture within living ecological systems. It states that production is to be based on ecological processes, and recycling.

3. Principal of fairness: Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.

4. Principal of care: Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generation and the environment.

Advantages of Organic Farming

1. Nutrition poison-free and tasty food: The nutritional value of food is largely a function of its vitamin and mineral content. In this regard, organically grown food is dramatically superior in mineral content to that grown by modern conventional methods.

2. Lower growing cost: The economics of organic farming is characterized by increasing profits via reduced water use, lower expenditure on fertilizer and energy, and increased retention of topsoil. To add to this the increased demand for organic produce makes organic farming a profitable option for farmers.

3. Enhances soil nourishment: Organic farming effectively addresses soil management. Even damaged soil, subject to erosion and salinity, are able to feed on micro-nutrients via crop rotation, inter-cropping techniques and the extensive use of green manure. The absence of chemicals in organic farming does not kill microbes which increase nourishment of the soil. Biodynamic farms had better soil quality: greater in organic matter, content and microbial activity, more earthworms, better soil structure, lower bulk density.

4. More energy efficiency: growing organic rice was four times more energy efficient than the conventional method (Mendoza, 2002). Organic agriculture reduces energy requirements for production systems by 25 to 50 percent compared to conventional chemical-based agriculture (Niggli et al., 2009).

5. Carbon sequestration: Carbon sequestration: Carbon sequestration: Carbon sequestration: German organic farms annually sequester 402 kg Carbon/ha, while conventional farms had losses of 202 kg (Clark et al., 1999; Küstermann et al., 2008; Niggli et al., 2009).

References

1. Alfven T, Braun-Fahrlander C, Brunekreef B, von Mutius E, Riedler J, Scheynius A, van Hage M, Wickman M, Benz MR, Budde J, Michels KB, Schram D, Ublagger E, Waser M and Pershagen G. 2006. Allergic diseases and atopic sensitization in children related to farming and anthroposophic lifestyle - the PARSIFAL study.
2. Brandt K and Mølgaard JP. 2001. Organic agriculture: does it enhance or reduce the nutritional value of plant foods? J. Sci. Food Agric . 81: 924-931.
3. Butler G, Nielsen JH, Slots T, Seal Ch, Eyre MD, Sanderson R and Leifert C. 2008. Fatty acid and fat-soluble antioxidant concentrations in milk from high- and low-input conventional and organic systems: seasonal variation. J. Sci. Food Agric., 88: 1431–1441.
4. Clark MS, Horwath WR, Shennan C, Scow KM, Lantini WT and Ferris H. 1999. Nitrogen, weeds and water as yield-limiting factors in conventional, low-input, and organic tomato systems. Agriculture Ecosystems & Environment, 73: 257-270.
5. Dobbs ThL and Smolik JD. 1996. Productivity and profitability of conventional and alternative farming systems: a long-term on-farm paired comparison. Journal of Sustainable Agriculture,91(1): 63-79.

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Possibilities of Employment in the Fisheries Sector

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Introduction

Fisheries is an important industry and less capital is required to start this industry. For this reason, this industry can be started easily. While the development of fisheries will improve the food problem on the one hand, foreign exchange will be earned on the other hand, which will also improve the economy. After independence, there has been a huge increase in fish farming in the country. The total production of fish in the country in the year 1950-51 was 7.5 lakh tonnes, while in 2018-19 this production increased to 13.7 million metric tonnes. India is the second largest producer of fish in the world. The fisheries sector provides employment to more than 10 million people in the country.

Since there is no growth in agricultural land and most of the agricultural work is being done by machinery, the state's poverty situation is becoming even more frightening, due to which small industries like fisheries in rural areas have to be encouraged only then rural. The economic and social status of the poor of the region can be improved. Special attention will have to be given to strengthening the economic condition of poor, unemployed, illiterate people for social development. For this, there will be a need to motivate the fisheries industry to adopt an affordable, cheap and high income in a short time.

Most of the Indian community lives in rural areas of the year, due to neglect of society and inhuman treatment of the system, especially people belonging to scheduled castes, scheduled tribes and poor communities have gone through a period of crisis. The rich people living in rural areas did not allow people belonging to scheduled castes and scheduled tribes to rise above the society and have been exploiting them completely as bonded laborers. There are considerable social evils among this class of people in rural areas, mainly due to their illiterate and superstition. The Government of India operated various schemes to keep them healthy and to provide self-employment for their social upliftment and to improve their economic condition, which prompted the adoption of fisheries as an important occupation. To plant fishermen in the fisheries industry in the rural area, to get them leased on ponds, to provide them with advanced type of fish seeds, to start training them with technical training related to fisheries.

Women in Fisheries Sector

Women are working to improve the economic standard by forming self-help groups and on the other hand they are doing a commendable job of tying the society together. In order to make an excellent place in society in today's environment, it is a commendable step to give proper attention to the education of children, to shape their future and to give proper place in the society. Education has been considered as the main part of the society because an educated society can create an advanced society and along with the society can give its full contribution in the development of our home, village and country. Today it is necessary that they should be made aware of the economics of fisheries, to change their mindset, to install confidence in them, to get out of the shackles of home and society and to give them full support in the business. Only then will they be able to improve their economic status by coming in the external environment and by creating a good society, they will be able to bring revolutionary social change and become fearless. A society whose economic level will be very good, certainly the social level of that society will be high. Their living, food, atmosphere will be good, their behaviour will be modest. Therefore, the economic status of the poor people in rural areas, especially those belonging to the Scheduled Castes / Scheduled Tribes, will have to be improved by engaging them in the fisheries business. Thus, fisheries can make a very significant contribution to the economy of the country.

Role of Fisheries in Other Sector

There are other ancillary industries based on this industry such as mesh manufacturing industry, boat building industry, nylon construction, wire towing industry, ice factory etc. industries are also benefiting from the fisheries industry. This industry is helpful in removing unemployment. Being an employment oriented, the backward state of the country can be improved through this industry. As there is no increase in agricultural land and most agricultural work is being done with machinery, the poverty situation of the country is becoming more frightening. Important industries like fisheries in rural areas will have to be encouraged only then the rural social standard can be improved. Special attention will have to be given on strengthening the economic condition of poor, unemployed uneducated people for social development. For this, the fisheries industry, which is accessible, cheap and gives more income in a short time, will need to be motivated to adopt the business. Before starting the fisheries system, fishermen will have to be informed and trained in advanced technology. If the fishery is done with advanced technology, then surely the fish productivity will increase and when the fish productivity increases then the income will increase and the income will increase then the social level will definitely improve because in the economic absence where the standard of living of poor people has dropped It would improve the children of the family; They will be able to educate and when children become educated, their level in the society will be high and the frustration of inferiority complex will be liberated and these educated children will be able to give special contribution to other members of the society in improving their social standard. Therefore, it is necessary to employ them in self-employment. Fisheries cum other sources of income - Along with this industry, other ancillary industries can be done in which the cost rate is low and profit is more. Along with fisheries, other productive organisms can be reared so as to meet the expenditure in fisheries production and waste materials emitted from other organisms can be used for fisheries and additional income from production of other organisms could be obtained. Currently, pig, duck and poultry farming along with fisheries has proved to be quite beneficial. The results obtained from these experiments are promising and encouraging.

Conclusion

Fisheries industry is one such business which a poor person can adopt and get a good income and a revolutionary change can be brought in the society. By engaging in the fisheries business through various means, its economic status has improved and social level has also improved a lot. Today, the women engaged in the fishery trade go on the market to sell the fish themselves, giving equal support to the men, which shows their clear interest to engage with this business.

References

1. Ayyappan, S. (2006). Handbook of Fisheries and Aquaculture, Published by Directorate of Information and Publications of Agriculture. Indian Council of Agricultural Research, New Delhi.
2. National Fisheries Development Board (NFDB), Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture and Farmers Welfare, Government of India.
3. Sathiadhas, R and Prathap, K. S. (2009). Employment Scenario and Labour Migration in Marine Fisheries. Asian Fisheries Science. 22 (2): 713-727.

Moringa Leaf Caterpillar Management

Article ID: 10330

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Leaf caterpillar *Noorda blitealis* (Pyraustidae: Lepidoptera)
Distribution and status: It are a sporadically serious pest of drumstick trees especially in South India.
Host range: Moringa.

Damage Symptoms

1. Caterpillars feed on leaf lamina, turning them into transparent parchment like structures.
2. Peak period of infestation is during March to April and December to January.

Identification of Pest

Egg: creamy white oval eggs and laid in clusters on leaves.
Eggs are laid in batches usually on ventral surface of leaves.
Egg: Durations last for 3days.

Larva: Devoid of prothoracic shield
Larval period 7 to 15 days.

Pupal period last with 6 to 9 days.
Pupation takes place in soil.

Adult: Adults are medium sized moths.
Fore wings are uniformly dark in colour with a small white streak near the base.
Hind wings are hyaline with broad black marginal band towards anal side.

Management

1. Plough around trees to expose and kill pupae
2. Collect and destroy damaged buds along with caterpillar
3. Set up light trap @ 1/ha
4. Spray insecticides like carbaryl 50 WP@ 1gm/lit or malathion 50 EC 2 ml/lit of water.

	
Early stage of Larva - Noorda blitealis	**Later stage of larva - Noorda blitealis**

Adult - Noorda blitealis

Healthy plant

Leaf eating caterpiller infested plant

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Marigold Magic!

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Trap Crop

A trap crop is a plant that attracts agricultural pests, usually insects, away from nearby crops. This form of companion planting can save the main crop from decimation by pests without the use of pesticides. Trap cropping is the planting of a trap crop to protect the main cash crop from a certain pest or several pests. The trap crop can be from the same or different family group, than that of the main crop, as long as it is more attractive to the pest. There are two types of planting the trap crops; perimeter trap cropping and row intercropping. Perimeter trap cropping (border trap cropping) is the planting of trap crop completely surrounding the main cash crop. It prevents a pest attack that comes from all sides of the field. It works best on pests that are found near the borderline of the farm. Row intercropping is the planting of the trap crop in alternating rows within the main crop.

Trap crop: Most marigolds can help combat soil-borne pests.

How Trap Cropping Works

Trap crops distract pests away from food crops. By providing a rich food source for these pests, they are less likely to damage your food crops. Also, heavy pest infestations attract beneficial predators, such as lacewings and lady beetles. Once an infestation occurs, the trap crop can be fed to your chickens, tilled under, or composted. In commercial fields, pests attracted to trap crops are killed off with pesticides or vacuumed off the plants and destroyed.

Nematode Killing Power

Marigold plants and especially roots, contain a chemical called alpha-terthienyl, which is toxic to harmful nematodes and has been shown to have antifungal and some antiviral properties. There is no better organic solution to counteract nematode pests, and if certain diseases are also dissuaded by marigolds, then there's no reason not to plant them alongside tomatoes and other veggies.

Roots knots or galls in tomato root systems is a sure sign of root knot nematodes. Root knot nematodes (Meloidogyne spp.) know this is among the few nearly incurable pest problems. Microscopic soil-borne worms reach sufficient populations, little will survive long in that ground. Nematodes invade the root tips of plants where they take up residence, laying eggs that contain up to 500 offspring, each to quickly infest the root system. Nematodes are easily spread and may be introduced to gardens via nursery plants, topsoil, tillers and manure.

Alpha-terthienyl is present in a marigold's living roots and branches, so you can't chop up the plant and extract the chemical for use in a soil drench. Living plants are the only way to solve nematode problems. When planted in infested soil, the worms will invade the roots of the marigold, but not for long. Once inside, the adults will not thrive and eggs will not hatch. The marigold roots act as "traps" to lure existing nematodes to enter and die, thus destroying a good number of them every year.

Types of Trap Cropping

Conventional trap cropping places an attractive low value crop next to a high value crop. Examples of conventional trap cropping are planting collards near cabbages to provide protection from the diamondback moth, installing frequently mowed alfalfa near cotton plants to protect against lygus bugs, and planting mustard between rows of broccoli to lure flea beetles away.

Perimeter trap cropping occurs when an attractant plant is grown around the perimeter of a cash crop, surrounding it completely. This barrier interrupts pests before they ever reach the high value crop. One popular perimeter trap crop is the use of hot cherry peppers planted around bell peppers. Apparently, the hot peppers stop pepper maggots from infesting the sweet peppers! In another example, Blue Hubbard squash is planted around summer squash, reducing damage from cucumber beetles by 95%!

Sequential trap cropping installs attractive plants before high value crops; similar to nurse crops. Strawberries are protected against wireworms when wheat is planted in the same bed 8 days ahead of time.

Multiple trap cropping uses several species to lure pests throughout a valuable crop's lifecycle. For example, flea beetles have been repelled when bunching green onions, dill, and marigolds are planted nearby, and stink bug and leaf-footed bug control is provided when a cash crop is surrounded with triticale, sorghum, millet, buckwheat, and sunflowers. [I imagine the local birds are pretty happy about it, too!]

Push-pull trap cropping surrounds a cash crop with an attractant, and intercrops it with a repellant. One highly effective combination, for growing corn, is to surround a field with fountain grasses (Pennisetum), and to intercrop with tick clover (Desmodium).

Dead-end trap cropping lures pests away from cash crops, but then fails to provide sustenance to the larval forms of the pests. Cowpeas and soybeans can be protected against bean pod borers by planting brown hemp (Crotalaria juncae, not the other hemp) nearby. If you have problems with Japanese beetles eating your roses, try installing Pelargonium geraniums nearby. The beetles will feed on the geraniums and die.

Semi-chemically assisted trap cropping uses kairomones, chemicals emitted by plants that attract pests, to lure pests into areas where they can be destroyed. This method is outside the home garden scenario.

Biological control assisted trap cropping lures beneficial predators to attractive perimeter crops, where they can then feed on the pests. For example, cotton fields may be surrounded with plantings of sorghum, providing protection against cotton bollworms.

Genetically modified trap cropping uses genetically modified plants to make it possible to start growing earlier in the season, thereby avoiding infestation at vulnerable growth stages. In other cases, pests and disease resistance is built into the plant.

Advantages of Trap Cropping

1. Lessens the use of pesticide.

2. Lowers the pesticide cost.
3. Preserves the indigenous natural enemies.
4. Improves the crop's quality.
5. Helps conserve the soil and the environment.

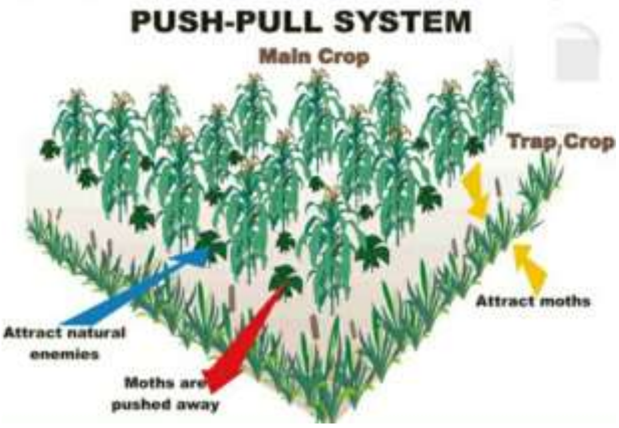
Examples of Trap Cropping Practices

Trap crop	Main crop	Method of planting	Pest controlled
Alfalfa	Cotton	Strip intercrop	Lygus bug
Marigold	Garlic	Border crop	Thrips
Caster	Cotton	Border crop	*Heliothis* sp.
Cabbage mustard and radish	Cabbage	Planted every 15 rows of cabbage	Cabbage webworm flea hopper mustard aphid
Beans and other legumes	Corn	Row intercrop	Leafhoppers stalk borer and fall army worm
Cow pea	Cotton	Row intercrop cotton	Stemborer
Marigold	Solanaceous vegetable	Row / strip Intercrop	Nematodes
Okra	Cotton	Border crop	Flower cotton weevil
Vertiver grass	Corn	Perimeter crop	Corn stalk borer
Tomato	Cabbage	Intercrop (Tomato is planted 2 weeks ahead at the plots' borders)	Diamondback moth
Sunflower	Cotton	Row intercrop in every 5 rows of cotton	*Heliotis* sp.

Tomato with marigold

Collards around cabbage - Perimeter trap cropping

Chilli with Marigold

	
Push – Pull trap crop system	**Meloidogyne Incognita – Root knot nematode**

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Fungal Secondary Metabolites

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Summary

Certain fungi are capable of producing mycotoxins in infected food grains under favourable environmental conditions. Consumption of food grains contaminated with mycotoxins can cause adverse effects on human and animal health. Hence it is most important to appropriately handle and store food grains under ideal storage conditions, in order to prevent infection by mycotoxin-producing fungi.

Introduction

Mycotoxins are low molecular weight secondary metabolites produced by fungi, which are capable of causing adverse effects on the health of humans and farm animals that feed on contaminated agricultural products. Mycotoxin contamination is not only a post-harvest problem of stored food grains; many mycotoxin-producing fungal species cause plant disease under field conditions. The major classes of mycotoxins which are of importance in animal and human diseases worldwide are aflatoxins, ergot alkaloids, trichothecenes and fumonisins. The major genera of fungi producing mycotoxins are *Aspergillus, Fusarium*, and *Penicillium*.

Aflatoxins

The modern era of mycotoxicology began in England in 1960 with Turkey X disease and the discovery of aflatoxins. Aflatoxins are mycotoxins produced by *Aspergillus flavus* and *A. parasiticus*. The four major aflatoxins are called B_1, B_2, G_1, and G_2 based on their fluorescence under UV light (blue or green) and relative chromatographic mobility during thin-layer chromatography. Aflatoxin B_1 is the most potent natural carcinogen known and is usually the major aflatoxin produced by toxigenic strains.

Aflatoxins are potent liver toxins and liver carcinogens in a wide variety of animals. Human exposure to aflatoxins can result from consumption of contaminated peanuts and other agricultural commodities, but also from consumption of meat, milk and eggs from animals that have consumed contaminated feeds. When cows consume aflatoxin-contaminated feeds, they metabolically transform aflatoxin B_1 into a hydroxylated form called aflatoxin M_1. Temperature and relative humidity are the most important factors affecting the formation of aflatoxins. Hence it is important to store food grains ideally in order to prevent infection of *Aspergillus* species.

Ergot Alkaloids

Ergot alkaloids represent a large family of mycotoxins that are derived from both amino acid and isoprenoid precursors, and include clavines, simple derivatives of lysergic acid and ergotamine. The most notorious mycotoxicosis in human history is ergotism, which is caused by consumption of rye grains contaminated with sclerotia of Claviceps purpurea. These compounds are produced as a toxic cocktail of alkaloids in the sclerotia of species of Claviceps, which are common pathogens of various grass species. Sclerotia can contain a complex mixture of biologically active alkaloids, which are the principal causative agents of ergot poisoning (Marasas and Nelson 1987; Beardall and Miller 1994). Modern methods of grain cleaning have almost eliminated ergotism as a human disease.

Fumonisins

Fumonisins are produced by a number of *Fusarium* species, notably *Fusarium oxysporum*, *F. culmorum* and *F. graminearum*. Fumonisins are amino polyalcohols and are structurally similar to the long-chain base backbones of sphingolipids. Fumonisins inhibit the activity of sphingosine N-acetyltransferase, which leads to the accumulation of toxic sphingoid bases.

Pure fumonisins at low concentrations have been shown to cause necrosis and other symptoms in maize, tomato seedlings, and other plants. Fumonisins are acutely toxic to the liver and kidney; consumption of feed contaminated with fumonisins or an intravenous injection of pure fumonisin BI can produce a fatal lung edema in pigs.

Ochratoxin

Ochratoxin A was discovered as a metabolite of *Aspergillus ochraceus* in 1965 during a large screen of fungal metabolites that was designed specifically to identify new mycotoxins. Thereafter, it was isolated from a commercial corn sample and recognized as a potent nephrotoxin.

Members of the ochratoxin family have been found as metabolites of many different species of *Aspergillus*, including *Aspergillus alliaceus*, *Aspergillus auricomus*, *Aspergillus carbonarius*, *Aspergillus glaucus*, *Aspergillus melleus*, and *Aspergillus niger*. Although some early reports implicated several *Penicillium* species, it is now thought that *Penicillium verrucosum*, a common contaminant of barley, is the only confirmed ochratoxin producer in this genus.

As with other mycotoxins, the substrate on which the molds grow as well as the moisture level, temperature, and presence of competitive microflora interact to influence the level of toxin produced. Ochratoxin A has been found in barley, oats, rye, wheat, coffee beans, and other plant products, with barley having a particularly high likelihood of contamination. Of the *Aspergillus* toxins, only ochratoxin is potentially as important as the aflatoxins, being a nephrotoxin to all animal species.

Patulin

Patulin is produced by many different molds but was first isolated as an antimicrobial active principle from *Penicillium patulum* (now *Penicillium griseofulvum*). Nowadays, *Penicillium expansum*, the blue mold that causes soft rot of apples, pears, cherries, and other fruits, is recognized as one of the most common offenders in patulin contamination. Patulin is regularly found in unfermented apple juice, although it does not survive the fermentation into cider products. Patulin is toxic at high concentration in laboratory settings, but evidence for natural poisoning is indirect and inconclusive.

Trichothecenes

The trichothecenes constitute a family of more than sixty sesquiterpenoid metabolites produced by a number of fungal genera, including *Fusarium, Myrothecium*, *Phomopsis, Stachybotrys*, *Trichoderma*, *Trichothecium*, and others. The term trichothecene is derived from trichothecin, which was the one of the first members of the family identified. They are commonly found as food and feed contaminants.

Consumption of these mycotoxins can result in alimentary hemorrhage and vomiting. For more than 100 years, both acute and chronic mycotoxicoses in farm animals and in humans have been associated with consumption of wheat, rye, barley, oats, rice, and maize contaminated with *Fusarium* spp. that produce trichothecene toxins.

Zearalenone

The zearalenones are biosynthesized through a polyketide pathway by *Fusarium graminearum, Fusarium culmorum, Fusarium equiseti,* and *Fusarium crookwellense*. All these species are regular contaminants of cereal crops worldwide. Zearalenone naturally occurs in agricultural crops, particularly in maize.

This mycotoxin could contaminate products made of barley, wheat, oats, rice, and sorghum. The estrogenic activity of ZEA causes several reproductive disorders in domestic animals as well as hyperestrogenic syndromes in humans (Poor *et al.*, 2015), which depend on the dose and time of exposure.

Conclusion

Mycotoxins are secondary metabolites synthesized by a number of fungal species. These are toxic and have a significant impact on human and animal health. Following good agricultural practices, sufficient drying of crops after harvest and storing of food grains at ambient temperature and relative humidity conditions would be the only methods to prevent contamination by moulds and thereby prevent the formation of mycotoxins.

References

1. Marasas W. F. O. and Nelson P.E. (1987). Mycotoxicology. The Pennsylvania State University Press, University Park, Pa.
2. Beardall J. M. and Miller J.D. (1994). Disease in humans with mycotoxins as possible causes, In J. D. Miller and H. L. Trenholm (ed.), Mycotoxins in grains. Compounds other than aflatoxin. Eagan Press, St. Paul, Minn.p. 487–539.
3. Poor M., Kunsagi-Mate, S., Sali, N., Koszegi, T., Szente, L. and Peles-Lemli, B. (2015). Interactions of zearalenone with native and chemically modified cyclodextrins and their potential utilization. J. Photochem. Photobiol. B 151, 63–68.

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Inheritance of Qualitative Characters in Vegetables

Article ID: 10333

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Qualitative traits are usually determined by single genes, quantitative traits tend to be more complex and are usually controlled by multiple genes. When traits are controlled by more than one gene or by groups of genes, they're called polymorphic traits. An inheritance of a character that differs markedly in its expression among individuals of a species; variation in that species is discontinuous. Such characters are usually under the control of major genes. A principal example is gender.

Inheritance of Qualitative Characters

The genes in which dominant allele expresses the complete trait are called monogenes, e.g., TT or Tt for tallness in Pea. Qualitative inheritance produces a sort of discontinuous trait variations in the progeny, e.g., either tallness or dwarfness. Intermediate forms or continuous trait variations are not produced.

The easiest characters or traits, to deal with are those involving discontinuous or qualitative, differences that are governed by one or a few major genes. Many such inherited differences exist, and they frequently have profound effects on plant value and utilization.

Examples are starchy versus sugary kernels (characteristic of field and sweet corn respectively) and determinant versus indeterminant habit of growth in green beans (determinant varieties are adapted to mechanical harvesting).

Characteristics

1. It deals with the inheritance of qualitative characters which have two contrasting expressions eg. tall and dwarf plants.
2. Each character is controlled by a single pair of contrasting alleles. There is no intermediate type.
3. Each character has two distinct contrasting expressions ie. they exhibit two distinct phenotypes.
4. The degree of expression remains the same whether the character is controlled by one or both the dominant genes.
5. Single effect genes are seen.
6. It is not influenced by environmental factors. It shows a discontinuous pattern of inheritance.
7. Individuals of F1 generation resembles dominant parent.
8. Individuals of F2 generation are in the ratio of 3:1.An intermediate expression is absent.
9. It concerns with individual mating and their progeny. Analysis of this inheritance can be done by counting and finding ratios.

Examples: Inheritance of qualitative characters like height, seed coat and seed colour of pea plant.

Peas

A common example can be seen with Mendel's famous pea plant experiments that spawned much of the modern understanding of genetics. Mendel found that these pea plants could produce either plants where the peas were smooth or plants where the peas were wrinkled.

Pea smoothness is a qualitative or discrete trait since there are distinct categories the trait can be. There are no half-wrinkled half-smooth plants or semi-wrinkled plants. They are only smooth or wrinkled, which classifies that trait as qualitative.

Watermelon

Genes for watermelon fruit traits have been identified since the 1930s. Study conducted on fruit traits including fruit stripe width, stripe color, rind color, fruit shape, and blossom end shape (concave Vs convex). Ten watermelon cultivars (inbred lines) were used as parents. Several new genes or alleles were discovered. A series of alleles at the g locus is proposed to explain the inheritance of fruit rind pattern: G (medium or dark solid green), gW (wide stripe), Gm (medium stripe), gN (narrow stripe) and g (solid light green or gray). The dominance series is G >gW>gM>gN> g.

Another series of alleles at the ob locus is proposed for the fruit shape: allele ObE for elongate fruit, which is the most dominant; Allele ObR (not the same as the o gene for round) for the round fruit; Allele ob for oblong fruit, which is the most recessive. Gene csm is proposed for the clear stripe margin in the cultivar Red-N-Sweet and is recessive to the blurred stripe margin (Csm) in 'Crimson Sweet', 'Allsweet', and 'Tender sweet Orange Flesh'.

Downy Mildew Resistance in Cauliflower

The qualitative characters that were inherited such as the TSS, total sugars, total phenols were recorded in Cauliflower.

Single dominant gene was observed to govern downy mildew resistance in cauliflower. Correlation matrix revealed that plant disease index exhibited significant and positive correlation with total sugars, days to curd initiation, days to marketable curd maturity, stalk length and number of leaves per plant, whereas this association was significant and negative with vitamin C, total phenols, marketable yield per plant, net curd weight, gross curd weight, harvest index, curd diameter, curd size index, per cent marketable curds, curd depth and curd compactness.

Here the qualitative character total phenol reported to have resistance to Downy mildew in cauliflower.

Brinjal

Purple flower is dominant over white flower. Purple flower is controlled by nuclear genes and dominant in nature. Purple corolla as monogenically dominant over non pigmented corolla. Leaf spine was dominant over non spiny leaf. Presence or absence of spines was controlled by single gene and pleiotropic in action. Spines on stem, leaf and petioles had monogenic inheritance and were controlled by single gene (Sp), which was also responsible for pleiotropism of these characters. Elongated (ellipsoid and cylindrical) fruit shape was dominant over round (globular, ovoid and obovate) fruit shape. Round shape was dominant over oval (pear and club shaped) fruit shape. The character fruit stripes would be controlled by polygenes. Calyx colour was found to be controlled by three factors in which two duplicate and inhibitory genes were observed. Monogenic inheritance for the inheritance of the spine character. Variation observed for pattern of inherence of the fruit colour was continuous and governed by polygenes. Fruit colour would be governed by oligogenes. The pattern of expression of flower colour indicated that purple flower was dominant over white flower.

References

1. Dharmendra Patidar(2015).DUS and Qualitative Characters Inheritance Studies of Brinjal (Solanum melongena L.) genotypes.Trends in Biosciences 8(1).
2. Lingli Lou and Todd C. Wehner(2016). Qualitative Inheritance of External Fruit Traits in Watermelon. Hortscience. 51(5) :487-496.

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Afeem: The License Crop of Mandsaur Madhya Pradesh

Article ID: 10334

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Farmers in the region refer to opium cultivation as ‘ghulami ki kheti’ (a slave’s crop).

Opium cultivation is permitted in the notified tracts in the states of Madhya Pradesh, Rajasthan and Uttar Pradesh. The General Conditions, among others, include a Minimum Qualifying Yield (MQY) to be tendered by the cultivators of each of these three states, to be eligible for license in the succeeding year, while MQY was fixed at 56 kg/ha for Rajasthan as well as for Madhya Pradesh and 49 kg/ha for Uttar Pradesh. Some places where opium is grown are Pratapgarh in Rajasthan; Mandsaur, Ratlam, Neemuch in Madhya Pradesh; Barabanki, Bareilly, Lucknow, Faizabad in Uttar Pradesh.

Legal cultivation of opium for medicinal purposes is carried out in India, only in selected areas, under free licensing conditions. India is the world's largest manufacturer of legal opium for the pharmaceutical industry. The crop year starts from 1st September and ends on 30th October each year.

A Licensed Plot of Opium Poppy Crop in Mandsaur, Madhya Pradesh

The Central Bureau of Narcotics (CBN), Gwalior (Madhya Pradesh) under the Narcotics Commissioner issues licenses to the farmers to cultivate opium poppy. Each field of every cultivator is individually measured by officers of the CBN to ensure that they do not exceed the licensed area. The cultivators are required to tender their entire opium produced to the CBN and they are paid a price at the rates decided by the Government.

The CBN sets up weighment centers during the harvest season and the cultivators bring their opium to these centers and tender the opium to the CBN. Opium-gum produced by the cultivators is procured by the officers of Central Bureau of Narcotics (CBN) and transferred to the Government Opium and Alkaloid Works (GOAW). There are two GOAWs one in Ghazipur (Uttar Pradesh.) and the other in Neemuch (Madhya Pradesh). Each GOAW has an Opium Factory and an Alkaloid Plant.

The Opium Factories dry the opium for export and for use in the Alkaloid Plants. The Alkaloid Plants extract alkaloids from opium and sell them to manufacturers of pharmaceutical preparations. Drugs whose manufacturing is completely prohibited: Crude cocaine and diacetylmorphine (commonly known as heroin) and their salts.

Capsules and Flowers of Opium

The extraction of opium takes place during the months of February and March. Farmers still use the traditional method where they lance each poppy capsule manually with a special blade like tool, a process known as lancing. The lancing is done in late afternoon or evenings.

The opium latex oozes out and congeals in the night is scraped and collected manually by next morning. Each poppy capsule is given three to four lancings. All such opium collected is required to be necessarily tendered to the government, at specially set up opium collection centers, in early April. Opium is checked for quality and consistency and weighed at the centers. Prices are paid which are fixed by the Government in slab rates, depending on the quality and quantity of opium tendered. 90% of payment is made to the cultivators, directly in their bank account through e-payment method. Final payment is made after laboratory testing at opium factory after confirming that no adulteration has been done. All the opium procured is sent to Government Opium and Alkaloid Factories situated at Neemuch and Ghazipur. Opium is dried and processed at these factories for export and is also used for extraction of various products like Codeine Phosphate, Thebaine, Morphine Sulphate, Noscapine but Heroin is illegal.

The Latex (Crude Opium) Oozing out of Capsule

India is one of the few countries that legally grow opium poppy and the only country which legally produces opium gum. Opium poppy (Papaver somniferum) plant is the source of opium gum which contains several indispensable alkaloids such as morphine, codeine and thebaine. Morphine is the best analgesic in the world. In case of extreme and excruciating pain such as that of terminally ill cancer patients, nothing alleviates the suffering except morphine. Codeine is commonly used in manufacture of cough syrups.

Of the various alkaloids, Codeine Phosphate is required in the largest quantity. The total production of Codeine Phosphate by the two GOAWs is not sufficient to meet India's needs. Hence, we import Codeine Phosphate every year.

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A Soul Blossoming Edible Flowers in Vegetables: A Need of Special Treat for Healthy Gourmand of Recent Era

Article ID: 10335

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Introduction

Flowers have been used for culinary purposes in Ancient Greece, Rome, and Egypt. The first recorded mention of edible flowers was in 140 B.C. Edible flowers were especially popular in the Victorian era during Queen Victoria's reign.

The Indian culinary world might have accepted the concept of edible flowers passably due to their different, original flavours and colour. However, these floral ingredients have paced beyond the meek walls of grandmas' kitchens, restaurants, and the tables of young Indians.

Edible flowers add something special taste and a splash of colour to an ordinary dish. The delectable bit of the flowers usually comes from the petals.

Importance of Edible Flowers

Flowers are widely used in nutraceutical research, due to rich pigmentation, it evolved in the process of attracting the pollinators, pigments with important antioxidant activity turning flowers into an unexplored resource for human nutrition.

Since ancient times flowers are used as medicines in the form of dried petals, herbs, some flowers in a crystallized manner, making teas, wines, sauces, jams, butter and desserts.

Picking of Edible Flowers

1. Harvest the flowers in the early morning when their water content is highest.
2. Separate the pistils and stamens from flowers prior to eat.
3. Pull out the flower petals from the rest of the flower to minimize the wilting.
4. Consume only the flower petals. The pollen can detract the flavour of the blooms, it may cause an allergic reaction.

Cleaning of Edible Flowers

1. Shake each flower to dislodge insects from petals.
2. After removal of stamens, wash the flowers with clean water.
3. Drain and allow them to dry on absorbent paper.
4. The flowers are not exposed to direct sunlight to retain their odour and colour.

Shelf Life of Edible Flowers

Immediately after harvesting, we should use flowers for cooking purposes. These are most delicate in nature, and their "best by" date is around two days and will be usable for 4-6 days if we kept under cool temperature.

What Flowers are Edible for Humans in Vegetables?

4 major edible flowers in vegetables include pumpkin, drumstick, agathi, and rosella among others these are very nutritive and having medicinal properties.

			
Moringa	**Pumpkin**	**Rosella**	**Agathi**

Moringa

1. Scientific name: *Moringa olifera*
2. Family: Moringaceae

It is called as drumstick tree, the miracle tree, the ben oil tree, or the horseradish tree.
It is also known as "brimma vriksham" by the siddars.

Importance of Drumstick Flower

1. Contains amino acids, Ca and K, making them a valuable supplement for nursing mothers.
2. Resembles the taste of mushrooms.
3. A tea from moringa is acting as a health tonic, soup a good remedy for cold and cough.
4. Used in the preparation of cosmetics and perfumes.
5. Act as a natural “Air-freshener”.
6. Increases immunity, decreases infertility problems and body heat.
7. Flowers powder with milk improves the memory in children as well as prevent memory loss for old people.
8. Flower powder with honey increases vision and enhance the moisture level.

		
Tea	**Scrub**	**Kheer**

Pumpkin

1. S.N: *cucurbita sps.*
2. F: Cucurbitaceae.

Male flowers are erect and females are distinguished by a small ovary at the base of the petals.

Importance of Pumpkin Flower

1. It contains abundant amount of water and very little amount of fat.
2. They are rich in Ca, P, Fe, vitamin-A, Vc, folic acid, protein, glutamic acid, aspartic acid, leucine, valine, phenylalanine and tryptophan.
3. Vitamin B9 enhances immunity, treating the common cold, for strong bones, and improving vision, hence, are known to be super-healthy.
4. Ca and P, used to restore the problems in osteoporosis.
5. Potassium reduces hypertension, from stroke, protects against loss of muscle, and prevention of bone mineral density.

		
Curry	**Rice**	**Pakoda**

Rosella

1. S.N: *Hibiscus sabdariffa*
2. F : Malvaceae

It is also known as Indian Sorrel, Jamaican Sorrel, and red sorrel.

Importance of Rosella Flower

1. Good source of nutrients, vitamins, and minerals, Ca, Fe, Vc, Mg, P, K, Vitamin B2, Vitamin A, omega-3, beta-carotene, lysine, and arginine.
2. Refreshing and very popular beverage can be made by boiling the calyx, sweetening it with sugar, and adding ginger.
3. Calyx is rich in citric acid and pectin and so is beneficial for making jams, jellies, etc.
4. Natural anti-oxidant, liver protector, anti-cancer, and diuretic.
5. Helps in lowers high blood pressure, reduce wounds, ulcers, and colds, aids in weight loss and indigestion.

		
Tea powder	**Tea**	**Jam**
		
Juice	**Jelly**	**Syrup**

Agathi

1. S.N: *Sesbania grandiflora.*
2. F: Leguminaceae.

It is known as Agastya or agasti because it blossoms at the time when the star Agastya appears in the sky.

Importance of Agathi Flower

1. Contains proteins, tannins, oleanolic acid, kaempferol, grandifloral, cystine, isolucineaspargine, valine, nicotinic acid, cyanidin, delphinidin, and Vc.
2. These are cooling, bitter, astringent, acrid, emollient, laxative, and antipyretic.
3. Floral juice can be applied to the eyes for checking blindness and sight weakness and also promoting vision.

4. Used in anti-aging treatments.
5. Sinus congestion is reduced by taking a flower decoction.
6. Juice is used in leucorrhea, smallpox, poisoning cases, biliousness, and general debility, it has anti-microbial activity.

	
Juice	**Bhaji**

Some Key Points to be a Consideration while Taking Edible Flowers

1. Select the flowers if you are positive, they are edible, be sure about medicinal values and effectiveness.
2. Clean all flowers properly.
3. Never consume the flowers from off filed.

Conclusion

Flowers are not typically found in everyday meals, so their deliberate inclusion in a dish making it more medicinally balanced & nutritionally rich. Flowers in food acknowledges the cares about the beauty of what you are about to eat. Appearance of flowers in a dish elevates it to something beyond the ordinary in contex of herbal remedies and supplements.

Reference

1. Pragya, S, Mahejibin, K, and Hailu, H. 2017. Nutritional and health importance of Hibiscus sabdariffa: a review and indication for research needs. Journal of Nutritional Health & Food Engineering. V(6).
2. Raquel, P. F. G, Eunice, S. and Paula, M. R. C. 2017. Edible Flowers: Knowledge and Consumption Habits. Journal of Acta Scientific Nutritional Health. V(1).

Vermicomposting: A Sustainable Technology

Article ID: 10336

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Introduction

Vermicompost is considered as a high nutrient biofertilizer with diverse microbial communities, it plays a major role in improving growth and yield of different field crops, vegetables, flower and fruit crops. Vermicomposting is the process of conversion of organic wastes into finely degraded peat like substances using earthworms, it is an alternative method for waste management through which vermicompost is produced with relatively high nutrient content than compost and manures. Vermiwash is another important product obtained during vermicomposting, it is the liquid that is collected after the passage of water through a column of worm action. Vermiwash is rich in enzymes, plant growth hormones, vitamins along with micro and macronutrients which increases the resistance power of crops against various diseases and enhances the growth and productivity of crops. The concept of vermiculture of organic material with earthworms provides most useful organic manure on one hand and on the other hand it also minimizes the environmental pollution and health hazard. It maintains the soil in a proper homeostatic state. It also removes excessive amounts of heavy metals such as copper and lead and there by served as a means of detoxification.

Vermicomposting is a non-thermophilic process by which organic materials are converted by combined action of earthworms and micro-organisms into soil amendments with greatly increased microbial activity and nutrient availability. Remarkable focusses have been given on vermiculture studies (rearing of useful earthworms' species) for achieving quicker and cheaper solutions for waste management. Land and soil remediation and safe and sustainable food production with reduced use of agro-chemicals. Charles Darwin called them 'friends of farmers and unheralded soldiers of mankind working day and night under the soil'. Under optimum temperature (20–30°C) and moisture (60–70%), about 5 kg of worms (approximately 10,000 worms) can process about 1 ton of waste into vermicompost in just 30 days.

Vermicomposting

"Vermicomposting is a process in which the earthworms convert the organic waste into manure rich in high nutritional content."

Vermicomposting is the scientific method of making compost, by using earthworms. They are commonly found living in soil, feeding on biomass and excreting it in a digested form. Vermiculture means "worm-farming". Earthworms feed on the organic waste materials and give out excreta in the form of "vermicasts" that are rich in nitrates and minerals such as phosphorus, magnesium, calcium and potassium. These are used as fertilizers and enhance soil quality.

Vermicomposting Comprises Two Methods

1. Bed Method: This is an easy method in which beds of organic matter are prepared.
2. Pit Method: In this method, the organic matter is collected in cemented pits. However, this method is not prominent as it involves problems of poor aeration and waterlogging.

Principle

This process is mainly required to add nutrients to the soil. Compost is a natural fertilizer that allows an easy flow of water to the growing plants. The earthworms are mainly used in this process as they eat the organic matter and produce castings through their digestive systems.

The nutrients Content of Vermicompost are

Nutrient element	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Fe (ppm)	Mn (ppm)	Zn (ppm)
Vermicompost	1.6	0.7	0.8	0.5	0.2	175	96.5	25.5

Materials Required

1. Water.
2. Cow dung.
3. Thatch Roof.
4. Soil or Sand.
5. Gunny bags.
6. Earthworms.
7. Weed biomass
8. A large bin (plastic or cemented tank).
9. Dry straw and leaves collected from paddy fields.
10. Biodegradable wastes collected from fields and kitchen.

Procedure

1. To prepare compost, either a plastic or a concrete tank can be used. The size of the tank depends upon the availability of raw materials.
2. Collect the biomass and place it under the sun for about 8-12 days. Now chop it to the required size using the cutter.
3. Prepare a cow dung slurry and sprinkle it on the heap for quick decomposition.
4. Add a layer (2 – 3 inch) of soil or sand at the bottom of the tank.
5. Now prepare fine bedding by adding partially decomposed cow dung, dried leaves and other biodegradable wastes collected from fields and kitchen. Distribute them evenly on the sand layer.
6. Continue adding both the chopped bio-waste and partially decomposed cow dung layer-wise into the tank up to a depth of 0.5-1.0 ft.
7. After adding all the bio-wastes, release the earthworm species over the mixture and cover the compost mixture with dry straw or gunny bags.
8. Sprinkle water on a regular basis to maintain the moisture content of the compost.
9. Cover the tank with a thatch roof to prevent the entry of ants, lizards, mouse, snakes, etc. and protect the compost from rainwater and direct sunshine.
10. Have a frequent check to avoid the compost from overheating. Maintain proper moisture and temperature.

Advantages of Vermicomposting

The major benefits of vermicomposting are:

1. Develops roots of the plants.
2. Improves the physical structure of the soil.
3. Vermicomposting increases the fertility and water-resistance of the soil.
4. Helps in germination, plant growth, and crop yield.
5. Nurtures soil with plant growth hormones such as auxins, gibberellic acid, etc.

Disadvantages of Vermicomposting

Following are the important disadvantages of vermicomposting:

1. It is a time-consuming process and takes as long as six months to convert the organic matter into usable forms.
2. It releases a very foul odour.

3. Vermicomposting is high maintenance. The feed has to be added periodically and care should be taken that the worms are not flooded with too much to eat.
4. The bin should not be too dry or too wet. The moisture levels need to be monitored periodically.
5. They nurture the growth of pests and pathogens such as fruit flies, centipede and flies.

Conclusion

Vermicomposting turns the kitchen waste and other green waste into dark, nutrient-rich soil. Due to the presence of microorganisms, it maintains healthy soil. Vermicomposting is an eco-friendly process that recycles organic waste into compost and produces valuable nutrients.

Reference

1. Kumar, A., Gupta, R. K., Kumar, S. and Kumar, S. (2017) Nutrient variations in vermicompost prepared from different types of straw wastes. Forage research 42(4), 267-270.
2. Singh, A. and Singh, G. S. (2017) Vermicomposting: A Sustainable tool environmental equilibrium. Environmental Quality Management 27(1), 23-40.

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Aloe Vera and its Importance for Human Health

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Introduction

Aloe vera is an important medicinal plant and it has been known and used for centuries as it possesses various important properties like health, medicinal, beauty and skin care. The name *Aloe vera* has been derived from the Arabic word "Alloeh" which means "shining bitter substances" while "vera" in Latin means "true" (Akinyele and Odiyi, 2007). It is known around the world as 'Miracle Plant', 'Natural healer', 'Lily of the desert', 'Nature's Tonic', 'Wonder Plant', 'Fountain of Youth' and 'Plant of Immortality'. This plant became popular in the world due to its medicinal value. This plant is being used extensively in cosmetic as well as pharmaceutical industry.

According to Adodo (2009), over 325 species of the genus Aloe have been identified and the common varieties of *Aloe vera* are: *Aloe barbadensis* Miller, *A. saponaria, A. chinensis, A. variegata, A. forex, A. latifolia* and *A. curacao* but *Aloe vera* (Syn. *Aloe barbadensis* Miller) is more popular all over the world because it propagates itself faster than any other known species and have more therapeutic value and referred as 'True Aloe' (Panwar *et al.,* 2013). Hence, it is more readily available for use than any other species of *Aloe*.

Botany

It is shrubby, perennial, xerophytes, succulent plant with triangular, fleshy leaves with serrated edges and filled with a viscous but an essentially clear gel which is the most important constituent of the plant and has great medicinal value. It is having yellow tubular flowers and fruits contain numerous seeds. Each leaf composed of three layers:

1. An inner clear gel that contains 99% water and rest is made of glucomanans, amino acids, lipids, sterols and vitamins.
2. The middle layer of latex which is the bitter yellow sap and contains anthraquinones and glycosides.
3. The outer thick layer of 15-20 cells called as rind which has protective function and synthesizes carbohydrates and proteins.

Vascular bundles present inside the rind are responsible for transportation of substances such as water (xylem) and starch (phloem) (Tyler et al., 1993). Normally it flowers during October to January and the long inflorescence has a large number of small yellow tubular flowers all around. Fruits are developed during February to April. It is normally not propagated through seeds. Vegetative propagation by suckers is easy and convenient.

Figure.1. A) Aloe vera plant and B) Flower

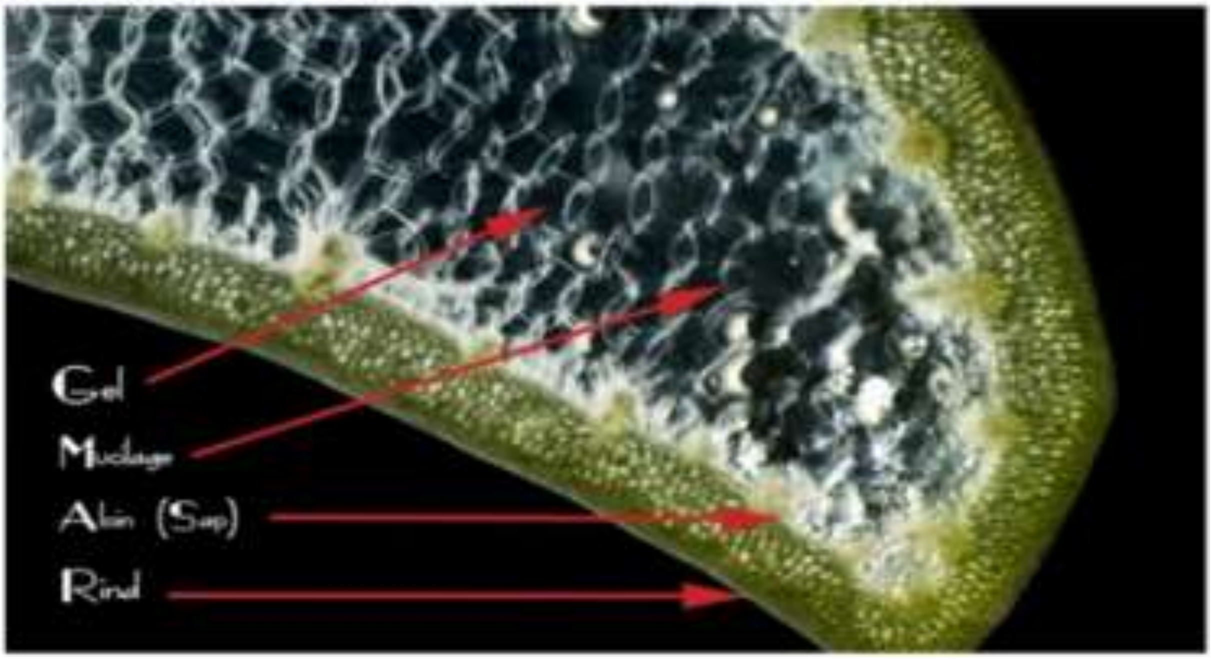

Figure.2. Three layers of Aloe vera leaf

Cultivation of Aloe Vera

Aloe barbadensis is widely adapted all over the world, ranging from tropical to temperate region, grows mainly in the dry regions of Africa, Asia, Europe and America. In India it is cultivated in Rajasthan, Madhya Pradesh, Chhattisgarh, Gujarat, Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu, Bihar, West Bengal, and Jharkhand.

This plant is native to Africa & Mediterranean regions. Africa, China, U.S.A, Australia, Mexico, tropical regions of Latin American countries and coastal area of south India are the major producers of Aloe vera in the world.

Climatic requirements: Aloe vera plants can survive constant drought conditions. However, the crop thrives well in entire tropical and subtropical conditions with mean annual rainfall of 35-40 cm. Its cultivation doesn't need huge water supply, and hence best suited for cultivation in arid and semi-arid regions like Rajasthan, Gujarat, Madhya Pradesh and Maharashtra.

Soil requirement: Marginal to sub-marginal soils with low fertility can favours growth and development of Aloe vera plant. Aloe vera plantation can be carried out in soils with high pH, sodium and potassium content. In central India, black cotton soil is found to be appropriate for Aloe vera cultivation. Well drained loam soils to coarse sandy loam soils with pH value up to 8.5 are more suitable for its commercial cultivation.

Constituents of Aloe Vera

Aloe vera became popular in the world due to its high medicinal value. It contains over seventy-five nutrients and twenty minerals, nineteen amino acids and twelve vitamins. It is an important pharmaceutical plant and a source of many phytochemicals (Ilondu, 2011).

Phytochemistry of Aloe vera gel have revealed the presence of more than 200 active substances including vitamins, minerals, enzymes, sugars, anthraquinones of phenol compounds, lignin, saponins, sterols, amino acids and salicylic acid (Barcroft et al., 2009; Panwar et al., 2013).

The Aloe vera plant contains at least six antiseptic agents like lupeol, salicylic acid, urea nitrogen, cinnamic acid, phenol and sulphur. It contains over 200 ingredients, and seems to affect thousands of biomedical actions in the human body.

The cathartic properties of Aloe are attributed to the presence of anthraquinones including the hydroxyanthracene derivatives, aloin A and B, barbaloin, isobarbaloin and aloe amedin (Grindlay and Reynolds, 1986). Anthraquinones such as aloin A and B are responsible for laxative and healing properties. It aids in digestion and cures digestive disorders.

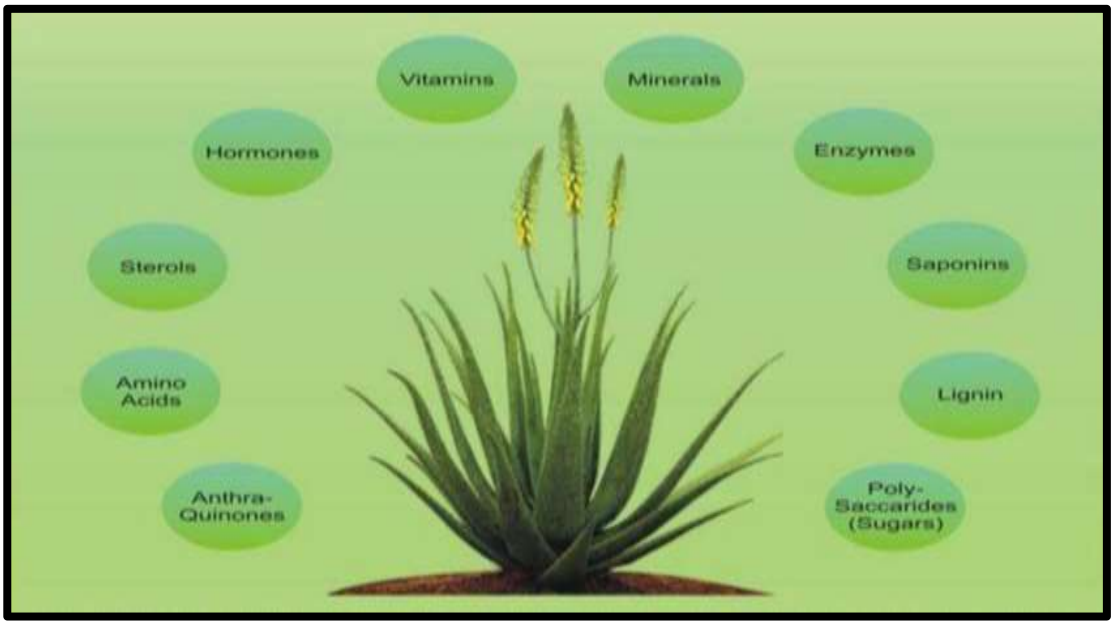

Figure.3. Constituents of Aloe vera

Benefits of Aloe Vera

Most people are already very much familiar with the medicinal and healing benefits of Aloe vera plants. There are several health benefits of Aloe vera. It is anti-biotic, anti-microbial, anti-bacterial, germicidal, anti-fungal and anti-viral. It is excellent for the skin treatments/cosmetic use.

Aloe gel has moisturizing property. It is used in balms, skin cream, body lotion, shampoo, bath soap, talc powder, detergent, soft drink, etc. Medicinally, it is very effective in burns, eczema, herpes lesions, rashes, insect bites, stings, sunburn and wound healing (Rajeswari et al., 2012). It helps in detoxification process, improves immunity and is widely used as a major ingredient of various beauty products (Sharma et al., 2013).

It contains large number of active compounds including vitamins, minerals, sugars, sterols, enzymes, amino acids, lignin, saponins and salicylic acids. No other herb in nature contains so many different elements that are beneficial to humanity, so it is called as 'The Miracle Plant'.

Valuable Products

Today we can find Aloe vera gel in everything from skin and hair care products, to drinks, supplements and food products. In food industry, it is used in preparation of health drinks, beverages, ice cream, jam, jelly, pickles etc.

In pharmaceutical industry, used in preparation of topical ointments, gels and also available as tablets and capsules. The most effective use of Aloe vera is found in cosmetics and toiletry industries where we can find it in creams, soaps, beauty lotions, shampoos, hair oils, hand wash, facial cleansers etc.

Conclusion

Due to presence of many physiologically active substances with amazing properties that are very beneficial for humans, we can say that Aloe vera is really a 'wonder plant' and a gift to humanity by nature.

Reference

1. Adodo, A. (2009). Nature Power 4th edition. A Christian Approach to Herbal Medicine: Paxherbal Clinic and Research Laboratory, Benedictine Monastery, Ewu-Esan, Nigeria, p. 278.
2. Akinyele, B. O., Odiyi, A. C. (2007). Comparative Study of vegetative morphology and the existing taxonomic, nutritional and medicinal status of Aloe vera L. African Crop Science Conference Proceedings. 8: 1567-1570.
3. Barcroft, A., Myskja, A. (2009). Aloe vera Nature's Silent Healer. BAAM Publishing Limited London.

4. Grindlay, D., and Reynolds, T. (1986). The Aloe vera phenomenon: a review of the properties and modern uses of the leaf parenchyma gel. Journal of Ethnopharmacology, 16:117– 151.
5. Ilondu, E. M. (2011). Comparative efficacy of water and ethanol for the extraction of phytochemical constituents of Aloe vera succulent leaves. Nigerian Journal of Science and Environment. 10(1&2): 233-241.
6. Panwar. (2013). In vitro evaluation of fungicides and bioagents against Alternaria alternate-An incident of leaf spot of Aloe vera.
7. Rajeswari, R., Umadevi, M., Rahale, S. C., Pushpa, R., Selvavenkadesh, S., Kumar, S. K. P. and Bhowmik, D. (2012). Aloe vera: The miracle plant its medicinal and traditional uses in India. Journal of Pharmacognosy and Phytochemistry. 1: 118–124.
8. Sharma, G. P., Rani, A., Zala, D. A., Sain, M., Singh, A., and Rathore, S. (2013). Aloe barbadensis Miller a valuable ingredient for traditional uses and toxicological properties - A Review. International Journal Recent Biotech 1: 48–54.
9. Tyler, V. (1993). The honest herbal: A sensible guide to the use of herbs and related remedies. 3rd Edition. Binghamton, New York: Pharmaceutical Product Press.

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ICAR Farmer FIRST Programme Helps to Raise Socio-Economic Empowerment of Smallholder Agriculture

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In the past ICAR took challenges and other issues of Indian agriculture whether it was Green Revolution, National Demonstration, 1964, upliftment of small & marginal farmers they started Lab to Land Programme, 1979, Operational Research Project, 1974 started for watershed development, soil improvement, crop protection, focus on weaker section and for technology assessment and refinement initiated IVLP, 1995etc., its response was timely and need based. At present situation to raise socio- economic empowerment of small holder agriculture ICAR led new project initiated from October, 2016 i.e ICAR Farmers FIRST Project.

The long form of FIRST is farmers Farm, Innovation Resource, Science and Technology. This programme is initiated by ICAR to provide privilege to smallholder agriculture through farmers- scientists interacions beyond the production and productivity

Components of the FFP

1. Enriching Farmers–Scientist interface.
2. Technology assemblage.
3. Application and feedback.
4. Partnership and institutional building.
5. Content mobilization.

It seeks to provide a platform to farmers and scientists for creating linkages, capacity development, technology adaptation and application, on-site input management, feedback and institution building.

The two terms 'enriching knowledge' and 'integrating technology' it gives meaning of Farmer FIRST in Indian context. Enriching knowledge means farmers and researcher learn from each other in context to surrounding farm environment and perception of each other and interaction with sub system establish around. Technology integration means whatever is coming out from research institutions , is many times not suit to as such in farmers field and thus some changes and adaptations are required for field level acceptance ,adoption and success.

Animal component

Vermicompost Bed


Backyard Poultry

Fishery in farm pond

Goatry

Benefits of FFP

1. Farmers and villagers:

a. Farmers get an opportunity to solve their problems or try out new ideas that they themselves could not do without the support of the researchers and extension person.

b. Improve Farmers nature of doing experiments in field and technology development capacity.

c. It helps to raise the confidence in farmers and capacity building.

d. Farmer have courage to learn and share production experience with other farmers.

f. Increasing awareness of farmers towards extension programmes and getting access to information regarding markets, prices and technology.

2. Researchers and teachers:

a. Acquired new and indigenous knowledge through working with farmers and extension personnel.

b. Implement research that suits farmers' conditions.

c. Improve research methods and facilitate field-based learning.

d. Increase their efficiency and skill by participating participatory research approaches.

3. Extensionists (Field Extension Officials):

a. Extension personnel used new way of applying extension tools and methods to satisfy farmers expectations.

b. Improve their capacity through close monitoring of experiments, a learning-by-doing process.

c. Better access to scientific and local knowledge.

d. Extension person build confidence and motivate farmers to spread the results to other farmers.

Various Seed Dressing Insecticides and their Efficacy in Insect Pest Management

Article ID: 10339

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Introduction

"Seed treatment is a biological, chemical, mechanical or physical processes design to mitigate the seed borne pests to improve the quality of seed."

Seed treatment is defined as the application of fungicide, insecticide, bio-fertilizer or any other growth regulator either to control the pathogens or insects or to improve the germination potential."

Why do We Treat Seed?

1. Qualitative improvement in the seed.
2. Improve the field performance and storability.
3. Enable mechanized sowing.
4. Prevent infection or predation of seeds and seedlings by pest's resident on seed or in the soil.
5. Low pesticide dosage: Pesticide is applied directly to the 'target' in very small dosages, not throughout the environment.
6. To transform seeds as a carrier of basic inputs such as pesticides, herbicides, nutrients etc., which redefines agriculture as a profit-oriented art, business or science.

How Seed Treatment are Applied?

1. Seed Dressing: The most common method of seed treatment. The seed is either dressed with a dry formulation or wet treated with a slurry or liquid formulation. Dressings are applied both on-farm or in specialized seed treatment facilities.

2. Seed Coating: A special binder is used with a formulation to enhance adherence to the seed and begin to impact seed size and shape. Coatings require advanced treatment application technology.

3. Seed Pelleting: The most sophisticated seed treatment technology, resulting in changing the physical shape of a seed to enhance plant ability and handling. Pelleting requires specialized application machinery and techniques and is the most expensive of the applications.

Efficacy of Seed Dressing Insecticides in Insect Pest Management

1. Efficacy of some plant extracts as storage protectants against *Callosobruchus maculates:* 3 different plant extract used against the adult of *C. Maculatus.* Due to high toxic effect of the oil of *Cymbopogan citratus* and peel of *citrus sinensis* against *C. Maculates*. These can serve as alternative to synthetic chemicals used in insect pest control in storage which may accumulate to damage health and the environment. Orange peel had the highest mortality rate of 100% weevil mortality within 24 hrs of insect exposure. The order of mortality – orange peel >neem>lemon grass.

2. Control efficacy of different seed dressing insecticides against sorghum shoot fly, *Atherigona soccata* (Rondani) in forage sorghum (Kumar and Tiwana 2018): Seed treatment with thiamethoxam 30 FS @ 10 ml per kg seed emerged as good option for the shoot fly control with lesser incidence of dead hearts and higher monetary returns.

3. Bio-Efficacy of Chemical Insecticides and Organic Pesticide for Management of Termites in Wheat (Kumar *et al.* 2017): The bio-efficacy of chemical Insecticides and organic pesticides for effective management of termites. The soil application of neem cake @ 2.5q/ha along with seed treatment with chlorpyriphos 20EC@ 6ml/ Kg of seed was found significantly lowest per cent of plants damage due to incidence of termites and maximum germination followed by fipronil 0.3% GR @ 25 kg/ha and chlorpyriphos 20EC@ 6ml/ Kg of seed . Grain yield was significantly higher in treated plots than control. Among the treatments, soil application of neem cake @ 2.5q/ha + chlorpyriphos 20EC@ 6ml/ Kg of seed plot recorded significantly higher grain yield being at par with each other Moreover, the highest I.C.B.R. was obtained in seed treatment of chlorpyriphos 20EC@ 6ml/ Kg of seed followed by neem cake @ 2.5q/ha + chlorpyriphos 20EC@ 6ml/ Kg of seed and fipronil 0.3% GR @ 25 kg/ha.

4. Effect of seed treatment with insecticides on the control of *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae) in soybean (Triboni *et al* 2018): Six insecticide treatments applied through seed treatment: Imidacloprid plus thiodicarb at the dose of 52.5 plus 105 g a.i. (active ingredient) 100 kg-1 of seed (Cropstar® 0.350 L 100 kg-1 of seed), Thiamethoxam at 105 g a.i. 100 kg-1 of seed (Cruiser 350 FS® 0.3 L 100 kg-1 of seed), Chlorantraniliprole at 62.5 g a.i. 100 kg-1 of seed (Dermacor® 0.1 L 100 kg-1 of seed), Cyantraniliprole at 120 g a.i. 100 kg-1 of seed (Fortenza 600 FS® 0.2 L 100 kg-1 of seed), Fipronil plus pyraclostrobin and thiophanate-methyl 50 + 5 + 45 g a.i. 100 kg-1 of seed (Standak Top® 0.2 L 100 kg-1 of seed), and a control treatment. Treatment of soybean seeds with insecticides of the diamide chemical group was shown to be the best option for controlling *Spodoptera frugiperda*, significantly reducing the consumed leaf area and quickly increasing caterpillar mortality. The application of the insecticide thiamethoxam (Cruiser®) through seed treatment showed the lowest control efficiency of *Spodoptera frugiperda* during the evaluation period in soybean plants.

5. Studies on New Seed Dressing Insecticides against Insect pest of green gram (Somasundar *et al* 2016): Seed treatment with:- Thiamethoxam @ 4.3 g and 8.6 g/kg, Imidacloprid @ 5ml and 10 ml /kg, Acetamiprid @ 15 g and 30 g/kg, Carbosulfan @ 30ml and 40 ml/kg, Clothionidon @ 6 g and 12 g/kg, Untreated control against sucking pests of green gram. To assess the influence of seed dressing chemicals in the suppression of early season insect pests in green gram. Thiamethoxam @ 4.3 g/kg and 8.6 g/kg were highly effective against aphids, thrips, leaf hoppers upto 30 days after germination in green gram.The leaf damage was low in thiamethoxam, imidacloprid, acetamiprid treatments. Low plant stand was recorded in clothionidon @ 6 g and 12 g/kg. The seed treatment can also be included as a component in the eco-friendly modules of integrated pest management in Green gram.

6. Fortenza Duo (Cyantraniliprole + Thiamethoxam) (Syngenta india): MODE OF ACTION: FORTENZA® Duo is a seed applied insecticide. It is quickly taken up by the roots & moves upward in the plant through the xylem system, hence controlling a broad range of above ground insects. The product is also distributed into the soil around the root zone forming a bulb of protection against below ground insects.

FORTENZA® Duo provides excellent crop protection resulting from a rapid feeding inhibition and long-lasting residual effect. FORTENZA® DUO is best-in-class early-season insect control for both above and below the ground. It has long-lasting residual effect with dual mode of action with no known cross - resistance. Its strong root uptake and highly systemic in the xylem hence results in efficient movement around and within the plant. It maximizes return on investment via early season insect control, maintaining plant stand, excellent crop establishment, resulting in greater yield potential. Main crops and dose/kg of seed: Corn @ 4 ml/kg of seed Targets: Fortenza Duo is a Broad-Spectrum Seed Applied Insecticide (SAI) for the control of early season insect chewing and sucking pests. Fortenza Duo is a systemic seed treatment Insecticide and is recommended for its use to control Cutworms, Stemborer, Shootfly and aphids in corn.

Advantages of Seed Treatment

1. Seed borne pathogens are vulnerable. The seed borne phase is often the weak link in the life cycle for many plant pathogens.
2. Precision targeting: Seed treatments are not subject to spray drift. Because chemicals are applied directly to seeds,
3. Low dose: Relatively small amounts of pesticides are used in seed treatments compared to broadcast sprays.
3. Easy to apply: Seed treatments are relatively easy and cheap to apply compared to broadcast sprays.

Disadvantages of Seed Treatment

1. Limited protection under high pest pressure. Under high pest pressure, significant crop damage may occur. Even through pests are killed when they feed on the treated seedling, each 'attack' causes damage and cumulatively this can still be significant enough to cause seedling loss.

2. Duration of protection. Seed treatment may not provide protection for long enough to provide complete protection to the establishing crop. Pesticide breakdown is most rapid under warm, moist conditions.

3. Limited shelf life of treated seed. Surplus treated seed cannot be sold for grain. This is a particularly serious limitation for seeds such as soybean, where seed germination and vigour decline relatively quickly.

4. Phytotoxicity. Some seed treatments may be phytotoxic when applied at high rates. Cracked, sprouted, and scuffed seeds are particularly susceptible to toxic effects.

References

1. Kumar and tiwana (2018) Control efficacy of different seed dressing insecticides against sorghum shoot fly, Atherigona socata (Rondani) in forage sorghum, Sorghum bicolor (L.) Moench. Journal of Entomology and Zoology Studies 6(2): 795-799.
2. Kumar et al. (2017) Bio-Efficacy of Chemical Insecticides and Organic Pesticide for Management of Termites in Wheat. Chemical Science Review and Letters.
3. Somasunder et al. (2016) Studies on New Seed Dressing Insecticides Against Insect pests of green gram. International Journal of Agriculture Innovations and Research 4(6).
4. Thiamethoxam, Clothianidin, and Imidacloprid Seed.
5. Treatments Effectively Control Thrips on Corn Under Field.
6. Triboni et al (2018) Effect of seed treatment with insecticides on the control of Spodoptera frugiperda (J. E. Smith) (Lepidoptera: Noctuidae) in soybean. Agricultural entomology / Scientific Article.

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Identification and Prevention Measures of *Diaphorina citri*

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Introduction

The Asian citrus psyllid, *Diaphorina citri* Kuwayama, is widely distributed in southern Asia. It is an important pest of citrus in several countries as it is a vector of a serious citrus disease called greening disease or Huanglongbing. This disease is responsible for the destruction of several citrus industries in Asia and Africa (Manjunath 2008). Until recently, the Asian citrus psyllid did not occur in North America or Hawaii, but was reported in Brazil, by Costa Lima (1942) and Catling (1970).

In the United States, the psyllid was first detected in Florida in 1998 and is now also found in Louisiana, Georgia, Arizona, South Carolina, and Texas In Southern California, the San Joaquin Valley, and Central Coast counties, such as San Luis Obispo, an eradication program has been instituted in an attempt to prevent it from becoming established. In the whole of the United States and its territories, areas where this psyllid is found are under quarantine restrictions

Citrus psylla (Diaphorina citri Kuwayama) (Homoptera: Psyllidae) is the most devastating and important insect pest of citrus cause heavy losses to citrus orchards through the greening disease of citrus being a viral vector (Hall et al., 2012). It was first time identified from South-East Florida during 1998, known as Asian citrus psyllid (ACP) (Halbert and Manjunath, 2004; Bové, 2006), which with the combination of citrus leafminer (Phyllocnistis citrella Stainton), slowed down development of young citrus trees in whole Florida. Then, ACP was recorded from Texas during 2001 (French et al., 2001). ACP has a wide range of host up to sixty plants including different Citrus.

Citrus psylla is one of the serious pests of citrus in north India especially in Punjab Haryana Maharashtra and Madhya Pradesh also. The insect has been recorded to attack sourlime (Citurs *medica acida*), Sweet lime (Citrus *medicalunetta*), Orange (Citrus *aurantium*), Lemon (Citrus *Medicalinonium*), Pomela (Citrus *decamana*) Citron (Citrus *medicamedica),* Mandarin and Grape fruit. Both the adults and nymphs of Citrus psylla suck the plant sap from leaves and young shoots. The infested plants become weak, its growth is arrested and especially the fresh crop of leaves and buds is completely destroyed. The insect also secrets a large quantity of honey dew on the leaves and shoots which gives rise to black fungus and hinders the photosynthesis. Citrus Psylla belongs to the family Psyllidae, genus Diaphorina and the speacies *Diaphorina citri*.

Figure 1. Adult Asian citrus psyllid, *Diaphorina citri* Kuwayama. Photograph by Jeffrey Lotz, FDACS-Division of Plant Industry.

Host Plant and Host Range

Mainly *Citrus* spp., at least two species of *Murraya*, and at least three other genera, all in the family Rutaceae. Citrus psylla acts as vector for "*Candidatus* Liberibacter spp." which is known etiological agent of most devastating disease "Citrus greening". Citrus Greening (Huanglongbing, HLB) is considered as most damaging disease of Citrus. HLB kills millions of citrus trees in many citrus growing areas worldwide. Some of the symptoms showed by HLB disease are yellow shoots, stunted growth, and abnormal pigmentation of fruit and have a bitter taste fruits unusable for juice production etc. There are three species of Candidatus liberibacter ssp. "*Candidatus* liberibacter asiaticus", "*Candidatus* liberibacter africanus", and "*Candidatus* liberibacter ammericanus". The Indian citrus psylla "*Diphoriana cirri"* transmit the *Candidatus* liberibacter asiaticus and which is found to be a most devastating species of *Candidatus* liberibacter. To control the vertical transmission of this deadly bacterium there is an urgent need to control citrus psylla.

Identification

Citrus psylla remains active throughout the year but is less visible in winter. Eggs hatched in 4 to 6 days in summer season and 10 to 20 days in winter season. The process of breeding start in February-March. Female lays eggs on the leaf and stem. The eggs of *Diaphorina citri* are approximately 0.3 mm long, elongate, almond-shaped, thicker at the base, and tapering toward the distal end. Newly laid eggs are yellow, but then turn yellow and finally orange before hatching. The eggs are placed on plant tissue with the long axis vertical to surface. *Trioza erytreae* eggs are laid with the long axis horizontal to surface. Nymphs are flattened and oval in shape with orange colour. *Diaphorina citri* nymphs are 0.25 mm long during the 1st instar, and 1.5 to 1.7 mm in last (5th) instar. Their color is generally yellowish-orange. There are no abdominal spots, whereas in *Trioza erytreae*, advanced nymphs have two basal dark abdominal spots. The wing pads in *Diaphorina citri* are large, while *Triozaerytreae* has small pads. In *Diaphorina citri*, large filaments are confined to the apical plate of the abdomen (in *Trioza erytreae*, there is a fringe of fine white filaments around the whole body, including head). The adult is four millimeters long in size, its body is brown and its head is light brown. The insect has shiny black feathers spread over the body with gray dust. It is covered with a whitish, waxy secretion that makes it look dusty. The façade is broad at the back and has a dark edge around the perimeter with a yellow gap near the top. The antennae are black and light brown. These characteristics distinguish it from the superficial African citrus psyllid. Normally it adopts a head, tails the pedestal as it sucks the sap. Aphids are also often present on citrus and psyllids can be distinguished from them by more active, jumping insects, while aphids are sedentary. In addition, the antennae of a psyllid have ten segments whereas aphids typically have four or six segments. Most aphids have a cornea on their abdomen and lack psyllids.

Symptoms of Damage

It is one of the harmful pests of citrus. It causes excessive loss by the amount of damage on the basis of pest population. Citrus affects trees in a different way depending on the season adapted to the Psylla nymph and the adult stage. Both nymphs and adults suck from venomous salivary plants. Feeding by adults and nymphs can damage and weaken the new redness of the season, which is buds, flowers, tender sprouts and small fruits. Nymphs are more destructive, crowded terminal shoots, buds and tender leaves.

Figure 2. Feeding damage caused by the Asian citrus psyllid, *Diaphorina citri* Kuwayama to citrus foliage. Photograph by University of Florida.

The abundant honey produced during feeding on the sugar sap is due to an increase in the mould of soot and a decrease in the photosynthesis of leaves. The higher population becomes condensed and the curling of new leaves and the length of shoots decrease, often leading to the effects of witches. Larger populations slow down the growth of young trees and cause a significant reduction in yield. The insect can be extremely harmful as it is also a major vector of the citrus greening pathogen. If the pest is not examined in time, the entire garden may suffer continuous damage in a year or two.

Life Cycle

1. The adults lay 500 almond shapes, orange and stalked eggs on tender leaves and shoots of citrus trees.
2. The eggs are laid either singly or in groups which hatch in one week in the summer.
3. There are 5 nymph stages and the development is completed in 2 weeks.
4. Full grown nymphs migrate to the lower surface of the leaves and convert into adults.
5. There are 8-9 overlapping generation in a year.

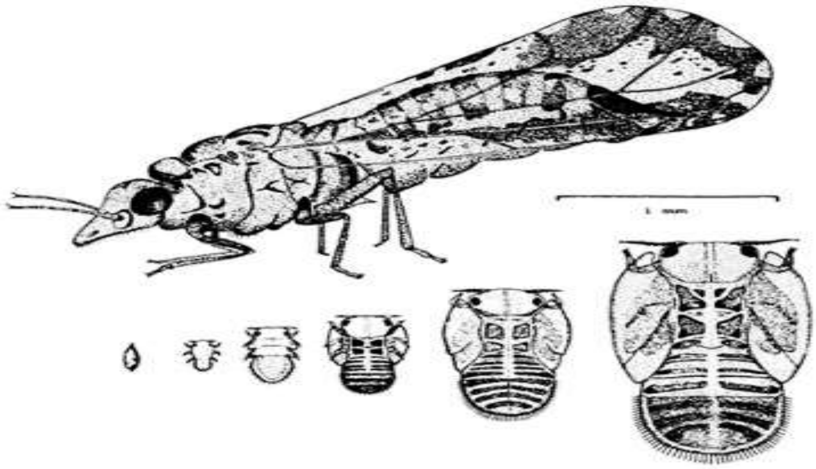

Figure 3. Adult female and nymphal instars of Asian citrus psyllid. Drawing by Division of Plant Industry.

Citrus Psylla as a Vector of Greening Disease

Huanglongbing (HLB) is caused by a phloem-limited bacterium that has a true cell wall. There are at least three forms or species: *Candidatus* L. africanus causing African HLB; *Candidatus* L. asiaticus causing Asian HLB; and a new varient found in Brazil, tentatively called *Candidatus* L. americanus. Asian HLB is the bacterium found in Florida (Chung and Brlansky 2009). Capoor et al. (1974) reported a high percentage of transmission by tissue grafts. They found that 4th and 5th instar nymphs and adults could affect transmission. *Diaphorina citri* requires an incubation period before it can transmit the pathogen, which it retains for life following a short access feeding (15 to 30 minutes) on a diseased plant.

Figure 4- Symptoms of greening disease, Liberobacter spp, on citrus. Photograph by University of Florida.

Infectious nymphs retain their ability to vector the disease into adulthood. Adult psyllids can transmit the pathogen that causes greening after feeding for as little as 15 minutes, but transmission was low. One hundred percent infection was obtained when the psyllids fed for one hour or more. Capoor et al. (1974) indicated that the pathogen multiplied in the body of the psyllid and that there was an absence of transovarial transmission. They summarized differences between *D. citri* and *Trioza erytreae* in various aspects of greening transmission.

Management

Cultural Methods:

a. Do deep plough in summer season.
b. Sanitation of the field should be maintained.
c. Balanced fertilization and irrigation in the dry season to avoid nutrient concentration in the leaves.
d. Pruning should be avoided in summer.
e. Infected twigs and plants should be separated.

Mechanical Methods:

a. Adult insect should be picked up by hand and destroy.
b. Use light traps for adult citrus psylla control.

Biological Methods:

a. Parasitoid: *Eulophid parasite, Tamarixia (Tetrasticus) radiata (Waterston), encrytid endoparasite, Diaphorencytrus aligarhesis.*

b. Fungal pathogen: *Cladosporium* sp. Nr. Oxysporium and *Capnodium citri Hirsutella citriformis Speare*.

c. Predators: *Mallada boninesis* (Okamoto) and *Chellomenes sexmaculata* (Fabricius) Histerid beetle, *Saprinus chalcities*: predaceous carabid *Egapola cremlata*.

d. Biological control of the citrus greening Pathogen using several strains of CTV through cross protection (van Vuuren et al.2000).

Chemical Control:

a. Systemic pesticides should be sprayed for citrus Psylla.
b. Malathion should be sprayed with 0.05% or Carbaryl 0.1%.
c. Spray trees with imidacloprid SL 40ml per 100 L of water.

References

1. Capoor SP, Rao DG, Viswanath SM. 1974. Greening disease of citrus in the Deccan Trap Country and its relationship with the vector, Diaphorina citri Kuwayama. p. 43-49. In Weathers LG, Cohen M (editor). Proceedings of the 6th Conference of the International Citrus Virology, University of California, Division of Agricultural Sciences.
2. Catling HD. 1970. Distribution of the psyllid vectors of citrus greening disease, with notes on the biology and bionomics of Diaphorina citri. FAO Plant Protection Bulletin 18: 8-15.
3. Costa Lima AM. da. 1942. Homopteros. Insetos do Brazil 3: 1-327. Esc. Na. Agron. Min. Agr.
4. French, J., Kahlke, C., Da Graça, J., 2001 - First record of the Asian citrus psylla, Diaphorina citri Kuwayama (Homoptera: Psyllidae) in Texas. Subtropical Plant Science, 53, 14-15.
5. Halbert, S.E., Manjunath, K.L., 2004 - Asian citrus psyllids (Sternorrhyncha: Psyllidae) and greening disease of citrus: a literature review and assessment of risk in Florida. Fla. Entomol., 87, 330-353.
6. Hall, D.G., Richardson, M.L., Ammar, E.- D., Halbert, S.E., 2012 - Asian citrus psyllid, Diaphorina citri, vector of citrus huanglongbing disease. Entomol. Exp. Applicata, 146, 207- 223.

The Multi-Dimensional Role of Women in Agriculture its Allied Sector

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Our Prime Minister Shri Jawaharlal Nehru once said that, "You can tell the condition of a nation by looking at the status of women".

Introduction

Agriculture plays a vital role in industrial and non-industrial economies, as a major contributor to the country's export earnings and as a source of employment and livelihood. Official statistics often underestimate the value of women's work and their overall contribution to national wealth. Women continue to provide a large proportion of the labour that goes into agriculture. Food and Agricultural Organization's (FAO's) estimates show that women represent a substantial share of the total agricultural labour force, as individual food producers or as agricultural workers. It further stated that around two-thirds of the female labour force in developing economies is engaged in agricultural work.

Agriculture is underperforming in many developing countries for a number of reasons. Among these is the fact that women lack the resources and opportunities they need to make the most productive use of their time. Women are farmers, workers and entrepreneurs, but almost everywhere they face more severe constraints than men in accessing productive resources, markets and services. This "gender gap" hinders their productivity and reduces their contributions to the agriculture sector and to the achievement of economic and social development targets. Closing the gender gap in agriculture would produce significant gains for society by increasing agricultural productivity, reducing poverty and hunger and promoting economic growth.

Women, like men, can be considered "productive resources", but they are also citizens who have an equal claim with men on the protections, opportunities and services provided by their governments and the international community. Gender equality is a Millennium Development Goal (MDG) in its own right, and it is directly related to the achievement of the MDG targets on reducing extreme poverty and hunger. Agricultural policy-makers and development practitioners have an obligation to ensure that women are able to participate fully in, and benefit from, the process of agricultural development. At the same time, promoting gender equality in agriculture can help reduce extreme poverty and hunger. Equality for women would be good for agricultural development, and agricultural development. (Dr. Basavaraj Patil and Dr. V Suresh Babus 2018).

The roles and status of women in agriculture and rural areas vary widely by region, age, and social class and are changing rapidly in some parts of the world. Policy-makers, donors and development practitioners need information and analysis that reflect the diversity of the contributions women make and the specific challenges they are confronted with in order to make gender-aware decisions about the sector.

Status of Women in India

The status of women can be judged by some indicators. To measure the status of women a composite index is constructed by the Population Crisis Committee (PCC) and used by the World Bank and the United Nations which focuses on indicators measuring health, education, employment, marriage and childbearing and social equality. Rustogi14 tried to measure women's status with the help of a diverse set of indicators (Ruchi Thakur1, Afsah Iqbal Nahvi2*, Vishal Sharma3 and Sanya Khan4). The literacy rate of females was 54.16% in 2001 and reached 74.8% in 2019.

Contribution of Women in Agricultural

Women make very important contributions to the agricultural and rural development in all developing countries. Rural women often manage complex households and pursue multiple livelihood strategies. Their activities include production of agricultural crops, supervision of animals, processing and preparing food, working for wages in agricultural or other rural enterprises, collecting fuel and water, engaging in marketing, caring for family and maintaining their homes. Many of these activities are not defined as “economically active employment” in national accounts but they are essential to the well-being of rural household.

Women play an essential role in building economy of the nation. Over the years, women play an important and crucial role in agricultural, allied fields. The nature and extent of women's involvement in agriculture varies greatly from region to region. But regardless of these variations, women are actively involved in various agricultural activities. As per Census 2011, out of total female main workers, 55 per cent were agricultural labourers and 24 per cent were cultivators. However, only 12.8 per cent of the operational holdings were owned by women, which reflect the gender disparity in ownership of landholdings in agriculture. Moreover, there is concentration of operational holdings (25.7 per cent) by women in the marginal and small holdings categories. percent labour for processing the basic food stuffs, 80 per cent for food storage and 90 per cent for water and fuel wood collection for households. Women produce between 60 to 80 percent of the food in most developing countries and are responsible for half of the world’s food production; therefore, women’s role in food production ensures the survival of millions of people in all regions. (Ruchi Thakur et.al 2018).

In India, the percentage of women who depend on agriculture is as high as 70%. In 2009, 94% of the female labour worked in cereal production, while 1.4% worked in vegetable production and 3.72% were engaged in fruits and spice crops. According to the Food and Agriculture Organization, Indian women represent a share of 21% and 24% of all fishers and fish farmers respectively.

A recent study conducted by Women and Population Division of FAO revealed that in developing countries women provide 70 percent of agricultural labour, 60-80 percent labour for household food production, 100 percent labour for processing the basic food stuffs, 80 per cent for food storage and 90 per cent for water and fuel wood collection for households. Women produce between 60 to 80 percent of the food in most developing countries and are responsible for half of the world’s food production; therefore, women’s role in food production ensures the survival of millions of people in all regions.

Women play a vital role in contributions to agriculture and rural development activities in all developing countries. Their roles vary considerably among and within regions and are changing rapidly in many parts of the world where economic and social forces are transforming the agriculture sector. The emergence of contract farming and modern supply chains for high-value agricultural products, for example, present different opportunities and challenges for women than they do for men. These differences derive from the different roles and responsibilities of women and the constraints that they face.

Women work in agriculture as farmers on their own account, as unpaid workers on family farms and as paid or unpaid labourers on other farms and agricultural enterprises. They are involved in both crop and livestock production at subsistence and commercial levels. They produce food and cash crops and manage mixed agricultural operations often involving crops, livestock and fish farming. All of these women are considered part of the agricultural labour force (FAO, 2010).

Multi-Dimensional Role of Women in Agriculture and Allied Sector

Agricultural Activities: Seed treatment , Sowing, transplanting, irrigation ,weeding, fertilizer application, plant protection, harvesting, winnowing, storing etc.

Domestic Activities: Cooking, child rearing, fuel wood gathering, water collection, household maintenance etc.

Other Activities: Cattle management, fodder collection, milking etc.

Agricultural activity means the cultivation of the soil, treatment of seed, sowing of seed, planting of crops, growing of fruit trees, including the harvest of such farm products and other farm activities.

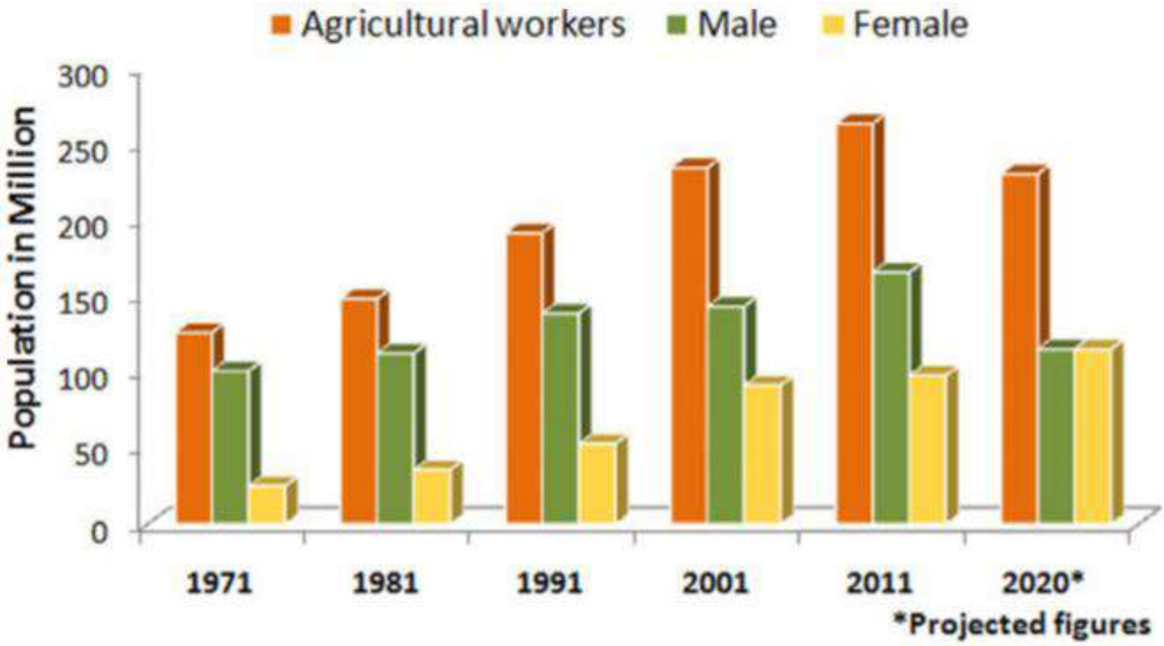

Fig 1: Population dynamics of women in Indian agriculture (Vision 2050, CIAE Bhopal.)

Women in Livestock Management

In mixed farming systems, livestock play an important role in supporting women and in improving their financial situation, and women are mostly engaged in the sector. Role of women in small-scale livestock production is well recognized and much less has been documented about women's engagement in intensive production and the market chains associated with large commercial enterprises.

Demand for livestock products, fuelled by rising incomes, has grown much faster than the demand for crop staples during the past 40 years – particularly in Asia and Latin America – and this trend is expected to continue. While small-scale mixed-farming systems continue to be important in meeting the needs of rural consumers, the demands of growing urban populations are increasingly supplied with meat, milk and eggs from intensive commercial systems. This has implications for the engagement of women in the livestock sector because of the different roles, responsibilities and access to resources that are evident within different scales of production system and at different points on the production and marketing chain.

The available evidence suggests that the role of women in meeting these changing demands may diminish, for two reasons. The first is that when livestock enterprises scale up, the control over decisions and income, and sometimes the entire enterprise, often shifts to men. The second important factor is that all smallholders face challenges when the livestock sector intensifies and concentrates and many go out of business.

Women in Fisheries and Aquaculture

Women have rarely engaged in long-distance capture fisheries because of the vigorous work involved but also because of their domestic responsibilities and/or social norms. They are more commonly occupied in subsistence and commercial fishing from small boats in coastal or inland waters. Women also contribute as entrepreneurs and provide labour before, during and after the catch in commercial fisheries.

Women in Forestry

Women contribute to both the formal and informal forestry sectors in many significant ways. They play roles in agroforestry, watershed management and forest protection and conservation. Forests also often represent an important source of employment for women, especially in rural areas. From nurseries to plantations, and from logging to wood processing, women make up a notable proportion of the labour force in forest industries throughout the world.

Women in Rural Labour Markets

Presently women have essential role in income generating activities of agriculture, but have little control over income. They are largely engaged in small scale activities and have better access to local market, often at a price discount. The challenge is to aggregate their small-scale production and improve the access to markets. This needs capacity development for access of women to technology, financial services and markets.

Main Obstacles in Women growth in Agricultural Sector

Main obstacles of women in agriculture sector are- Women have no power for decision making process, either inside or outside the home. However, women perform all un-mechanized agricultural tasks and perform multiple tasks which add more over burdens to them.

Women workers in agriculture suffer from high illiteracy rate among them and drop out of higher education. They have no proper knowledge about modern agriculture technologies and system . Women earn fewer wages, especially in joint informal and private sector. Therefore, women do not know their legal rights.

Conclusion

Our Prime Minister Shri Jawaharlal once said that, "You can tell the condition of a nation by looking at the status of women". So, we can say that development , prosperity and growth of any country can be measured by the status and development of its women. Almost half of the human resource of the world constitutes women and that is why they influence the growth of nation's economy. According to Swaminathan, the famous agricultural scientist, "some historians believe that it was women who first domesticated crop plants and thereby initiated the art and science of farming". In Indian society, women have a multi-dimensional role. The largest number of women in India is engaged in farming operations either as cultivators or as supervisors or as agriculture laborers. Most of the contributions made by women to the farm sector also go unaccounted as they are not directly paid. Therefore, rural women are the major contributors in agriculture and allied fields. Her work includes all activities in different fields i.e., crop production, livestock management, household, family maintenance, collecting drinking water, fuel and fodder. Women status is low by all social, economic and political indicators.

Women have been contributing extremely to agricultural growth and development through their involvement in crop production, livestock management, vegetable production, horticulture, aquaculture, fisheries, natural resource management etc. Though the proportion of women workers in agriculture has declined, yet they constitute a significant workforce in agriculture. Universally, they constitute large percent of economically active population in agriculture. Region-wise figures show that agriculture supports a very high proportion of economically active women, particularly in India. Women's contribution varies across regions, socio-cultural and agro-production systems. On the other hand, the continuing gender gap in access to and control of resources remains an important concern which has not only kept women in a ruthless circle of low productivity but also has thrown up questions about inclusive and sustainable growth of the sector. The need of the hour is on how to bridge the gender gap and empower women with new knowledge and technology is a very big challenge in present time, especially in the context of socio-economic changes.

References

1. Ruchi Thakur1, Afsah Iqbal Nahvi2*, Vishal Sharma3 and Sanya Khan4 "Multi-Dimensional Role of Rural Women in Agricultural: A Review" ISSN: 2320 – 7051 Int. J. Pure App. Biosci. 6 (5): 510-515 (2018)
2. Manas Modal, (Assistant teacher in Geography, Mata Monomohini madhyamik Vidyalaya "The Role of Rural Women In Agriculture Sector Of Sagar Island, West Bengal, India"The International Journal Of Engineering And Science (Ijes) ||Volume||2 ||Issue|| 2 ||Pages|| 81-86 ||2013|| Issn: 2319 – 1813 Isbn: 2319 – 1805
3. Dr. Basavaraj Patil and Dr. V Suresh Babus " Role of women in agriculture"ISSN Print: 2394-7500 ISSN Online: 2394-5869.
4. IJAR 2018; 4(12): 109-114 www.allresearchjournal.com
5. ICAR-CIAE, 2014, Vision 2050, CIAE Bhopal.
6. FAO. Agri-Gender statistics toolkit, 2010. (http://www.fao.org/gender/arigender/agri-gender-toolkit/it/).

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Impact of Covid-19 on Horticulture

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Introduction

India has always been known as an agricultural state, personified by small holdings, where maximum of its farmers is small and marginal, depending on farming as a survival, yet they feed 1.3 billion people. Agriculture employs about 55 % of the population and contributes roughly 17 %to the GDP. India stands second in agricultural production after China. Today we are living in unusual situation where countries are in shutdown, industries are locked, production get halted, trading stopped, economy is flattened, people are staying inside, overall, the earth is "healing" now. Covid-19 an invisible strain became a threat to the whole world. Destructions done by human beings to the nature are now paying off. Off course we should see it in both negative and positive outlook, things that we ignored is getting exposed, it is giving a chance to learn the lessons from the losses that are happening. In the present scenario of covid-19, functioning of agricultural supply chains is essential not only for food and nutritional security but also for livelihood of millions engaged in farming. Horticulture has a number of advantages compared with agriculture crops and it is more gainful. Besides higher productivity, the value of horticultural produce is far more than that of grains and pulses. Farmers' health needs attention, particularly because they have a relatively older demographic profile as compared to the general worker population. The sector has faced a number of enactments and amendments in the policies and programmers between the first Industrial Policy and Micro, Small and Medium Enterprises Development Act for better performance. It has acquired a highly regarded rest in the socioeconomic giving of India even after a variety of shortcomings in the strategy proposal, poor infrastructure, inadequate training, incomplete credit facility, higher sickness rate and so forth.

Role of Horticulture in Indian Sector

India produces 313.85 million tons of fruit and vegetables from an area of 25.49 million hectares and productivity of around 12.31 tons per hectare, which, compared to cereals and pulses, is nearly four times. Besides higher productivity, the value of horticultural produce is far more than that of food grains and pulses. This makes the horticulture sector a major driving force for doubling farm incomes even in this pandemic. India is the second largest producer of both fruits and vegetables in the world after China. India stands largest in production of ginger and okra amongst vegetables & ranks second in production of potatoes, onions, cauliflowers, brinjal, cabbages, etc. Amongst fruits, the country ranks 1st in production of bananas, papayas and mangoes (including mangosteens and guavas) grapes, pomegranates, mangoes, bananas, oranges account for larger portion of fruits exported from the country while Onions, Mixed Vegetables, Potatoes, Tomatoes, and Green Chilly contribute largely to the vegetable export basket. Importance of horticultural foods in meeting the Sustainable Development Goal of "Zero Hunger" by 2030 (United Nations) has assumed greater significance after covid-19, mainly because they are a source for many nutraceuticals and build our immune system. Certain horticultural plants with medicinal value will occupy center stage in the post-covid period because of their stated value in strengthening the immune system. This field needs more research and exploration. With the support of horticulture, many agro – industries came up in villages itself. It is an acceptable fact that horticulture can come in a big way to solve the problem of unemployment. Source of other industries e.g. rubber, oil, gum, dyes, chemicals etc. raw material for fruit and vegetable processing plants, hence become a solution in reducing unemployment. Employment is also generated in doing field operations like fruit picking / harvesting, grading, packing, selling etc. In cereals labor engagement is of 143 days and in fruits it is of 850 days (in intensively grown fruits like grapes, banana and pineapple it is 1000 to 2500 man-days).

How this Pandemic Affected our Horticulture Sector

1. Due to the impact of covid-19, migrant workers have moved back home. The question is what will they do back at home? Many, of course, will return to cities once the lockdown is over, yet a substantial number will stay back, most likely taking to agriculture. Reverse migration, made huge hit to horticulture sector. Starting from end of March to first of week of June is the pick period for harvesting Rabi crops, and demand of horticulture crops is huge in this season. For harvesting, skilled labour is required because of shortage, most of the crops get ripening in orchards without harvesting them, resulting quality deterioration. According to GOI data, around 263 million people are involved in agriculture sector and of them, more than half of them are agriculture labourers, these shows how far the impact is.

2. The unpredicted outbreak made huge impact both in supply and demand. Majorly two factors accounted high impact on horticulture, breakdown of logistics and decrease in demand.

3. Supply chain in India is diverse, highly scattered and disorganized. Supply chain is the life line of horticulture crops, being perishable in nature the shelf life of the produce is very short. Due to lockdown of nation, the transportation between inter-states and intra- states gets disrupted at beginning phase, even the government exempted for essential commodities, bottlenecks in chain still being the burning issue. With a greater number of halts in between, there is delay in reaching destinations. Due to this circumstance, produce in on-board is rotting without unloading them because of transporting under uncontrolled conditions. Banana, sweet lemon, watermelon, tomato and chilli farmers in Andhra Pradesh too are badly affected by the situation.

4. Exports of fruits & vegetables have declined 0.7% to US$ 0.29 billion in February. As India ranked second in horticulture globally, and recent marginal shift in cultivating horticulture from other crops there is estimation of high output, because of shutdown in trading there will be huge impact on farmers and economically to country.

5. As incomes fall, people consume less. The lockdown has dealt a blow to the agricultural sector at a time when crops like paddy, maize, red jowar, chillies, tomato and horticulture products like banana, watermelon, musk melon, sweet lime, grapes, pomegranate and papaya are ready to be harvested.

Can we Boost our Economy through Horticulture?

S. Mahendra Dev and Rajeswari Sengupta,(2020)2 in their paper entitled “Covid-19: Impact on the Indian Economy” On the health risk in rural areas, it is true to currently the problem is much more solemn in inner-city areas since of high compactness. But it can spread to 70% of the India’s inhabitants who live in rustic areas. There is a risk of Covid-19 dispersion to the grower, agricultural laborers, workers and others working throughout the food supply chains. The wrap up material used for agricultural merchandise can also carry the virus.

In spite of first economic contraction in 4 decades, India’s GDP shrinks 23.9% in Q1 of 2020-21, our agriculture and allied activities were the sole bright spot clocking a growth rate of 3.4% at constant prices in the first quarter of 2020-21:

1. Future lies in horticulture because of:
   a. High value crops.
   b. Less area with high output.
   c. Low inputs with high output.
   d. Having high potential value addition.
   e. Highly nutritious and safe for health.
   f. High potential for foreign exchange earnings.
   g. Provide higher employment opportunities.
   h. Highly remunerative for replacing subsistence farming that can alleviate poverty level.

i. Change in eating habits globally after outbreak, shifting to fruits and vegetable is a good sign.

2. Agriculture, therefore, has to be more intensive and profitable for them to make a living. Linking of MGREGA with agriculture, therefore, should be a long-term policy and not just a temporary one-time measure.

3. The ruination of the Indian farmer has been that agriculture goods cannot be expensive as millions of poor people would otherwise starve. The government thus has to ensure that the MSP for agricultural products is reasonably high so that farmers find farming a profitable venture and are able to sustain farming.

4. The supply of hybrid seeds of staple and horticultural crops needs to be watched to sustain productivity. Farmers should follow the policy of "atmanirbhar Bharat" by producing our own hybrid seeds rather than depending upon imports. Another means to become self-reliant in the seed sector is to promote our own land races, particularly in the tribal areas and thus can help in building our economy.

5. Government should focus on establishing perishable collection clusters with value added facilities like sorting, grading, packing etc., including village level cold storage units which can help in giving employment at village level even in lockdown.

6. Government should act proactive and should come forward strategically to mitigate the loss and to see crisis as open doors to make New India.

Conclusion

1. With such diverse benefits from the agriculture sector in the lockdown and post-COVID-19 period, when food demand is expected to keep growing, it should remain a priority sector.

2. As we learn to live with corona, we also must realize that empathy will be our major healer, and agriculture is our only saviour. It is ultimately our self-reliance in agriculture that would help us sustain in this pandemic.

3. The sector creates wealth from land, water and light, using semi-skilled labour and agri-inputs. In learning to live with coronavirus, we also must realize that agriculture may be a saviour. It is ultimately our self-reliance in agriculture that would help us sustain during this pandemic.

4. It is appreciable that the government envisions developing post-harvest and value addition sectors right at the village level; this will provide jobs and livelihood. Entrepreneurs can also take advantage of the economic package announced by the government.

5. Every crisis gives opportunities, converting opportunities to key driver's matters.

References

1. M. Alaguraja, Dr G.Nedumaran, M. Manida, Performance of Khadi and Village Industries Commission through Micro, Small, & Medium Enterprise, AEGAEUM JOURNAL, Volume 8, Issue 3, Pages 677-68, 2020/3.
2. S. Mahendra Dev and Rajeswari Sengupta, Covid-19: Impact on the Indian Economy, Indira Gandhi Institute of Development Research, Mumbai April 2020.
3. www.orfonline.org/expert-speak/impact-covid19-rural-lives-livelihoods-india-64889.
4. https://www.downtoearth.org.in/news/agriculture/poor-post-harvest-storage-transportation- facilities-to-cost-farmers-dearly-61047.
5. http://www.nhb.gov.in/OnlineClient/MISDailyReport.aspx.

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Small RNAs (A Non-Coding RNA) and their Biogenesis

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Summary

Small, non-coding RNAs are a discrete class of regulatory RNAs that control a variety of biological processes. In plants, several classes of small RNAs with explicit sizes and keen functions have originated through a series of pathways. The major classes of small RNAs include microRNAs (miRNAs) and small interfering RNAs (siRNAs) that differ mainly in their biogenesis. miRNAs control the expression of associated target genes by binding to complementary sequences, resulting in translational inhibition or cleavage of the target RNAs. siRNAs have almost similar structure and function but differs in biogenesis as siRNAs are derived from long double-stranded RNAs in contrary to miRNAs which are derived from hairpin/stem-looped dsRNA precursors and moreover siRNAs often direct DNA methylation at target sequences. These small RNAs have profound roles in growth and development of plants as well as in the maintenance of genome integrity but besides these functions, small RNAs are also an important component of plant stress responses. Plants are reported to modify their gene expression through the activity of small RNAs in a way to respond against environmental stress.

Introduction

Plants are continuously challenged to both abiotic and biotic stresses that severely reduce their potential productivity. Plant responses to these stresses are complex and comprise number of physiological, molecular and cellular adaptations. These adaptive responses are well coordinated and operational at the transcriptional, post-transcriptional, translational and post-translational levels.

A small double-stranded RNA (dsRNA) in *Caenorhabditis elegans* acting as a regulator that turned off translation was first observed by **Fire (1998)**. Afterwards, with the beginning and advent of sequencing projects and development of high-throughput sequencing techniques, genes encoding small RNAs (sRNAs) have been identified. Interestingly, the genome of *C. elegans* was reported to contain 1,300 genes coding for functional non-coding RNA (ncRNA) transcripts. These genes were termed as ncRNA genes, which transcribed functional RNAs, although translation was not observed. Therefore, a comprehensive understanding of regulation at all levels will provide improved tools to mend plant's performance under stress. However, newly discovered 21–24 nt small RNAs i.e., microRNAs (miRNAs) and small-interfering RNAs (siRNAs), which regulate gene expression at the post-transcriptional level, are also altered during stress and probably contribute to the stress-induced changes in mRNA profiles or protein profiles.

Although there are various types of RNA including, miRNA (microRNA), small-interfering RNAs (siRNAs), piRNA (Piwi-interacting RNA), heterochromatic small interfering RNA (hcRNA), snoRNA (small nucleolar RNA), lincRNA (large non-coding intergenic RNA), SRP RNA (signal recognition particle RNA), tRNA (transfer RNA), mtRNA (mitochondrial RNA) and mRNA (messenger RNA) but amongst these, miRNA and siRNA are reported to have profound role in biotic and abiotic stress response of plants.

In plants, small RNAs act in gene silencing by mediating RNA slicing, translational repression, and histone modification and DNA methylation. The RNA slicing and translational repression control gene expression post-transcriptionally, whereas the histone modification and DNA methylation affect gene expression at the transcriptional level. Together with the knowledge of stress-responsive genes, a better understanding of the role of miRNAs during stress will contribute to the better design of strategies aimed at improving stress tolerance of crop plants.

Classification of sRNAs

RNAs are classified into coding and non-coding RNA. ncRNAs have been variously classified depending upon their origin and functions. In C. elegans, ncRNA genes have been described as a repertoire consisting of transfer RNA (tRNA) genes, ribosomal RNA (rRNA) genes, trans-spliced leader RNA genes, microRNA (miRNA) genes, spliceosomal RNA genes and small nucleolar RNA genes. It was later demonstrated that other organisms do possess ncRNA genes.

Before going into details of small RNAs it is vital to understand differences and similarities between these small RNAs (sRNAs) and coding RNA i.e., messenger RNA (mRNA). Therefore, the major differences and similarities are enlisted in (Table 1).

Table 1. Differences and similarities between sRNAs and mRNAs Property:

Property	Non-coding RNAs	Protein coding RNAs
Length	20-30 nt (processed small RNAs) 64-303 nt (plant precursors) 60-70 nt (animal precursors)	Polynucleotides
Location of synthesis	Nucleus and cytoplasm	Nucleus and cytoplasm
RNA polymerase required	RNA polymerase II and IV	RNA polymerase II
Protein synthesis	No	Yes
Binding to Argonaute protein	Yes	No
Expression pattern	Mostly tissue- and developmental stage-specific expression	Only few with tissue- and developmental stage -specific expression
Energy consumption	Expressed without translation, requiring less energy	Translation, requiring relatively higher energy
Degradation rate	Less stable	More stable
Open reading frames	Absent	Present
Response to point mutations	Less sensitive	More sensitive
Effect of point mutations	More drastic effect	Less effect
Functions	Transcriptional and post-transcriptional gene silencing	Expression of genes
Identified types	miRNAs, siRNAs, tasiRNAs, rasiRNAs, vsiRNAs, piRNAs	mRNAs

Among the various classified ncRNAs, sRNAs have been extensively studied. sRNAs are a class of double-stranded RNAs with 20-30 nucleotides (nt) in length. They tend to target chromatin as well as transcripts, thus regulating both genome and transcriptome. But the term sRNA is rather a misnomer. This is because all known types of ncRNAs are recognized as small RNAs.

In addition, bacterial short regulatory RNAs are also designated by the same term. So, the unique feature distinguishing eukaryotic sRNAs from remaining known RNAs of genome is their small size (20-30 nt) and tendency to bind with Argonaute (AGO) family proteins. AGO proteins are the sRNA effector proteins and the key components of RNA-induced silencing complex (RISC). These proteins are involved in directing mature sRNA to its target mRNA. Though both sRNAs and protein-coding RNAs (mRNAs) possess variations, sRNAs can effectively regulate gene expression, gene splicing, nucleotide modifications and protein transport.

Amongst all, miRNAs and siRNAs have been characterized in plant as well as animal systems whereas piRNAs have been identified only in animals, miRNAs are 20-22 nt in length and siRNAs are 21-24 nt long. Various types of siRNAs have been identified, including trans-acting siRNAs (Ta-siRNAs), repeat-associated siRNAs (Ra-siRNAs) and natural-antisense transcript-derived siRNAs (Nat-siRNAs) based on biogenesis and functions.

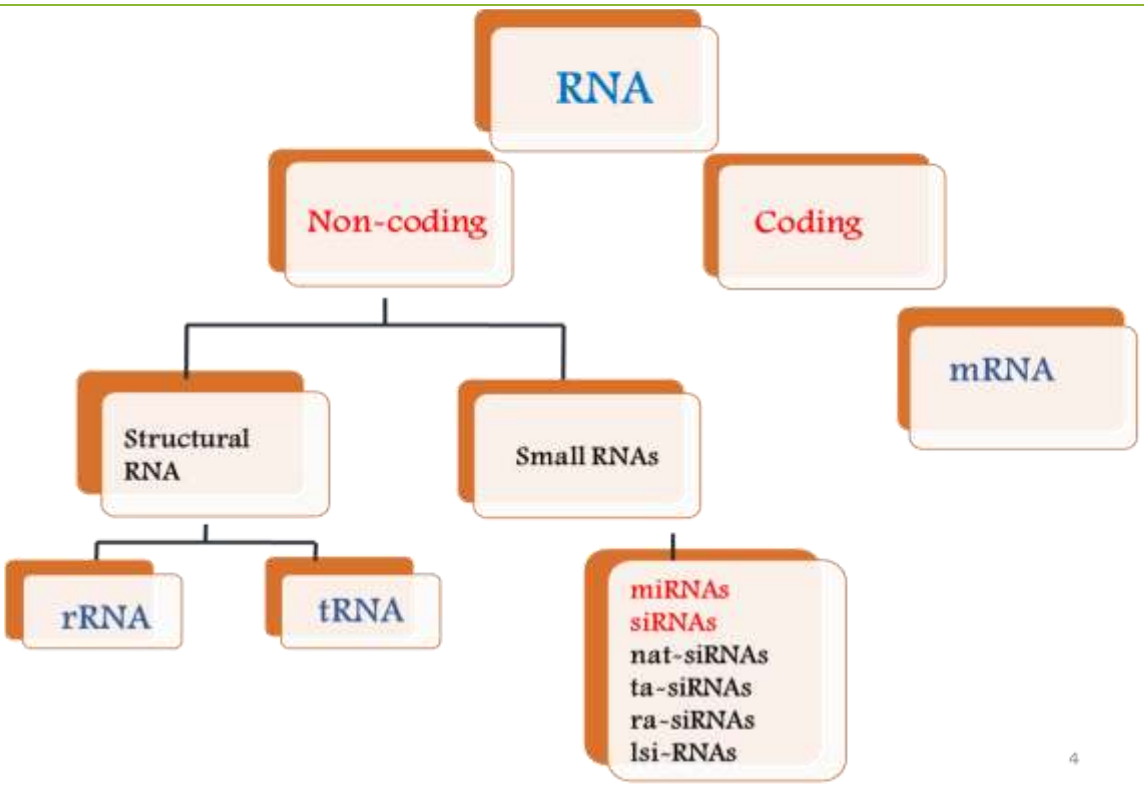

Figure 1. Types of RNAs: RNAs are classified into coding and non-coding RNAs. Coding-RNAs comprise of messenger RNAs (mRNAs). Non-coding RNAs are sub-divided into ribosomal RNAs (rRNAs), transfer RNAs (tRNAs) and small RNAs. Small RNAs constitute microRNAs (miRNAs), short interfering RNAs (siRNAs) and piwi interacting RNAs (piRNAs).

The biogenesis and functions of most of these small RNA classes have been well characterized in the model plant *A. thaliana*. In general, small RNAs are generated from at least partially double-stranded RNA precursors by the action of ribonuclease III-like Dicer proteins (DCL). miRNAs are 21-nucleotide noncoding RNAs and are processed from hairpin precursors by the Dicer family of enzymes.

Biogenesis and Function of miRNAs

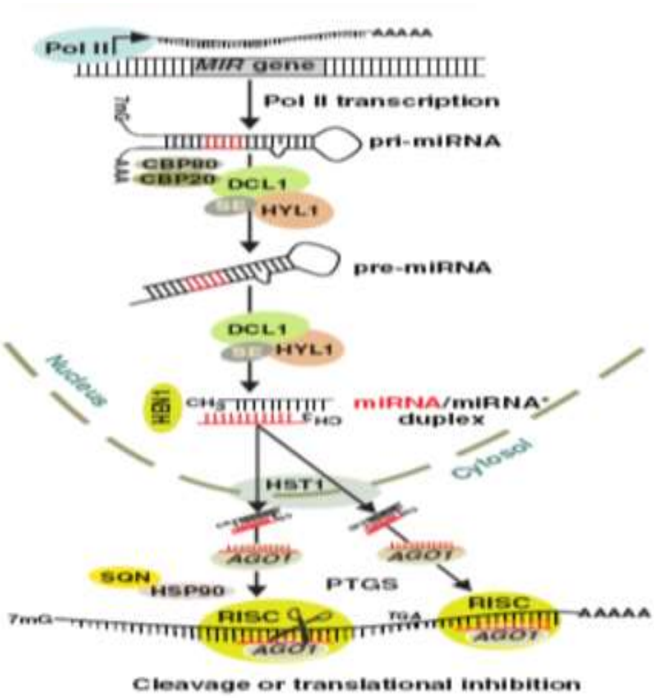

Fig: Biogenesis of miRNA

MIR genes are initially transcribed by PolII into a single-stranded RNA that folds back to form a hairpin structure (also called pri-miRNA) thought to be stabilized by the RNA-binding protein DAWDLE (DDL). Splicing and further processing in nuclear dicing bodies involve the interactive functions of HYL1 and SE and of the cap-binding proteins (CBP) CBP20 and CBP80. Pri-miRNAs and pre-miRNAs are generally thought to be processed from the free-end opposite to the loop by DCL1 to yield one or several phased miRNA/miRNAs* duplexes. These are then methylated by HEN1 and transported to the cytoplasm by HST1. The miRNA guide strand is selected, incorporated, and stabilized in dedicated AGO1 protein. miRNA-guided AGO1-containing RISC directs mRNA cleavage or translation inhibition of the target transcript. miRNA-guided AGO1 functions are promoted by SQUINT (SQN) and HSP90.

Biogenesis of siRNA and Function

Various sources of dsRNA, its processing into siRNAs by one of four DCLs proteins assisted by dsRNA-binding proteins, HEN1-mediated siRNA stabilization, and selected strands of siRNA duplexes guide AGO-containing RISC to target RNAs for endonucleolytic cleavage and for translation repression, or these siRNAs can then guide AGO4 or AGO6 to function in RNA-directed DNA methylation (RdDM) pathway involving PolIV and PolV. Cytosine methylation at these specific sites involves different effectors like the de novo methyl-transferase DOMAINS REARRANGED METHYLTRANSFERASE 2 (DRM2); DEFECTIVE IN RNADIRECTED DNA METHYLATION 1 (DRD1), a member of the SWI2-SNF2 chromatin remodelling protein family; and DEFECTIVE IN MERISTEM SILENCING 3 (DMS3), a structural maintenance of chromosomes (SMC) protein.

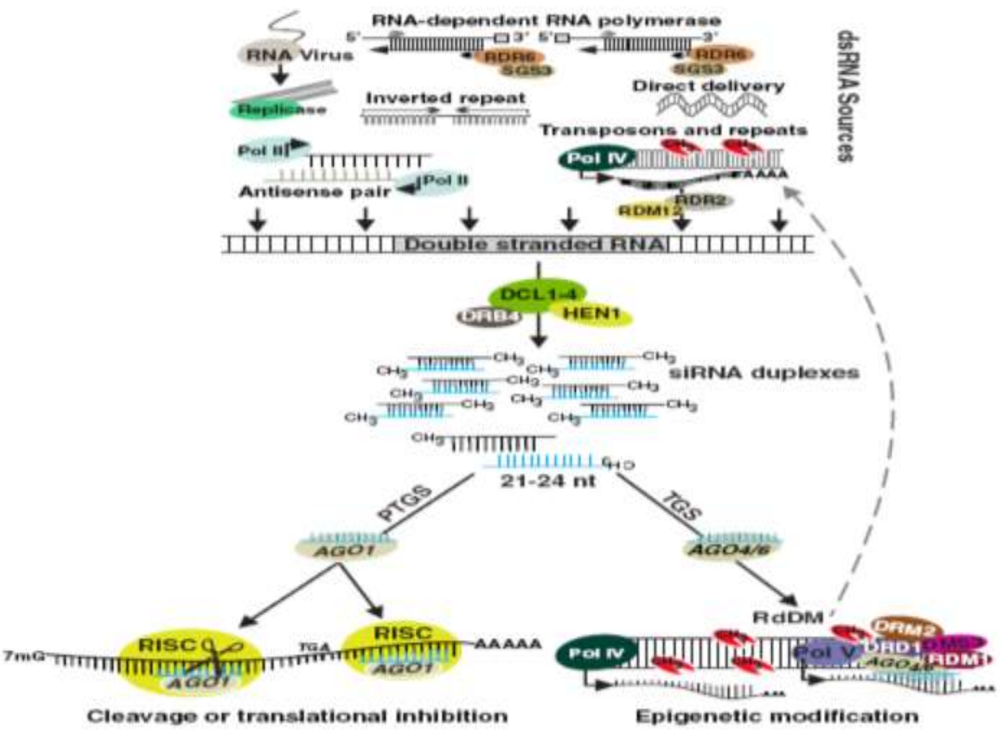

Fig: Biogenesis of siRNA

References

1. Bartel D. P. 2004. MicroRNAs: Genomics, biogenesis, mechanism, and function. Cell 116: 281-297.
2. Carrington J. C. and Ambros V. 2003. Role of microRNAs in plant and animal development. Science 301: 336-338.
3. Carthew R. W. and Sontheimer E. J. 2009. Origins and mechanisms of miRNAs and siRNAs. Cell 136: 642-655.
4. Finnegan E. J. and Matzke M. A. 2003. The small RNA world. Journal of Cell Science 116: 4689-4693.
5. Fire A. 1998. Potent and specific genetic interference by double-stranded RNA in Caenorhabditis elegans. Nature 391: 806-811.
6. Guleria P., Mahajan M., Bhardwaj J. and Yadav S. K. 2011. Plant small RNAs: biogenesis, mode of action and their roles in abiotic stresses. Genomics Proteomics and Bioinformatics 9: 183-199.
7. Kim V. N. 2005. Small RNAs: classification, biogenesis, and function. Molecular Cells 19: 1-15.

Physiological Disorders of Cauliflowers

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Introduction

Among of all the Cole crops, Cauliflower is one of the major Cole crops grown in the world. As a vegetable it provides leaves, stem, flower and roots that are consumed freshly or by processing. It has high amount of nutrients and vitamins. Cauliflower is sensitive to a number of disorders which reduce the quality and yield of the produce. Physiological disorders of crops are abnormalities in economically necessary a part of vegetables or different components that contribute to yield and quality of vegetable is termed as physiological disorder. The abnormalities occur as a result of environmental stress, nutritional deficiencies or excesses on the plant.

Riceyness

A premature initiation of floral buds on the upper surface of curds and the surface of the curd become loose or granular due to elongation of pedicel, such condition is called riceyness. This disorder mainly caused by fluctuations in temperature at the time of curd development and poor seed stock. Riceyness mainly develops during the warm weather. Heavy dose of nitrogen and high relative humidity also contributes to riceyness.

Control: It can be controlled by proper selection of varieties in accordance with the growing season, optimum application of nitrogenous fertilizer and proper management of soil moisture and fertility during the development of head or curd help minimize this condition.

Fuzziness

In this disorder the curd appears velvety due to elongation of flower pedicle. This is caused to hereditary or due to unfavourable conditions.

Control: Sowing of good quality of seed in right times under proper culture practices minimizes the fuzziness.

Leafiness

This condition is characterized by development of small green leaves between the sections of the curd is thought to be caused by relatively high temperatures and delayed harvesting.

Control: This can be controlled by selection of proper varieties based on their adaptability and seasons.

Buttoning

Development of small curd or 'button' with small leaves in cauliflower is known as buttoning. It is also referred to as premature heading. This is mainly caused by deficiency of nitrogenous fertilizers, transplanting over-aged seedling, water stagnation in field, planting of early variety late and exposure of the transplants to poor light conditions.

Control: This disorder can be controlled by application of an adequate amount of nitrogen, timely field transplanting and provides favourable conditions during the vegetative growth of plant and the seedlings to be transplanted should not be more than six weeks.

Whip-Tail

Young cauliflower plants become chlorotic in nature and may turn white, particularly along the leaf margins, leaves also become cupped and wither and eventually the leaf dies and the growing point also collapses. No proper development of leaf blades. This condition is called Whip-tail. This is generally caused due to molybdenum deficiency. It is more frequent when cauliflowers are grown on acidic soils because availability of molybdenum is reduced with the decrease in soil pH below 5.5.

Control: It can be corrected by proper liming the soil with 5-7.5 t/ha of limestone which reduces the acidity and increases the soil pH up to 6.5. Application of 1-2 kg /ha ammonium molybdate reduce this problem.

Browning

Browning is a common problem in cauliflower. Sometimes there is an appearance of water-soaked lesions in the steam, leaf and on the surface of the curd which later become rusty and brown in colour. Affected curds develop a bitter taste. This symptom is mainly observed when there is a deficiency of boron in plant or in soil.

Control: Application of borax or sodium borate @20kg/ha is recommended to get rid out of browning in cauliflower.

Blindness

When the terminal bud does not develop or gets broken or eaten away by the insects, the condition is called 'blindness. In the earlier stages of plant growth, the growing buds of cauliflower get affected due to which curd formation does not occur. The leaves become large, dark green and leathery owing to the accumulation of carbohydrates. This is due to low temperature and insects such as cutworms.

Control: It can be controlled by avoiding young plants from low temperature exposures and avoid damage to seedlings from insect-pests /rodents.

Hollow Stem

This is mainly caused due to high nitrogen and boron deficiency. The Stem becomes hollow and necrotic due to internal splits in the stem.

Control: This can be controlled by adopting close spacing and required amount of nitrogen or by spraying 15-20 kg/ha borax.

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Symbiosis in Aquatic Environment

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Introduction

Symbiotic relationships are an important component of aquatic biota, forming relationships where plants or animals of diverse species may be dependent on one another for existence where they may share habitats or interact in a certain manner to benefit from the presence of another organism. Symbiosis can be defined as an interaction between organisms, within a biotic community, which can be both positive or negative. In positive associations either both organisms are benefitted or at-least one out of the two organisms get benefitted other being neither benefitted nor harmed, while in negative association one out of the two organism gets harmed and other gets benefitted. In aquatic environment following three types of symbiosis can be seen prominently:

1. Mutualism.
2. Commensalism.
3. Parasitism.

All types of symbiosis are highly efficient and help to achieve a balance in the ecosystem also are non-competitive in nature.

Mutualism

Mutualism is a symbiotic relationship benefitting both the species of the association, usually seen in aquatic system between some sea anemones and Boxer crabs, *Lybia tesselata.* The latter holds the anemone in its claws to take advantage of its stinging tentacles to fend off predators; also providing left overs of meal to the sea anemone.

Another mutual relationship is seen among Remoras, collectively known as "suckerfish" as they have tendency to attach themselves to another species, like dugongs, sharks, sea turtles, and manta rays. The remora, which is a fairly large fish, utilizes its host for protection, transportation, and scraps from the meals of larger predators. The remora can also exist in mutualism with its host and establish a cleaning symbiosis by removing bacteria and parasites from the skin of respective host. For instance, it attaches itself to a shark and uses the shark for transportation and eats all the food that is left over from the shark, they also remove parasites from the teeth and skin of shark.

Another kind of mutualistic association formed by the interaction of algae and fungus are Lichens. Fungus being the major partner allows the lichen to thrive in extreme conditions, thus providing a safe environment for algae to grow, while the algae in turn is capable of photosynthesis, thus providing nutrients for the fungus.

Fig. a) Remora fish and Shark

Fig. b) Boxer crab and Sea anemone

Commensalism

Commensalism is a symbiotic relationship where one species provides protection for another less mobile or more vulnerable species. In this association, there is no physiological interdependence among the partners and the partners are termed as commensals. The purpose of establishing commensalism is to obtain food, space, shelter, protection and transport. The relationship between Clownfish and anemones is a well-known example of commensalism. Clownfish live in the stinging tentacles of sea anemones. They are coated in mucous, which protects them from the stinging nematocysts of anemone. Other animals like crabs and shrimps also seek protection in anemones.

Imperial shrimps ride on sea cucumbers, hopping off when they need to feed in certain areas. When the shrimp is ready to go to another area, it will hop back on the cucumber and get transported to the new area without using very much energy.

Sometimes Imperial shrimp will ride on other animals like nudibranchs, and these animals offer protection to the shrimp as they are poisonous to other animals. Several species of sea cucumbers host the Pearlfish inside their intestines during the day. At night, the Pearlfish swims out of the anus of the sea cucumber to eat crustaceans. The sea cucumber remains unaffected by the whole process and the Pearlfish earns protection from predators during the daytime.

Fig. c) Clown fish and Sea anemone

Fig. d) Imperial shrimp and Sea cucumber

Parasitism

Parasitism is one of the harmful associations towards the host organism, where one animal or species (parasite) gets benefit over the other (host). The partner getting advantage is referred as parasite and the partner getting affected is termed as host. Some organisms go through a parasitic stage at some point during their lives while afterwards leading a different life.

Therefore, based on the duration of parasitic mode during their lives, parasites are classified as permanent and temporary parasites. For example, glochidium larva of freshwater mussel attaches itself to the host fish via its hooks, once it attains younger stage it leads a permanent benthic-life.

The permanent parasites are categorized as ectoparasites and endoparasites. Ectoparasites are those which live on the outside of the host and endoparasites live inside the system of host. The endoparasites are further divided into intracellular and intercellular parasites.

Parasites present inside the host cell are called intracellular parasites (e.g., Trypanosoma) and those which live in between the cells of the host are intercellular parasites (e.g., flukes, isopods, etc.). Ectoparasites are often crustaceans in the order Isopoda or Copepoda. Isopods have adapted strong suckers, flat bodies, and sharp jaws used to attach to their host, they mostly feed on blood.

Other external parasites found on gills of fish are leeches, fish lice on fish skin, further damaging tissue and, in seawater, larvae of gnathiid isopods feeding on fish blood and tissue.

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Fig. e) Fish lice on fish fin	**Fig. f) Trypanosoma (Protozoan)**

Symbiotic relationships can be important standards of the ecosystem health. For example, Lichens (symbiosis among fungi, algae, and/or cyanobacteria) and bryophytes (mosses and liverworts) are generally used to estimate air pollution. These serve as effective bioindicators of air quality due to absence of roots, cuticle and acquire all of their nutrients directly from the atmosphere.

Their high surface area to volume ratio further advances the interception and accumulation of contaminants from the air. Furthermore, large tracts of coral reefs are severely damaged or dead due to recent elevations in ocean temperature caused by climate change. The rise in temperature induces coral to expel the algae that inhabits mutualistically inside them. Removal of algae turns the coral turn white, further causing death. This loss of symbiosis is an early indication of degradation in coral health and indicates not only the importance of considering symbiosis within aquatic environments, but also of scrutinizing the ill-effects that humans can imprint on these associations.

Such different types of interactions in the aquatic environment along with maintaining the balance among biotic communities also at times act as potent bio-indicators providing a hand in bio-monitoring of the ecosystem.

References

1. https://www.leisurepro.com/blog/explore-the-blue/5-marine-symbiotic-relationships/
2. https://marinebio.org/conservation/marine-ecology/symbionts-parasites/
3. https://prezi.com/z2eddifud0_n/remora-fish-and-shark-symbiosis-relation-ship
4. http://ecoursesonline.iasri.res.in/
5. Symbiosis: The art of living together, nationalgeographic.org
6. E. A. Holt and W. Scott, 2010. Bioindicators: Using Organisms to Measure Environmental Impacts. Nature Education.

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WWW.AGRIFOODMAGAZINE.CO.IN
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Nanotechnology: A New Perspective in Herbicide Residue Management

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In recent years, water pollution and pesticide residues in the food chain have become a serious environmental and health hazard problem. Therefore, an efficient technology is essential for complete mineralization of pesticides to non-toxic forms. Nanotechnology has the potential to make a beneficial impact on several agricultural, forestry, and environmental challenges. Nano-sensors and nano-remediation methods may detect and remove environmental contaminants. However, limited knowledge concerning nanomaterial biosafety, adverse effects, fate and acquired biological reactivity once dispersed into the environment, requires further scientific efforts to assess possible nano-agricultural risks.

Introduction

Pesticides are widely used in agricultural production throughout the world to protect plants against pests, fungi and weeds. Therefore, residues of pesticides are extensively dispersed in drinking waters, groundwaters and soils. The increasing demand for agricultural products and the resultant commercialization of agriculture have induced a rising use of agricultural chemicals in India. The shift of agriculture management strategies to the mode of agribusiness laid emphasis on risk management as one of the major challenges in agriculture.

Persistence and Residues of Herbicides

An herbicide is said to be persistent if it is present in the soil in its original or closely related but phytotoxic forms even after its mission is accomplished. The length of time an herbicide remains active in soil is called persistence. The quantity that exists is referred to as residue. Persistence of some herbicides are presented below.

Herbicide	Persistence in soil (days)
Atrazine	45- 90
2, 4-D	45-90
Dithiopyr	90-150
Isoproturan	90-120
Pendimethalin	60-200
Metolachlor	40-190

Problems of Herbicide Residues

Causes injury to sensitive plants grown in rotations, inhibition of beneficial soil micro - organisms, accumulation of residues from application rates which exceeds rate of dissipation, adverse effects on non-target plants and phytotoxicity to crop plants.

Nanotechnology has attracted a lot of attention recently, particularly in the research and industrial communities. Nanotechnology is the development and utilization of structures and devices with a size range from 1 nm (molecular scale) to about 100 nm where new physical, chemical and biological properties occur as compared to their bulk counterparts, such as extremely small size, high surface area to volume ratio, surface modifiability and excellent magnetic properties and the recent advances in nanotechnologies for removal of pesticides is adsorption, filtration and degradation (Firozjaee et al., 2018).

The Process Involved in the Pesticide Removal are

1. Adsorption: Adsorption is well known equilibrium separation process and an effective method. It is a surface phenomenon and depend on the number of sites available, porosity and specific surface area of the absorbent. Commonly used absorbents are:

a. Carbon Nanotubes: A new class of nano-materials composed of graphite carbons with one or more several concentric tubules. The adsorption capacities of pollutant by carbo nanotubes are affected by the pore structure and existence of broad spectrum of surface functional groups. Types are single walled carbon nanotube and multiwalled carbon nanotube. These nanomaterials have been shown to have good potential to remove various types of pesticides. the adsorption of diuron and dichlobenil increase with an increase in surface area and total pore volume of MWNTs. The presence of Pb^{2+} decreased the adsorption of diuron and dichlobenil.

Fig.1: Single walled Carbon nanotube

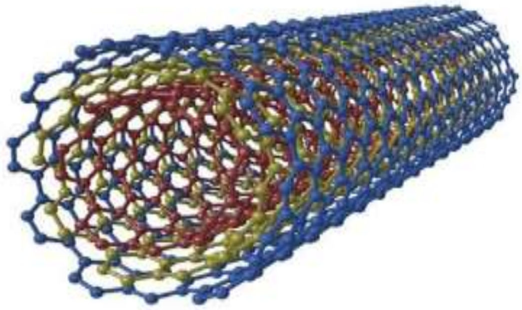

Fig.2: Multiwalled Carbon nanotube

b. Graphene: These are carbon-based nanomaterial, having adsorption capacities for pesticides ranging from 600 – 2000 mg/g. graphene can combine with other materials to improve pesticide adsorption. Graphene coated silica (GCS) as a highly efficient sorbent was used for removal of residual organophosphorus pesticides.

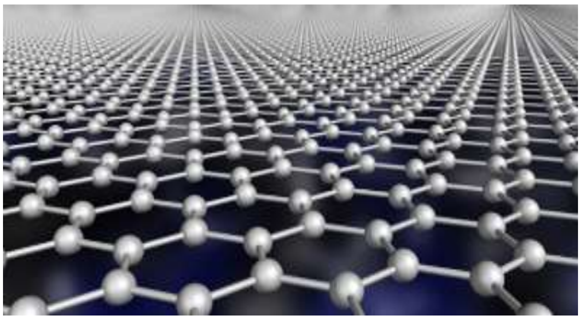

Fig.3: Graphene

c. Nanocrystalline metal oxides: These are highly effective absorbents for broad range of pesticides. Low-cost metal oxides include ferric oxides, manganese oxides, aluminium oxides. They not only absorb but also destroy many chemical hazards by converting them into much safer by-products. nanocrystalline alumina can effectively adsorb organophosphate pesticides in a short period of time because of high surface area and the concentration of hydroxyl groups on the surface of nanocrystalline alumina.

2. Filtration: Nanofiltration is the most recent technique of membrane filtration. It is a type of pressure driven mechanism with properties between reverse osmosis (RO) and ultrafiltration (UF) membrane. Plakas and Karabelas (2009) indicated that combined nanofiltration of triazines (atrazine, prometryn) and naturally occurring humic substances facilitated the formation of complexes with triazines which in turn enhance their removal by nanofiltration.

3. Degradation:

1. Zerovalent iron (ZVI): zero valent ion classified into two types:

a. nZVI: Having diameter of 100 – 200 nm composed of Fe with a valence of zero.

b. Reactive nanoscale iron product: These particles have 50:50 weight of Fe and $Fe3O_4$.

i. It is used in the dechlorination of highly recalcitrant pesticides and herbicides.

ii. ZVI acts as a chemical reductant.

iii. Many pesticides are vulnerable to degradation by ZVI.

iv. Nitroaromatic pesticides were rapidly reduced with zero-valent iron to the corresponding amines as major reduction products.

b. Photocatalysis: Photocatalytic oxidation is an environmentally friendly process used in the removal of the wide range of organic pollutant. Photocatalysis can also be used as a polishing step to treat recalcitrant organic compounds.

In this process, photoexcitation of semiconductor solid surfaces happens by irradiation, either by near UV or solar light. As a result, mobile electrons and positive surface charges are generated. These excited sites and electrons accelerate oxidation and reduction reactions, which are essential step for pollutant degradation. photocatalytic degradation of dicofol with TiO_2 nanoparticles under UV light irradiation showed that dicofol could be completely degraded and active hydroxyl radicals (Yu et al., 2008).

Conclusion

Sensitive detection and efficient removal of an increasing number of persistent and emerging environmental pollutants are major challenges in our industrialized world. Sensors, diagnostic and remediation devices for on-site application may allow close monitoring of environmental conditions, therefore increasing plant growth and protection as well as agricultural productivity, while reducing the use of agrochemicals in a precision farming perspective.

References

1. Firozjaee, T. T., Mehrdadi, N. M., Baghdadi and Bidhendi, G. R. N., 2018. Application of Nanotechnology in Pesticides Removal from Aqueous Solutions- A review. International Journal of Nanoscience and Nanotechnology. 14(1): 43-56.
2. Plakas, K and Karabelas, A., 2009. Triazine retention by nanofiltration in the presence of organic matter: The role of humic substance characteristics. Journal of Membrane Science. 336: 86-100.
3. Yu, B., Zeng, J., Gong, L., Yang, X., Zhang, L., Chen, X., 2008. Photocatalytic degradation investigation of dicofol, Chinese Science Bullettin. 53: 27-32.

Soil Moisture Sensors: A Tool to Increase Water Productivity and Yield

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Introduction

The growing water demand has raised serious concern to the future of irrigated agriculture in many parts of the country. Therefore, the knowledge of crop water demand is an important practical consideration to improve the water use efficiency in irrigation practices. Climate change and scarcity of water have led to the need for a system which effectively manages irrigation of fields. There is need of soil moisture sensors in irrigation, sensor technology and their applications in different aspects of agriculture and in irrigation scheduling. Among various methods in field to measure soil moisture content, the quickest and better one is the use of soil moisture sensor electronic devices. For successful irrigation, it is required to measure soil moisture content continuously in the irrigation fields.

Soil moisture sensors (SMS) are reliable source for monitoring spatial variation of soil moisture and hence it is an effective tool for precisely managing water application to various crops. These sensors allow site specific crop management which is the most crucial part of precision agriculture (Badewa et al., 2018). Estimation of water content based on sensor measurements provide real time, in situ measurements at a relatively affordable cost. Soil moisture sensors potentially provide the means to irrigate in accordance with the unique characteristics of a given crop in a given field.

Different Types of Soil Moisture Sensors

Soil moisture content is estimated by using various techniques which can be categorised into classical and modern techniques for both the laboratory and in situ soil moisture measurements.

1. Classical soil moisture measurement techniques: Includes thermo-gravimetric, calcium carbide neutron scattering, gypsum block and tensiometer methods.

Fig 1: Different types of sensors used to estimate soil moisture

2. Modern soil moisture measurement techniques: Includes techniques using soil resistivity sensor, tensiometers, infrared moisture balance and dielectric techniques like Time Domain Reflectometry (TDR), Frequency Domain Reflectometry (FDR) capacitance technique, heat flux soil moisture sensors, micro-electro mechanical systems and optical techniques.

Why Sensors in Water Management?

1. Efficient water management plays an important role in irrigated agricultural systems.
2. Under conventional blanket irrigation (uniform rate irrigation across the land) many parts of irrigated fields are either over or under-irrigated due to spatial variability in soil available water-holding capacity, water infiltration and runoff.
3. Under irrigated areas are subject to water stress, resulting in production loss, while over-irrigated areas suffer from poor plant health and nutrient leaching.
4. Precision irrigation tools tackle this issue by controlling soil moisture status related to irrigation events, minimizing drainage and run-off events, and improving nutrient use efficiency.

Benefits of Sensor-Based Irrigation

Sensor based irrigation has the potential to increase both the water use and economic efficiencies. The potential economic benefit of this irrigation system lies in reducing the cost of inputs or increasing yield for the same inputs. The traditional farmland irrigation techniques require manual intervention. With the automated technology of irrigation, the human intervention can be minimized. The benefits of this technology include:

Water Saving: It has been reported that the use of sensors with drip and sprinkler irrigation system can improve application efficiency of water up to 80-90% as against 40-45% in surface irrigation method (Priyamitra Munoth, 2016). Sensor based irrigation scheduling offers an opportunity for improving water productivity. It helps to save the water by applying only when it is required. Durga et al., (2020) reported that sensor-based irrigation scheduling using drips was recorded highest water productivity when compared to surface method of irrigation scheduling in maize crop. Higher water productivity (1.53 kg m-3) was noticed in Nano sensors followed by granulated gypsum blocks (1.52 kg m-3) and Tensiometers (1.34 kg m-3).

Yield and Profit: Proper timing of irrigation is an important factor for production while delaying irrigation can result in losses of between US$ 62/ha and US$ 300/ha. The experimental results of Reddy et al., (2002) observed higher sugar beet yield (95 t ha-1) when irrigation was scheduled based on watermark sensors (gypsum block) along with saving of 18 % water when compared to farmers practice.

Conclusion

In reality there is need to improve the efficiency of irrigation systems and prevent the non-optimal use of water, the focus is to develop an intelligent irrigation scheduling system which will enable irrigation farmers to optimize the use of water and only irrigate where and when need for as long as needed. Sensor technology found to be suitable for collecting real time data for different parameters pertaining to weather, crop and soil helps in developing solutions for majority of the agricultural processes related to irrigation and other agricultural processes. The development of wireless sensor applications in agriculture makes it possible to increase efficiency, productivity and profitability of farming operations.

References

1. Durga, C., Ramulu, V., Umadevi, M and Suresh, K., (2020). Evaluation of Effectiveness of Nano sensor (IITB) Based Irrigation System on Water Productivity and Yield of Maize (Zea mays). International journal of Current Microbiology and Applied Sciences. 9(8): 2697-2706.
2. Reddy, S., Neufeld, J., Gallian, J., Neibling, H., Ellsworth, J and Gortsema, S., (2002). Sugarbeet irrigation management using watermark moisture sensors. University of Idho Extension, Idho Agricultural Experiment Station.
3. Priyamitra Munoth., Rohit Goyal. and Kuldeep Tiwari, (2016). Sensor based Irrigation System: A Review. International Journal of Engineering Research & Technology (IJERT)., NCACE-2016 Conference Proceedings.

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Drones: A Modern Breakthrough in Future Agriculture

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Abstract
The adoption of modern technologies in agriculture, such as use of drones or Unmanned Aerial Vehicles (UAVs) can significantly enhance risk assessments and revolutionize the way we prepare for and respond to disasters that affect the livelihoods of vulnerable farmers and the country's food security. The Use of as drone in agriculture offer potential for facing several major or minor challenges. The major applications of drone in agriculture are irrigation, crop monitoring, soil and field analysis and bird control.

Introduction
DRONE (Dynamic Remotely Operated Navigation Equipment) also known as UAV, is a device which can fly either with the help of autopilot and GPS coordinates on the pre-set course or can be operated manually with radio signals using the remote control or smartphone app. It was first introduced during WWI for enemy surveillance. Drones have a plethora of applications in various fields ranging from military surveillance, cinematography, disaster management, wedding videos, railway track monitoring, wildlife monitoring, delivery of small packages, security purposes, law enforcement operations, search and rescue operations. Thus, the potential of drones to become an element of the green technologies in the near future with vast utility in attaining sustainable agriculture cannot be undermined.

There are two kinds of UAVs based on their structure – Fixed wing and Rotary copter. Fixed wing UAVs are ideal for aerial surveys, capturing high – resolution aerial photos, mapping and land surveying whereas Rotary copter UAVs are best for surveillance, and detection of crop pests, diseases and weeds (Nikki, 2015).

Fig1: Two types of UAVs: Rotary copter (left) and fixed-wing airplane (right)

Drones Application in Agriculture
The following are the various applications cum advantages of using drones in agriculture being deployed for day-to-day agriculture tasks (Alka et al., 2019):

Soil and field analysis: Drones can be used to mount sensors which are able to analyze the soil conditions, terrain conditions, moisture content, nutrients content and fertility levels of the soil which can be further used for planning the pattern of sowing of different crops, irrigation scheduling as well as for managing fertilizers application considering spatial variability of the crop growth and field conditions.

Planting crops and trees: It can be used for planting crops which can save labour cost and reduce human drudgery.

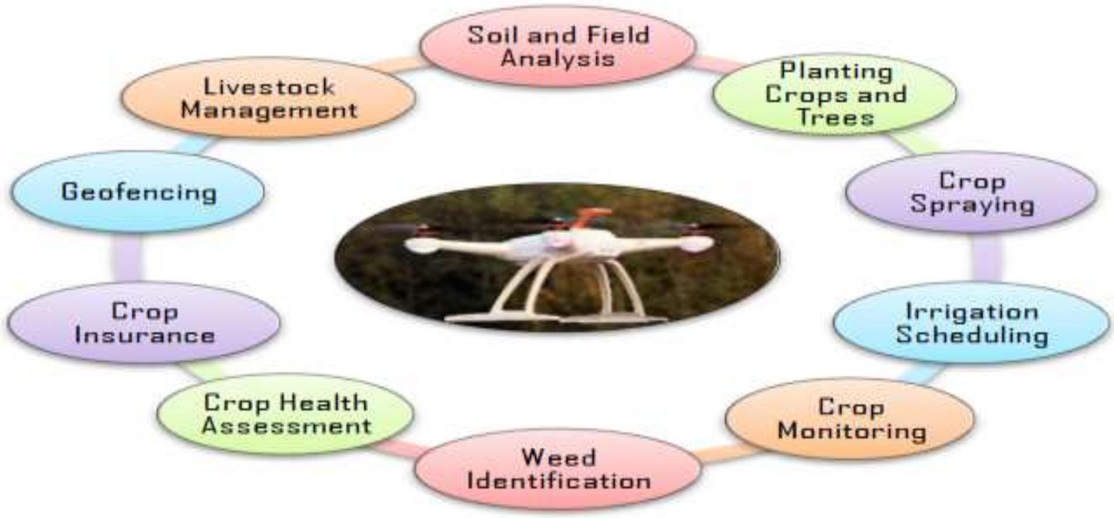

Fig 2: Application of Drones in Agriculture

Crop monitoring: Used for monitoring the conditions of crops throughout the crop season so that the need-based and timely action can be taken. The data acquired by drones during crop monitoring could be used to compute vegetation indices, which can be integrated with weather forecast data and soil fertility data. This could be used to precisely estimate the time of harvesting and yield of the crops.

Weed identification: To identify the weeds present in the field. These weeds could be timely rooted out from the field so that they do not compete for resources with the main crop.

Crop spraying: Used to spray chemicals like fertilizers, pesticides, etc. based on the spatial variability of the crops and field. The amount of chemicals to be sprayed can be adjusted depending upon the crop conditions, or the degree of severity of the insect-pest attack.

Irrigation scheduling of crops: Drones having sensors for optical, multispectral, and thermal imaging which can pinpoint the heat and water stress in the crops at a specific location. It can be used to apply irrigation to the crops based on their requirement. This will prevent the wastage of water and will ensure the efficient utilization of irrigation water.

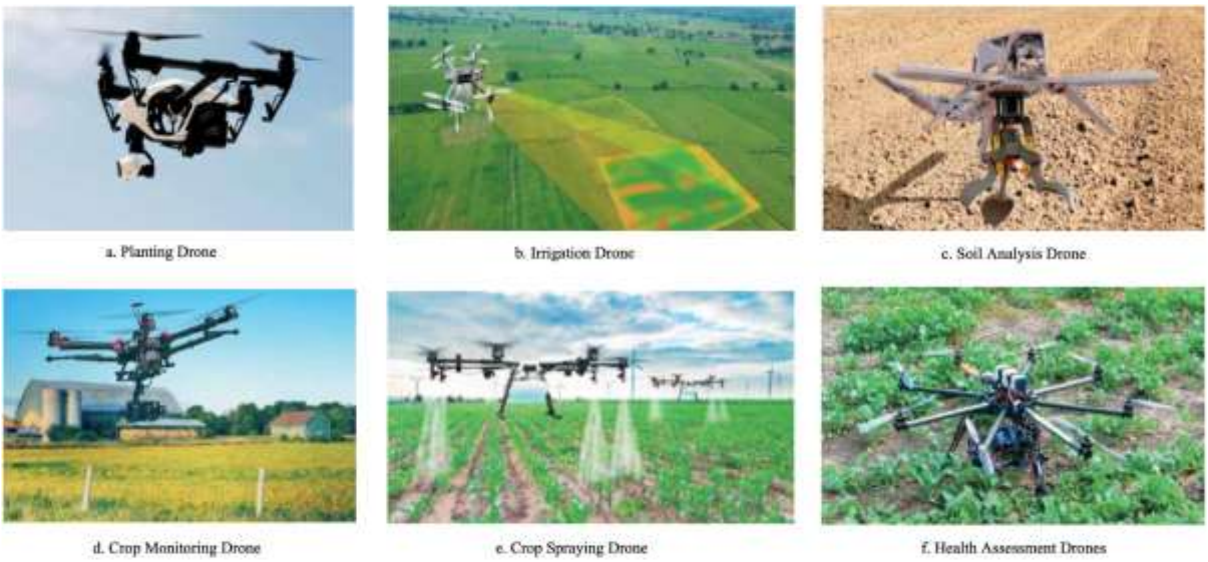

Fig 3: Types of Agricultural drones

Crop health assessment: The sensors present over the drones can see the incidence of diseases or deficiency even before the appearance of visible symptoms. Thus, they serve as a tool for early detection of the diseases.

Geofencing or protecting the field from animal damage: The thermal cameras mounted over drones can detect animals or human beings during the night. So, it can be used to protect fields from the damage caused by animals, which are otherwise difficult to detect in the large fields during night time.

Crop insurance: Drones can be used for precisely estimating and monitoring of the crop failure. So, it can be helpful for the farmers as well as for insurance companies in providing insurance claims based on the degree of damage.

Livestock management: The sensors having high-resolution infrared cameras present over drone can detect the diseased animal swiftly by their heat signatures. The detected diseased animal can then be separated from their fellow animals, and the early treatment can be provided.

There are several challenges in the application of drones in Indian agriculture, which is responsible for its limited adoption.

Conclusion

The agricultural industry faces various challenges such as lack of effective irrigation systems, weeds, issues with plant monitoring due to crop height and extreme weather conditions. The implication of drones may fascinate and encourage the youth towards agriculture. The next agricultural revolution would be data-oriented, and drones can play a major role in it. Appropriate usage of data may increase agricultural productivity without any adverse effect on the environment, along with improving the livelihoods of farmers. Therefore, drones may become part and parcel of agriculture in the future by helping farmers in managing their fields and resources in a better and sustainable way.

References

1. Alka, R., Amresh, C., Nishant, K. S., Mohanty, M. and Chaudary, R. S., (2019). Drone: The Green Technology For Future Agriculture. Soil Health: Technological interventions.
2. Nikki, J. S., (2015). Drones: The Newest Technology for Precision Agriculture. Natural Sciences Education. 44.

Vertical Farming: Efficient Utilization of Resources and Maximising Profits

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Introduction

Traditionally different crops are grown in open fields under natural conditions. Under such situations the resources use efficiency is very poor for many reasons. In this system of farming crop plants are open and are more susceptible to sudden changes in various weather parameters e.g., temperature, humidity, light intensity, photo period and other conditions. Such abrupt changes in weather conditions lead to poor quality produce. Production or yield of considered crops is also drastically reduced. Manny a time different kind of vagaries of weather e.g., occurrence of frost, hail storms, severe droughts and other biotic and abiotic stresses result in complete failures of the crops. Another problem uses to arise every year and everywhere which is related vegetables price hikes for many reasons. Price of almost all the vegetables go up by three to four times abruptly any time and are highest in the summer seasons. Answer to all these problems is Greenhouse /Net houses and / or Poly houses particularly for cash and high values crops where almost all the components of weather elements are effectively manageable and it is possible to realize sustainable and profitable returns. Protected cultivation can be practiced using various type of structures e.g., Green house, Poly house and Net house.

Why Protected Cultivation?

Protected cultivation provides us the following:
1. Better quality of produce.
2. Higher productivity.
3. Nursery raising and hardening of plants.
4. Off-season cultivation.
5. Efficient use of resources.
6. Better insect and disease control with reduced use of pesticides.

The term “Vertical farming” was coined by Gilbert Ellis Baily in 1915 in his book Vertical Farming. Vertical farming as a component of urban agriculture. It is the practice of cultivating plants in a skyscraper greenhouse or on vertically inclined surfaces. In present scenario, where world is going to face serious issues related to climate change, scarcity of natural resources, pollution, loss of biodiversity etc., vertical farming/ gardening is being solution. It is predicted that the world population will reach 9 billion by 2050, of which 70% will live in urban centres which will increase pressure on urban landscape. Now soil is becoming limiting factor due to increase in demand for agriculture, industry, housing etc. To feed such a large population agriculture land won’t be sufficient. By practicing vertical farming more produce can be harvested per unit area in comparison to traditional farming. It is easy to manipulate microclimate, nutrient supply in more efficient way on vertical frames. Most of the vertical gardens and farming practices use hydroponics technique, which reduce weight of the production structure and can be maintained quite easily. The vertical frames are adjusted to allow the flow up and down of the nutrient solution and keep media and roots moist. The vertical farming in India is at very initial stage mostly used for beautification and landscaping purposes and sometimes for food production too. The concept in being used in many aspects the details are discussed below

Vertical Gardening for Greener Cities

Greener cities are the need of the hour, something like a new paradise to harmonize technical advances and nature, urbanization and countryside, population explosion and ecological balance. It can be used for production of vegetables, fruits and flowers with a positive impact on greening and cleaning of cities, offering green zones for micro-climate changes (shade, temperature and CO_2 sequestration) and also reduces air and noise pollution. Real estate is also taking interest in it as it has impact on price of property.

It is used for polyhouse production, landscaping and interior designing of multi-storey buildings, malls, offices, societies, hospitals, schools, hotels, public places, home etc. The vertical gardens not only increase the aesthetic value of the surrounding but also change the indoor microclimate. The selection of plants should be done according to use and site where it is supposed to be established like for indoor, shade loving dwarf plants. It is becoming important part of bio-aesthetic planning as land is a scared resource in city.

Hi Tech Farming Practices

Hi-tech technologies are those techniques which are modern, less environment dependent, capital intensive and have capacity to improve productivity and quality of products. Now a days Why Greenhouse Technology is becoming more popular as it leads to the following advantages:

1. The yield may be 10-12 times higher than that of outdoor cultivation depending upon the types of greenhouse, types of crops and environmental control facilities.
2. Reliability of the crops increases under greenhouse cultivation.
3. Efficient utilization of the chemicals, pesticides to control pest and diseases.
4. Water requirements of crops very limited and easy to control.
5. Production of quality produces free from blemishes.
6. Monitoring of the crops become very easy.
7. Conservation of water and soil.
8. Efficient utilization of the natural resources presents nearby.

The various crops which are grown inside greenhouse includes different types of vegetables such as Tomatoes, Cucumber, Lettuce, Onions, Cabbage, Beans, Peas, Chilies and Okara. The fruits which are grown inside the greenhouse include Strawberries, Grapes, Citrus and Melons. An ornamental plant includes Roses, Poinsettias and other plants such as Tobacco and nurseries can also be successfully grown inside the greenhouse.

Vertical Farming

It is an innovative way of farming on vertical surface. This utilizes vertical space and thereby gives more yields per unit area under controlled environment than conventional farming. It is a soilless farming wherein concept of hydroponics, aquaponic and aeroponics are applied. It aims to optimize plant production, reduce chemical use for management of pesticides and weeds.

Integration of vertical farming concept in Horticultural crops like Strawberry, tomato, chilli, leafy vegetables; exotic vegetables can help farmers earn more per unit area under Protected cultivation. It can also increase the profit, quality of planting material from Nursery Management. From a small area large number of propagules can be produced if grown on vertical frames.

Hydroponics is a valuable soil-less culture method to grow fresh vegetables in countries having little arable land and those that are very small in area yet have a large population. It could also be particularly useful in some smaller countries whose chief industry is tourism. In such countries, tourist facilities, such as resort hotels, can grow their own products instead of importing them from many thousands of miles away, with long shipping periods.

Hydroponics is a type of horticulture and a subset of hydro culture, which is a method of growing plants without soil, by using mineral nutrient solutions in an aqueous solvent (Santos, et al., 2013). Growing plants with their roots immersed in a nutrient solution without soil are known as hydroponics or soilless culture. Water, nutrients, and light are important determinants for hydroponics, and plants can be grown anywhere as long as their growth requirements are met.

Advantages of Hydroponics

Hydroponics is a space-age science, but at the same time can be used in developing countries of the third world to provide intensive food production in limited area.

1. Its only restraints are sources of fresh water and nutrients. In areas where fresh water is not available, hydroponics can use seawater through desalination. Therefore, it has potential application of providing food in areas having vast regions of non-arable land.

2. Hydroponic operations can be located along coastal regions in combination with petroleum-fuelled or solar, or atomic desalination units, using beach sand as the medium for growing the plants.

3. Horticulture has improved economic status of farmers, seasonal availability of fruits and vegetables throughout the year increased per capita consumption.

4. It has also played a significant role in women endowment, providing employment opportunities to them in floriculture and vegetable seed production etc.

5. The unremitting trends of increasing population, urbanization, diminishing water supply, and continued climate change have contributed to declining stocks of arable land per person and is projected to decrease by 2050 to one-third of the amount available in 1970 (FAO 2016). Therefore, our planet is running short of farmland to feed the growing population resulting in an increasing need for alternative methods of food production.

6. To maintain the sustainability of earth and effective utilization of resources like soil, water, nutrients, and sunlight; soilless cultivation remains as one of the options.

7. The pursuit of agriculture as a part city's infrastructure is often a challenge particularly within compact cities, where there is a limited amount of space between buildings for urban farming and gardening,

8. Soilless farming, though it has been around for over two millennia, is becoming more prevalent in modern food production as it not only saves water and space but also provides an effective option for indoor urban farming.

For Cattle Feed / Fodder Production

Vertical farming in combination with hydroponics is also gaining popularity in Goa State. The major issue with dairy farming was non availability of feeds and fodders. produce and feed the cattle. For the betterment of dairy business, one hydroponics green fodder production unit has been established by Goa Dairy at ICAR Research Complex for Goa, Old Goa under the Rashtriya Krishi Vikas Yojna (RKVY) scheme of Government of India. Each unit has production potential of 600 kg green fodder daily in seven days. In comparison to conventional green fodders, hydroponics green fodders contained more crude protein (13.6 vs 10.7; %) and less crude fibre (14.1 vs 25.9; %). By spending Rs.40 on hydroponics green fodder farmer saves Rs. 20 on concentrate mixture and additionally earns Rs. 30 on enhanced milk production per cow per day. Along with the additional net profit of Rs.10 per cow per day, the animals remain healthy.

Precautions to be Taken While Practicing Vertical Farming

For establishing a vertical farm first step is proper planning and selection of site and planting material. Then selection of shape, size and strength of vertical frame. It depends on the plant and the planting media to be selected. To fertilize the vertical garden fertigation system is suitable. The plants must receive good amount of light for proper growth and uninterrupted power supply to run the system. The vertical frame with slight slope with plants increase the space and give the feeling of more space.

BR Application

Role of BRs on seed Physiological parameters has been reported to enhance germination of certain parasitic angiosperms (Takeuchi *et. al.,* 1995), cereals (Yamaguchi *et. al.,* 1987), Arabidopsis (Steber and McCourt, 2001) and tobacco (Leubner-Metzger, 2001). Pre-treatment with brassinolide stimulates the germination and seedling emergence of aged rice seeds (Yamaguchi *et. al.,* 1987) and seed treatment of barley accelerated subsequent seedling growth (Gregory, 1981). BR regulates elongation growth of shoots and photo-morphogenesis of seedlings (Bishop and Koncz, 2002). BR seed treatment has enhanced the germination, seedling length, seedling fresh and dry weight in radish (Raghu *et. al.,* 2014). *Brassica juncea* seeds pre-soaking with 24-epibrassinolide has increased the germination, shoot length, root length and fresh weight of the seedlings when compared with the control (Sharma and Bhardwaj, 2007). Seed treatment with BR has improved the seed germination in several tree species such as red pine (*Pinus tabuliformis*) and black locust (*Robinia pseudoacacia*) (Li *et. al.,* 2002); sycamore (*Acer pseudoplatanus* L.) and ash (*Fraxinus excelsior* L.) (Prochazka *et. al.,* 2015).

Conclusion

India receives plenty of sunshine all-round the year which is favourable for developing vertical gardens. However, in northern parts frost during winter may harm the plants. Therefore, care must be taken while selection of site and planting material. It is found to be easier and more convenient if used with hydroponics, but requires care and protection from extreme weather conditions. The setup of vertical garden is expensive and failure may lead to losses. Turning a wall into a production structure is a great way to utilize vertical space. Especially in a country like India, where urbanization is increasing, there is no option but adopting soilless culture to help improve the yield and providing quality produce to the people, therefore hydroponics is better option to achieve this. However, Government intervention and Research Institute interest can propel the use of this technology sooner and faster.

References

1. Benke K., and Tomkins B. (2017). Future food-production systems: vertical farming and controlled-environment agriculture. Sustainability: Science, Practice and Policy, 13(1):13-26. 2.
2. De Anda, J., and Shear, H. (2017). Potential of vertical hydroponic agriculture in Mexico. Sustainability, 9(1):140. 3. agement. 114: 8 12. 4.
3. FAO, (2016). FAOSTAT. Food and Agriculture Organization of the United Nations, Rome, Italy. 5. NHB, (2018-19). National Horticulture board. Ministry of Agriculture and Farmers Welfare, Government of India. (http://nhb.gov.in/).

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Zeolite Farming: Towards Sustainable Agriculture

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Abstract
Now a days in many parts of the country people are facing food security due to decreasing in the quality or quantity of soil resource base and climate change. Zeolites are crystalline, hydrated aluminosilicates of alkali and earth metals that possess infinite, three-dimensional crystal structures.

Use of zeolite has gained a momentum in the recent past owing to multitude of benefits accrued from them. Zeolites are useful in agriculture because of their large porosity, cation exchange capacity and selectivity for ammonium and potassium cations.

Introduction
India is a developing nation practicing intensive agriculture for fulfilling the needs of more than eighteen million peoples, for which huge and imbalance amount of fertilizer has been used. In this context farming with natural zeolites have assumed great significance.

Zeolites were discovered by a Swedish mineralogist Alex Fredrick Cronstedt in the year 1756, who named them from the Greek words which means “boiling stones” because of ability to froth when heated to about 200°C. Thereafter, zeolites were considered as a mineral found in volcanic rocks for a period of 200 years. Their commercial production and use started in the 1960s.

Classification of Zeolites
Zeolites have been classified on the basis of their morphological characteristics, crystal structure, chemical composition, effective pore diameter, natural occurrence.

Zeolites are classified on the basis of silica: alumina ratio as follows:
1. Zeolites with low Si: Al ratio (1.0 to 1.5).
2. Zeolites with intermediate Si: Al ratio (2 to 5).
3. Zeolites with high Si: Al ratio (10 to several thousands).

Applications of Zeolites in Agriculture
Zeolites are important materials with broad applications in refineries as catalysts, sorption and separation processes, agriculture and also in environmental engineering (Ramesh et al., 2011).

Improving soil physico-chemical properties: Natural zeolites are extensively used to improve soil physical environment, particularly in sandy and clay poor soils. They may hold water more than half of their weight due to high porosity of the crystalline structure.

Farmers add the zeolites to the soil to control soil pH and to improve ammonium retention. The CEC of soil may be increased by using zeolites as soil amendments.

Zeolite as a soil amendment: The porous structure of natural zeolite helps keep the soil aerated and moist as well as active for a long time. Natural zeolites have been reported to be used extensively in Japan as amendments for sandy soils.

Zeolite does not break down over time, but remains in the soil to improve nutrient retention. Therefore, its addition to the soil may significantly reduce water and fertilizer costs by retaining beneficial nutrients in the root zone.

Improving Nitrogen use efficiency: Zeolites with their specific selectivity for ammonium ($NH4+$) can take up this specific cation from either farmyard manure, composts or ammonium-bearing fertilizers thereby reducing losses of nitrogen to the environment.

Kavoosi (2007) found increased nitrogen-use efficiency in rice owing to application of zeolites and ensured good retention of soil-exchangeable cations.

Enhancing phosphorus use efficiency: Ammonium-charged zeolites have been shown their ability to increase the solubilization of phosphate minerals, leading to improved phosphorus uptake and yields of crops.

Slow release of nutrients: The main use of zeolite is nitrogen capture, storage release, as they adsorb molecules at relatively low pressure and is considered as nano-enhanced green application. Zeolite applied with urea reduced the ammonia volatilization by 8%. Concentrated zeolite used a sand-soil amendment also increased at least 10 % of soil water retention.

Organic manure handling: Zeolites could be used as an effective additive to control the odour as they could adsorb the volatile substances like acetic acid, butanoic acid, isovaleric acid, indole, and enhances effectiveness of the manure. Zeolite incorporated with poultry manure served as an effective fertilizer and soil conditioner.

Slow release of herbicides: Porous materials with well-ordered structures are attractive candidates for storage and release of organic guest molecules. Controlled release of paraquat using zeolite.

The most hydrophobic solids such as zeolite 'ZSM 5' were found to adsorb atrazine better when organics were present in the compartmentalized intracrystalline void space of zeolites.

Wastewater treatment: It is well known that aluminosilicate molecular sieves (zeolites) are considered the best sorbents which are used in technological processes of division and deep clearing of liquid and gas mixtures due to their chemical nature and particularities of their porous structure.

Clinoptilolite is effective for selective removal of NH^{4+} cations from wastewater. Zeolites are an appropriate material for removing heavy metal ions from wastewater because of their relatively low price coupled with the harmless nature of their exchangeable ions.

Remediation of heavy metal contaminated soils: Zeolites in general have large cation exchange capacity and expectedly attract positive-charged ions and, therefore, are widely used for sequestration of cationic pollutants like heavy metals. The application of zeolites to soil contaminated with heavy metals or radionuclides can be effective in lowering their input.

Increasing water use efficiency: Zeolites possess high water holding capacities without reducing air filled pore space. Zeolites act as soil amendments for crop production improve available water to the plants.

Enhancing crop yields: Addition of clinoptilolite increased yields of barley, potato, clover and wheat after adding 15-ton ha-1 in a sandy loam soil. Wiedenfeld (2003) found that zeolite application did not affect cabbage yields, but pepper yields showed a quadratic response to zeolite application rate, primarily as an initial decrease than an increase in fruit size as rate increased. Highest green herbage yield of Alfalafa was obtained by Turk et al. (2006) when 20% zeolite180% soil was used.

Conclusion

There is an increasing interest in the utilization of nanoporous zeolites in farming over the years because of current public concern about the adverse effects of chemical fertilizers on the agro-ecosystem. Zeolites find a large number of potential applications in agriculture, particularly in soil management. They can be used as either carriers of nutrients or medium to free nutrients to promote nutrient use efficiency. Zeolites are effective as soil ameliorants and in remediation of heavy metal contaminated soils. Considerable research has been carried out globally to exploit the potential of zeolites in the perpetual maintenance of soil productivity.

References

1. Ramesh, K and Reddy, D. D., (2011). Zeolites and Their Potential Uses in Agriculture. Advances in Agronomy. 113.
2. Kavoosi, M., (2007). Effects of zeolite application on rice yield, nitrogen recovery and nitrogen us efficiency. Communication in Soil Science and Plant Analysis, 38:69-76.
3. Turk, M., Bayram, G., Budakli, E and Celik, N., (2006). A study on effects of different mixtures of zeolite with soil rates on some yield parameters of Alfalfa (Medicago sativa). Journal of Agronomy, 5(1):118-121.
4. Wiedenfeld, B., (2003) Zeolite as a soil amendment for vegetable production in the Lower Rio Grande Valley. Subtropical Plant Science, 55:7-10.

Medicinal and Aromatic Plants: A Treasure House of Bioactive Compounds

Article ID: 10351

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Medicinal plants play an essential part in development of human culture. Several medicinal plants/herbs are used in Ayurveda, Siddha, and Unani and other traditional preparations to cure disease ailments since time immemorial. In India, around 80 per cent is exported as raw materials including dried plants, extracts and isolated ingredients. Remaining 20 per cent products are exported as final product in the form of homoeopathic and ayurvedic medicines. Out of thirty percent of the drugs existing worldwide encompass molecules derived of plant origin. There is growing demand for MAPs, WHO estimated the global market for plant-based medicine will reach 5 trillion US$ by the year 2050. Medicinal and aromatic plants are valued for their therapeutic and industrial purpose and used in various sectors like, health management, obtaining natural dyes, perfumery, cosmetics, botanicals, toiletry articles and confectionery in various food items. The quality of these plants depends on the major biomolecules present in them. Majority of these medicinal and aromatic plants are collected from wild and natural sources.

Medicinal and aromatic plants are those which possess secondary metabolites, either in different parts like, leaves, flowers, fruits, seeds, pods, root or whole herb. The secondary metabolites are important for the therapeutic uses for humankind. Plant produces these secondary metabolites for their defence mechanism. These metabolites are produced from various pathways basically they are derivatives of primary metabolism (Fig-1). The secondary metabolites are producing either from Shikimic acid pathway, Tricarboxylic acid cycle, Malonic acid pathway and MEP pathway (Ncube and Staden, 2015). The major group of phytochemicals derived from medicinal and aromatic plants is (Fig.2) phenolics (45%), terpenoids (27%), alkaloids (18%) and other groups (10%).

The biomolecules are diversified in different species of MAP's and content will always be varied and we cannot get the uniform quality raw materials which are demanded by the industry. Hence, in present day the scope and importance for this sector is gaining much importance.

List of Medicinal and Aromatic plants with major bioactive compounds and uses:

Source	Family	Major bioactive compounds	Economic part	Uses
Aloe vera	Asphodelaceae	Aloin and barbloin	Leaves	Laxative, anti-obesity, Wound healer, Skin and hair care, Cosmetic purpose
Andrographis paniculata	Acanthaceae	Andrographolide, Neo-andrographolide and andrographinin	Whole herb	Malaria, fevers, Jaundice, anemia, Anti dysenteric
Artemisia annua	Asteraceae		Leaves	Anti-malarial and anti-microbial

Bacopa monnieri	Scrophulariaceae	Bacosides	Whole plant	Nerve tonic, epilepsy, Enhancing memory, Treating rheumatism and asthma
Cassia angustifolia	Fabaceae	Sennosides	Leaves and pods	Laxative, used as fungicide
Catharanthus roseus	Apocynaceae	Vincristine and Vinblastine	Leaves and roots	Anti-cancer, treatment of leukemia
Centella asiatica	Apiaceae	Madecassoside, asiaticoside, madecassic acid and asiatic acid	Leaves	Enhancing memory
Chlorophytum species	Asparagaceae	Saponins	Tubers	Adaptogen
Clitoria ternatea	Fabaceae	Kaempferol and Shankapushpin	Pods/seeds	Memory enhancing, nootropic, antistress
Coleus forskohlii	Lamiaceae	Forskholin	Root	To treat malarial fever, hepatopathy, renal and vesical calculi, cough, chronic asthma, hiccough, bronchitis
Costus specious	Costaceae	Diosgenin	Rhizome and leaves	Anthelmintic, expectorant, tonic, and aphrodisiac
Cymbopogon species	Poaceae	Citral, citrol and linalool	Leaves/ Root (vetiver)	Soaps, hair oils, scents, medicines, confectionary
Fagopyrum esculentum	Polygonaceae	Rutin	Seeds	Lowers blood pressure, circulatory problems
Gloriosa superba	Colchicaceae	Colchicine	Seeds	To treat gout, infertility, open wounds, snakebite, ulcers
Gymnema sylvestre	Apocynaceae	Gymnemic acid	Leaves	Anti-diabetic, to treat constipation,

				cough, dental caries
Lavandula angustifolia	Lamiaceae	Linalool	Herb	Bile stimulant, carminative and anti-inflammatory
Leptadenia reticulata	Asclepiadaceae	Tanins and tepenoids	Leaves	Used in cardiac disease and haemorrhage, as diuretic
Matricaria chamomilla	Asteraceae	Azulene and chamazulene	Flower tops	Anti-inflammatory
Mint species	Lamiaceae	Menthol, linalool and carvone	Leaves	Cold remedies, Mouth washes, confectioneries
Ocimum species	Lamiaceae	Eugenol	Leaves and flower tops	Cough, fever, eye problems
Origanum majorana	Lamiaceae	Terpenoids derivates	Whole herb	To treat runny nose, coughs, colds, infections, digestive problems
Pelargonium graveolens	Geraniaceae	Geraniol and Rhodinol	Leaves	Anti-depressant and anti-septic
Phyllanthus niruri	Phyllanthaceae	Steroidal terpenoids	Whole plant	Treatment of kidney stones, , hepatitis, flu, cold, tuberculosis and viral infections
Piper longum	Piperaceae	Piperine	Fruits	Treat stomachache, heartburn, indigestion, diarrhea, and cholera
Plumbago species	Plumbaginaceae	Plumbagin and plumbagic acid	Root and leves	expectorant, laxative
Psoralea corylifolia	Fabaceae	Psoralin	Leaves	Menopause and depression
Rosmarinus officinalis	Lamiaceae	Cineol	Leaves	Treating circulation problems, toothache, anti-depressant, mosquito repellent

Ruta graveolens	Rutaceae	Rutin	Whole herb	Lowers blood pressure, circulatory and eye problems
Solanum nigrum	Solanaceae	Solasodine	Leaves	Anti-asthma and to treat whooping cough
Spilanthes acmellea	Asteraceae		Leaves	Treat mouth related troubles
Stevia rebaudiana	Asteraceae	Steviosides	Leaves	Natural sweetener
Tagetes minuta	Asteraceae	Flavonoids and β-ocimene	Leaves/ whole plant	Anti-spasmodic, anti-parasitic, antiseptic
Withania somnifera	Solanaceae	Withanolides	Root	Cure impotency
Tinospora cordifolia	Menispermaceae	Columbin, tinosporaside and tinosporic acid	Leaves/ stems	Upset stomach, gout, lymphoma and other cancers, rheumatoid arthritis
Trachyspermum ammi	Apiaceae	Linalool, p- cymene, γ-terpinene, β-pinene and β-phellandrene	Seeds	Indigestion, bloating, fatigue, abdominal pain, flatulence, diarrhea
Tylophora species	Apocynaceae	Trianthemine	Leaves	Bronchial asthma and allergic rhinitis

References

1. Mamta, S., Jyoti. S., Rajeev, N., Dharmendra, S. and Abhishek, G., 2013,Phytochemistry of Medicinal Plants, Journal of Pharmacognosy and Phytochemistry, 1(6): 168- 182.
2. Ncube, B. and Staden, J.V., 2015, Tilting Plant Metabolism for Improved Metabolite Biosynthesis and Enhanced Human Benefit, Molecules, 20 (17): 12698-12731.

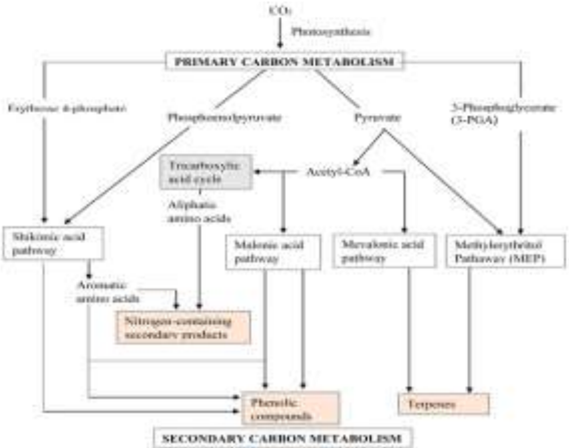


Fig.1 Biosynthetic pathway for secondary metabolites (Ncube and Staden, 2015)

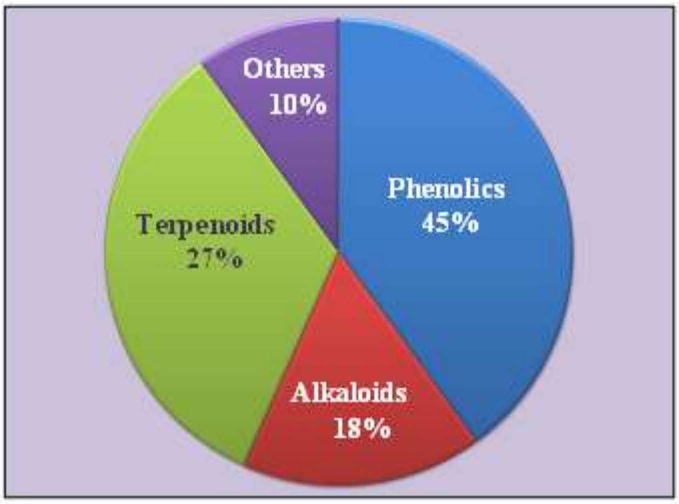
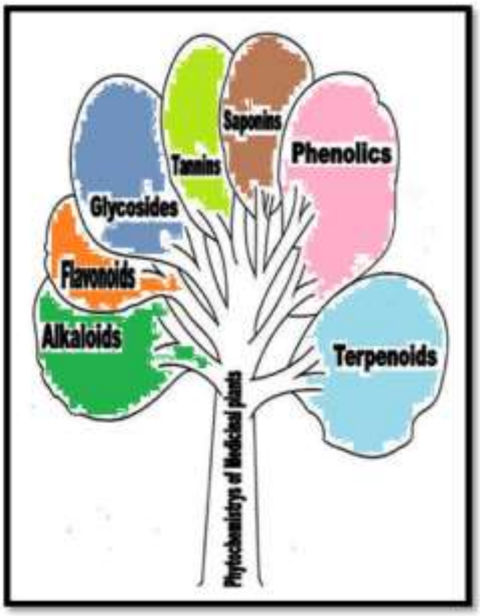
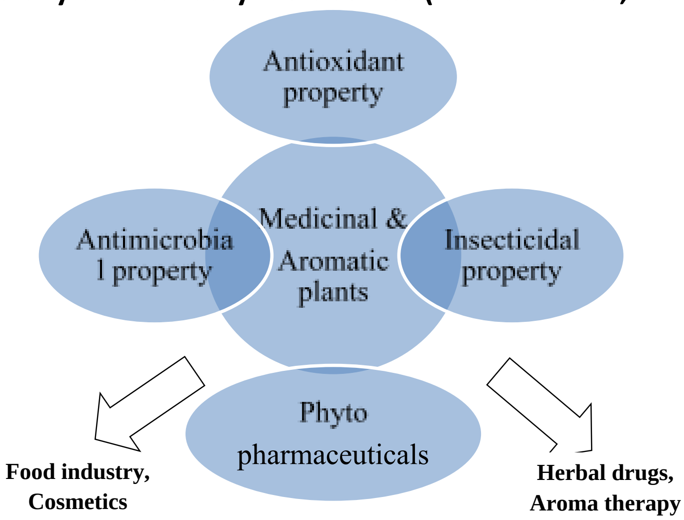


Fig. 2: Pie chart representing the major groups of plant Phytochemicals (Mamata et al., 2013)



Diversity of Secondary metabolites (Mamata et al., 2013)



Uses and activity of Medicinal and Aromatic

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Propagation of Medicinal and Aromatic Plants: An Overview

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Medicinal and aromatic plants (MAPs) are found abundant under natural vegetation. Among these species of plants are of grater use in Ayurveda, Siddha, Unani, Homeopathy as well in various systems of Indian medicine. This offers a huge demand for domestic consumption as well to the herbal industry. WHO estimated the global market for plant-based medicine will reach 5trillion US$ by the year 2050? The demand in the domestic and international market has created a huge exploitation of native medicinal and aromatic plants from the wild leading to the destructive collections and loss of important medicinal plant species. The way left behind to overcome the issues of over exploitation is to bring the larger area under cultivation of MAPs at commercial scale/ in a larger area. In today's context, a larger number of medicinal plant species are under virtue of RET (Rare, Endangered and Threatened) status due to the higher demand and destructive collection practices from the nature. Priorities on collection, conservation and propagation of commercially important medicinal and aromatic plant species are alarming factors for sustainable production of MAPs.

Plant Propagation and Propagules

Plant propagation is the technique of multiplication of individuals either by means of sexually or asexually. Plant propagation is the first phase of complete package of production technology of herbal medicines that passes through cultivation, post-harvest, storage, primary processing and quality control. The plant propagation offers huge advantages to conserve the RET medicinal plants and enrich the diversity among the native flora. The hurdle in commercial cultivation in various MAPs can be overcome by adopting suitable propagation method for the desired plant species employing various modern tools and techniques. The propagules in MAPs includes, largely through seed. The other propagule includes terminal cuttings, bulbs, rhizomes, suckers, runners, stolons, division of clumps and slips. The modern technique of tissue culture has evolved with enormous potential to overcome the barriers in propagation of medicinal plants for mass multiplication with uniform quality. Many of the MAPs species propagated by seeds and we have to be careful about the seed dormancy where, it's the physiological condition of the seed in which, it's unable to sprout and germinate on sowing. Such difficulties can be overcome by specific physical and chemical treatments based on the species of interest. Seeds of Gloriosa, Safed musli, Caesalpinia, Isabgol etc., are treated before sowing them in the nursery or field. Seed viability also plays an important role in case of seed propagated plant species. Seed viability is the natural capacity of the seed to retain the potential of germination over a certain period of time. The seed viability varies with the species. Seeds of *Terminalia bellarica* are viable for a year where, seeds of *Andrographis paniculata* remain viable for about six months. Seeds of *Phyllanthes emblica* remain viable only for a month once their fruit pulp is removed. Hence, the idea of seed dormancy and seed viability should be noted and proper care to be taken before sowing of such plant species in the nursery or in the field for commercial cultivation.

Conclusion

The over exploitation of MAPs from the nature can be decreased only through commercial cultivation. Various national and international organizations are working on collection, conservation and utilization of medicinal plants. There is a need to practice Good Agriculture and Collection Practices (GACP) for sustainable production of MAPs as well as to conserve the biodiversity. The herbal industry targets largely on homogenous supply of raw herbal materials. Hence, cultivation under commercial scale can help the industry to obtain the drug of homogenous quality. The MAPs cultivation is largely depending on quality planting material from genuine sources. The propagation techniques for conservation of various RET species are developed by various organizations. Utilization of Micro propagation techniques helps in production of propagules in large scale and uniform planting materials in difficult to root or germinate plant species. The choice of quality planting material always influences on the developmental and chemical quality of the plant species at harvest. The propagation method employed for various plant species depends on soil, climate, irrigation quality. Hence one should takle care of season of flowering, collection of seed, use of vegetative planting material in appropriate time/season gives us better planting material for commercial cultivation of MAPs.

References

1. Somashekar, B.S. and Manju, S., 2002, Training manual on Propagation Techniques of Commercially Important Medicinal Plants, pp-1-118.
2. Sorce; Virendra, S. Concepts of propagating Medicinal plants using Modern tools, IIHBT, HP.

List of MAPs and their Propagation Method

Sl No.	Common name	Botanical name	Family	Propagation method
1.	Achyranthes	*Achyranthes aspera*	Amaranthaceae	Seeds
2.	Aconitum	*Aconitum heterophyllum*	Ranunculaceae	Leafy stems
3.	Adhatoda	*Adhatoda vasica*	Acanthaceae	Semi hardwood cuttings
4.	Ajowan	*Trachyspermum ammi*	Apiaceae	Seeds
5.	Aloe	*Aloe vera*	Asphodelaceae	Suckers
6.	Ambrette	*Abelmoschus moschatus*	Malvaceae	Seeds
7.	Anise	*Pimpinella anisum*	Apiaceae	Seeds
8.	Asalio	*Lepidium sativum*	Brassicaceae	Seeds
9.	Ashoka	*Saraca ashoka*	Caesalpiniaceae	Seeds
10.	Ashwagandha	*Withania somnifera*	Solanaceace	Seeds
11.	Asparagus	*Asparagus racemosus*	Asparagaceae	Seeds/root division
12.	Babchi	*Psoralea corylifolia*	Fabaceae	Seeds
13.	Basil	*Ocimum basilicum*	Lamiaceae	Seeds
14.	Belladonna	*Atropa belladonna*	Solanaceae	Seeds/soot cuttings
15.	Betelvine	*Piper betel*	Piperaceae	Stem cuttings
16.	Bixa	*Bixa orellana*	Bixaceae	Seeds
17.	Buck wheat	*Fagopyrum esculentum*	Polygonaceae	Seeds
18.	Bursera	*Bursera penicillata*	Burseraceae	Cuttings
19.	Centalla	*Centella asiatica*	Apiaceae	Rooted suckers/seeds
20.	Chamomile	*Matricaria chamomilla*	Asteraceae	Seeds
21.	Champak	*Michelia champaca*	Magnoliaceae	Seeds
22.	Cinchona	*Cinchona officinalis*	Rubiaceae	Seeds/cuttings
23.	Citronella	*Cymbopogon winterianus*	Graminae	Slips
24.	Coleus	*Plectranthus barbatus*	Lamiaceae	Terminal cuttings
25.	Coleus	*Coleus aromaticus*	Lamiaceae	Cuttings
26.	Costus	*Costus speciosus*	Costaceae	Rhizome
27.	Crown flower	*Calotropis gigantea*	Apocynaceae	Softwood cuttings
28.	Damask rose	*Rosa × damascena*	Rosaceae	Budding/cuttings
29.	Danti	*Baliospermum montanum*	Euphorbiaceae	Seeds/stem cuttings
30.	Davana	*Artemisia pallens*	Asteraceae	Seeds
31.	Dodi	*Leptadenia reticulata*	Asclepiadaceae	Stem cuttings
32.	Eclipta	*Eclipta alba*	Asteraceae	Semi hardwood cuttings
33.	Eucalyptus	*Eucalyptus globulus*	Myrtaceae	Seeds/cuttings
34.	Eye grass	*Curculigo orchioides*	Hypoxidaceae	Rhizomes
35.	Fox glove	*Digitalis purpurea*	Plantaginaceae	Seeds

36.	Galangal	*Alpinia galanga*	Zingiberaceae	Rhizomes
37.	Garden rue	*Ruta graveolens*	Rutaceae	Seeds
38.	Geranium	*Pelargonium graveolens*	Geraniaceae	Cuttings
39.	Giloe	*Tinospora cordifolia*	Menispermaceae	Semi hardwood cuttings
40.	Ginger	*Zingiber officinale*	Zingiberaceae	Rhizome
41.	Ginseng	*Panax ginseng*	Araliaceae	Seeds/cuttings
42.	Glory lily	*Gloriosa superba*	Colchicaceae	Tubers/Seeds
43.	Gokharu	*Tribulus terrestris*	Zygophyllaceae	Seeds
44.	Gudmar	*Gymnema sylvestre*	Apocynaceae	Semi hardwood cuttings
45.	Guggal	*Commiphora wightii*	Burseraceae	Hardwood cuttings
46.	Henbane	*Hyoscyamus niger*	Solanaceae	Seeds
47.	Henna	*Lawsonia inermis*	Lythraceae	Hardwood cuttings
48.	Ipecac	*Cephaelis ipecacuanha*	Rubiaceae	Seeds/cuttings
49.	Isabgol	*Plantago ovata*	Plantaginaceae	Seeds
50.	Jal brahmi	*Bacopa monnieri*	Plantaginaceae	Softwood stem cuttings
51.	Jasmine	*Jasminum species*	Oleaceae	Cuttings
52.	Jatamansi	*Nardostachys jatamansi*	Valerianaceae	Seeds/root cuttings
53.	Kalmegh	*Andrographis paniculata*	Acanthaceae	Seeds/stem cuttings
54.	Kewada	*Pandanus fascicularis*	Pandanaceae	offshoots
55.	Kutki	*Picrorhiza kurroa*	Scophulariaceae	Seeds
56.	Lavender	*Lavandula angustifolia*	Lamiaceae	Cuttings
57.	Lemongrass	*Cymbopogon flexuosus*	Graminae	Slips/seeds
58.	Liquorice	*Glycyrrhiza glabra*	Fabaceae	Stolons
59.	Long pepper	*Piper longum*	Piperaceae	Cuttings
60.	Makoi	*Solanum nigrum*	Solanaceae	Seeds
61.	Marjoram	*Origanum majorana*	Lamiaceae	Seeds/cuttings
62.	Mint	*Mentha species*	Lamiaceae	Stolons
63.	Mucuna	*Mucuna pruriens*	Leguminaceae	Seeds
64.	Mushakbala	*Valerianajatamansi*	Valerianaceae	Seeds/rhizomes
65.	Myrobalan	*Terminalia chebula*	Combretaceae	Seeds
66.	Nannari	*Hemidesmus indicus*	Asclepiadaceae	Seed/root cuttings
67.	Noni	*Morinda citrifolia*	Rubiaceae	Seeds/ stem cuttings
68.	Opium poppy	*Papaver somniferum*	Papaveraceae	Seeds
69.	Palmarosa	*Cymbopogon martini*	Graminae	Seeds
70.	Patchouli	*Pogostemon patchouli*	Lamiaceae	Cuttings
71.	Periwinkle	*Catharanthus roseus*	Apocynaceae	Seeds
72.	Phyllanthus	*Phyllanthus amarus*	Euphorbiaceae	Seeds
73.	Plumbago	*Plumbago rosea*	Plumbaginaceae	Seeds/stem cuttings
74.	Punarnava	*Boerhavia diffusa*	Nyctaginaceae	Seeds
75.	Pyrethrum	*Chrysanthemum cinerariaefolium*	Asteraceae	Seeds/cuttings
76.	Red spiderling	*Boerhavia diffusa*	Nyctaginaceae	Seeds
77.	Rosalle	*Hibiscus sabdariffa*	Malvaceae	Seeds
78.	Rosary pea	*Abrus precatorius*	Fabaceae	Seeds
79.	Rosemary	*Rosmarinus officinalis*	Lamiaceae	Cuttings
80.	Safed Musli	*Chlorophytum borivilianum*	Liliaceae	Tubers/fingers
81.	Saffron	*Crocus sativus*	Iridaceae	Corms
82.	Salacia	*Salacia reticulata*	Celastraceae	Seeds/cuttings

83.	Sandal wood	*Santalum album*	Santalaceae	Seeds
84.	Sappan	*Caesalpinia sappan*	Caesalpiniaceae	Seed
85.	Sarpagandha	*Rauvolfia serpentina*	Apocynaceae	Seeds/ cuttings
86.	Senna	*Cassia angustifolia*	Caesalpiniadeae	Seeds
87.	Shoeblack plant	*Hibiscus rosa-sinensis*	Malvaceae	Hardwood cuttings
88.	Singli	*Dioscorea deltoidea*	Dioscoreaceae	Seeds/rhizome cuttings
89.	Solanum	*Solanum viarum*	Solanaceae	Seeds
90.	Stevia	*Stevia rebaudiana*	Asteraceae	Seeds/cuttings
91.	Swallow root	*Decalepis hamiltonii*	Asclepiadaceae	Seed/cutting/root suckers
92.	Sweet flag	*Acorus calamus*	Acoraceae	Rhizome
93.	Swertia	*Swertia chirata*	Gentianaceae	Seeds
94.	Thyme	*Thymus vulgaris*	Lamiaceae	Cuttings
95.	Trumpet flower	*Oroxylum indicum*	Bignoniaceae	Seeds
96.	Tuberose	*Polianthes tuberosa*	Asparagaceae	Bulbs
97.	Turmeric	*Curcuma longa*	Zingiberaceae	Rhizome
98.	Veld grape	*Cissus quadrangularis*	Vitaceae	Stem cuttings
99.	Vetiver	*Chrysopogon zizanioides*	Graminae	Slips
100.	Vitex	*Vitex negundo*	Lamiaceae	Stem cuttings

Impacts of COVID-19 on Food Supply Chain

Article ID: 10353

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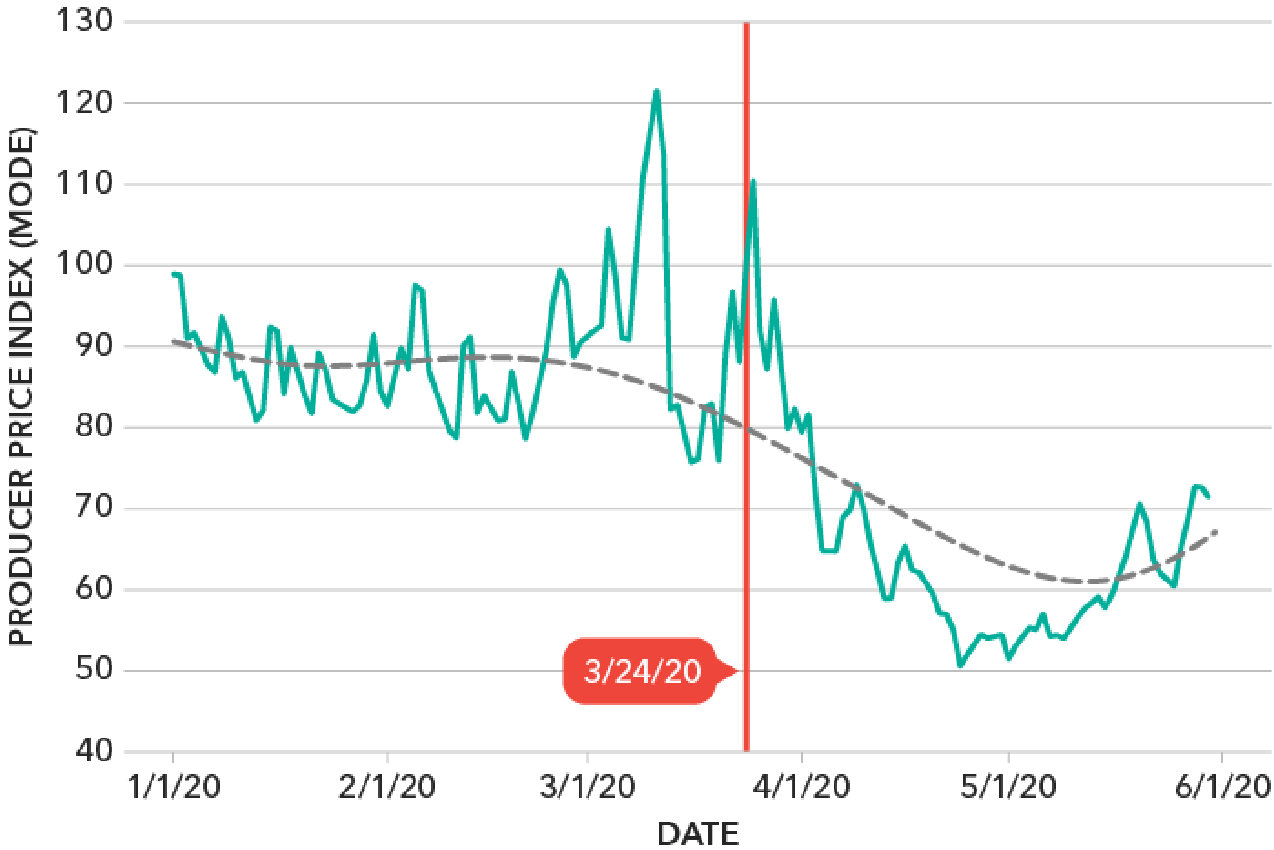
Summary

A pandemic is not a new event encountered in the history of humanity, because mankind has faced various pandemics in history. The common point of pandemics is their serious negative effects on the global economy. Considering the food supply chain, one of the most important sectors of the economy, it has seen that COVID-19 has an impact on the whole process from the field to the consumer.



Introduction

WHO explained that a pandemic caused by a coronavirus has not been seen before, and this disease is the first pandemic caused by the coronavirus? COVID-19 is the fifth pandemic, following 1918 influenza virus (H1N1), 1957 influenza virus (H2N2), 1968 influenza virus (H3N2), and 2009 Pandemic flu (H1N1), that resulted in the human deaths of around 50 million, 1.5 million, 1 million, and 300.000, respectively (Liu et al., 2020). WHO indicated that this outbreak is not just a public health crisis, it is a crisis that will touch every sector? Therefore, every sector and every individual should participate in the struggle (WHO, 2020b). As of 5 August 2020, the number of cases per 1 million population are given for different regions as follows: 9.613.03 in Americas, 3.694.43 in Europe, 1.136.41 in South-East Asia, 2.167.25 in Eastern Mediterranean, 742.75 in Africa and 176.36 in Western Pacific region.

The ''Strategic preparedness and response plan'' by WHO includes the health measures that all countries had to prepare and respond to for this pandemic.
1. Coordination, planning and monitoring at the country level.
2. Risk communication and community participation.
3. Surveillance, quick response teams and case investigation.
4. Entry points.
5. National laboratories.
6. Prevention and control of infection.
7. Situation management.
8. Operational support and logistics.

Effects of Pandemic on Food Supply Chain

Food supply chain can be divided into five stages, including agricultural production, post-harvest handling, processing, distribution/retail/service, and consumption. Two systems are being used in the food supply chain regarding to food quality and safety. First one is based on regulations and laws that use mandatory standards which are inspected by state agencies. Second one is relying on voluntary standards which are defined by market laws or international associations (Bendekovic et al., 2015).

Effects on Pandemic on Consumer Behaviour

When the issue of how the COVID-19 pandemic affects consumers' food demand is examined, it is seen that the demand varies depending on the price of foodstuffs, income level of consumers, sociodemographic situation, consumption and shopping preferences and time constrains. In addition, number of visits to food store and spending money on food in per visit changed (Bakalis et al., 2020; Cranfield, 2020). COVID-19 outbreak interrupted the daily routine and resulted in boredom which can be defined as high energy intake by the consumption of high amount of fat, carbohydrate, and proteins.

Effects of Pandemic on Global Food Trade

Although the current conditions are seeming exceptional, the vulnerability of food systems to problems related to climate and diseases has been seen long before the COVID-19 crisis. Food systems have actually been unstable from various events and shocks before such as the oil crisis in the 1970s, the SARS and Ebola outbreaks and the 2007-2008 food crisis. Africa Swine Fever disease upset global commodity markets just a year ago, has become a progressive epidemic in Eastern Europe and Asia. The world's largest swine producer (has 1/3 of the global market) and biggest exporter, China, lost 37% of its pigs by the end of 2019 (IPES, 2020).

Recommendations to Minimize the Effect of Covid-19

The COVID-19 outbreak seriously threatens food safety, security, and nutrition. The economic chaos due to the pandemic threatens economic access and physical availability of food. Disruptions and possible problems in marketing, logistics, and trade systems may restrict access to food in some places and at times, and therefore hunger and malnutrition problems may appear (FAO, 2020g).

Report from World Food Program showed that the number of people facing extreme hunger can be increase to 265 million in 2020 as a result of COVID-19 (WFP, 2020a). Another study performed by Headey et al., (2020) indicated that COVID-19 lead to 14.3% increase in the prevalence wasting among children younger than 5 years in lowand middle-income countries due to malnutrition or interruption to health and social protection.

Strategies for Food Supply Chain

Before the pandemic, one third of all food produced for human consumption was lost or wasted across the food supply chain stages including production, postharvest handling, processing, distribution, and consumption. Therefore, food waste has gained more attention than ever before in the era of coronavirus. A study performed by Aldaco et al., (2020) indicated that, COVID-19 had a minor impact on the overall food waste and loss generation but resulted in 12% higher creation of food waste on the household level.

References

1. Liu, Y. C., Kuo, R. L., & Shih, S. R. (2020), "COVID-19: The first documented coronavirus pandemic in history", unpublished manuscript, Biomedical Journal, doi: 10.1016/j.bj.2020.04.007.
2. Bendeković, J., Naletina, D., & Nola, I. (2015), "Food safety and food quality in the supply chain", Trade Perspectives, 151, 1-13.
3. Rizou, M., Galanakis, I. M., Aldawoud, T.M.S., Galanakis, C.M. (2020), ''Safety of foods, food supply chain and environment within the COVID-19 pandemic'', Trends in Food Science & Technology, 102, 293- 299, doi: 10.1016/j.tifs.2020.06.008.
4. FAO (2020a), "Adjusting business models to sustain agri-food enterprises during COVID-19", Food and Agriculture Organization, available at: http://www.fao.org/3/ca8996en/CA8996EN.pdf (accessed 15 May 2020), doi: 10.4060/ca8996en.

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Flaxseed – A Super Food

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Summary

Flaxseed is a rich source of healthy fat, antioxidants, and fiber. The seeds contain protein, lignans, and the essential fatty acid alpha-linolenic acid, also known as ALA or omega-3. The nutrients in flaxseed may help lower the risk of diabetes, cancer and heart disease. Flax is one of the oldest fiber crops in the world. It is known to have been cultivated in ancient Egypt and China. In Asia, it has played a role in Ayurvedic medicine for health promotion, prevention, and a range of conditions, many to do with skin health. Today, flaxseed is available as seeds, oil, powder, tablets, capsules and flour. It is consumed as a dietary supplement to prevent constipation, diabetes, cholesterol, cancer, and other conditions. It contains nutrients that may help prevent several health problems. Flaxseeds can be sprinkled on cereal, mixed with yogurt, blended into smoothies, or added to soups.






Nutritional Status of Flaxseed

Grown since the beginning of civilization, flax seeds are one of the oldest crops. There are two types: brown and yellow or golden, which are equally nutritious. Flaxseed is an excellent source of fiber, lignans, and linoleic and alpha-linolenic acid (ALA), two omega-3 fatty acids that are essential for human health. One tablespoon provides a good amount of protein, fiber and omega-3 fatty acids, in addition to being a rich source of some vitamins and minerals.

According to USDA one tablespoon of ground flax seeds contain the following:

Content	Quantity	Content	Quantity
Calories	37 Kcal	Vitamin B1	8% of the RDI
Protein	1.3 grams	Vitamin B6	2% of the RDI
Carbohydrates	2 grams	Folate	2% of the RDI
Fiber	1.9 grams	Calcium	2% of the RDI
Total fat	3 grams	Iron	2% of the RDI
Saturated fat	0.3 grams	Magnesium	7% of the RDI
Monounsaturated fat	0.5 grams	Phosphorus	4% of the RDI
Polyunsaturated fat	2.0 grams	Potassium	2% of the RDI
Omega-3 fatty acids	1,597 mg	Lignans	0.3 g /100 g
Phytosterols	49.00 mg/100 g		

Nutrients and Health Benefits of Flaxseed

Charles the Great ordered his subjects to eat flax seeds for their health. So, it's no wonder they acquired the name *Linum usitatissimum*, meaning "the most useful". Nowadays, flax seeds are emerging as a "Super Food" as more scientific research points to their health benefits.

High in Omega-3 Fats

Flax seeds are the best source of omega-3 fats if anyone is vegetarian or does not eat fish. Flax seeds are a rich source of alpha-linolenic acid (ALA), a mostly plant-based omega-3 fatty acid (Goyal et al., 2014). ALA in flax seeds prevented cholesterol from being deposited in the blood vessels of the heart, reduced inflammation in the arteries and reduced tumor growth (Delfin et al., 2013 and Kajla et al., 2015). Campos et al. (2008) reported that those who ate more ALA had a lower risk of heart attack than those who consumed less ALA.

High-Quality Protein

Flax seeds are a great source of plant-based protein. Flaxseed protein is rich in the amino acids arginine, aspartic acid and glutamic acid (Shim et al., 2014 and Chung et al., 2005). Flaxseed protein helped improve immune function, lowered cholesterol, prevented tumors and had anti-fungal properties (Rabetafika et al., 2011; Udenigwe and Aluko 2010; Xu et al., 2008). Flax seeds are a good source of plant-based protein and can be an alternative protein source for people who do not eat meat.

Helps in Reducing the Risk of Cancer

Flax seeds contain a group of nutrients called lignans, which have powerful antioxidant and estrogen properties. Flax seeds contain up to 800 times more lignans than other plant foods (Kajla et al., 2015). Flaxseed may help in preventing breast and prostate cancer, as well as other types of cancer (McCann et al., 2007; Lowcock et al., 2014; Mason and Thompson., 2014). It contains omega-3 fatty acids which disrupt the growth of cancer cells and prevent their development. Consuming omega-3 oils may help protect against different types of cancer. Lignans have antiangiogenic properties that stop tumors from forming new blood vessels. Flax seeds potentially valuable food in the fight against various cancers, especially if consumed for life as a part of a healthful diet and lifestyle.

Rich Dietary Fiber and Improve Cholesterol

One tablespoon of flax seeds contains 3 grams of fiber, which is 8–12% of the daily recommended intake for men and women, respectively (Slavin., 2008). Flax seeds contain two types of dietary fiber – soluble fiber (20–40%) and insoluble fiber (60–80%). Soluble fiber increases the consistency of the contents in the intestine and slows down the digestion rate. This leads to regulate blood sugar and lower cholesterol (Kristensen et al., 2012). According to Mayo Clinic, the soluble fiber dissolves to produce a gel-like substance that can help reduce cholesterol and glucose levels. Insoluble fiber allows more water to bind to the stools, increases their bulk and results in softer stools. It is useful for preventing constipation and for those who have irritable bowel syndrome or diverticular disease (Kajla et al., 2015). According to the National Center for Complementary and Integrative Health (NCCIH), there is little evidence that flaxseed helps reduce constipation. Consuming it with too little water can make constipation worse and possibly lead to an intestinal blockage. The high fiber content of flax seeds can help lower cholesterol and may play an important role in improving heart health. Flaxseed could offer an alternative to marine sources of omega 3.

Helps in Lowering Blood Pressure

Flax seeds have a natural ability to lower blood pressure (Caligiuri et al., 2014). A Canadian study found that those who ate 30 grams of flax seeds daily for six months lowered systolic and diastolic blood pressure by 10 mmHg and 7 mmHg, respectively (Delfin et al., 2013). Flax seeds have been proven to lower blood pressure and are especially helpful for those with high blood pressure.

Helps in Control Blood Sugar

Type 2 diabetes is a major health problem worldwide. It's characterized by high blood sugar levels as a result of either the body's inability to secrete insulin or resistance to it. It may help in lowering the blood sugar level due to its insoluble fiber content present in flaxseed. Insoluble fiber slows down the release of sugar into the blood and reduces blood sugar (Kajla et al., 2015; Thakur et al., 2009). Flaxseed oil lacks fiber, which is credited with flax seeds' ability to lower blood sugar.

Helps in Weight Control

It reduces the feelings of hunger in the human body due to soluble fiber content present in flax seeds which slow digestion in the stomach and triggers a host of hormones that control appetite and provide a feeling of fullness (Denis et al. 2007; Wanders et al. 2011).

Risks of Flaxseed

The nutrients in flaxseed may not benefit everyone. Too much flaxseed can lead to:

1. Flatulence and bloating, abdominal pain, nausea, constipation or diarrhea
2. Raw and unripe flaxseeds are not suitable for consumption, as they may be toxic. Flaxseed should always be consumed with plenty of fluid.
3. During pregnancy, women are advised not to consume it, because the phytoestrogens it contains could have an adverse effect. It may not be suitable while breastfeeding.

References

1. Caligiuri SPB, Edel AL, Aliani M and Pierce GN. (2014). Flaxseed for hypertension: implications for blood pressure regulation. Current Hypertension Reports, 16(12): 499.
2. Campos H, Baylin A, and Willett WC. (2008). Alpha-linolenic acid and risk of nonfatal acute myocardial infarction. Circulation, 118(4): 339-345.
3. Chung MWY, Lei B and Li-Chan ECY. (2005). Isolation and structural characterization of the major protein fraction from NorMan flaxseed (Linum usitatissimum L.). Food Chemistry, 90(1–2): 271-279
4. Delfin Rodriguez-Leyva, Wendy Weighell, Andrea L Edel, et al. (2013). Potent antihypertensive action of dietary flaxseed in hypertensive patients. Hypertension, 62(6): 1081-1089.
5. Denis L, Barbara Play, Dominique Jourdheuil-Rahmani. (2007). Digestible and indigestible carbohydrates: interactions with postprandial lipid metabolism. The Journal of Nutritional Biochemistry, 18(4): 217-227.
6. Goyal A, Sharma V, Upadhyay N, Gill S, and Sihag M. (2014). Flax and flaxseed oil: an ancient medicine & modern functional food. Journal of Food Science and Technology, 51(9): 1633–1653.
7. Kajla P, Sharma A and Sood DR. (2015). Flaxseed-a potential functional food source. Journal of Food Science and Technology, 52(4): 1857–1871.
8. Kristensen M, Morten G Jensen, Julie Aarestrup, Kristina En Petersen et al. (2012). Flaxseed dietary fibers lower cholesterol and increase fecal fat excretion, but magnitude of effect depend on food type. Nutrition and Metabolism, 9(8): 1-8.
9. Lowcock EC, Cotterchio M and Boucher BA. (2013). Consumption of flaxseed, a rich source of lignans, is associated with reduced breast cancer risk. Cancer Causes and Control, 24(4): 813–816.
10. Mason JK and Thompson LU. (2014). Flaxseed and its lignan and oil components: can they play a role in reducing the risk of and improving the treatment of breast cancer?. Applied Physiology, Nutrition, and Metabolism, 39(6): 663-678.

11. McCann SE, Jean Wactawski-Wende, Kari Kufel, James Olson, Bladimir Ovando, et al. (2007). Changes in 2-hydroxyestrone and 16alpha-hydroxyestrone metabolism with flaxseed consumption: modification by COMT and CYP1B1 genotype. Cancer Epidemiology, Biomarkers and Prevention, 16(2): 256-262.
12. Rabetafika HN, Remoortel VV, Danthine S, Paquot M and Blecker C. (2011). Flaxseed proteins: food uses and health benefits. International Journal of Food Science and Technology, 46(2): 221-228.
13. Shim YY, Gui B, Paul G. Arnison, Wang Y and Martin JT Reaney. (2014). Flaxseed (Linum usitatissimum L.) bioactive compounds and peptide nomenclature: A review. Trends in Food Science & Technology, 38(1): 5-20.
14. Slavin JL. (2008). Position of the American Dietetic Association: health implications of dietary fiber. Journal of the American Dietetic Association, 108(10): 1716-1731.
15. Thakur G, Mitra A, Pal K and Rousseau D. (2009). Effect of flaxseed gum on reduction of blood glucose and cholesterol in type 2 diabetic patients. International Journal of Food Sciences and Nutrition, 60 (Suppl 6):126-36.
16. Udenigwe CC and Aluko RE. (2010). Antioxidant and Angiotensin Converting Enzyme-Inhibitory Properties of a Flaxseed Protein-Derived High Fischer Ratio Peptide Mixture. Journal of Agricultural and Food Chemistry, 58, 8, 4762–4768.
17. Wanders AJ, J J G C van den Borne, C de Graaf, et al. (2011). Effects of dietary fibre on subjective appetite, energy intake and body weight: a systematic review of randomized controlled trials. Obesity Reviews, 12(9): 724-739.
18. Xu Y, Hall C, and Wolf-Hall C. (2008). Antifungal activity stability of flaxseed protein extract using response surface methodology. Journal of Food Science, 73(1): 9-14.

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Mishti Dahi

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Introduction

Mishti dahi or mishit doi is a popular traditional sweetened fermented milk product. Eastern part of India, especially in West Bengal, Assam, Bihar and Orissa the sweetened variety of Dahi known as Mishti dahi. It is a delicacy of choice during religious festival and is considered an auspicious item to serve while starting journey or any important work. The product is commonly sold in earthen pots of varying sizes and served chilled.

Composition of Mishit Dahi

Mishti dahi is a fermented milk product, having creamish to light brown color, firm body smooth texture, sweet-acidic flaxom and pleasant aroma. As such No PFA or BIS standards for mishit dahi. The quality of mishit dahi depends upon the type of milk, level of concentration and fermentation condition employed in its manufacture.

Composition

Constituents (%)	Low fat	Medium fat	High fat
Milk fat	2-3	4-5	8-9
Milk SNF	13-14	11-13	10-11
Sugar	17-19	17-18	17-18
Total solids	32-35	32-35	35-38

Method of Manufacture of Mishit Dahi (Traditional Method)

1. Mishti dahi is prepared from cow or mixed milk.
2. Fresh, good quality milk is boiled with a required amount of sugar and partially concentrated by simmering and low free.
3. This healing is continued for quite some time during which milk develops a distinctive light cream to light brown caramel colour and flavour.
4. The contents are then cooled to ambient temperature and cultured with dahi (lactic) culture.
5. It is than filled into earthen pots of consumer side or bulk size vessels and incubated overnight.
6. Normally, the curd is set within 12-14hrs.
7. After firm setting of curd it is transferred to a cooler place or stored under refrigeration.

Flow Diagram of Manufacture of Misthi Dahi

Traditional Method, Low Milk, Mixed Milk
↓
Adding Sugar and Boiling
↓
Partially Concentrated
↓
Cooled to Room Temperature
↓

Culture is added

↓

Filled in Earthen pot

↓

Keep It Overnight

↓

Settled of Curd (12-14hrs)

↓

Store at Cooler Place under Refrigeration

Production of Misthi Dahi from Buffalo Milk

Whole Buffalo Milk

↓

Standardization (fat 3.5%, SNF 9.0%)

↓

Pre- Heating (65^0C -70^0C)

↓

Homogenization (56kg /cm^2 65^0C)

↓

Concentration to 1.44 feld

↓

Addition of Sugar (Approx. 14%)

↓

Heating at 85^0C for 10 min

↓

Cooling to 40^0C

↓

Inoculation (at 40^0C for 6-7hrs)
CLF -40 Cultures

↔

↓

Storage at 4^0C

Probiotic Dahi

1. Probiotic foods are the most important discipline of functional foods. Defend as foods containing live micro-organization.
2. Which actively enhance the health of consumers by improving the balance of micro flora in the gut when ingested live in sufficient numbers.
3. The consumption of probiotic production is helpful in:
    a. Maintaining good health.
    b. Restoring Body vigor
    c. Skirmishing intestinal and other diseases.

According to fuller (1989)- Benefits Claimed beneficial effects such as: • Maintenance of normal intestinal realm. • Augmentation of immune system. • Reduction of lactase intolerance. • Reduction of in serum cholesterol level. • Anticarcinogenic activity. • Improved nutritional value of food.	**Therapeutic applications: -** such as • Prevention of urogential infection. • Mitigation of constipation. • Protection against travelers, diamhea. • Prevention of in fantile dimahae etc.

At NDR

The probiotic lactobacilli viz *H. acidophillus* and lcasei used to prepare dahi either alone or in combination with measophillic dahi culture. Lactococcus lactic ssp. Lactic bioxan diacety lactis 60 and mixed dahi culture 167(BO4) Standardized buffalo milk (Milk 4%) as well as milk with different fat%(1to3%) is used for preparation of two types of dahi. Dahi incubation carried out at 37^0 C for 9-10 hours. After incubation dahi is forced at 4^0 C.

Dahi exhibited good taste and flavor also good. Texture is firm exhibit ph 4.27 to 4.47 and filterable acidity ranging from 1.08 to 1.2 %. The number of probiotic organisms is 7.1 X1010 approximately. Number of probiotic organisms is ranged from 3.8*10- 4.24*1010.

Fruit Dahi

Manufacture of fruit dahi: (Flow Chart).

Preparation of mix
↓
Heating (600 ^{0}C)
↓
Homogenization (2000 psi (117) 500psi)
↓
Heating (85degreeC/ 15 min)
↓
Cooling (32+ - /1^{0}C)
↓
Incubation (1.5%)
↓
Fruit pulps (pasteurized)
↓
Incubation (32^{0}C)
↓
Cooling and storage (6+_ 1^{0}C) (Fruits used may be mango, pineappleand banana.)

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Management of Partial Root Parasite (Striga Sp.)

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Striga with sorghum plant

Introduction

1. Striga, commonly known as witchweed, is a genus of parasitic plants that occur naturally in parts of Africa, Asia, and Australia. It is in the family orobanchaceae. Some species are serious pathogens of cereal crops, with the greatest effects being in savanna agriculture in Africa. It also causes considerable crop losses in other regions, including other tropical and subtropical crops in its native range and in the Americas.

2. They are obligate hemiparasites of roots and require a living host for germination and initial development, though they can then survive on their own.

Life Cycle

1. Each plant is capable of producing between 90,000 and 500,000 seeds, which may remain viable in the soil for over 10 years.

2. An annual plant, witchweed overwinters in the seed stage. Its seeds germinate in the presence of host root exudate, and develop haustoria which penetrate host root cells. Host root exudate contain strigolactones, signalling molecules that promote striga seed germination.

3. A bell-like swelling forms where the parasitic roots attach to the roots of the host. The pathogen develops underground, where it may spend the next four to seven weeks before emergence, when it rapidly flowers and produces seeds.

4. Witchweed seeds spread readily via wind and water, and in soil via animal vectors. The chief means of dispersal, however, is through human activity, by means of machinery, tools, and clothing.

Suitable Environmental Conditions for the Growth of Striga

1. Temperatures ranging from 30 to 35 °C (86 to 95 °F) in a moist environment are ideal for germination.
2. Agricultural soils with a light texture and low nitrogen levels tend to favour Striga's development.
3. witchweed has demonstrated a wide tolerance for soil types if soil temperatures are favourably high.
4. Seeds have been shown to survive in frozen soil of temperatures as low as −15°C (5°F), attesting to their aptitude as overwintering structures.

Hosts

1. Although most species of Striga are not pathogens that affect human agriculture, some species have devastating effects upon crops, particularly those planted by subsistence farmers. Crops most commonly affected are corn, sorghum, rice and sugarcane.

2. Three species cause the most damage: *Striga asiatica, S. gesnerioides*, and *S. hermonthica.*

Symptoms

Host plant symptoms, such as stunting, wilting, and chlorosis, are similar to those seen from severe drought damage, nutrient deficiency, and vascular disease.

Haustorium Development

1. Once germination is stimulated, the Striga seed sends out an initial root to probe the soil for the host root. The initial root secretes an oxidizing enzyme that digests the host root surface, releasing quinones.

2. If the quinone product is within the appropriate concentrations, a haustorium will develop from the initial root. The haustorium grows toward the host root until it makes contact with the root surface, establishing parasitic contact in relatively short order. Within 12 hours of initial haustorium growth, the haustorium recognizes the host root and begins rapid cell division and elongation.

3. The haustorium forms a wedge shape and uses mechanical force and chemical digestion to penetrate the host root, pushing the host cells out of the way. Within 48–72 hours, the haustorium has penetrated the host root cortex.

4. Finger-like structures on the haustorium, called oscula (from Latin osculum, "little mouth") penetrate the host xylem through pits in the membrane.

5. The oscula then swell to secure their position within the xylem membrane. Striga sieve tubes develop along with the oscula. Shortly after the host xylem is penetrated, Striga sieve tubes develop and approach the host phloem within eight cells. This eight-cell layer allows for nonspecific nutrient transport from the host to the Striga seedling. Within 24 hours after tapping the host xylem and phloem, the Striga cotyledons emerge from the seed.

Management

1. Management of witchweed is difficult because the majority of its life cycle takes place below ground. If it is not detected before emergence, it is too late to reduce crop losses.

2. To prevent witchweed from spreading it is necessary to plant uncontaminated seeds and to clean soil and plant debris off of machinery, shoes, clothing, and tools before entering fields.

3. If populations are low, hand weeding before seeds are produced is an option.

4. Striga in the United States has been controlled through the use of several management strategies, including quarantines imposed on affected areas, control of movement of farm equipment between infected and uninfected areas, herbicide application, and imposed "suicidal germination". For the latter, in fields not yet planted in crops, seeds present in the soil are induced to germinate by injecting Ethylene gas, which mimics the natural physiological response tied to host recognition. Because no host roots are available, the seedlings die. Unfortunately, each Striga plant can produce tens of thousands of tiny seeds, which may remain dormant in the soil for many years.

5. Another method called trap cropping involves planting a species in an infested field that will induce the Striga seeds to germinate but will not support attachment of the parasite. This method has been used in sorghum plantations by planting Celosia argentea between the sorghum rows.[21] Cotton, sunflower and linseed are also effective trap crops. Planting silverleaf desmodium *(Desmodium uncinatum),* as is done in push-pull intercropping, inhibits striga seed germination and has worked effectively intercropped with maize.

6. Increasing nitrogen levels in the soil, growing striga-tolerant varieties, trap-cropping, and planting susceptible crops harvested before witchweed seed is produced, are proven anti-striga tactics.

7. Coating maize seeds with fungi or an herbicide also appears to be a promising approach. An example is TAN222, the "striga-resistant" maize variety which is coated with the systemic herbicide imazapyr, to which it is resistant. Any striga seeds sprouting when this maize is in the seedling stage are poisoned when their haustoria embed in the seedling's roots.

8. Several sorghum varieties have high levels of resistance in local conditions, including 'N-13'.

References

1. Carsky RJ, Berner DK, Oyewole BD, Dashiell K and Schulz S. Reduction of Striga hermonthica parasitism on maize using soybean rotation. International Journal of Pest
2. Management, 2000; 46:115–120.
3. Ejeta G, LG Butler and AGT Babiker.New Approaches to the Control of Striga.Striga Research at Purdue University.Research Bulletin, 1993; 991:27.
4. Gethi JG and Smith ME. Genetic responses of single crosses of maize to Striga hermonthica (Del.) Benth and Striga asiatica (L.) Kuntze. Crop Sci, 2004; 44: 2068- 2077.
5. Gomez-Roldan V, Fermas S, Brewer PB,Puech-Pagès V, Dun EA, Pillot JP, Letisse F, Matusova R, Danoun S, Portais JC, Bouwmeester H, Bécard G, Beveridge CA, Rameau C, and Rochange SF. "Strigolactone inhibition of shoot branching". Nature, 2008; 455:180-194.
6. Khan ZR, Pickett JA, Hassanali A, Hooper AM and Midgea CAO. Desmodium species and associated biochemical traits for controlling Striga species: Present and future prospects. Weed Research, 2008; 43: 302- 306
7. Parker C. Observations on the current status of Orobache and Striga problems worldwide. Pest ManagSci, 2008; 65: 453-459.
8. Kamara AY, Ekeleme F, Menkir A, Chikoye D and Omoigui LO. Influence of nitrogen fertilization on the performance of early and late maturing maize cultivars under natural infesta-tion with Striga hermonthica. Archives of Agronomy and Soil Science,2009; 55(2):125–145.

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Micrografting (Shoot Tip Grafting) in Horticultural Crops

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Introduction

The necessity to modernize the planting material production technologies of fruit crops has been stimulated by many considerations such as the trends towards increasing the planting densities in field grown trees and the transition to intensive growing systems and modernization of tree habit and pruning. All of these changes have created a demand for more and more quantities of quality planting material. The conventional system of propagation is time consuming as it requires about one year to raise the saplings and the material raised is neither uniform nor healthy. But, application of in vitro techniques in fruit growing can, therefore, be a viable alternative tool to circumvent these problems associated with conventional method of propagation and one such method is shoot tip grafting or micro grafting. Micro grafting is an in vitro grafting technique which involves the placement of a meristem or shoots tip explant onto a decapitated rootstock that has been grown aseptically from seed or micro propagated cultures. It has the potential to combine the advantages of rapid in vitro multiplication of healthy plants with the increased productivity that results from grafting superior rootstock–scion combinations (Hartmann et al., 2002).

Methods of In Vitro Grafting

Horizontal grafting: Scion is horizontally cut and placed onto rootstock after cutting its top (decapitation)

Wedge grafting: Base of scion is cut into a V-shape and placed onto decapitated (wedge or vertical slit) rootstock.

Protocol of In Vitro Micro Grafting

Fig 1: Raising of in vitro rootstock

1. Raising in vitro rootstock: Collect the ripen fruits and extract the seeds, later seeds are denuded after removing both seed coats and surface sterilize with 0.5-0.7 per cent sodium hypochlorite solution for 10 minutes. Then seeds are cultured (test tube) on basal MS medium solidified with 1 per cent agar. All cultures are incubated in a growth room (26±2°C). Plants are grown under regular greenhouse conditions. Seedlings by seed germination under in vitro are used as rootstock. Rootstock (seedling) is removed from the test tube under aseptic conditions. Remove the tip of the rootstock (Decapitated), leaving 1 – 2 cm of the epicotyl and root is cut to length 4-6 cm. Remove the cotyledons and axillary buds (Fig 1).

2. Scion preparation: Shoot tips are taken from sprouted flushes of elite plant grown under green house. In a laminar flow hood, disinfect (5% sodium hypochlorite) for 10 minutes. Pick up a shoot-tip with inverse tweezers and place under the dissecting scope. Then shoot tips with 0.1-0.3 mm apical meristem and 2-3 leaf primordial. These microscions can be used for grafting under microscope (Fig 2).

Fig 2: Preparation of micro-scion (shoot tip) under laboratory condition

3. Grafting - In vitro: Take the decapitated rootstock and micro scion (with 0.1-0.3 mm apical meristem and 2-3 leaf primordia). Make incision by 1 mm long vertical cut and 1-2 mm horizontal cut at the top of the decapitated epicotyl seedling (Rootstock). Shoot tip is placed inside the incision of the rootstock with its cut surface in contact with the cortex at the top of the decapitated rootstock.

4. Culture In vitro grafted plants: Micrografted plants are cultured in a liquid nutrient medium composed with MS salt modified with White's vitamins and 75 g sucrose /l. A folded paper platform, perforated at its center for insertion of the root portion of the rootstock is placed in the nutrient solution. Cultures are kept at 27° C and exposed 16 hrs of daily photoperiod. Growing small leaves from shoot tip coming out from the incision can be observed. Successful grafts (2-4 expanded leaves) can be transplanted to pot.

5. Transplanting: Successful grafts (2-4 expanded leaves) transferred to pot with sterilized soil mix. Pots are enclosed in polyethylene bags that are closed with rubber bands. Placed in shaded area of temperature-controlled greenhouse at 18-25°C. Bags are opened and removed. Plants are grown under regular greenhouse conditions.

Improvement in Micrografting Technique

For the commercialization of micrografting, protocol should be perfect for getting maximum success of micrografting.

1. Light/ dark incubation treatments: Significant variations have been reported in the percentage of successful graft according to the exposure of seedling to light. Ewa and Monika (2006) found high percentage of successful micrografts in cherry under dark conditions. Hamaraie et al., 2003 reported higher frequency of successful grafts (50%) in grapefruit (Citrus paradisi) cv. "Miami, when rootstock seedlings (sour orange) were obtained from seeds germinated under continuous darkness for two weeks as compared to only 5% successful grafts with seedlings which developed under light. Navarro et al. in 1975 reported a very low frequency of successful grafts using Troyer citrange seedlings grown under continuous light as compared to seedlings grown in continuous darkness.

2. Browning and tissue blackening: Rather et al. in 2011 found that use of PVP in micrografting has reduced the oxidation of PPO enzyme that cause browning. It can be done by either soaking explants in anti-oxidant solution or by placing a drop of solution onto the rootstock before inserting the scion.

3. Use of growth regulators: Under in vitro conditions, growth regulators particularly cytokinins and auxins have been found effective for improving the graft success rate. These growth regulators increase the rate of cell division and improve callus formation, which in turn help in increasing the percentage of successful graft unions. Wang et al. in 2010 found NAA effective in improving the micrograft success in walnut. Rafail and Mosleh in 2010 reported increase in micrograft success from 30 to 90% in pear (cv. Aly-sur on Calleryana pear) and 40 to 90% in apple (cv. Anna on MM106) with increasing BAP concentration from 0-2.0 mg/L.

4. Sucrose concentration of the medium: Navarro et al. (1975) reported that sucrose concentration of medium of grafted plants played a significant role and that the highest rate of successful grafts in citrus species was obtained with 7.5% sucrose. Generally in vitro growth and development increases with increased sugar concentration (Pierik, 1987). Naz et al. (2007) used 14 days old seedlings of rough lemon (Citrus jambheri Lash) grown under in vitro etiolated conditions as rootstock and microshoots of Kinnow mandarin/Succari sweet orange as scion. Micrograft success improved with increase in sugar levels in both cultivars from 20-22% with 3% sucrose to 36-38% with 7% sucrose.

5. Preventing desiccation of the graft: Desiccation of graft or surfaces of the graft in partners is one of the major causes of graft union failure (Pliego and Murashige, 1987; George et al., 2008). To prevent this phenomenon, Pliego and Murashige (1987) applied a layer of moist nutrient agar gel to connect the grafting partners and obtained better graft success. Rafail and Mosleh (2010) used an agar drop from the solidified culture medium and placed it on the cut area of the rootstock. Micrografts in which an agar drop was added to their grafted area were highly successful (70% in apple and 60% in pear) as compared to those without an agar drop (10%). Adding an agar drop usually prevents scion drying and makes the transport of different materials possible and holds the graft units together until the fusion takes place. Addition of agar drop supplemented with minerals and/or phytohormones further improved graft success. Amiri (2007) obtained 65% successful grafts in cherry using homoplastic grafting method (adding two drops of agar solution around the fitting site of micrograft) as compared to 41% through heteroplastic method (without application of agar drops).

Conclusion

Successful micrografting protocols have been developed for various fruit crops including almond, apple, cherry, citrus, grapes, pear, olive, etc. Graft success largely depends on number of factors individually and as well as in interactive manner such as scion length, scion origin, graft method, media used and rootstock development stage.

References

1. Amiri, M. E., 2007, Special microgrfting technique for cherry (Prunus avium L.). Acta Hort. 764:151-154.
2. Ewa, D., Monika, M., 2006, Vegetative cherry rootstocks in tissue culture. Scientific works of the Lithuanian institute of horticulture and Lithuanian university of agriculture, Sodininkyste Ir Darzininkyste 25:77-84.
3. Hamaraie, M. A. Ali., Osman, M. Elamin., Mohamed, A. Ali., 2003, Propagation of grape fruit by shoot-tip micrografting. Acta Hort. 45: 147-153.
4. Hartmann, H. T., Kester, D. E., Davies, F.T. and Geneve, R. L., 2002, Plant Propagation Principles and Practices. 7th Ed. Prentice hall. Upper saddle river. NJ, ISBN., 0-13-679235-9: 849.
5. Navarro, L., Roistacher, C.N., Murashige, T., 1975., Improvement of shoottip grafting in vitro for virus-free citrus. J. Amer. Soc. Hort. Sci. 100:471-479.
6. Naz, A. A., Muhammad, J., Jaskani, H. A. and Qasim, M., 2007, In vitro studies on micrografting technique in two cultivars to produce virus-free plants. Pak. J. Bot. 39: 1773-1778
7. Pierik, R. L. M., 1987, In vitro culture of higher plants. Martinus Nijhoff Publishers, Dordrecht, Netherlands.10: 60-63.
8. Pliego-Alfaro, F. and Murashige, T., 1987, Possible rejuvenation of adult avocado by graftage onto juvenile rootstocks in vitro. Hort-Sci. 22:1321-1324.
9. Rafail, S.T. and Mosleh, M. S., 2010., Factors involved in micropropagation and shoot tip grafting of apple (Malus domestica Borkh.) and pear (Pyrus sp. L.). Tropentag, "World Food System– A Contribution from Europe September 14 -16, 2010 in Zurich.
10. Rather, Z. A., Siddique, M. A. A., Nazki. I.T., Nelofar, H. G.,2011, Strategies for controlling explant browning during in vitro cultures of herbaceous peony (Paeonia lactiflora) cv. Sara Bernherdt. J. Orn. Hort. New series 13(1):1-7.
11. Wang, G., Li, X., Chen, Q. and Tian, J., 2010., Studies on factors affecting the microshoot grafting survival of walnut. Acta Hort. 861:327-331.

Liquid Organic Fertilizers

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Introduction

Growing concerns regarding food safety, environmental degradation and human health have currently generated interest in alternative agricultural systems like organic farming. The demand for organic food is steadily increasing day by day owing to their nutritional and health benefits. The farmers practicing organic cultivation are mainly depends upon the soil applied organic manures, many of them are lacking the knowledge of liquid organic fertilizers.

Foliar feeding is a technique of feeding plants by applying liquid fertilizer directly to the leaves. Plants are able to absorb essential elements through their leaves. Foliar fertilization of crops offers specific advantages over soil application of fertilizers, because the nutrients are applied and taken-up directly by their target organs thereby they can address an urgent need within a relatively short time, providing a specific and rapid response. Vermiwash, panchagavya, jeevamirtham, amrit pani, fish amino acid, egg amino acid and biogas slurry are some of the liquid organic fertilizers that can be easily prepared by farmers.

Vermiwash

Vermiwash is a liquid extract obtained from vermicompost, has been used as an organic fertilizer for crop plants. It is the lechate collected by passing water through a medium containing freshly formed compost and earthworms. It is rich in nutrients, beneficial microorganisms and growth promoting substances and can be diluted and applied as foliar spray to crops.

Method of preparation: Construct a cement tank of size 80 x 80 x 80 cm. Place a layer of small brick pieces or gravel at the bottom of the tank. Place a layer of coconut fibre of 3-4 cm thickness above it. Add 4 Kg of biowaste to the system along with 2 kg of earthworms. After two weeks, the entire mass of biowaste will turn to brownish black compost. Then add 2 litres of water. Vermiwash is collected through the side tap after 24 hours. Again, biowaste is added to the system and the process is repeated (Kissan Kerala, 2020).

Panchagavya

Panchagavya is an organic product prepared from nine products such as cow dung, cow urine, milk, curd, jaggery, ghee, banana, tender coconut and water. It plays potential role in promoting growth and providing immunity in plants.

Method of preparation: Add cow dung and cow ghee in a wide mouthed mud pot, concrete tank or plastic can and mix the ingredients thoroughly in morning and evening hours. Keep it for 3 days. After 3 days mix cow urine and water and keep it for 15 days with regular mixing both in morning and evening hours.

After 15 days mix cow milk, curd, tender coconut water, jaggery and banana. Panchagavya will be ready after 30 days. Three percentage solution (3 litres of panchagavya to every 100 litre of water) is ideal for all crops (Selvaraj, et al., 2007).

Ingredients:

a. Cow dung - 7 kg.
b. Cow ghee - 1 kg.
c. Cow Urine - 10 liters.
d. Water - 10 liters.
e. Cow milk - 3 liters.

f. Cow curd - 2 liters.
g. Tender coconut water - 3 liters.
h. Jaggery - 3 kg.
i. Well ripened poovan banana – 12 nos.

Jeevamirtham

This is an excellent culture for enabling the exponential increase of beneficial microbes. Higher number of bacteria, different fungi and N-fixers clearly indicate that the jeevamrutha is enriched consortia of native soil microorganisms (Devakumar et al., 2014).

Ingredients:

a. Cow dung – 10 kg.
b. Cow's urine – 10 litres.
c. Jaggery (old) – 2kg.
d. Flour of gram / pigeon pea/ moong dal / cowpea / urad dal – 2 kg.
e. Live soil – 1 kg.
f. Water – 200 litres.

Preparation: Take 100 litres of water in a barrel and add 10 kg of cow dung and 10 litres of cow's urine. Mix well with the help of a wooden stick, add 2 kg of old jaggery and 2 kg of flour. Mix this solution well with wooden stick. Keep the solution undisturbed for 2 to 7 days for fermentation. Stir the solution regularly three times a day.

Fish Amino Acid

Ingredients: 1 kg native fish, 1 kg jiggery.

Preparation: Remove the fish intestines and chop into fine pieces. (Using intestines is not harmful but it smells bad). Powder the jiggery and add it.

Add the two to broad-mouthed glass jar (best) or plastic jar that is just the right size (not too big), cover the jar with the lid (cap), tighten it, and mix it well by shaking the jar.

Don't add water. In thirty days, this will be fermented. Filter it using nylon mesh to get 300-500 ml solution changed into honey-like syrup. This is a great nutrient for the plants (TNAU - agritech portal, 2014).

Usage: Add 5 ml of this with one liter water for spraying. It could also be mixed with irrigation water.

Table 1. Nutrient content of liquid organic fertilizers:

	N (%)	P (%)	K (%)	Ca (mg L^{-1})	Mg (mg L^{-1})	S (mg L^{-1})
Panchagavya	0.45	0.18	0.11	147.50	46.00	465.00
Jeevamrutha	0.04	0.17	0.01	187.00	17.17	553.00
Fish amino acid	0.13	0.41	0.06	324	49	565
Vermiwash	0.08	0.06	0.07	91.27	24.26	425

(Parvathy, 2017)

Egg Amino Acid

Ingredients: 5 eggs, juice of 10 - 15 lemons, and 250 gms jaggery.

Preparation (Nair, 2020): Place the eggs in a jar and pour lemon juice in it until the eggs are completely immersed. Keep it for ten days with lid closed. After ten days smash the eggs and prepare the solution.

Add equal quantity of thick jaggery syrup to it and set aside for ten days. The solution will then be ready for spraying. This is a great nutrient for the plants just like Fish Extract and will boost plant growth.

Usage: Add one to two ml of this with one liter water for spraying.

Biogas Slurry

Biogas slurry is a safe, organic, liquid fertilizer. It is the residue comes out as sludge, after fermentation of dung and water from biogas plant. Plants can immediately absorb the nutrients as it is fermented. It can be applied directly to plants, with water in 1:1 ratio.

NPK content - 0.25%, 0.13%, 0.12%.

Other Liquid Organic Fertilizers

Fish-based fertilizers such as fish emulsion or fish powder and seaweed (soluble seaweed powder, seaweed extract) are common foliar fertilizers in organic farming. Compost tea is a popular foliar spray material having high nutrient content and disease-suppressive characteristics. Other soluble organic materials and materials for extracts preparation include spray dried blood, bat guano, worm castings, manure teas, molasses, milk, B vitamins, and herbal extracts of plants like stinging nettle and horsetail (Kuepper. 2003).

References

1. Devakumar N., Shubha S., GOUDER S.B. and RAO G.G. E., (2014). Microbial analytical studies of traditional organic preparations beejamrutha and jeevamrutha. In: Rahmann G. and Aksoy U. (Eds.). Proceedings of the 4th ISOFAR Scientific Conference. 'Building Organic Bridges', at the Organic World Congress 2014, 13-15 Oct., Istanbul, Turkey.
2. Kissan Kerala. Available: http://www.kissankerala.net/kissan/kissancontents/alied.jsp
3. Kuepper G., (2003). Foliar fertilization. Available:https://www.slideshare.net/Elisa Mendelsohn/ foliar-fertilization
4. Nair A. R., (2020). Egg Amino Acid: Excellent for Pest Control and Crop Growth. Available: https://krishijagran.com/agripedia/egg-amino-acid-excellent-for-pest-control-and-crop-growth/
5. Parvathy S. U., (2017). Characterization and evaluation of on- farm liquid organic manures on soil health and crop nutrition. Ph. D. thesis. Kerala Agricultural University, Thrissur.
6. Selvaraj N., Anitha B., Anusha B. and Guru Saraswathi. M., (2007). Organic Horticulture. Horticultural Research Station, Tamil Nadu Agricultural University, Udhagamandalam.
7. TNAU Agritech portal. Available: https://agritech.tnau.ac.in/or g_farm/orgfarm_farming_pr actices_treatment_preperation.html.

Agripreneur: Emerging Trade in India

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Summary

Agripreneurship also play following role in the economic system, it helps in inducing productivity gains by smallholder farmers and integrating them into local, national and international markets. It helps in reducing food costs, supply uncertainties and improving the diets of the rural and urban poor in the country. It also generates growth, increasing and diversifying income, and providing entrepreneurial opportunities in both rural and urban areas. Recently, Government emphases on Agripreneur concept for create the opportunity, innovation and also business in Agricultural sector.

Introduction

India is a global agricultural powerhouse. It is the world's largest producer of milk, pulses, and spices, and has the world's largest cattle herd (buffaloes), as well as the largest area under wheat, rice and cotton. It is the second largest producer of rice, wheat, cotton, sugarcane, farmed fish, sheep & goat meat, fruit, vegetables and tea.

In the developed countries, agribusiness is defined as the total output arising from farm production and product processing at both pre- and post-farm gate levels. In developing countries like India, the agribusiness sector encompasses four distinct sub-sectors, viz. agricultural inputs; agricultural production; agro-processing; and marketing and trade. All these add value or utility to the goods. Agribusiness is emerging as a specialized branch of knowledge in the field of management sciences. In this context, agribusiness can be said as science and practice of activities, with backward and forward linkages, related to production, processing, marketing, trade and distribution of raw and processed food, feed and fiber, including the supply of inputs and services for these activities.

Need for Agribusiness

Over the years, the agricultural marketing and trade scenario has undergone tremendous changes but, it has not changed enough to meet the emerging demand for such services.

Acharya (2006), narrated some of the marketing system related limitations as:

1. The market size is already large and is continuously expanding. The farmers' market linkages (both backward and forward) have also increased manifold, but the marketing system has not kept pace.

2. Private trade, which handles around 80 percent of the marketed surplus, did not invest in marketing infrastructure due to excessive regulatory framework and dominance of the unorganized sector.

3. Increased demand for value-added services and geographic expansion of markets require lengthening of the marketing channel, but this has been hampered by lack of rural infrastructure.

4. Direct marketing by 'farmers to consumers' remains negligible. In 85% of the 27,294 rural periodic markets, where small and marginal farmers come in contact with the formal economy, facilities for efficient trade are still almost absent.

5. For facilitating trade at the primary market level, 7161 market yards/ sub-yards have been constructed, but they have become inadequate, ill-equipped, and mismanaged.

6. Food processing industry has a high multiplier effect and employment potential. But in India, the value addition to food production has been only around 7 percent.

7. Due to lack of proper handling (cleaning, sorting, grading and packaging) at the farm gate or village level, about 7% of grains, 30% of fruits and vegetables, and 10% of seed spices are lost before reaching the market.

8. Farmers, shifting to higher-value crops, face increased risks of fluctuations in yield, price and income.

Why Agricultural Entrepreneurship?

Traditionally, agriculture is seen as a low-tech industry with limited dynamics dominated by numerous small family firms, which are mostly paying attention to doing things better rather than doing novel things. Over the last decade, this situation has changed dramatically due to economic liberalization, a reduced shelter of agricultural markets, and a fast changing, more decisive, society. Agricultural companies progressively more have to adapt to the vagaries of the market, varying consumer lifestyle, enhanced ecological regulations, new necessities for product quality, chain management, food security, sustainability, and so on. These alterations have cleared the way for new participatory, innovation, and portfolio entrepreneurship.

Agripreneur

Agripreneur defined an entrepreneur whose main business is agriculture or agriculture base or related. Agriculture + Entrepreneur = Agripreneur.

Agripreneurship

Generally, it is understood as, sustainable, community-oriented and directly-marketed agriculture. Sustainable agriculture denotes a holistic, systems-oriented approach to farming that focuses on the interrelationships of social, economic, and environmental processes.

Emerging Areas of Agribusiness

Agribusiness Opportunities As already mentioned, for improving the efficiency of the marketing system, there is a need for substantial investment in marketing infrastructure, both physical and institutional. The investment needs and opportunities for investors exist in the following broad areas (NAAS, 2006).

Production

1. Production of high-yielding seeds.
2. Production of high-quality planting material, including the use of tissue culture methods of micro-propagation.
3. Nurseries, including hardening nurseries.
4. Production of microbial cultures and vermicompost.
6. Floriculture.

Processing

1. Processing of maize for starch and feed through improved mini/ small mills and dry milling plants.
2. Fruit and vegetable processing, including dehydration, canning, aseptic packaging, processing of underutilized fruits and processing for other products like grape raisin, air-dried fruits, fruit toffee, bleached dry ginger and spices' powders.
3. Processing of millets for various purposes, including malt from finger millets and RTE (Ready-to-Eat) products.
4. Processing of sugarcane for various jaggery products like spiced jaggery, powdered jaggery, and jaggery cubes.
5. Processing of herbal and medicinal plants.

6. Processing of dairy products.
7. Processing for poultry products, including poultry dressing.
8. Processing of livestock products and livestock wastes.

Infrastructure

1. Cool chain infrastructure, including cold stores.
2. Storage and warehousing.
3. Specialized transport services.
4. Packaging infrastructure, including pack houses.
5. Agri-clinics and service centres.

Trade and Others

1. Procurement through contract arrangements, including contract farming.
2. Retailing.
3. Supply chain management, and Capacity building, including human resource development in agribusiness.

Governmental Support for Innovation and Entrepreneurship in India

1. Startup India.
2. Make in India.
3. Atal Innovation Mission (AIM).
4. Support to Training and Employment Programme for Women (STEP).
5. Jan Dhan- Aadhaar- Mobile (JAM).
6. Digital India.
7. Biotechnology Industry Research Assistance Council (BIRAC).
8. Department of Science and Technology (DST).
9. Stand-Up India.
10. Trade-related Entrepreneurship Assistance and Development (TREAD).
11. Pradhan Mantri Kaushal Vikas Yojana (PMKVY).
12. National Skill Development Mission.
13. Science for Equity Empowerment and Development (SEED).

References

1. NAAS (National Academy of Agricultural Sciences (2006) Employment Opportunities in Farm and Non-farm Sectors through Technological Interventions with Emphasis on Primary Value Addition, Policy Paper 37, October.
2. Acharya S. S. (2006) Agricultural Marketing and Rural Credit for Strengthening Indian Agriculture, Asian Development Bank, INRM Policy Brief No. 3.
3. http://www.worldbank.org/en/news/feature/2012 /05 /17 / India- agriculture - issues-priorities.
4. https://www.ges2017.org/govt-of-india-support-for-entrepreneurs.

Lac Cultivation and its Product Uses

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Introduction

Lac is a natural resin secreted by lac insect, *Kerria lacca* (Kerr) which thrives on the tender twigs of specific host trees. The most common host trees for commercial lac cultivation are *Butea monosperma* (palas), *Ziziphus mauritiana* (ber) and *Schleichera oleosa* (kusum), *Flemingia semialata* (bushy host) besides several other trees of regional importance. Three natural, renewable, non-toxic and eco-friendly products i.e., resin, dye and wax are derived from the lac.

Rangeeni and kusmi are the two strains of lac insect which are based on preference of the insect for specific host plants. Rangeeni strain produces two crops in a year known as rainy season (katki) lac crop (harvesting in October-November) and summer season (baisakhi) lac crop (immature crop harvesting in April-May and mature crop harvesting in June –July), while kusmi strain also produces two crops in a year known as winter season (aghani) lac crop (crop harvesting in December –February) and summer season (jethwi) lac crop (harvesting in July-August).

Cultivation of Lac

Following steps are involved in this process:

1. Selection of site and the host plants.
2. Pruning.
3. Inoculation.
4. Swarming.
5. Harvesting of lac.

Selection of Site and the Host Plants

Host selection is of primary importance in lac cultivation as the quality and yield of the lac depends on the host plant. The host plants include palas, kusum, khair etc. The lac from the host plant kusum attracts highest price in the market.

Pruning

The time of pruning also plays an important role in lac production. The proper care of host plant is required in relation to health, nutrition and quality and quantity of lac. Pruning is normally done 6-12 months before inoculation of lac insect. The general time of pruning is Jan – Feb. if inoculation is to be done in June - July and pruning time is April-May is inoculation is to be done in Oct - Nov. Avoid excessive pruning. This helps in maintaining normal health and strength of the tree.

Inoculation

Inoculation is the first step in the cultivation of the lac insect. In this process the young ones get associated properly with the host plant. Inoculation can be done two types natural inoculation or artificial inoculation. Natural inoculation done in normal way and it is very simple process where the swarmed larvae infect and suck out the sap from the same host plant again. Another artificial inoculation the twigs bearing the insect larvae which are about to swarm are cut. These cut pieces are transferred to new host plant. Artificial inoculation is generally considered to check all possible drawbacks of natural inoculation.

Swarming

Swarming is the important steps of the lac insect. During swarming, the upper surface has yellow spot on the anal region. In this process the muscles contract and insect get detached from the place of attachment. This leaves a hollow cavity which is later filled with resin.

Harvesting of Lac

Finally collecting ready lac from host tree is known as harvesting. Harvesting is of two types:

1. Immature harvesting: Harvesting is done before swarming is called immature harvesting. The obtained lac is called as Ari lac. Ari lac obtained from palas host plant.

2. Mature harvesting: Harvesting is done after swarming is called mature harvesting. The obtained lac is called as mature lac.

The highest production of lac is obtained by harvesting twigs with the females still living. Harvesting can be done twice a year. The lac bearing twig along with the eggs is called brood lac stick and the lac is called as brood lac or stick lac.

Lac Products and their Uses

Products: Shellac, seedlac, sticklac, dewaxed and decolorized lac, bleached lac, gasket lac, button lac, aleuritic acid, lac dye and other lac products.

Seedlac: Sticklac is refined through coarse crushing, repeated washing with water to remove much of the impurities till the wash water become colorless. The dried lac grains are called seedlac. Seedlac has a wide range of application and is used as a raw material for shellac bleached lac and aleuritic acid.

Shellac: Shellac is a natural gum resin. It is natural nontoxic, physiologically harmless and edible resin. It is used in fruit coatings e.g., for cheese and eggs, as a binder for mascara, nail varnish additive conditioning shampoo, film forming agent for hair spray, micro encapsulation for perfumes.

Stick lac: The lac encrustations are separated by knife or broken off with finger from the twig of host plants and is known is stick lac or crude lac or raw lac.

Button lac: After melting process, lac is dropped on a zinc sheet and allowed to spread out into round discs of about 3” diameter and ¼”thickness is called button lac.

Garnet lac: It is inferior seed lac or kiri by the solvent extraction process. It is dark colour and free from wax.

Bleached lac: It is prepared by chemical treatment. It is repared by shellac or seed lac in sodium carbonate solution, bleaching the solution with sodium hypochorite and precipitating the resin with sulphuric acid. This form of lac deteriorates quickly and should be used within 2-3 months of manufacture.

Lac dye: is a mixture of anthroquinoid derivatives.it is used to colour wool and silk and also used in food and beverages industry for colouring.

Lac wax: is a mixture of higher alcohols, acids and their esters. it is used in polishes applied on shoes, floor, automobiles etc. Food and confectionary, drug tablet finishing, lipsticks and crayons.

Aleuritic acid (shellac aleuritic powder): Aleuritic acid (9,10,16-trihydroxypalmitic acid) obtained from shellac by saponification, is a unique acid containing three hydroxyl groups of which two are of adjacent carbon atoms. It is a white powder or granule. Aleuritic acid (purity 99%)a slight yellow and almost odourless solid.it is used for manufacturing of perfumes and is very much in demand with perfume manufacturing companies in france, Italy, Germany, USA etc.

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Incredible Health Benefit of Emperor's Rice: The Black Rice

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Introduction

Black rice is a range of rice types of the species *Oryza sativa*, some of which are glutinous rice. *Oryza sativa* is the cultivated form of wild rice and is known for its rare trifecta of delicious, healthy, and aesthetically pleasing. The dark-coloured rice, which is a deep purple-black, has alternate names including purple rice, forbidden rice, and emperor's rice. It is known as forbidden rice or emperor's rice because in ancient China only those belonging to the upper class could afford to eat it and forbidden to all who were not noble or royalty. But now-a-day black rice is no longer forbidden, though it is cultivated relatively in small amount in comparison with other varieties of rice. Today, there are two varieties of *Oryza sativa — japonica*, which is stickier and short-grained and grows in drier, upland fields, and *indica*, which is long-grained and grows in submerged, low land fields.

Black rice gets its signature black-purple colour from a pigment called anthocyanin (chynidin-3- glucoside), which has potent antioxidant properties. (Balasubramanium et. al, 2019). Black rice contains higher level of protein, vitamin and minerals compared to other white rice. Protein content of black rice are lysine and tryptophan which are known as good amino acids; Vitamins such as Vitamin B_1,Vitamin B_2 and folic acid; and it is good source of minerals such as iron, zinc, calcium , phosphorous and selenium. (Qiu LC et.al,1993). It contains highest amount of antioxidant, protein and dietary fibre which are found almost in all rice varieties besides it contains phenolic, flavanoid and anthocyanin (Parimalavalli R et.al, 2018).

Photograph of raw Black rice

Good Source of Nutrients

Black rice is a good source of several nutrients particularly fiber, iron and protein. Moreover, black rice is known for highest protein content compared with other varieties of rice. Per 3.5 ounces (100 grams), black rice contains 9 grams of protein, compared with 7 grams for brown rice.(Kang MY et. al, 2011). It is free of gluten, free of cholesterol, low in sugar, salt, and fat. (Kushwaha UKS, 2016).

45 gm (¼ cup) of uncooked black rice provides:

a. Calories: 160
b. Fat: 1.5 grams
c. Protein: 4 grams
d. Carbohydrates: 34 grams
e. Fiber: 1 gram
f. Iron: 6% of the Daily Value

Out of the two varieties of black rice that is short-grained and long-grained, long-grained rice is slightly healthier since it has less starch, giving it a lower glycemic index.(Saragih et. al, 2019).

Health Benefit of Black Rice

1. Black rice and Management of Type 2 Diabates Mellitus: People with diabetes are advised to stay away from foods that can spike their blood sugar levels. The best foods for diabetics are those that are low in carb and sugar, and high in fiber, healthy fats, and protein. Black rice is rich in powerful disease-fighting antioxidants, dietary fiber, protein, and iron.

This type of rice gets its signature black-purple color from anthocyanins, a group of flavonoid plant pigments that have strong anti-inflammatory, antioxidant, and anticancer effects. Anthocyanins can act against free radicals and help diabetics get protection from cell damage and fight inflammation. Black rice is also rich in fibre, which is digested slowly by the body.

This, in turn, helps in the slow release of glucose in the blood, preventing any sudden spikes in blood sugar levels. Fibre keeps you feeling full for longer and helps reduce calorie intake. This helps fight obesity, which is a risk factor for diabetes (Dineshwari L, 2020).

Black rice enriches with 18 amino acids and plays a vital role in body development through protein metabolism. Excess amino acid is converted to ammonia by removal of amine group in the liver and thus modifying risk of pre-diabetes.(Prasad B.J et.al, 2019).

2. Black rice and liver health: Excess intake of high-fat diet causes accumulation of fat in the liver and induces oxidative stress and inflammation which in long run leads to non-alcoholic fatty liver disease. Anthocyanins in black rice reduce the storage of fat in the liver and assist healthy liver cell regeneration and also restore the normal function of the liver.

Moreover, high antioxidant content in black rice also prevents hepatic steatosis (fatty liver) disease (Sewlani SS, 2020). Excessive fat in the liver can cause liver inflammation, which can damage liver and create scarring, and even lead to liver failure.

3. Black rice and brain function: Black rice is filled with Anthocyanins are potent antioxidants, part of the flavonoid family, and the same phyto-nutrients responsible for giving blueberries their deep blue hue and brain power.

Spoon for spoon, forbidden rice has higher anthocyanin content than black and blue berries. Studies show that anthocyanin compounds in food combat oxidative stress in the part of the brain that is under attack most with Alzheimer's disease – the hippocampus.(Fenn A, 2020). Clinical study shows that anthocynin help to improve learning capacity, improve memory impairment and reduce symptoms of depression.(R. Parimalavalli et.al. 2018).

4. Black rice and prevention of cancer: Cancer is caused by interaction of dietary, genetic and environmental risk factors and diet is considered to be the major factor associated with cancer etiology. (Glade M.J 1999).Healthy diet and lifestyle have excellent potential for cancer prevention and might reduce the burden of frequently occurring cancer of breast, colon and prostrate.

Several epidemiological and laboratory tests suggest that there is a strong relationship between colon and dietary fiber. There is a increase evidence that high intake of red meat and saturated fat will increase the risk of cancer and decrease with high intake of fruits, vegetables and whole grains and cereals (Michels KB, 2005).Hence natural dietary agents have great potential to suppress cancer and reduce the risk of cancer development by reducing oxidative stress. (Khan N. et. al, 2008).

Presences of antioxidant in black rice stop the formation of free radical which protect the body from onset and development of cancer cells. Moreover, consumption of black rice will also reduce tumor metastasis (Spreading of cancer around the body),(Young G.P et. al. 2002). Therefore, regular intake of black rice will not only provide anthocyanin antioxidant but also provide high dietary fiber which in turn reduce the risk of tumor metastasis but also reduce the risk of prostrate and colon cancer respectively.

In the same context, presence of anthocyanine in black rice reduces the risk of breast cancer in women by controlling the production of cell protective agents by turning on genes on genes on the body. (Agrawal A. et.al, 2020).

5. Black rice and heart health: The anthocynin phytochemical found in black rice help in reducing Low density lipo protein (LDL) known as bad cholesterol which is known for common contributor of heart disease. It not only brings down the cholesterol level but also prevent hardening of arteries commonly known as atheroschlerosis. (Senguupta S, 2018). American Health Association, the American Cancer Society and the 2005 Dietary Guidelines for Americans recommended an increase in the consumption of black rice to prevent heart disease and certain kinds of cancers.(Kushwaha UKS, 2016).

6. Black rice and anti-inflammatory: Black rice is a major source of anti-inflammatory agents, therefore is a great source of health. The bran of black rice restricts the release of histamine which leads in decrease in inflammation. (Dias et al., 2017).

7. Black rice and management of body weight: The black rice contains 3 grams of fiber per 1/2 cup of serving and thus it helps to regulate bowel movement preventing constipation, diarrhoea and bloating. The fiber help to bind toxin and waste within the digestive tract and help in ease of bowel movement. The fiber gives a satiated feeling after consumption which prevent into binding of other fatty food and thus help in management of body weight (R. Parimalavalli, 2018).

8. Black rice and anti-oxidant properties: The deep black or purple hues of black rice are the indicators of high antioxidant properties. The outermost layer (the bran and the hull) contain immense amount of antioxidant named anthocynin which not only help in restricting free radical movement which cause varieties of disease such as diabetes, cancer etc but also reduce inflammation and improves brain health.

Black rice also contains another important antioxidant – Vitamin E (tocopherol) which is beneficial for eyes, skin and immune health.(Kumar N et.al, 2020).

9. Black rice and eye health: Black rice contains high amounts of lutein and zeaxanthin which are two type of Carotenoids not only help in protecting eyes from potentially damaging free radicals but also help in protecting retina by filtering out harmful blue light waves (Dineshwori L, 2020).

Conclusion

Hence, Black rice is an excellent alternative to white and brown rice due to its nutrient density, high fiber content and rich in antioxidant viz. anthocyanin and tocopherol. Awareness among the public toward consuming black rice will gives a way to healthier life.

Reference

1. R. Parimalavalli and Thanuja B (2018). Review article- Role of black rice in health and disease; International journal of health science and research;,8(2) (2018) :241-248
2. Kang MY, Kim JH, Rico CW and Nam SHA,(2011).Comparative study on physiochemical study of black rice, International journal of food properties;14(6):1241-1254
3. Sengupta S,(2018).Article-7 incredible benefit of forbidden rice- the black rice, Food and drink, 17(7).
4. Saragih, Bernatal, Naibaho, Netty Maria and Saragih Barnulus, (2019). Nutritional, functional properties, glycemic index and glycemic load of indigenous rice from North and East Borneo.Food research.3(5): 537-545
5. Qiu LC, J Pan and Dan BW,(1993). The mineral nutrient component and characteristics of colored and white brown rice. Chinese journal of rice science.7(2):95-100.
6. Prasad BJ, Pazhaniyandi SS and Rengaraj S, (2019).Health benefit of black rice-a review.Grain and oil science and technology.2(4):109-113.
7. Aman Agrawal, Ankit Patel, Drista Kala, Jay Patidar, Lokesh Agrawal.(2020). Black Rice the New black gold of India. Food and agriculture spectrum journal.1(4):1-4
8. Hui Zhang, Guoyin Kai, Yongjun Xia, Guangqiang Wang and Lianzhong Ai,(2020).Antioxidant and in vitro digestion property of black rice (Oryza sativa L.): a comparison study between whole grain and rice bran. International journal of food engineering.16(9):
9. Kushwaha UKS, (2016). Black rice anthocyanin content increases with increase in altitude of its plantation. Adv Plants Agric Res.;5(1):469-472. DOI: 10.15406/apar.2016.05.00170

10. Dias, A. L. D. S., Pachikian, B., Larondelle, Y., & Quetin Leclercq, J. (2017). Recent advances on bioactivities of black rice. Current Opinion in Clinical Nutrition and Metabolic Care, 20(6), 470–476
11. Doneshwari L (2020). Why Ayurveda experts are encouraging diabetics to eat black rice?.The healthsite.com
12. Sneha sadwani sewlani, 2020.Article- top 10 benefit of Black rice- the forbidden rice.www.medindia.net
13. Annie Fenn (2020). 5 Reasons Why Forbidden Rice is my Favorite Brain-Healthy Grain. https://www.brainhealthkitchen.com/why-forbidden-rice-is-my-favorite-brain-healthy-grain/+&cd=17&hl=en&ct=clnk&gl=in
14. Glade MJ (1999).Food, nutrition and prevention of cancer-a global prospective.Nutrition.15:523-526.
15. Michels K.B (2005). The role of nutrition in cancer development and prevention. International journal of cancer.114:163-165
16. Khan N, Afaq F, Mukhtar H (2008).Chemo prevention through dietary antioxidant : progress and promise. Antioxidant redox signal.10:475-510.
17. Young GP, Lelue RK(2002). Preventing cancer: dietary intake or clinicakl intervention?. Asia pacific journal of clinical nutrition.11(3): 618-631.
18. Murali RD and Kumar N, (2020).Black rice: a novel ingredient in food processing. Journal of nutrition and food science.10(2):771-776.

Insect Cuticle and Moulting

Article ID: 10362

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Cuticle

The cuticle is an outer layer which contains a characteristic chemical compound called chitin, proteins and pigments. The cuticle is made up of three principal layers: epicuticle, exocuticle and endocuticle. The exo- and endo- cuticle together referred as procuticle.

Functions of Insect Cuticle

Being an interface between a living animal and an environment, the cuticle of an insect serves many functions:
1. It limits the dimensions of an exoskeleton and is a basis for muscle insertions(mechanical function and function of locomotion).
2. It is an important element in organism defence against a variety of external factors, such as mechanical stresses, dry, wet, cold or hot environments.
3. It takes part in the transport of diverse epidermal secretions, and serves as a chemical reservoir for the storage of metabolic waste products.
4. A variety of cuticular structures are parts of mechano- and chemoreceptors.
5. The cuticle, its coloration pattern, and chemical components are important for thermoregulation, and are often involved in diverse communication systems.
6. Specialised cuticular protuberances may serve a variety of functions, such as oxygen retention, food grinding, body cleaning (grooming), etc.

Moulting (Ecdysis)

Moulting (Ecdysis): Periodical process of shedding the old cuticle accompanied by the formation of new cuticle is known as moulting or ecdysis.

The cuticular part discarded during moulting is known as Exuvia.

Moulting occurs many times in an insect during the immature stages before attaining the adult-hood.

The time interval between the two subsequent moulting is called as Stadium and the form assumed by the insect in any stadium is called as Instar.

Steps in Moulting

1. Behavioural changes: Larva stops feeding and become inactive.
2. Changes in epidermis: In the epidermis cell size, its activity, protein content and enzyme level increases. Cells divide meiotically and increases the tension, which results in loosening of cells of cuticle.
3. Aolysis: Detachment of cuticle from epidermis
4. Formation of Sub cuticular space
5. Secretion of moulting gel in the sub cuticular space which is rich with chitinase and protease.
6. New epicuticle formation: Lipoprotein layer (cuticulin) is laid over the epidermis.
7. Procuticle formation: Procuticle is formed below the epicuticle.
8. Activation of moulting gel: Moulting gel is converted into moulting fluid rich in enzymes. This activates endocuticle digestion and absorption.
9. Wax layer formation: Wax threads of pore canals secrete wax layer.

10. Cement layer formation: Dermal glands secretes cement layer (Tectocuticle).

11. Moulting: This involves two steps:

a. Rupturing of old cuticle: Insect increases its body volume through intake of air or water which enhances the blood flow to head and thorax. There by the old cuticle ruptures along predetermined line of weakness known as ecdysial line.

b. Removal of old cuticle: Peristaltic movement of body and lubricant action of moulting fluid helps in the removal of old cuticle. During each moulting the cuticular coverings discarded are the cuticular of legs, internal linings of foregut and hindgut and trachea.

12. Formation of exocuticle: The upper layer of procuticle develops as exocuticle through addition of protein and tanning by phenolic substance.

13. Formation of endocuticle: The lower layer of procuticle develops as endocuticle through addition of chitin and protein. This layer increases in thickness.

Control of Moulting

It is controlled by endocrine gland like prothoracic gland which secrete moulting hormone. Endocrine glands are activated by prothoracico-tropic hormones produced by neurosecretory cells of brain.

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Plant Mites and its Morphological Features

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1. Mites are the 2nd most diverse group of living organisms after insects.
2. Until 1999, about 50,000 species of mites have been identified all over the world (Walter and Proctor, 1999).
    a. Up to 2011, a total of 54,617 mites and tick's species has been reported (Zhang, 2011).
    b. There is an estimate that half a million species are still to be identified.
3. Mites are minute to small range from 300 to 500 µm in body length. The largest Acari (Red velvet mites: Trombidiidea) may reach lengths 10 – 20 mm i.e., 0.4 – 0.8 inches (Weygoldt, 1998).
    a. The small in size and strongest in evolutionary flexibility of the Acari have permitted mites to colonize most of the aquatic and terrestrial habitats.
4. Moreover, this little animal plays an important role in litter, grasslands and agricultural soils, where they recycle minerals (Balogh, 1972).
    a. Walter and Proctor (1999) summarized very effectively the ecological importance and the economic role of mites as "The average mite is minuscule, barely perceptible to even the sharpest eyes. When enough are present, mites can exert efforts disproportionate to their size?"
5. Mites are microscopic in nature and worldwide in distribution and successfully colonized the terrestrial and aquatic habitats.
    a. They are present in all types of abiotic and biotic habitats like planes, mountains, desert, fresh water, salt water and springs, oceans, organic matter and lotter.
    b. Mites are present in large number in soils where they constitute up to 7% of total weight of invertebrate fauna.

Morphological Features

1. The mite are too small in size to be studied like insects.
    a. Therefore, they have been ignored by zoologies and Entomologists.
    b. At the time of Linnaeus, only 30 species had been known.
2. In the mites, the developing integument initially appears as undifferentiated tissues which is covered by thin layer of cuticulin and separated from the epidermis layer by 'Schmidt layer'.
    a. During developmental process, base of the integument undergoes more conversion and shows from the outside inwards.
    b. An epiculicular layer an underlying Schmidt layer and finally, a basal lamina below the epidermis.
3. In addition to micropores, in integument, the body surface of mites also has variety of macropores that play a functional role in secretory and sensory process (Henriot, 1969). Cement layer Basal lamina Epidermis Nucleus Schimdt layer Endoculticle Evolving pore canal Exocuticle Pore canal Inner epicuticle Outer epicuticle Wax layer.
4. Mostly mites have oval-shaped bodies with two body regions that may appear fused together.
    a. Mostly mites have piercing sucking mouthparts such as Phytophagous and Predatory mites.
    b. Some mites have chewing mouthparts as Stored grain mites.

Body Division

1. Mites can easily be distinguished from their sister class Insecta by the following characters S. No. Features Insects Mites:

a. Body Division Head, thorax and abdomen Gnathosoma and Idiosoma.
b. Antenna Present Absent.
c. Wings Present Absent.
d. Legs 3 pairs 4 pairs.

2. Mites can easily be distinguished from their sister class Insecta by the following characters S. No. Features Insects Mites:
    a. Body Division Head, thorax and abdomen Gnathosoma and Idiosoma.
    b. Antenna Present Absent.
    c. Wings Present Absent.
    d. Legs 3 pairs 4 pairs.
3. The mites lack the true head and conspicuous body segmentation.
    a. The body of mites divided into:
        i. Gnathosoma.
        ii. Idiosoma.
    b. The anterior part of the mite body is called as 'gnathosoma' that is moveably connected to the idiosoma.
    c. The idiosoma is divided into the anterior podosoma and the posterior opisthosoma.

Podosoma Prosoma

(Gnathosoma + Podosoma) Sejugal furrow disjugal furrow Propodosoma Idiosoma Hysterosoma Gnathosoma Opisthosoma.

Gnathosoma

1. Considered the mouth parts which are mainly concerned with feeding and for sensatory purpose.
    a. It is generally located anterior to the body but in some cases, it may be hidden under the propodosoma.
    b. The gnathosoma having the mouthparts differ from a true head in a sense that is lacks the eyes, antennae and brain.
2. If eyes present, they are located in idiosoma.
    a. It generally consists of chelicerae and pedipals (Krantz, 2009).
3. Chelicerae:
    a. Chelicerae are the main food getting organs.
    b. They are placed dorsally in relation to the opening mouth and commonly consist of three segments known as cheliceral base, digitus fixus and digitus mobilis.
    c. First segment is basal and bears the digitus fixus which is articulated with the distal digitus mobilis dorsally (Grandjean, 1947).
    d. Both digits are provided with teeth on the opposite side of each other.
4. The chelicerae are used for the cutting and piercing of food.
    a. They vary from three segmented and pincer like appendages of mesostigmata to slender prostigmata.
    b. In phytophagous and parasitic mites, there are modification in chelicerae that result in styliform, hood-like or finely toothed like adapted to pierce plant or animal tissues or attacked on bacterial film.
5. Pedipalp:
    a. The pedipals are usually called simply "pulp" have five segments beyond coax, usually resembling legs but shorter and primarily sensory in nature rather than locomotors.
    b. The coax portions border the cheliceral bases and form the side walls of the gnathosoma. Their distal segments bear many setae and sometimes claws.

6. Secretory Organs:

a. Pore-like openings located in the cuticle of mites and connected by a duct to suncuticular gland cells (Alberti and Seeman, 2005).

b. The nature of the secretory products is heterogenous and varies from cement like to waxy (Evans, 1992 and Coons, 1999).

c. The secretory products contain vary chemical composition, having monoterpenes, hydrocarbons, esters, aromatics etc and may have various functions that act as pheromones.

7. Legs:

a. Adult and nymphs of mites, except in some Prostigmata and Astigmata, have four pairs of jointed legs and the larval instar has three pairs of legs.

b. Typically the legs consist of seven segments.

c. Their names are coxa, trochanter, femur, genu, tibia, tarsus and apotele.

d. According to systematic group, the coxae may be free or fused with the ventral podosoma and femur may be divided into basifemur and telofemur.

8. The idiosoma has different types of sensory receptors known as chemoreceptors, mechanoreceptors and photoreceptors with setal structure (Evans, 1992 and Coons, 1999).

a. The cuticular surface has different pore-like openings, which have a sensory function (Krantz, 2009).

b. These pores have various shaped but mostly small membrane covered clefts Sensory Receptors.

Economic Importance of Insects

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The estimated annual value of the ecological services provided by insects in the United States alone is at least $57 billion, an amount that justifies greater investment in the conservation of these services. Without the activities of insects, human life on earth would eventually be extinguished. Over one lakh currently living species of insects have been identified, but the true number is surely much larger, about a million.

Beneficial Insects

Pollinators of crops (Bees, wasps, butterflies, moths, hoverflies, beetles). Many plants depend on insects to transfer pollen as they forage. Plants attract insects in various ways, by offering pollen or nectar meals and by guiding them to the flower using scent and visual cues. This has resulted in strong relationships between plants and insects. Predators of pests (Dragonflies, beetles, bugs, lacewings, wasps).

Major characteristics of arthropod predators:
1. Adults and immature stages are often generalists rather than specialists.
2. They generally are larger than their prey.
3. They kill or consume many preys.
4. Males, females, immature stages and adults may be predatory.
5. They attack immature and adult prey.

Parasites of pests (Hymenoptera and Diptera). Parasitoids are insects with an immature stage that develops on or in an insect host, and ultimately kills the host. Adults are typically free-living, and may be predators. They may also feed on other resources, such as honeydew, plant nectar or polle.

Human Food Value

There are 1,462 recorded species of edible insects. Doubtless there are thousands more that simply have not been tasted yet. 100 grams of cricket contains: 121 calories, 12.9 grams of protein, 5.5 g of fat, 5.1 g of carbohydrates, 75.8 mg calcium, 185.3 mg of phosphorous, 9.5 mg of iron, 0.36 mg of thiamin, 1.09 mg of riboflavin, and 3.10 mg of niacin. Compare this with ground beef, which, although it contains more protein (23.5 g.), also has 288.2 calories and a whooping 21.2 grams of fat.

Podosoma Prosoma

(Gnathosoma + Podosoma) Sejugal furrow disjugal furrow Propodosoma Idiosoma Hysterosoma Gnathosoma Opisthosoma.

Scavanger

Ants, beetles, apterygotes, cockroaches, crickets and a large number of other insects thrive on dead carcasses, left over organic matter or excreta and in the process clean the environment. Economic losses avoided every year by the burial of livestock waste by dung beetles only are estimated to be over $3.8 billion.

Insect of Medical and Vetenary Importance

(Mosquitos, flea, beetles, flies). Mosquitoes can spread diseases such as malaria, yellow fever, dengue fever. Tsetse flies spread sleeping sickness. Lice suck human blood and can cause sores, which if left untreated can become infected which may lead to blood poisoning.

Insects in Agriculture

1. In order to secure high and quality yields to make and to make agricultural production environmentally compatible.
2. Insects are successful in terms of species richness and abundance.
3. Insects have been predominantly perceived as competitors in the race of survival.
4. Herbivorous insects damages 18% of the world agricultural productions. Of the total known insect species on earth 0.5% is considered to be pests.
5. Insect pests are created through the manipulation of habitats by humans, where the crops are selected for larger size, higher yields, nutritious value and are cultivated in monocultures for maximum production. This provides a suitable environment for the favourable growth of herbivorous insects.
6. To ensure stable crop yields we need to change the management strategies of agro ecosystems.
7. We need to manage these systems where the insects performing valuable ecosystem services are also incorporated into the system.
8. This will ensure stable, resilient and sustainable systems in a constantly changing environment and will go a long way to ensure future food security.

Economically Importance

Major functions are:
1. They aerate soil and fertilizes the soil with the nutrients from their droppings.
2. Pollinate blossoms by bees, wasps, ant and butterflies.
3. Helps in maintaining the ecosystem balance by controlling the insect and plant pest like big eyed bugs and praying mantis controls the infestation of aphids and caterpillars which feed on new plant growth.
4. Some insects acts as decomposers; like beetle (scavengers), they feed on dead animals and fallen trees, thereby recycling nutrients back into soil. Also, they help in creating nutrient rich top soil, which is essential for plant growth.
5. Burrowing bugs, ants and beetles, dig tunnel that provides water growth.

Scope of Entomology

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Definition

The entomology is derived from two Greek words, Entomon means an insect and logos means to study.

Entomology is the scientific study of insects.

Division

Insect Ecology: This branch of entomology deals with the relationship of insects with their environment.

Insect Morphology: The study of insect body parts as well as their function.

Insect Pathology: The study of diseases that may harm or effect the health of insect.

Insect Physiology: This branch of entomology deals with various functions and behavioural systems present inside the insect body.

Insect Taxonomy: Insect taxonomy is the practice as well as theory of naming the insects.

Insect Toxicology: This branch of entomology deals with how the insecticides and other chemical affect the insect's physiological functions.

Industrial Entomology

Study as well as rearing of insects for business or beneficial purposes.

Medical and Veterinary Entomology.

Deals with the insects that harm not only humans but effect animal also.

Biological Control Entomology

This branch deals with using insects against harmful insects.

Post-Harvest Entomology

Deals with the study, practice and control of those insects that harm the stored commodities and products like stores, wheat, rice etc.

Forensic Entomology

The use of insects to determine the time, place of human health for legal purposes.

Forest Entomology

The branch of entomology deals with the trees and insects.

Crop Protection Entomology

Deals with the study of controlling insects from damaging the crops in the fields is called as crop protection entomology.

Scope

1. The scope of entomology typically includes the study of any terrestrial arthropod and even few creatures that are not technically arthropod but are non-aquatic invertebrates with legs like tardigrades and onychophorans.
2. Entomology helps in pest control, eventually leading to a better agriculture output.
3. Forensic entomology, which can help in various criminal investigation.
4. It helps in prediction of climate change.
5. Aiding in archaeological discoveries etc.

Postembryonic Development of Insect

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Introduction

1. Postembryonic development allows some of the most remarkable examples of the diversity and ecology success of insect.
2. The distinguishing between juvenile & adult phenotypes can be extreme, allowing different life stages to occupy very different ecological niches.
3. During their postembryonic growth period insects pass through a series of stages (instars) until they become adult, the time interval (stadium) occupied by each instar being terminated by a molt.
4. Juvenile insects have become more concerned with feeding and growth, whereas adults form the reproductive and dispersal phase.

Hatching

1. Most insects force their way out of the egg by exerting pressure against the inside of the shell.

2. The insect increases its volume by swallowing the extra embryonic fluid & in some cases by swallowing air which diffuses through the shell.

3. Then waves of muscular contraction pump haemolymph forwards so that the head & thoracic regions are pressed tightly against the inside of the shell.

4. In grasshoppers & perhaps in other insects these muscular waves are interrupted periodically by a simultaneous contraction of the abdominal segments which cause a sudden increase in pressure in the anterior region.

The dorsal membrane of the neck in grasshoppers has a pair of lobes – cervical ampullae, which are inflated by the increase in haemolymph pressure. They serve to focus the pressure on a limited area of the shell.

5. If the shell does not split, the ampullae are withdrawn & a further series of posterior to anterior waves of contraction follows ending with anterior or another sudden abdominal contraction. One of this sudden contraction ultimately ruptures the shell.

6. The position of the rupture generally depends on where the insect puts pressure on the chorion.
   - a. Grasshopper chorion split --- transversely above the ampullae Agabus (water beetle) longitudinal split of chorion.
   - b. Egg of Blowfly have longitudinal hatching lines running along its length.
   - c. In Acrididae , Heteroptera produce digestive enzyme & secreted directly into extra embryonic space.
   - d. Cuticular structure known as Egg bursters aid hatching in a number of insects (usually on head).
     - i. Pentatomidae T or Y shaped central tooth.
     - ii. Cimicomorpha row of spines along each side of face.
     - iii. Fleas, Mosquitos & tse tse flies - Cuticular tooth in the membrane depression erected by blood pressure etc.

Intermediate Molt

It's process of shedding of embryonic cuticle immediately after hatching. In this process the larva swallows air & by further pumping, splits embryonic cuticle over the head.

Hatching Stimuli

The stimuli that promote hatching are largely unknown & in many cases insects appear to hatch whenever they reach the appropriate stage of development.

Suitable temperature is necessary for an insect to hatch. Temperature is species specific:
1. Cimex - 8º C.
2. Milkweed bug - 13º C.
3. Desert locust - 20º C.

Environmental stimuli:
1. Chilo partellus (stem boring moth) ----- high light intensity need for hatching.
2. Aedes (Aquatic insect) ---- lower oxygen greater percentage of hatching.
3. Agabus (Coleoptera) ----- high oxygen greater percentage of hatching.

Forms of Development

1. Through insect evolution there has been a trend toward increasing functional and structural divergence between juvenile and adult stages.
2. In modern insects three basic forms of postembryonic development can be recognized, described as:
    a. Ametabolous.
    b. Hemimetabolous.
    c. Holometabolous: According to the extent of metamorphosis from juvenile to adult.

Ametabolous Development

1. In Thysanura (and other primitive hexapods), which as adults remain wingless, the degree of change from juvenile to adult form is slight and is manifest primarily in increased body size and development of functional genitalia.
2. Juvenile and adult apterygotes inhabit the same ecological niche, and the insects continue to grow and molt after reaching sexual maturity.
3. The number of molts through which an insect passes are very high and variable.
4. For example, in the firebrat, Thermobia domestica, between 45 and 60 molts have been recorded.

Hemimetabolous Development

1. In almost all exopterygotes the later juvenile instars broadly resemble the adult, except that their wings and external genitalia are not fully developed.

2. Early instars show no trace of wings, but, later, external wing buds arise as sclerotized, non-articulated evaginations of the tergopleural area of the wing- bearing segments. Wings develop within the buds during the final larval stadium and are expanded after the last molt.

3. Other, less obvious, changes that occur during the growth of exopterygotes include the addition of neurons, Malpighian tubules, ommatidia, and tarsal segments, plus the differentiation of additional sensilla in the integument.

4. This mode of development is described as hemimetabolous and includes a partial (incomplete) metamorphosis from larva to adult.

5. Exopterygotes usually molt a fixed number of times, but, with the exception of Ephemeroptera, which pass through a winged subimago stage, never as adults.

Holometabolous Development

1. Holometabolous development, in which there is a marked change of form from larva to adult (complete metamorphosis).

2. Occurs in endpterygotes and a few exopterygotes. For example: Whiteflies (Aleyrodidae : Hemiptera), Thrips (Thysanoptera), and male Scale insects (Coccidia: Hemiptera).

3. Most obvious structural difference between the larval and adult stages of endopterygotes is the absence of any external sign of wing development in the larval stages.

Larval Development

1. Postembryonic development is divided into series of stages, each separated from next by a molt.
2. The form that insect assumes between molts ins known as Instars/stages/stadia.
3. No further molts occur once the insect is adult except in Apterygota.
4. During larval development there is usually no marked change in body form, each successive stage being similar to proceeding one.
5. But the degree of change from last larval stage to adult varies considerably & may be very marked.
6. These changes is called metamorphosis loss of adaptive features peculiar to larva & gain of features peculiar to adult. Metamorphosis occurs in the absence of peculiar level of Juvenile hormone (JH). JH is morphostatic hormone.
7. A key finding illuminating the nature of metamorphosis is that the gene encoding transcription factor --- broad Complex (BRC).
8. BRC is expressed during molting in several insects in response to ecdysteroid molting hormones, but only in the absence of JH
9. BRC thus appear to be a key determinant of metamorphic developmental progression.

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The Vistas of Class Insecta

Article ID: 10367

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Class Insecta

1. Class insecta belongs to arthropoda phylum and consists of all insects.
2. They are largest class in the arthropoda phylum.
3. They are hexapods i.e., comprises of six legs.
4. They are found everywhere on the earth- land/air/sea.

Many insects are considered to be pest while there are number of them which is found to be important in many cases; which are to be discussed in the following.

Ecological Importance

1. Insects can easily adapt to different habitats and they eat almost all nutritious substance available on that habitat.
2. Insects have their own crucial roles to perform in an ecosystem.

Major Functions are

1. They aerate soil and fertilizes the soil with the nutrients from their droppings.
2. Pollinate blossoms by bees, wasps, ant and butterflies.
3. Helps in maintaining the ecosystem balance by controlling the insect and plant pest like big eyed bugs.

Important Families of Mites and it's Examples

Article ID: 10368

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Mites

Kingdom: Animalia.
Phylum: Arthropoda.
Subphylum: Chelicerata.
Class: Arachnida.
Subclass: Acari.

Class: Eriophyoid

Plant feeding mites form an integral and important part of the natural ecosystem. Some species, especially eriophyoid mites, can be utilised for the biological control of weeds. Many plant feeding mites are of economic importance as pests of crop plants.

1. All eriophyoid mites are plant feeding. They are extremely tiny, the majority are less than 300 micron long, and essentially invisible to the unaided eye. They have elongated, worm-like bodies, with only two pairs of legs.

2. Eriophyoid mites are commonly known as gall mites, bud mites, rust mites, erineum mites, witches' broom mites, blister mites and so on, referring to the symptoms caused by a particular species. The feeding of almost half of eriophyoid species known, though, does not cause visible damage to their plant hosts.

3. The eriophyoid mites belong to three families: Phytoptidae, Eriophyidae and Diptilomiopidae. About 3 400 species are known, but these probably represent only as little as 5% or less of extant eriophyoid species. Most woody and many herbaceous flowering plants, and gymnosperms and ferns most likely host these minute mites. Most eriophyoid species are highly host specific, restricted to one or single closely related plant species.

Class: Tetranychoidea (Spider Mites and their Relatives)

All tetranychoid mites are obligate plant feeders, and many species are well-known agricultural pests. The Tetranychoidea comprises five families:

1. Tetranychidae (spider mites): This family is a large group of plant feeding mites (about 1 200 species known worldwide), and can probably be regarded as the most important family in the Acari regarding members that are pests of agricultural crops and other plants.

The spider mites have round to oval-shaped bodies, and are as large or smaller than a pin head (about 0.3 to 0.8 mm long). Their colour varies: green, red, brown, yellow, orange, black or combinations of any of these, depending on the species and the life stage.

Most tetranychid species have a wide host range, other than the generally more host specific Eriophyoidea. Some species, especially Tetranychus spp., can produce extensive webbing which impedes effective control of these pests. Chemical control of spider mites is also compounded by development of resistance to acaricides.

2. Tenuipalpidae (false spider mites or flat mites): The false spider mites are very small (females about 0.2 - 0.4 mm long) (smaller than the spider mites) and somewhat flattened, and are difficult to see with the naked eye. They are usually reddish or brown red. They move relatively slowly and lie very flat against the plant surfaces. Tenuipalpid mites appear to be best adapted to subtropical or tropical regions. Members of the genera Brevipalpus, Tenuipalpus and Dolichotetranychus are of particular importance as plant pests. In southern Africa, four species are regarded as pests of economic importance:

Brevipalpus californicus (Banks) (citrus flat mite) *Brevipalpus obovatus Donnadieu* (ornamental flat mite) *Brevipalpus phoenicis* (Geijskes) (reddish black flat mite).

3. Tuckerellidae: The family Tuckerellidae consists of about 20 described species worldwide. All belong to the single genus, Tuckerella.

4. Allochaetophoridae.

5. Linotetranidae.

Class: Arachnida

1. Mites and ticks are among the best-known members of the order Acarina.
2. The science of acarology originated in 18th century Europe and Linnaeus described the first mite, Acarus siro, in 1758.
3. Mites (order Acarina) can be distinguished from their insect relatives by the two body regions, cephalothorax and abdomen in some orders , these two parts are fused, sucking mouthparts, lack of antennae and four pairs of legs (as adults).
4. The mite life cycle generally consists of an egg stage, a larval stage, one or more nymphal stages, and an adult stage.
5. The entire life cycle requires 1 to 6 weeks (2-3 weeks on average) for completion.

Morphological characteristics:

a. Very small, sometimes microscopic, arthropods with an oval or elongated body.
b. 2 Unsegmented abdomen is often attached to the cephalotborax (fused head and thorax).
c. The legs are 3 pairs in larvae and nymph while adult has four pairs of legs, although some have only two or three pairs.
d. The mouthparts, called chelecerae, are adapted for piercing, sucking and lacerating.
e. Respiration is taken care by trachea but in absence of tracheal respiration, cutaneous respiration plays role.

Mites as Control Agents of Weeds

Some phytophagous mites, in particular members of the Eriophyoidea, are increasingly considered as potential control agents of weeds. Some species are already successfully utilized for the control of weeds, e.g., *Aceria chondrillae* (Canestrini) against skeleton weed, *Chondrilla juncea* L. (Asteraceae), in Australia and the USA, *Aceria acroptiloni Shevtchenko* & Kovalev against Russian knapweed, *Acroptilon repens* (L.) DC (Asteraceae), in Uzbekistan, and *Aculus hyperici* (Liro) against *Hypericum perforatum* L. (Clusiaceae).

Several eriophyoid species are being considered, are being studied as potential control agents or have been released for the control of weeds e.g., on Acacia saligna, Convolvulus arvensis, Lantana camara and invasive Pinus spp. Others are indigenous, and have potential for weed control in Australia and other countries, e.g. on Acacia nilotica, Polygala myrtifolia and Chrysanthemoides monilifera. Some of the research is conducted at the Weeds Research Division, and the systematic research necessary for some of the projects is undertaken by Biosystematics: Arachnology - mite section under the umbrella research of the ARC-PPRI Mite Expert Centre.

Other phytophagous species, apart from the Eriophyoidea, that are being used for weed control include *Tetranychus lintearius* Dufour (Tetranychidae) for the control of Ulex europaeus L. (gorse) in New Zealand, and *Orthogalumna terebrantis* Wallwork (Galumnidae) for the control of Eichhornia crassipes (Martius) Solms-Laubach (water hyacinth). The latter species also established on water hyacinth in South Africa, and appears to affect the weed adversely.

Insecta

Article ID: 10369

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This is one of 7 classes of the largest phylum arthropoda.

Insects or Insecta (from Latin *insectum*) are hexapod invertebrates and the largest group within the arthropod phylum.

Insects have a chitinous exoskeleton, a three-part body (head, thorax and abdomen), three pairs of jointed legs, compound eyes and one pair of antennae. Insects are the most diverse group of animals; they include more than a million described species and represent more than half of all known living organisms. Potentially over 90% of the animal life forms on Earth are insects.

Insects may be found in nearly all environments, although only a small number of species reside in the oceans.

Scientific classification	
Kingdom	Animalia
Phylum	Arthropoda
Clade	Pancrustacea
Subphylum	Hexapoda
Class	Insecta

Synonyms:

1. Ectognatha.
2. Entomida.

Insects Reproductive System

Most insects reproduce oviparously, i.e., by laying eggs. The eggs are produced by the female in a pair of ovaries. Sperm, produced by the male in one testis or more commonly two, is transmitted to the female during mating by means of external genitalia. The sperm is stored within the female in one or more spermathecae. At the time of fertilization, the eggs travel along oviducts to be fertilized by the sperm and are then expelled from the body ("laid"), in most cases via an ovipositor.

Female Reproductive System

Internal: Their reproductive systems are made up of a pair of ovaries, accessory glands, one or more spermathecae, and ducts connecting these parts. The ovaries make eggs and accessory glands produce the substances to help package and lay the eggs.

Spermathecae store sperm for varying periods of time and, along with portions of the oviducts, can control sperm use. The ducts and spermathecae are lined with a cuticle.

The ovaries are made up of a number of egg tubes, called ovarioles, which vary in size and number by species. The number of eggs that the insect is able to make varies according to the number of ovarioles, with the rate at which eggs develop being also influenced by ovariole design. In meroistic ovaries, the eggs-to-be divide repeatedly and most of the daughter cells become helper cells for a single oocyte in the cluster.

Accessory glands or glandular parts of the oviducts produce a variety of substances for sperm maintenance, transport, and fertilization, as well as for protection of eggs. They can produce glue and protective substances for coating eggs or tough coverings for a batch of eggs called oothecae. Spermathecae are tubes or sacs in which sperm can be stored between the time of mating and the time an egg is fertilized.

Male Reproductive System

Internal: The main component of the male reproductive system is the testis, suspended in the body cavity by tracheae and the fat body. However, most male insects have a pair of testes, inside of which are sperm tubes or follicles that are enclosed within a membranous sac.

The follicles connect to the vas deferens by the vas efferens, and the two tubular vasa deferentia connect to a median ejaculatory duct that leads to the outside. A portion of the vas deferens is often enlarged to form the seminal vesicle, which stores the sperm before they are discharged into the female. The seminal vesicles have glandular linings that secrete nutrients for nourishment and maintenance of the sperm.

The ejaculatory duct is derived from an invagination of the epidermal cells during development and, as a result, has a cuticular lining. The remainder of the male reproductive system is derived from embryonic mesoderm, except for the germ cells, or spermatogonia.

External: The anal-genital part of the abdomen, known as the terminalia, consists generally of segments 8 or 9 to the abdominal apex. Segments 8 and 9 bear the genitalia; segment 10 is visible as a complete segment in many "lower" insects but always lacks appendages; and the small segment 11 is represented by a dorsal epiproct and pair of ventral paraprocts derived from the sternum.

A pair of appendages, the cerci, articulates laterally on segment 11; typically, these are annulated and filamentous but have been modified (e.g., the forceps of earwigs) or reduced in different insect orders. An annulated caudal filament, the median appendix dorsalis, arises from the tip of the epiproct in apterygotes, most mayflies (Ephemeroptera), and a few fossil insects.

A similar structure in nymphal stoneflies (Plecoptera) is of uncertain homology. These terminal abdominal segments have excretory and sensory functions in all insects, but in adults there is an additional reproductive function.

Genitalia

The organs concerned specifically with mating and the deposition of eggs are known collectively as the external genitalia, although they may be largely internal. Insect genitalia, especially male genitalia, is often directionally asymmetrical, and this trait has evolved multiple times in various orders. The components of the external genitalia of insects are very diverse in form and often have considerable taxonomic value, particularly among species that appear structurally similar in other respects.

The male external genitalia have been used widely to aid in distinguishing species, whereas the female external genitalia may be simpler and less varied.

The terminalia of adult female insects include internal structures for receiving the male copulatory organ and his spermatozoa, and external structures used for oviposition (egg-laying). Most female insects have an egg-laying tube, or ovipositor; it is absent in termites, parasitic lice, many Plecoptera, and most Ephemeroptera.

Ovipositors take two forms:
1. True, or appendicular, formed from appendages of abdominal segments 8 and 9.
2. Substitutional, composed of extensible posterior abdominal segments.

Types of Reproduction in Insects: Physiology of Reproduction

1. Spermatogenesis (occurs inside sperm tube):

Spermatogonia-----(mitosis)---- ➡ Primary spermatocytes (2n)-----(meosis)- ➡ Secondary spermatocytes(n)----- ➡ spermatids(n)------(Spermiogenesis) > Sperms (n)

2. Oogenesis: (occurs inside egg tube):

Oogonia -----(mitosis)-- ➡ Primaryoocytes(2n) -----(meosis)--- ➡ Secondary oocytes (n)------- (Oogenesis Mitosis)--- ➡ Oocytes (n) ➡ Ovum(n).

3. Sperm transfer:

a. Intragenital: Common method, though, aedeagus via vaginal orifice into female genital passage.

b. Haemocoelous: Sperms transfered into the body cavity e.g., Bed bug.

c. External: Spermatophores are ejected out into open place by male, while female walk over it and gets inseminated e.g., Silver fish.

4. Fertilization: Sperm entre into egg to produce morphogenesis. Egg nucleus divides.
meiotically into female gamete nucleus and polar body. Then the fertilization occurs by the fusion of male and female gamete nuclei.

Types of Reproduction

1. Oviparity: Majority of female insects are oviparous that is, they lay eggs. Embryonic development occurs after oviposition by utilizing the yolk, e.g., Head louse moths.

2. Viviparity: Unlike oviparous, here initiation of egg development take place within the mother. The life cycle is shortened by retention of eggs and even developing young within the mother. Four main types of viviparity is observed in different insect groups.

a. Ovoviviparity: Fertilized eggs containing yolk are incubated inside the reproductive tract of the female and hatching of egg occur just prior to or soon after oviposition e.g., Thysanoptera, some cockroaches, few beetles, and some flies-(flesh fly). Fecundity of this group is low.

b. Peseudoplacental Viviparity: This occurs when a yolk-deficient egg develops in the genital tract of the female. The mother provides a special placenta-like tissue, through which nutrients are transferred to developing embryos. There is no oral feeding and larvae are laid upon hatching. e.g., aphids, some earwigs, psocids and polytenid bugs.

c. Haemocoelous Viviparity: This involves embryos developing free in the female's haemolymph with nutrients taken up by osmosis. This form of internal parasitism occurs only in sterpsiptera and some gall midges.

d. Adenotrophic Viviparity: This occurs when a poorly developed larva hatches and feeds orally from accessory (milk) gland secretion within the uterus of the mother's reproductive system. The full-grown larva is deposited and pupariates immediately (e.g.) tsetse flies, louse or wallaby flies, bat flies.

3. Parthenogenesis: Reproduction without fertilization is called parthenogenesis. Different types of parthenogenesis are as follows:

a. Based on Occurrence:

i. Facultative (not compulsory) - e.g., bee.
ii. Obligatory or constant (compulsory) - e.g., stick insect
iii. Cyclic or spordic : alternation of gamic and agamic population, e.g., aphid.

b. Based on Sex Produced:

i. Arrhenotoky: Produce male e.g., bee.
ii. Thelytoky: Produce female e.g., aphids.
iii. Amphitoky or deuterotoky: produce both male and female e.g., cynipid wasp.

c. Based on Meiosis:

i. Apodictic: No meiosis occurs.
ii. Automictic: Meiosis occurs, but diploidy is maintained.

4. Polyembryony: This form of asexual reproduction involves the production of two or more embryos from one egg by subdivision. Mostly observed in parasitic insects (e.g., platygaster). Nutrition for a large number of developing embryos cannot be supplied by the original egg and is acquired from the host's haemolmph through a specialized enveloping membrane called trophamnion.

5. Paedogenesis: Some insect cut short their life cycles by loss of adult and pupal stages. In this precocious stage gonads develop and give birth to young one by parthenogenesis.

a. Larval paedogenesis - e.g., gall midges.

b. Pupal paedogenesis - e.g., Miaster sp.

Blue River Technology – Building Smart Farm Machines to Manage Crops at a Plant - Level

Article ID: 10370

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"Producing food is critically important and very complicated because of the immense variability and unpredictability a farmer encounters day to day," Jorge explains. "On top of that, the global population continues to grow while the amount of arable land decreases. This means farmers need to farm smarter and more precisely. The products we are working on can help immensely in increasing efficacy, crop yields and environmental sustainability while also controlling costs."

What is Blue River Technology?

Blue River Technology is a California-based machinery enterprise with a focus on designing, producing, and selling computer-vision-based robotics that can be used to aid the agriculture industry, specifically in cotton weeding. The company has created a machine called "See & Spray".


What is See and Spray?

1. The machine uses computer vision and artificial intelligence to detect, identify, and make management decisions about individual plants in the farmer's field so that plants which are essential to farmers and consumers are not unintentionally destroyed by herbicides.

2. The machine has robotic nozzles to ensure accurate spraying of herbicides.

3. The machine sprays only the necessary weeds with herbicides in an attempt to curb weeds that are resistant to herbicides, as these are growing in number and could eventually greatly hinder farmers' produce and production capabilities.

4. See & Spray is the next generation of Blue River's technology. See & Spray machines leverage deep learning to enable our machines to identify a greater variety of plants—both crops & weeds—with better accuracy, and then make crop management decisions on the spot. Custom nozzle designs enable <1-inch spray resolution, and powerful software powers faster and more agile crop protection. See & Spray is currently operating in weeding for cotton and soybeans.

"Longer term, we're looking at ways to expand this ultra-precise approach to other material applications used in agriculture like insecticides, fungicides and fertilizers, providing even more opportunities for engineers who want to work on technology that has a global impact."

Which are the Benefits Farmers Can Get by Adopting this Technology?

1. Farmers manage large networks of fields and millions of plants — in order to better maximize their yields, they need to revaluate their herbicide distribution on a plant-by-plant basis.

2. Farmers will typically employ the "one size fits all" approach, spraying their entire fields with a single uniform solution. This can result in applying unneeded herbicide, however, which is costly and subjects crops to herbicides that are meant to control the weeds.

3. Herbicides costs more, which are a massive recurring cost, could be reduced by up to 80%.

Conclusion

1. The best practice is to treat all plants as if they have the same needs.
2. Introducing see and spray precisely spraying herbicides only where needed, and with exactly what's needed.
3. Our smart machines give farmers a new way to control and prevent herbicide-resistant weeds.

Future of Blue River Technology

We can expect to see this technology out in the field sooner than you may think. Over the next months, Blue River will be improving and testing their designs, gathering customer feedback, at larger scales as they continue their path towards commercialization.

References

1. W. W. Stone, R. J. Gilliom, and K. R. Ryberg, "Pesticides in us streams and rivers: occurrence and trends during 1992–2011," 2014.
2. L. Tian, "Development of a sensor-based precision herbicide application system," Computers and electronics in agriculture, vol. 36, no. 2-3, pp. 133–149, 2002.

Fate and Toxicities of Nanoparticles in Agriculture

Article ID: 10371

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Introduction

A wide application of nanomaterial and its products have made their way into agricultural domains in the 21st century. Application of this technology has not only been limited to nano-formulations like controlled release fertilizers and nano-encapsulated fertilizers, but a surge need has been observed in:

1. Plant and animal health diagnosis.
2. Detection of residual agrochemicals.
3. Severity of disease detection (both in plants and animals).
4. Management of post-harvests.
5. Development of genetically modified crop varieties.
6. Processing and storage of food-products.
7. Different sensors.

However, these engineered products cannot be evaluated as a boon only. Current reports have shown progressive loadings of nanoparticles (NPs) in the environment which is becoming noxious to its inhabitants. These physio-chemically modified elements spread rapidly in the surrounding ecosystems. Very minute structure, reactivity, and mobility of these materials make them bio-available that causes various toxic effects to its ingesters. Most of these toxicities are chronic in nature. In the following, spread, accumulation, and toxicities, associated with NPs, are discussed in brief.

Sources of Nanoparticles in Agriculture

Both biogenic and synthetic sources are being used in field. Within biogenic sources plants and microbes are widely used. In plants, synthesis of NPs is primarily depended upon transport of element of interest through plant root cells, mode of transport in plants, endocytosis via ion channels, different polyphenols, terpenoids, cytoplasmic acids, reduction potential of ions etc.(Panpatte *et. al*., 2016).

NPs of silver, gold, zinc, copper, cobalt, and other cationic elements can be synthesized in alfalfa, mustard, sunflower, neem, tamarind, aloe vera, and *Bryophyllum* spp. (Bali *et. al*., 2006). Synthesis of NPs within microbes include capturing of elements in microbial periplasm through extracellular secretions, polymerization with specific proteins, and collection of these NPs via precipitation of microbial dead cells.

NPs of silicon, magnesium, gold, silver, and sulphides of zinc, cadmium, and lead can be produced by diatoms, *Pseudomonas* spp., *Desulfovibrio* spp., *Clostridium* spp., *Aspergillus* spp., and yeasts (Panpatte *et. al*., 2016). However, the biogenic synthesis can be cumbersome, low in recovery, and gives very poor structure to synthesized particles.

Thus, to encounter these problems apart from high scale production requirements, scientists have focused on engineering synthetic NPs production. These products not only just highly efficient in nature; rather, their behaviour can be controlled exploiting nano-scale carriers.

Besides smart delivery of these artificially synthesized products (nanofertilizers and encapsulated nanocides), nano-products are used in triggering gene expressions of certain traits in plants; while, nanosensors are widely used to detect and rectify abiotic and biotic stresses. The vast application of synthetic nano-products has liberated different NPs in the environment and upon exposure these particles pose toxicity to both animals and plants.

Fate of Nanoparticles

Being nano-sized entities, NPs are very ease to disperse as well as diffuse within or between media. Diffusion into air, deposition (dry and wet) on earth surface, runoff into water-bodies, leaching along the soil profile, adsorption on the surface of soil colloids (organic and inorganic), transformation within a media, intake by biosphere, and sedimentation in bottom of water are the most common fate of NPs, when applied in agricultural fields (Figure 1).

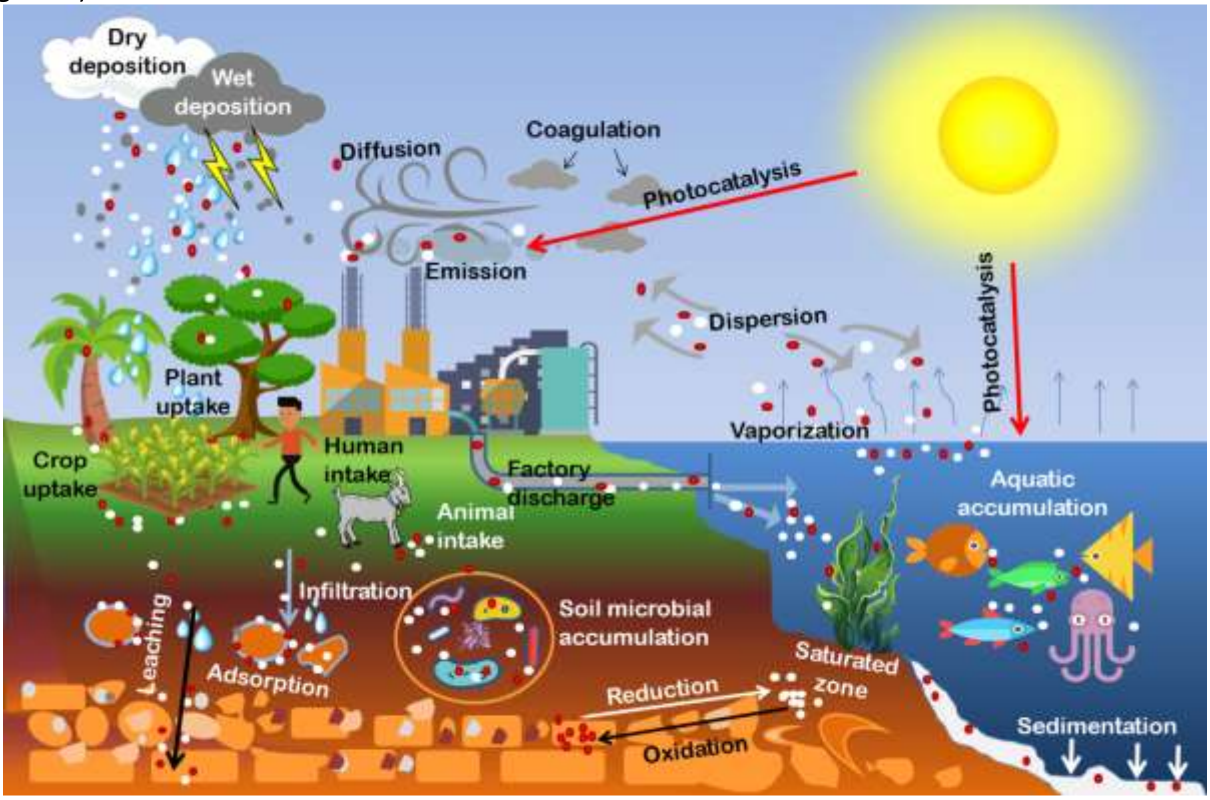

Figure 1: Illustration of fate of nanoparticles

Among them, soil and biosphere play the most crucial roles. Behaviour of NPs in soil system primarily depended upon surface charge of soil colloids and NPs, their partitioning between soil solid and soil solution, pH (especially zero-point charge), and interaction with different soil constituents. Soil organic matter also controls their mobility, reactivity, and stability depending on dominance of their functional groups in their polymeric chain. Upon reaction, organic matter forms coating on the surface of NPs, making it less reactive that accelerate aggregations (or solubility) in system. Similar case can be seen in soil minerals that reduce the activity of NPs upon adsorption and charge compensation. Zhang et. al., (2020) observed that iron bearing minerals along with high soil organic matter content increase the stability of titanium di-oxide NPs in soil. Accumulation in biospheres starts with plant uptake; direct ingestion by animals through respiratory tracts, and through food chains. NPs enter plant bodies through root cortex; get transported to leaves via xylem vessels and membranes; accumulate in photosynthates. In hyper accumulators, the concentrations get enriched within vacuoles. Marine animals accumulate NPs in good quantity when non-point sources of NPs meet their paths into the marine ecosystems. Consumption of these contaminated plants and animals make terrestrial lives vulnerable to different NPs associated toxicities.

Toxicity of Nanoparticles

Toxicity of NPs in biological systems is associated with higher surface charge, generation of free radicals, bio-accumulation in high concentrations, and size of NPs. Upon application for remediating problems in agricultural fields, NPs have affected non-target biological tissues in many ways. Types and severity of NPs associated toxicity vary significantly from one to another. Carbon nanotubes are associated with generation of reactive oxygen species (ROS) that induce cytotoxicity in plants and fibrosis in mammalian lungs (Murphy et. al., 2011).

Widespread use of TiO2-NPs in plant stress mitigation and their photoactivation under direct sunlight (UV) has led to immunotoxicity, genotoxicity, and ROS generation in different animals upon contact; however, their genotoxic potential is less significant as compared to ZnO- and CuO-NPs which cause permanent oxidative damage to genetic materials (DNA) (Bahadar et. al., 2016; Osman et. al., 2010). Antimicrobial features of silver (Ag) NPs have led to their more consumption in pesticides. The Ag+ ions, released from these products, directly bind with amino acids, causing serious cytotoxicity, ROS generation, and kidney as well as lung failure in animals (Gilga et. al., 2014). Silicon, iron, and aluminium oxide NPs and in carrier materials are responsible for oxidative stress, increased cell lysis, lysozomal and mitochondrial damage; while CuO-NPs induce lipid peroxidation via oxidative damage in membranes (Bahadar et. al., 2016). Size depended NPs-toxicity is more pronounced in these regards. Recently, smaller sized gold NPs (5 nm) are found to show higher cytotoxic effects, relative to larger ones (15 nm) (Coradeghini et. al., 2013). However, information regarding different toxicity promoting pathways of these NPs is still under consideration.

Conclusion

The backbone of Indian economy i.e., agriculture had been evolving day by day along with their contribution in GDP to feed country's heavy population. Thus, application of nanotech was seemed to be evident decades ago. The nano-based agri-products are spreading Indian markets rapidly, but before their widespread commercialization, proper norms should be disseminated among consumers (farmers in this regard). Therefore, Ministry of Science and Technology in association with Department of Biotechnology had formulated regulations for evaluating nano-agri-input products and nano-agri-products in August, 2019 to ensure the product quality, their imports, and safe handling. These regulations must be summarized before farmers' community to avoid environmental causalities without loss of food production. The extension departments of research institutes should also take actions in this regard. Further research should be conducted on residue management of nano-products, their inactivation after use, and alleviation of NPs-toxicity in living organisms.

References

1. Bahadar H., Maqbool F., Niaz K. and Abdollahi M., (2016). Toxicity of nanoparticles and an overview of current experimental models. Iranian Biomedical Journal. 20:1-11.
2. Bali R., Razak N., Lumb A. and Harris A.T., (2006). The synthesis of metallic nanoparticles inside live plants. In: 2006 International Conference on Nanoscience and Nanotechnology. IEEE, Brisbane, Australia.
3. Coradeghini R., Gioria S., García C.P., Nativo P., Franchini F., Gilliland D., Ponti J. and Rossi F., (2013). Size-dependent toxicity and cell interaction mechanisms of gold nanoparticles on mouse fibroblasts. Toxicology Letters. 217:205-216.
4. Gliga A.R., Skoglund S., Wallinder I.O., Fadeel B. and Karlsson H.L., (2014). Size-dependent cytotoxicity of silver nanoparticles in human lung cells: The role of cellular uptake, agglomeration and Ag release. Particle and Fibre Toxicology. 11:1-17.
5. Murphy F.A., Poland C.A., Duffin R., Al-Jamal K.T., Ali-Boucetta H., Nunes A., Byrne F., Prina-Mello A., Volkov Y., Li S. and Mather S.J., (2011). Length-dependent retention of carbon nanotubes in the pleural space of mice initiates sustained inflammation and progressive fibrosis on the parietal pleura. The American Journal of Pathology. 178:2587-2600.
6. Osman I.F., Baumgartner A., Cemeli E., Fletcher J.N. and Anderson D., (2010). Genotoxicity and cytotoxicity of zinc oxide and titanium dioxide in HEp-2 cells. Nanomedicine. 5:1193-1203.
7. Panpatte D.G., Jhala Y.K., Shelat H.N. and Vyas R.V., (2016). Nanoparticles: the next generation technology for sustainable agriculture. In: Microbial Inoculants in Sustainable Agricultural Productivity (pp. 289-300). Springer, New Delhi.
8. Zhang R., Tu C., Zhang H. and Luo Y., (2020). Stability and transport of titanium dioxide nanoparticles in three variable-charge soils. Journal of Soils and Sediments. 20:1395-1403.

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Strategies to Reduce Post-Harvest Losses in Perishable Crops

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Introduction

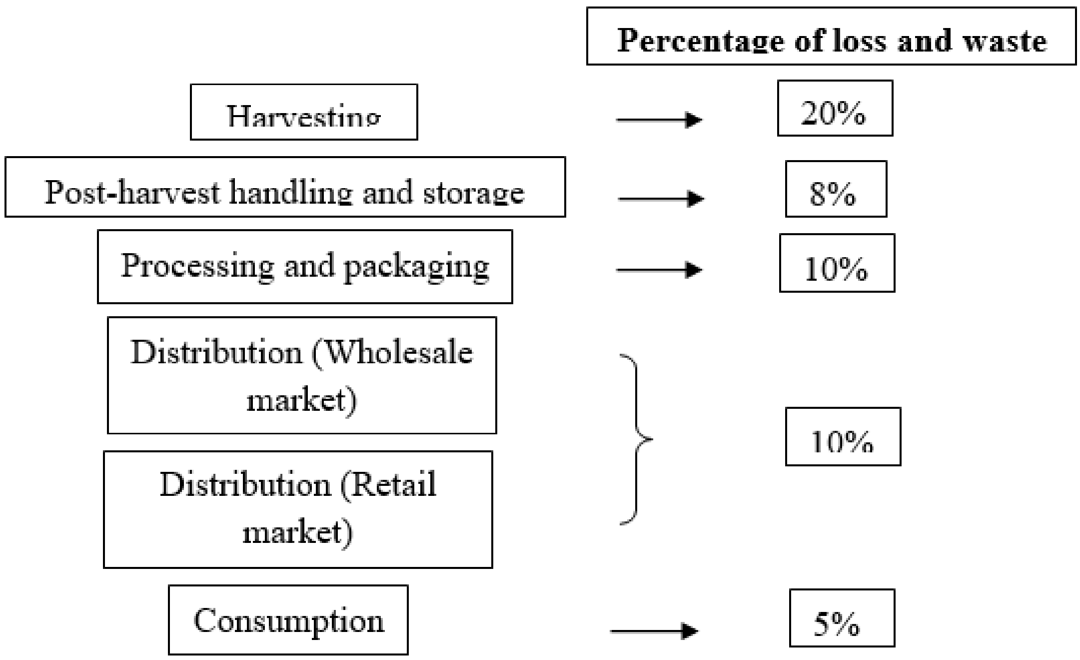
Today, one of the main global challenges is how to ensure food security for a world growing population whilst ensuring long-term sustainable development. According to the FAO, food production will need to grow by 70% to feed world population which will reach 9 billion by 2050. Further trends like increasing urban population, shift of lifestyle and diet patterns of the rising middle class in emerging economies along with climate change put considerable pressure strain on the planet's resources: declining freshwater resources and biodiversity, loss of fertile land, etc. Consequently, there is a need for an integrated and innovative approach to the global effort of ensuring sustainable food production and consumption.

Post-Harvest Loss

The term "postharvest loss" - PHL refers to measurable quantitative and qualitative food loss in the postharvest system. This system comprises interconnected activities from the time of harvest through crop processing, marketing and food preparation, to the final decision by the consumer to eat or discard the food.

A number of factors (processing, storage and transport conditions) plays role on these deteriorative reactions during the journey of fruits and vegetables from grower to consumer. Knowing where the losses occur in the food supply chain is important to determine potential reasons and improve best post-harvest approaches. Losses in food supply chains of fresh fruits and vegetables occur during harvesting, post-harvest handling and storage, processing stages, distribution and consumption (Figure 1). The large scales of postharvest losses are generated if these factors are not controlled properly. The changes which occur on fresh produce cannot be stopped, but it is possible to minimize with some precaution such as low temperature, relative humidity control during storage, proper packaging and transportation, etc.

Flow Diagram of Fresh Fruit and Vegetable Supply Chain Illustrating the Waste Generated at Each Stage



Strategies of Reducing Post-Harvest Food Losses in Perishable Crops (Roots and Tubers)

Harvesting: It is the most important phase. Unless this operation is carried out with maximum efficiency, later prevention of food loss activities may be a waste of time. If, for example, roots and tubers are bruised or otherwise damaged during harvesting, consideration of improved handling or packaging is not likely to be worthwhile, since an early infestation with molds and virus will occur and rotting will have started. If harvesting operations are correctly undertaken there is greater scope for later introduction of improved methods. Provision of the proper tools and equipment for harvesting and training workers in their correct use should be a priority prevention of food loss activity.

Handling: The skin of roots and tubers is an effective barrier to most of the opportunistic bacteria and fungi that cause rotting of the tissues. Breaking of the skin also stimulates physiological deterioration and dehydration. Careful digging and movement of roots and tubers significantly reduces post-harvest losses.

Packing: Packing of the roots is usually done in the field. Farmers commonly pack the roots and strategically place the large roots at the top on the bag to quickly attract the buyer on first sight. Packing should minimize deterioration of the roots within the container and cushion against impact and compression. During packing in the field care must be taken to minimize physical damage that results from impact bruises due to stacking and overfilling of bags, abrasion or vibration bruises due to root movement against each other.

Transportation: Temperature management is critical during long distance transport, so loads must be stacked to enable proper air circulation to carry away heat from the produce itself as well as incoming heat from the atmosphere and off the road. In many developing countries traditional baskets and various types of trays or buckets are used for transporting produce to the house or to village markets. These are usually of low cost, made from readily available material and serve the purpose for transport over short distances. But they have many disadvantages in large loads carried over long distances (i.e., they are difficult to clean when contaminated with decay organisms).

Storage: It is possible to store fresh roots successfully in specially constructed pits or in mounds, or clamp stores. For example, when storing potatoes, a field storage clamp is a low-cost technology that can be designed using locally available materials for ventilation and insulation.

Processing: Overcoming the perishability of the crops, improving marketing, enhancing nutritional value and adding economic value through processing are the main strategic areas in for reducing postharvest losses.

An important aspect of processing is that it is often intended to prolong the preservation period of a product under ambient conditions.

The most appropriate products in this respect are dehydrated root and tubers products such as: potato products (starch and flakes).

Strategies of Reducing Post-Harvest Food Losses in Perishable Crops (Fruits and Vegetables)

Harvesting: Harvesting should be carried out as carefully as possible to minimize mechanical injury such as scratches, punctures and bruises to the crop. The time of the day when harvesting is done also affects produce quality and shelf-life. In general, harvesting during the coolest time of the day (early morning) is desirable; the produce is not exposed to the heat of the sun and the work efficiency of the harvesters is higher. If harvesting during the hotter part of the day cannot be avoided, the produce should be kept shaded in the field to minimize product weight loss and wilting.

Handling: Mechanical injury provides sites for pest attack and increases physiological losses. Therefore, avoid mechanical injury to the crop while handling. Because of their soft texture, all horticultural products (fruits and vegetables) should be handled gently to minimize bruising and breaking of the skin. The skin of horticultural products is an effective barrier to most of the opportunistic bacteria and fungi that cause rotting of the tissues. Breaking of the skin also stimulates physiological deterioration and dehydration. Reducing the number of times, the commodity is handled reduces the extent of mechanical damage.

Sorting and cleaning: Systematic sorting or grading coupled with appropriate packaging and storage, will extend shelf life, maintain wholesomeness, freshness, and quality, and substantially reduce losses and marketing costs. Sorting is done to separate poor produce from good produce, and further classify the good produce based on other quality parameters like size

Packaging: Proper packing is essential to maintain the freshness of leafy vegetable. Packaging should be designed to prevent premature deterioration in product quality, in addition to serving as a handling unit. Use clean, smooth and ventilated containers for packaging. This is a very important factor in cutting down losses in these crops during harvesting, transportation, marketing and storage. Use containers that are appropriate for the crop.

Transportation: Minimizing losses during transport necessitates special attention to vehicles, equipment, infrastructure, and handling. Load and unload transport vehicles carefully. Use clean, well-ventilated vehicle covered at the top for transportation. Transport crops during the cool part of the day by driving carefully over smooth roads to minimize damage to crop. Fresh produce must not be watered prior to loading, as this will lead to decay, rotting, and extensive losses. Major causes of losses are improper handling during loading and unloading.

Storage: Only crops with high initial quality can be stored successfully; it is therefore essential to ensure that only crops of the highest quality (mature, undamaged) are stored. Shelf life can be extended by maintaining a commodity at its optimal temperature, relative humidity and environmental conditions.

Processing: Processing is an important value-added activity that stabilizes and diversifies food supplies and creates employment and income opportunities. It can minimize the high perishability problem of leafy vegetables. Processed products are also more stable, have improved digestibility, and permit a better diet diversity, giving consumers access to a wider choice of products and a wider range of vitamins and minerals. Few processing technologies are listed: Drying, salting, fermenting, and pickling.

References

1. Aysel Elik, Derya Kocak, Yanik Yildiray, Istanbullu Nurcan, Aysar Guzelsoy, Arzu Yavuz and Fahrettin Gogus. 2019. Strategies to Reduce Post-Harvest Losses for Fruits and Vegetables. International Journal of Scientific and Technological Research: Vol.5, No.3.
2. Technical paper: Scientific & Technical Department. Post-harvest losses and strategies to reduce them. ACF International. January, 2014.

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Key Role of Marketing Intelligence in Agriculture Sector

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Introduction

Agriculture has been the backbone of India and 58 percent of the population still depends on agriculture. Agriculture-rich countries like India, agriculture plays a critical role in meeting out the food and nutritional needs of society along with the raw material requirement of agro-processing industries. But the volatility in prices of agricultural commodities has remained a matter of serious concern for both farmers as well as traders. The high post-harvest losses, high market arrivals, and low prices led to a decrease in the producer's share in consumer's rupee.

Market intelligence is a type of market information that helps farmer's society to become aware of the future movement of prices based upon past and present trends. Market intelligence in agri-business should focus on establishing efficient marketing and agro-processing linkages between farmers/farmer producer groups, markets, and processors which would make agriculture a more viable proposition. The step would not only help in generating better returns but also help in reducing the losses, generating employment, and ensuring the price guarantee. It would serve as the source of commercialization for farmers who are doing subsistence farming only.

The production aspects and adoption of technologies were adopted by the majority of farmers but very less percent of farmers adopt new strategies in marketing of their produce. The efforts in production could be converted into income only if the reasonable price is realized. It could be made possible if the producers are empowered through providing the information on the marketing of produces and inputs as well.

The production of food grains increased with the increase in the production of food grains after the green revolution but the next important issue was poor marketing due to the lack of market information. The change in the marketing environment resulted in the utmost need for understanding the price behaviours to safeguard the income of farmers as well as various stakeholders. But the main issue is that most of the rural producers and entrepreneurs are not able to understand the market and price behaviour of various agricultural commodities. For gaining profitable returns in agricultural marketing and to prevent the ill effects of volatile prices farmers must be aware of the price behaviour of major marketing agricultural commodities.

There is an excess intermediary in the marketing channel, which makes the supply chain lengthier than the optimum. This makes the system inefficient and provides less income to the farmers and also more costly to the consumer. To solve these problems there is a need for clear market information to provide the knowledge and information to the farmers and also to the consumers.

Major Issues in Agricultural Marketing

1. Increase in Production levels/ Market Arrivals.
2. Instability of Prices.
3. Agricultural Market intelligence.

Components of Market Intelligence

It constitutes four major components:

1. Price: It provides information about prevailing prices of different commodities in the future based upon present and past conditions.

2. Product: It provides information about important features of a product which makes it distinguished in the market to get better prices.

3. Place: It gives intelligence about a place or market where the commodity would fetch better prices.

4. Period: It provides information about the right period at which the sale of products would provide high returns.

Methodologies Used for Market Intelligence

Various time forecasting models could be implied to have price forecasts for the agricultural commodities. A few of them are listed below which are frequently used and provide good results:

1. Exponential Smoothing.
2. ARIMA Models (Autoregressive Integrated Moving Average).
3. Seasonality.
4. ARCH (Autoregressive conditional Heteroscedastic).
5. GARCH (Generalized Autoregressive Conditional Heteroscedastic).
6. ANN (Artificial Neural Network).

Problems in Agricultural Market Intelligence

1. The market intelligence is also not free from issues and challenges. A few of them are listed below:
2. The size of the agricultural market is large and continuously expanding so market intelligence needs to keep the same pace of growth with the increasing size.
3. The privatized trade in agriculture is about 80 percent so there exists a difficulty in capturing the real image.
4. The market mandis are not well equipped and having a lack of market yards etc which cause the ill-defined results of market intelligence.
5. The poor market supply chain leads to causes high post-harvest losses which caused a lot of trouble in market intelligence.
6. The absence of grading and standardization measures causes a lot of difficulty in the marketing of agricultural commodities.

Advantages in Market Intelligence

The advantages of marketing intelligence are as follows:

1. It serves as the source for best practices on which one can rely to make decisions.
2. It helps in identifying the areas which need improvement to deal with risks and find opportunities.
3. It further helps in identifying the performance gaps in comparison to the competitors.
4. It helps in reducing the price risk level to a large extent.
5. It helps in deciding products that are optimum for the market along with the decision on market channels of distribution.
6. It also proved helpful in reducing post-harvest losses.

Impact on Agriculture of Marketing Intelligence

The impact of marketing intelligence use in agriculture leads to an increase in farmer's income, reduction of post-harvest losses, and increase in consumer satisfaction. Marketing intelligence will help in the better and efficient allocation of productive resources. The bargaining power of farmers with traders as well as a share of farmer's in consumer rupees could also be improved. The reduction in risks associated could lead to a reduction of transaction costs (i.e., the costs of selling the produce).

The marketing intelligence would help farmers in deciding the market as well as the marketing channel. With the help of market intelligence, farmers can switch to high-value crops that would generate better returns for them. The traders were mostly dependent on marketing intelligence to gain a competitive position in the marketing of agricultural commodities.

Conclusion

An efficient Market Intelligence is essential to develop the agriculture sector as a whole. It would help in providing outlets and incentives for increased production. It plays a great role in the commercialization of subsistence farmers. The Nonavailability of market intelligence would lead to nullifying most of the efforts of the government to increase agricultural production. Training in market intelligence to the rural farmers will empower the farmers to access and use the market intelligence to increase their profit.

References

1. Acharya SS, Aggrawal NL. Agricultural Marketing in India, 6th Edition, Oxford & IBH Publishing Company Pvt. Ltd. New Delhi, 2016.
2. Burark SS. Market Management of Organic Products: Concepts & Strategies. E-book: Research and Development in Organic Farming: Current Status and Way Foreward, 2019.
3. Ajjan N., Rohini A. and Raveendaran N. 2012. Maximising Farmers' Income through Market Intelligence Service, Agricultural Economics Research Review 25: 532.

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Reclamation Options for Management in Alkali Soil

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Introduction

Salt-affected soils are defined as those soils which have been adversely modified for the growth of most crop plants by the presence of soluble salts, with or without high amounts of exchangeable sodium. Common ions contributing to this problem are sodium (Na^+), calcium (Ca^{2+}), magnesium (Mg^{2+}), chloride (Cl^-), sulphate (SO_4^2), carbonate (CO_3^{2-}) and bicarbonate (HCO_3^-) in high concentrations and in some cases boron (B) and nitrate (NO_3). Salts generally originate from native soil and irrigation water. Salt-affected soils normally occur in arid and semiarid regions where rainfall is insufficient to leach salts out of the root zone. Salt problems, however, are not restricted to arid or semi-arid regions. These soils can develop even in sub-humid and humid regions. In addition, these soils may also occur in coastal areas subject to seatides. In India, an area of about 6.73 million hectares (Mha) suffers from the problem of salt accumulation out of which 3.77 Mha are sodic while 2.96 Mha are saline soils.

Reclamation Options Management in Alkali Soils

Reclamation of alkali soils requires the removal of exchangeable sodium and its replacement by calcium. It is accomplished by the application of gypsum or any other chemical amendment including several industrial wastes such as phospho-gypsum, distillery spent wash (DSW) or using organics. The details of technological packages management issues are given below.

Reclamation through Gypsum

The reclamation process is initiated by proper land levelling providing strong bunds on all sides of the farm to control ingress of water from the adjoining unclaimed areas. The on-farm development works including farm layout with irrigation and drainage channels should be completed by early summer before the on-set of rains. Although the amount of amendment to be applied, is based on soil analysis, as a thumb rule, 12-15 t gypsum ha-1 (50 % of gypsum requirement of 0-15 cm soil as per soil analysis) is sufficient enough to reclaim upper 15 cm soil layer of a highly deteriorated soil (pH as high as 10.7) for successfully growing rice-wheat crops in a rotation. The dose can be reduced to half, if 10-15 t FYM ha-1 is applied along with gypsum or salt-tolerant rice and wheat varieties are used in the first 3 years of cultivation. The amendment is uniformly spread in the whole field and thoroughly mixed within 10 cm top soil layer, followed by ponding of irrigation rain water for about 7-10 days to promote leaching and create conducive environment for ionic reactions at the soil exchange complex. After disappearance of excess water, land is properly cultivated and fertilized. Recommended crop varieties should be planted at the appropriate time. It is desirable to go in for a green manure crop during summer. It improves soil physical conditions and also saves about 60-70 kg ha-1 of fertilizer N in the following rice crop. Efficient, balanced and integrated nutrient management is an integral part of the reclamation of alkali lands.

Reclamation through Distillery Spent Wash

Experiments from AICRP centre at Gangavathi (Karnataka) suggested that use of distillery spent wash, highly acidic by-product of alcohol industry with pH 3.7 and EC 36.1 dS m^{-1}, was beneficial in reducing the soil pH from 8.82 to 7.66; ESP from 21.3 to 10.6; and bulk density from 1.33 to 1.05 Mg m-3 in case of alkali Vertisols while significantly increasing the organic carbon content. Grain yield increase was to the extent of 26 % over control.

Reclamation through Organics

Effect of green manuring on soil health and nutrient availability is well appreciated. Results of long-term experiment initiated in 2005 at Indore centre showed positive effect of organic/ green manuring on soil properties and crop yield on an alkali (sodic) Vertisol. Four treatments (i.e., control, 10 t FYM ha^{-1}, sunhemp and dhaincha as green manuring crops) were tested at four soil ESP levels (25, 35, 45 and 50 ± 2) achieved through one time gypsum application. Green manuring helped in reducing soil ESP and improving soil physical properties and soil fertility.

Reclamation through City Compost

Organic amendments upon addition to the soil supply essential nutrients (N, P, K and others secondary and micronutrients), improve soil physical and chemical properties, and enhance the microbial population and activity. Application of urban waste such as sewage sludge and municipal solid waste compost in conjunction with gypsum can be an option for reducing soil sodicity. Initial results of experiments at ICAR-CSSRI indicate that municipal solid waste (MSW) and sewage sludge can be effectively used for reclamation of sodic soils either in conjunction with gypsum or alone. Reduction in soil pH and enhancement in yield was evident with sludge/ compost application. Contents of available micronutrients such as Fe, Mn, Zn and Cu were higher in the organic-amended plots compared to control. Concentrations of heavy metals (Cd, Cr, Pb and Ni) in soil and leachate samples were below the permissible limits. Pathogen tests revealed that it was safer to apply compost and sewage sludge as a part of sodic soil reclamation. If industrial waste is not mixed with domestic city waste, then city compost can be an important material for reclamation as well as the nutrient supplement for sodic soils.

Conclusion

Alkali soils have been adversely modified for the growth of most plants due to presence of salts. These soils are generally low in organic matter and poor in fertility. The nutritional disorders on alkali soils may result from effects of alkalinity on nutrient availability, competitive uptake, transport or partitioning within plant. Therefore, for achieving reasonable levels of production, nutrient management in these soils is as crucial as their reclamation.

References

1. Choudhary, O.P. and Yaduvanshi, N.P.S. (2017) Nutrient management in salt-affected soils. Indian Journal of Fertilisers 12(12), 20-35.
2. Kaledhonkar, M.J., Meena, B.L. and Sharma, P.C. (2019) Reclamation and nutrient management for salt-affected soils. Indian Journal of Fertilisers 5(15), 566-575.

Antibiotics - The Ultimate Back Stabbers in Plant Disease Management

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Antibiotic is defined as a chemical substance produced by one micro-organism which is low concentration can inhibit or even kill another micro-organism. Because of their specificity of action against plant pathogens, relatively low phytotoxicity, absorption through foliage and systemic translocation and activity in low concentration, the use of antibiotic is becoming very popular and very effectively used in managing several plant diseases. They can be grouped as antibacterial antibiotics and antifungal antibiotics. Most antibiotics are products of several actinomycetes and a few are from fungi and bacteria.

Antibacterial Antibiotics

1. Streptomycin sulphate: Streptomycin is an antibacterial, antibiotic produced by streptomyces griseus. Streptomycin are streptomycin sulphate is sold as Agrimycin,-100, Streptomycin sulphate, Plantomycin, Streptocycline, Paushamycin, Phytostrip, Agristrep and Embamycin, Agrimycin -100 contains 15 per cent streptomycin sulphate + 1.5 percent terramycin (Oxy tetracycline). Agristerp contains 37 percent streptomycin sulphate. Phytomycin contains 20 percent streptomycin. Streptocycline and paushamycin contains 9 parts f streptomycin and 1 part of tetracycline hydrochloride.

This group of antibiotics act against a broad range of bacterial pathogens causing blights, wilt, rots etc. This antibiotic is used at concentrations of 100-500 ppm. Some important diseases controlled are blight of apple and pear *(Erwinia amylovora)*, Citrus canker *(Xanthomonas campestris p.v. citri)*, Cotton black arm *(X. c.* p.v. *malvacearum)*, bacterial leaf spot of tomato *(Pseudomonas solanacearum)*, wild fire of tobacco *(Pseudomonas tabaci)* and soft rot of vegetables *(Erwinia carotovora)*. In addition, it is used as a dip for potato seed pieces against various bacterial rots and as a disinfectant in bacterial pathogens of beans, cotton, crucifers, cereals and vegetables. Although it is an antibacterial antibiotic, it is also effective against some diseases caused by Oomycetous fungi, especially foot-rot and leaf rot of betel vine caused by *Phytophthora parasitica var. piperina.*

2. Tetracyclines: Antibiotics belonging to this group are produced by many species of Streptomyces. This group includes Terramycin or Oxymicin (Oxytetracycline). All these antibiotics are bacteriostatic, bactericidal and mycoplasmastatic. These are very effective against seed-borne bacteria. This group of antibiotics is very effective in managing MLO diseases of a wide range of crops. These are mostly used as combination products with Streptomycin sulphate in controlling a wide range of bacterial diseases. Oxytetracyclines are effectively used as soil drench or as root dip controlling crown gall diseases in rosaceous plants caused by *Agrobacterium tumefaciens*.

Antifungal Antibiotics

1. Aureofungin: It is a hepataene antibiotic produced in sub-merged culture of *Streptoverticillium cinnamomeum* var. *terricola*. It is absorbed and translocated to other parts of the plants when applied as spray or given to roots as drench. It is sold as Aurefungin-Sol. Containing 33.3% Aureofungin and normally sprays at 50-100 ppm. The diseases controlled are citrus gummosis caused by several species of Phytophthora, powdery mildew of apple caused by *Podosphaera leucotricha* and apple scab (*Venturia inaequalis*), groundnut tikka leaf spot, downy mildew, powdery mildew and anthracnose of grapes, potato early and late blight. As seed treatment it effectively checked are *Diplodia* rot of mango, *Alternaria* rot of tomato, *Pythium* rot of cucurbits and *Penicillium* rot of apples and citrus. As a truck application/root feeding, 2 g of aureofungin-sol+1g of copper sulphate in 100 ml of water effectively reduce Thanjavur wilt of coconut.

2. Griseofulvin: This antifungal antibiotic was first discovered to be produced by *Penicillium griseofulvum* and now by several species of *Penicillium, viz*., *P.patulum, P.nigricans, P.urticae, and P.raciborskii.* It is commercially available as Griseofulvin, Fulvicin and Grisovin. It is highly toxic to powdery mildew of beans and roses, downy mildew of cucumber. It is also used to control *Alternaria solani* in tomato *Sclerotinia fructigena* in apple and *Botrytis cinerea* in lettuce.

3. Cycloheximide: It is obtained as a by-product in streptomycin manufacture. It is produced by different species of *Streptomyces,* including *S.griseus* and S. *nouresi.* It is commercially available as Actidione, Actidione PM, Actidione RZ and Actispray. It is active against a wide range of fungi and yeast. Its use is limited because it is extremely phytotoxic. It is effective against powdery mildew of beans *(Erysiphe polygoni),* Bunt of wheat *(Tilletia spp.)* brownnot of peach *(Sclerotinia fructicola)* and post-harvest rots of fruits caused by *Rhizopus* and *Botrytis* spp.

4. Blasticdin: It is a product of *Streptomyces griseochromogenes* and specifically used against blast disease of rice caused by *Pyricularia oryzae.* It is commercially sold as Bla-s.

5. Antimycin: It is produced by several species of *Streptomyces,* especially *S. griseus* and *S. Kitasawensis.* It is effectively used against early blight of tomato, rice blast and seeding blight of oats. It is commercially sold as Antimycin.

6. Kasugamycin: It is obtained from *Streptomyces kasugaensis.* It is also very specific antibiotic against rice blast disease. It is commercially available as Kasumin.

7. Thiolution: It is produced by *Streptomyces albus* and effectively used to control late blight of potato and downy mildew of cruciferous vegetables.

8. Endomycin: It is a product of *Streptomyces endus* and effectively used against leaf rust of wheat and fruit rot of strawberry *(Botrytis cinerea).*

9. Bulbiformin: It is produced by a bacterium, *Bacillus subtills* and is very effectively used against wilt diseases, particularaly redgram wilt.

10. Nystatin: It is also produced by *Streptomyces noursei.* It is successfully used against anthracnose disease of banana and beans. It also checks downy mildew of cucuribits. As a post-harvest dip, it effectively reduces brown rot of peach and anthracnose of banana in stroage rooms. It is commercially marketed as Mycostain and Fungicidin.

11. Eurocidin: It is a pentaene antibiotic produced by *Streptomyces anandii* and called as pentaene G-8. It is effectively used against diseases caused by several species of *Colletotrichum* and *Helminthosporium.*

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Alternate Bearing in Fruit Crops

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Alternate bearing (AB) or biennial bearing (BB) is a major challenge to growers and traders of fruit crops. It is typically initiated by an abnormally heavy crop in trees (on year), followed by a light or no subsequent crop (off year).When on and off year sequence does not follow a systematic pattern it is called periodicity of cropping or irregular bearing. Alternate bearing is assigned due to genetic factor while irregular bearing may be due to lack of good orchard management practices. Alternation becomes entrained and difficult to change unless severe climatic events intervene, or drastic management interventions are made. A heavy "on" crop results in reduced vegetative shoot and root flushing, and less carbohydrate (energy reserves) build-up. Phenomenon of alternation is more prominent in the perennial fruit crops particularly in Anacardiaceae (mango and pistachio), Carylaceae (Hazelnut), Oleaceae (olives), Rosaceae (apple, pear, plums, apricot etc), Rutaceae (orange, Tangor, Satsuma etc) and also tamarind, jamun etc. fruit crops. Within a tree species some cultivars are regular while others are alternate bearer e.g., in mango Amrapali is regular while Langra is strongly alternate bearer. Development of Alternation An alternate bearing cycle are due to genetical and or environmental and orchard management practices resulting in either an exceptionally heavy or a very poor (or no) crop in young trees. Prior to this, the vegetative: reproductive balance favoured vegetative growth. In certain fruit crops, during the fruit development processes high amount of photosynthates are required to be transferred from leaves to the fruits. Such enhanced photosynthetic rates of leaves near fruits cannot compensate for the high fruit "carbon" (energy) demands. Therefore, less carbon reserves are left for vegetative renewal like development of roots and initiation of new growth flushes and development of new fruiting sites/fruit bud differentiation processes essential for the next season's fruiting. The result is no or very low fruiting or “off” crop. It is assigned due to detrimental effect of "on" crop on the subsequent crop's flowering and fruiting. The bearing behaviour of a crop can be affected by environmental conditions, cultivar and rootstock, and management. Alternate bearing index (ABI), an index to measure of the extent of alternate bearing is fruits in scientific research called Alternate Bearing Index (ABI). It is calculated using a formula as given below: ABI = (yield, year 1 - yield (years 2)/yield, year 1 + yield, year 2) in kg/tree for two consecutive (on/off) years. It ranges from 0 (no alternate bearer) to 1 (complete alternate bearer). ABI can be expressed as a percentage by multiplying by 100.

Causes of Alternate Bearing

Broadly two causes have been assigned for alternation namely, Environmental triggers and Endogenous factors:

1. Environmental Factors: Several environmental triggers have been found to influence alternation like climatic stress (frost, cool weather, low air humidity). Edaphic factors (salinity, drought, water table), pests and diseases etc. Frost has more influences on terminal bearing fruits. It is more damaging during spring season. Fruit setting was found to be influenced in Valencia grown in Australia due to cool weather in November months. Excessive fruit drops were observed in olives, oranges, avocado and mango due to low air humidity during early fruit development phases. Edaphic factors such as high salinity favours leaf drop and reduction in photosynthetic area. Moisture stress during flower formation increases sterile flowers in olives, while summer drought has resulted in excessive fruit drop in pome fruits. Shallow water table (about 1 m) causes low yield in mandarin and Washington Navel oranges. Severe attack of pest and diseases devastate the whole crop and bring the trees towards alternation.

2. Endogenous Factors: There are several endogenous causes responsible for alternation in fruit trees such as inhibition of flower initiation by growing fruits, lack of suitable pollinizers and pollinators resulting in poor fruit set, effect of seed on prevention on fruit drop and encouragement of very heavy crop load etc. Contribution of leaves to reproductive growth, competition between vegetative and reproductive sink, fruit load, C:N ratio and imbalances of hormones are other important contributors to the alternation.

3. Management of Alternate bearing: The basic aim of management of alternate bearing situations is to reduce overload in an „On‟ year and induce flowering in "Off" year. There are few horticultural operations which are able to reduce the intensity of alternation or irregularities in bearing.

a. Planting of Regular bearing varieties.

b. Proper orchard management: It is necessary to follow a proper orchard management schedule by providing adequate nutrients, irrigation, proper weed, pests and disease management etc cultural operations.

c. Pruning: Pruning has been found to reduce alternate bearing by restoring the vegetative vigour where it is declined excessively due to over-cropping. Girdling is an ancient horticultural tool to reduce excessive vigour, and to improve flowering and fruiting - either of the whole tree or of selected branches or shoots. Girdling can be used to increase cropping in a branch renewal/rotation management system, where branches are treated as distinctive modules (mini tree) which are re-cycled in an orderly manner by pruning.

d. De-blossoming and Fruit thinning: About 50 per cent of flower clusters recommended to remove soon after they emerge during "on" year. This process can be done manually or by using 3-chloroisoprophyl-N-phenyl carbonate at a concentration of 250-300 ppm.

e. Fruit thinning: Fruit thinning is a mean to reduce the crop load in the "on" season as the overbearing favours alternation. Early hand removal of smaller fruits, before the summer drop has been shown to reduce alternate bearing phenomenon.

f. Use of growth retardants: Growth retardants namely, Paclobutrazol (Cultar) in mango, uniconazole in Avocado has a proven role in reducing alternation.

A Review Article on Changing Over Rain into Grain: Opportunities for Realizing the Potential of Rain-Fed Agriculture and Water Harvesting Techniques in India

Article ID: 10377

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Abstract

This paper sums up the significance of water asset and an ever-increasing number of major circumstances confronting farming water use. Rainfed farming is an essential path for crop creation and food security. As perhaps the most proficient device, water gathering can enhance rainfed agriculture and henceforth improve the profitability. Notwithstanding, more thorough agreement and multidisciplinary study are expected to improve the productivity of water harvesting.

Keywords: Rainfed, Water harvesting, Crop, Food, agriculture etc.

Introduction

The management of water supplies worldwide has experienced changes due to population growth, urbanization and economic development; climate change is bringing a new layer to the continuing complexities of supply and demand for water. In the lower tropical latitudes, decreases in rainfall have been observed. Some scientists expect further reductions in rainfall and extreme events amplification. Rain-fed farming is conducted on 80 percent of the world's fertile land and produces 65-70 percent of the world's staple crops, but it still produces much of the food for disadvantaged populations in developed and least-favoured nations. For 70% of the world's poor who occupy these fields, the low and unpredictable productivity of those lands is the main cause of poverty. India ranks first among the rain-fed agricultural countries of the world in terms of both extent (86 M ha) and value of produce. The large population of landless households and agricultural laborers, owing to the minimal alternative options available beyond the agricultural industry, the bulk of poverty is clustered in rain-fed areas, along with poor land and labour productivity. At the same time, there is growing evidence to show that agriculture in these regions continues to play a key role in economic growth and in reducing poverty. Some of the available figures indicate that the 1% rise in agricultural production results in a decrease in the number of rural poor to 0.6-1.2%.

Rain-Fed Agriculture Scenario in India

There are extremely varied rain-fed areas in India, ranging from resource-rich areas with strong Farming ability to resource-constrained regions of far more limited potential. The cultivation of nutritious (coarse) cereals (91%), pulses, is in the rain-fed regions (91%), Oilseeds predominate (80 %) and cotton (65 %). Employing the impact model have estimated that even by 2025, one-third of India's cereal production shall be contributed by rain-fed areas (Table 1). Rain-fed agriculture supports 40 % of India's population. Earlier, the rain-fed farming systems, because of its risky nature, were dependent upon locally available inputs and grew traditional drought-resistant crops.

Table 1. Rain-fed and irrigated cereal area, yield and production in 1995 (actual) and 2025 (computed), and fraction of rain-fed area and production for India:

	Parameters	1995 (actual)	2025(computed with IMPACT model)
Irrigated	Area, M ha	37.8	46.7

	Yield, t/ha	2.65	3.81
	Production, M tonnes	100.3	177.7
Rain-fed	Area, M ha	62.3	49.8
	Yield, t/ha	1.20	1.63
	Production, M tonnes	74.6	81.4
Rain-fed area, %		62.2	51.6
Rain-fed production, %		42.7	31.4
Source: Adapted from Rosegrant et al. (2002).			

Importance of Rainfed Agriculture

Rainfed crop production, which uses infiltrated rainfall that forms soil moisture in the root zone (the so-called green water resource), accounts for most of the crop water consumption in agriculture. In the dry sub-humid and the semi-arid zones, where farming systems have experienced the lowest yields and the weakest yield improvements during the past decades, dry spell mitigation is a common water management practice for minimizing the risk of crop failure due to drought.

1. Rainfed Agricultural in Different Climate and Its Crop Yield: In the semi-arid and dry sub-humid zone, it is not the amount of rainfall that is the limiting factor of production (Fig. 1). Rather, it is the extreme variability of rainfall, with high rainfall intensities, few rain events, and poor spatial and temporal distribution of rainfall.

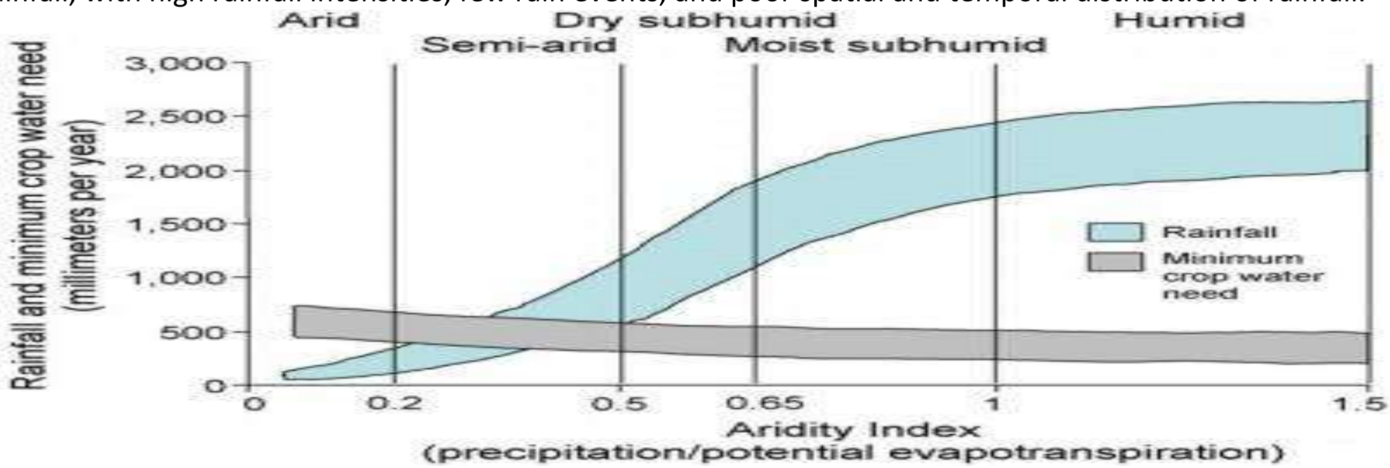


Figure 1. Range of rainfall variability across hydro-climatic zones from arid to humid Agro-ecosystems. (The ecosystem gradient is shown as the aridity index (ratio of annual precipitation to annual potential evapotranspiration). The range in total rainfall is expressed as plus or minus one standard deviation. Minimum crop water needs from Doorenbos and Pruitt (1992) and adjusted for aridity index)

Farming systems also suffer from agricultural droughts and dry spells exacerbated by water shortages caused by management. Therefore, crop failures typically blamed on "drought" could be avoided in certain instances by improved water control at the farm level. Interdisciplinary approaches are needed to tackle the challenge of obtaining the maximum yield under varying rainfall conditions:

a. To increase the quantity of water made available to crops to fulfill their requirements over time with improved water conservation through rainwater harvesting (RWH).

b. To optimize water penetration and soil holding capacity coupled with improved soil management through tillage, mulching, etc.

c. Increasing crop access to water with better crop management through crop species variety, date of planting, etc. The best approach is to merge the different methods and strategies to produce the maximum yield (intersection of the three rings, Fig. 2) and to accomplish this mix, sometimes it is an iterative operation.

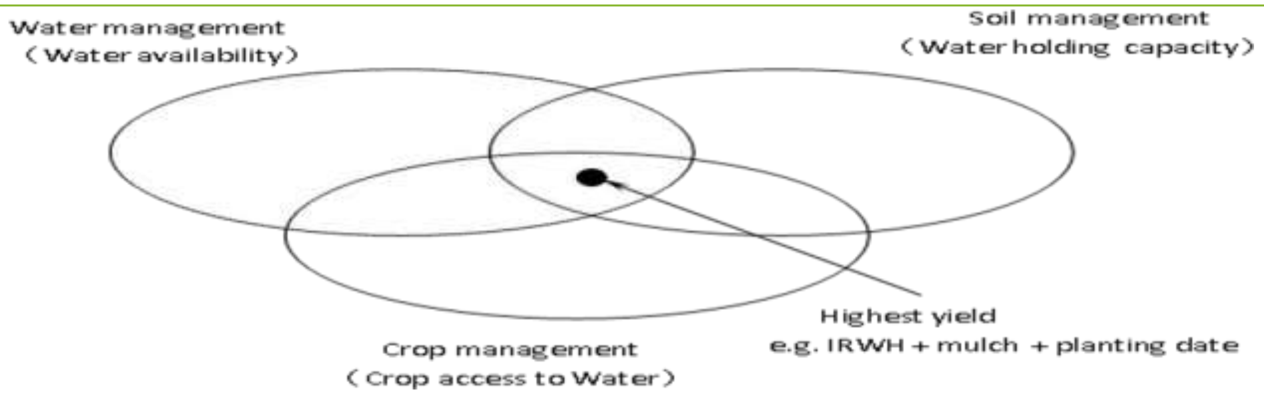
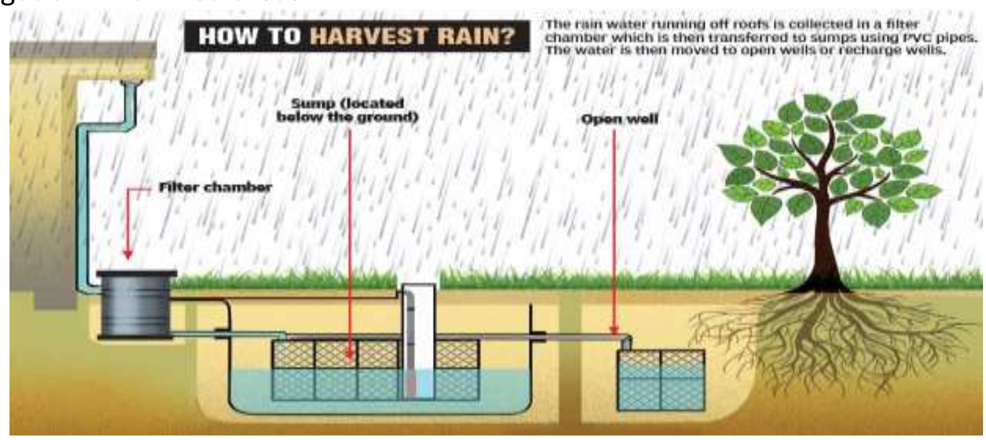


Figure 2. Integrated Water-soil-crop management strategies (FAO, 2008)

2. The Rainwater Harvesting Techniques: In smallholder rain-fed farming, the often-proposed solution to improving water productivity is to implement water storage and conservation technologies (WH). Rainwater harvesting (RWH) is massively promoted among the most popular soil and water conservation techniques by NGOs, national agricultural extension services and government agencies in African countries, as well as in India, where RWH practices already have a long tradition.

Supplemental irrigation is a key strategy, so far under-utilized, to unlock rain-fed yield potentials. The objective of supplemental irrigation is not to provide stress-free conditions through the crop growth for maximum yields, but to provide just enough water to tide over moisture scarcity at critical growth stages to produce optimal yields per unit of water. The existing evidence indicates that supplemental irrigation ranging from 50-200 mm/ season (50-200 m3/ha) is sufficient to mediate yield-reducing dry spells in most years and rain-fed systems, and thereby stabilize and optimize yield levels. India should not have to suffer from droughts, if local water balances were managed better.

Collecting small amounts using limited macro-catchments water harvesting, local springs, shallow groundwater tables or most importantly conventional water harvesting during rainy season can achieve this. Over the past 50 years, soil and water restoration, or in-situ water harvesting, has been the focus of much of the water supply expenditure in rainfed agriculture. As it is possible to apply in-situ water harvesting on any piece of land and is affordable to most smallholder farmers. In the general context, rainwater harvesting defines all strategies to focus, storing and collecting runoff from rainwater, for domestic and agricultural uses. These water harvesting systems can be grouped into three main types, namely; in-situ moisture conservation (soil and water conservation), concentration of runoff to crops in the field, and collection and storage of runoff water (from roofs and land areas) in different structures for both domestic and agricultural use. The study identified the dominant rain-fed districts for different crops (contributing up to 85 % of total grain-fed production), made an assessment of the surplus/ runoff available for water harvesting and supplementary irrigation in the identified districts, estimated the regional water use efficiency and effect of supplemental irrigation on increasing production of different crops and, finally, a preliminary estimate of the economics of water harvesting for supplemental irrigation in rain-fed areas.



Constraints of Rain-Fed Agriculture

Rainfall is a truly random factor in the rain-fed production system, and its variation and uncertainty are high in areas of low rainfall. Semi-arid regions, however, may receive enough annual rainfall to support crops but it is distributed so unevenly in time and/ or space that rain-fed agriculture becomes unviable note that due to high rainfall variation in semi-arid regions, a decrease of one standard deviation from the mean annual rainfall often leads to the complete loss of a crop. Whereas total water shortage is the biggest limiting factor in agriculture in the arid areas (< 300 mm/annum), extreme rainfall instability in time and space is the greatest water obstacle in the semi-arid and dry sub-humid tropical regions. In any cropping season, dry spells, which are typically 2-4 weeks with no precipitation during crucial growth stages that cause partial or full crop failures, frequently occur.

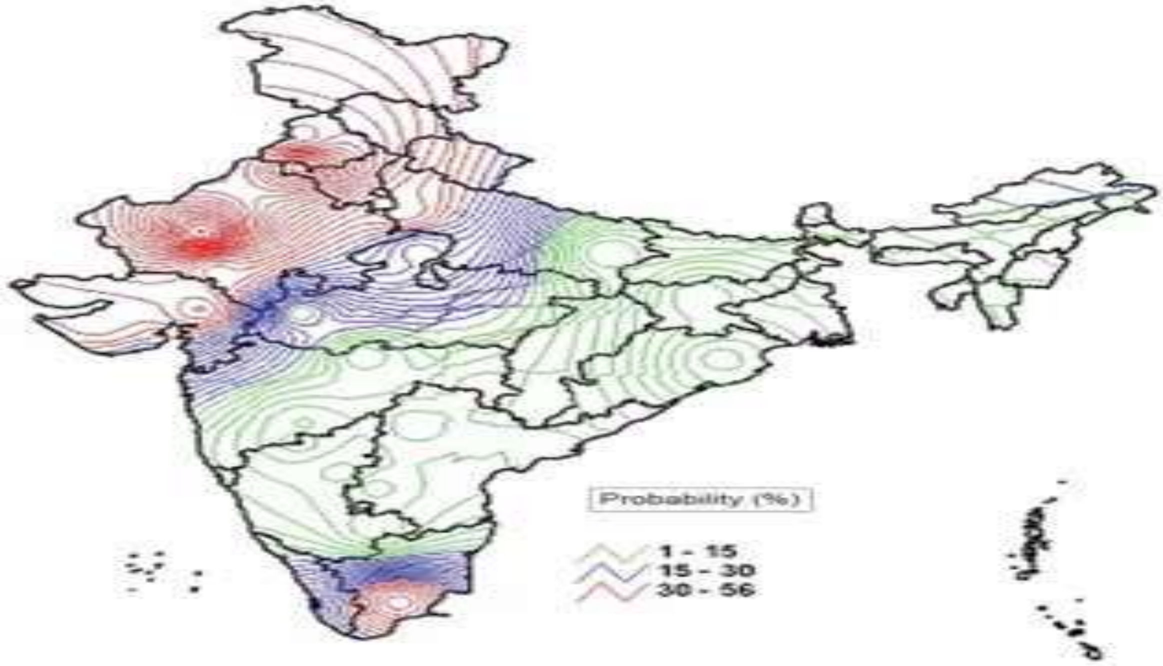


Figure 2. Probability of occurrence of terminal droughts in India—consecutive 3 dry weeks from second week of September.

During the southwestern monsoon season, the likelihood of deficient rainfall (deficiency in rainfall numerically equal to or greater than 25% of normal) in India is: once in 2.5 years in West Rajasthan; once in 3 years in Gujarat, east Rajasthan, western Uttar Pradesh, Tamil Nadu, Jammu and Kashmir, Rayalaseema and Telangana; once in 4 years in the south interior Karnataka, eastern Uttar Pradesh and Vidarbha; once in 5 years in West Bengal, Madhya Pradesh, Chhattisgarh, Konkan, Coastal Andhra Pradesh, Bihar, Jharkhand and Orissa; and once in 15 years in Assam Even dry sub-humid regions, where rainfall varies between 750-1,200 mm, experience contingent drought situations due to a break in monsoon conditions.

Effect of Irrigation Intensity on Crop Yields

An exercise based on district level secondary statistics to assess the effect of 'irrigation' and 'no irrigation' for the various crops in the 16 major states of India (where the rainfall is less than 1,500 mm/annum) revealed that:

1. Productivity increase due to irrigation varies between 7-74 %, except for soybeans (0 %) and rabi rice (550 %).
2. Achievable yields are much higher than productivity levels achieved through irrigation and improved practices at the district level.
3. Productivity enhancement due to irrigation is less than 30 % among oilseed crops, except for castor (52 %) and sunflower (47 %).
4. Among cereals, millets (pearl millet and finger millet), maize and barley recorded less than 30 % increase in productivity due to irrigation.

Yield differences between irrigated and rain-fed areas are more pronounced when the crop is grown under a variety of Agro-ecological regions, compared to its concentration in few and similar districts.

Conclusion

There is a growing scarcity of and competition for water among agricultural, industrial, commercial, and residential sectors forcing water resources management to allocate water more efficiently. In semi-arid and sub-humid regions, wherever rainfed agriculture is practiced, agricultural drought is a common problem. In order to improve crop water productivity and at the same time reduce the risk of rainfed agriculture, RWH potential assessment is necessary. It asks the clear understanding of soil hydrological properties, its spatial and temporal variation and affecting factors. These properties can be measured and monitored in field and indoors. GIS and hydrological models can be integrated to simulate the rainfall-runoff process and hence estimate the RWH potential. By balance the crop water requirement, available rainfall and soil moisture, the crop water deficit can be calculated. Small scale storage works can be the best choice for supplementary irrigation in hilly areas.

References

1. X. Zhang, F.W. Zwiers, G.C. Hegerl, F.H.Lambert, N.P.Gillett, S.Solomon, P.A.Stott, T. Nozawa. Detection of human influence on twentieth-century precipitation trends. Nature 448, 461–466 (2007).
2. IPCC (Intergovernmental Panel on Climate Change), Climate Change 2007. Fourth Assessment Report. Cambridge University Press, (Cambridge, UK., 2007).
3. Falkenmark, M.; Rockstrom, J. 1993. Curbing rural exodus from tropical drylands. Ambio 22 (7): 427-437.
4. Singh, R.P. 2001.Watershed management: A holistic approach for dryland agriculture. National Workshop on Watershed Area Development: Challenges and Solutions, Indian Institute of Management, Lucknow, India. July 28-29, 2001.
5. Rockstrom, J.; Falkenmark, M. 2000. Semi-arid crop production from a hydrological perspective- Gap between potential and actual yields. Critical Reviews in Plant Sciences 19 (4): 319-346.
6. D.N.Pandey, A.K. Gupta, D.M. Anderson. Rainwater harvesting as an adaptation to climate change. Current Science, 85: 46–59(2003).
7. B. R.Sharma, K.V.Rao, K.P.R.Vittal, Y.S.Ramakrishna, U. Amarasinghe. Estimating the potential of rainfed agriculture in India: Prospects for water productivity improvements. Agricultural water management, 97: 23-30(2010).

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Brown Manuring: An Effective Technique for Sustainable Agriculture

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Introduction

Brown manuring is an alternative green manuring technique under conservation tillage. Where monsoon is not mostly predictable and assured irrigation is not available. Brown manure crop is grown as an intercrop along with main crop. The main purpose of brown manuring is to control weed sand to add nutrients which are available to succeeding crops thereby improving soil fertility. Brown manuring is the process of growing green manures crops with rice and killing these green manure crops by the application of post emergence herbicides.

Procedure of Brown Manuring

In this practice, three days after sowing of rice (direct seeded rice mostly), Sesbania spp. @ 20 kg/ha is broadcasted and allowed to grow for 30 days, then 2,4 –D is sprayed in the field so as to kill only *Sesbania* spp. without adverse effect on rice. After 4-5 days of spraying Sesbania plants leaves turns into brown colour because chlorophyll is totally degraded that is why name is given brown manuring.

Brown manuring is mainly done in rice and can also be practiced in wheat and sugarcane crops. Rice has tillering capacity so its time of application and seed rate is manageable. Maize is a non-tillering crop so seed rate and time of application has to be taken care of so as not to hamper the growth of maize crop.

Crops Suitable for Brown Manuring

1. Leguminous crops: These crops have the ability to fix nitrogen in plants through nitrogen fixing bacteria and also add organic matter. e.g.: Sunhemp, Dhaincha, Sesbania, Cowpea and Mung bean.

2. Non leguminous crops: These crops add only organic matter into the soils. e.g.: Niger, Wild indigo.

Advantages of Brown Manuring

1. Less seed rate is required as compared to green manures crops.
2. It acts as a mulch on surface thereby indirectly aids in conserving soil moisture.
3. It improves the physical, chemical and biological properties of soil.
4. It supplies nitrogen, organic matter and other nutrients into the soils.
5. It reduces weed population without harmful effect on the main crop and ultimately increase the yield of the main crop.

Review of Literature

Sharma et al. (2017) reported that the application of 100% Brown manurin gave higher actinomycetes count as compared to 100% inorganic and FYM + vermicompost + neem oil cake but it was statistically at par with green manuring + vermicompost and Brown manuring + 25% RDF. Actinomycetes play important roles in the cycling of organic matter by decompose complex mixtures of polymer in dead plant, animal and fungal material results in production of many extracellular enzymes which are conductive to crop production

Sarangi et al. (2016) conducted an experiment to study effects of replacing 25% of nitrogenous fertilizer by brown manuring in direct seeded rice and observed that the plant height, effective tiller number, organic carbon content and grain yield were increased in the brown manuring plots as compared to farmers' practice. The biomass incorporated in the field was significantly improved in the brown manuring fields indicating better soil health. The benefit: cost ratio was more in the brown manuring plots than that of farmers' practice.

Table 1: Effect of treatments on grain yield, straw yield, net return and benefit: cost ratio of dry direct seeded summer rice:

Treatments	Grain yield (t/ha)		Straw yield (t/ha)		Net return (Rs/ha)		B:C ratio	
	2007	2008	2007	2008	2007	2008	2007	2008
Butachlor + BM + 2,4-D	4.36	4.18	6.11	6.00	21954	20494	1.30	1.22
Pretilachlor + BM + 2,4-D	4.28	4.13	6.06	5.96	18654	17429	0.96	0.89
Pendimethalin + BM + 2,4-D	4.12	4.01	5.87	5.84	19476	18621	1.13	1.08
Benthiocarb + BM + 2,4-D	4.06	3.96	5.80	5.79	18692	17932	1.06	1.02
Butachlor + hoeing + 2,4-D	3.94	3.79	5.57	5.54	19272	18117	1.22	1.14
Pretilachlor hoeing + 2,4-D	3.82	3.74	5.44	5.51	15592	15062	0.84	0.81
Pendimethalin + hoeing + 2,4-D	3.69	3.58	5.25	5.33	16639	15894	1.02	0.98
Benthiocarb + hoeing + 2,4-D	3.64	3.52	5.21	5.30	15960	15150	0.96	0.92
PIIH-2023 + hoeing + 2,4-D	4.20	4.06	5.99	5.86	20967	19787	1.27	1.20
Season long weedy	1.08	0.84	2.14	1.33	-3149	-5759	-0.24	-0.43
Season long weed free	4.53	4.31	6.37	6.17	13438	11588	0.50	0.43
Farmer's Practice	4.44	4.22	6.22	6.03	15993	14153	0.68	0.60
S.Em (±)	0.39	0.30	0.44	0.57	-	-	-	-
LSD (0.05)	0.81	0.61	0.91	1.18	-	-	-	-

(Maity and Mukharjee, 2009)

The highest grain and straw yield were recorded with butachlor 1.25 kg/ ha + brown manuring + 2,4-D 0.5 kg /ha which was statistically at par with the grain and straw yield obtained from complete weed free condition during both the years.

References

1. Maitra, Sagar and Zaman, A.(2017). Brown manuring: an effective Technique for yield Sustainability and Weed Management of Cereal Crops. International Journal of Bio resource Science. 4(1):1-5
2. Maity,S. K. and Mukhrjee,P.K (2009). Effect of brown manuring on grain yield and partial factor productivity of nutrients in dry direct seeded summer rice (Oryza sativa L.) under Terai agro-ecological region of West Bengal. Journal of Crop and Weed. 5(2): 31-35 (2009)
3. Sarangi, D. R., Sahoo, T. R., Sethy, S., Chourasia, M., Prasad, S.M., Mohanta, R. K. and Sadangi, B.N. 2016. Effect of replacing a part of nitrogenous fertilizer by brown manuring in direct seeded rice: a field study. ORYZA- An International Journal on Rice. 53(2): 226-228.
4. Sarangi,D.R. and Sadangi,B.(2015). Brown manuring:a tool for sustainable rice cultivation. Central Rice Research Institute, Cuttack-753006.
5. Sharma, A., Kachroo, D., Puniya, R., Ram, H., Joshi, D.,Soni, P.G., Yadav, T. and Yadav, M.R. 2017. Impact of Different Transplanting Dates and Nutrient Sources onSoil Microbial Population and Grain Yield of Basmati Rice (Oryza sativa L.) grown under SRI. International. Journal of Current. Microbiology and Applied Science. 6(3): 778-782.

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Baccaurea sapida (Roxb.) Muell. Arg.: The Lesser-Known Grape

Article ID: 10379

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Burmese grape [*Baccaurea ramiflora* Lour., syn. *Baccaurea sapida* (Roxb.) Muell. Arg.] is a minor fruit crop of the family Phyllanthaceae. The genus Baccaurea is derived from the Latin word 'baccaurea' meaning fruits having golden yellow colour (Chakrabarty and Gangopadhyay, 1997). It is an evergreen, dioecious, slow growing tree of South Asian origin, mainly India and Malaysia. Tree is found in wild or grown as homestead crop in eastern India (Arunachal Pradesh, Assam, Bihar, Manipur, Meghalaya, Mizoram and Nagaland). Burmese grape is known with various names in different parts of India. 'Motok hei' in Manipuri, 'Bureng' in Arunachal Pradesh, 'Leteku' in Assam, 'Sohramdieng' and 'Gasampe' in Meghalaya (Singh *et al*., 2017), 'Latka' in West Bengal (Deb and Bhowmick, 2013) and 'Kusum' in Northern India (Mann *et al*., 2016).

The tree grows to a height of 15-25 m, prefers tropical climate with moist humid condition. It performs better in areas receiving optimum rainfall of 200-350 cm and altitude up to 1000 m from sea level. It also prefers shade for better crop. Optimum temperature is 24-28℃, though it can withstand up to 35℃. They are seen growing in wide range of soils but they do best in well drained sandy loam soil with a pH of 5-6.

Burmese grape is propagated by seed. Attempts have been made by Abdullah *et al*. (2005) to propagate them through stem cutting as well. It flowers during summer months (March-April) and ripens during rainy season (June-July). Availability of the fruits is extended up to September month. Burmese grape shows cauliflorous and biennial bearing habit (Bhowmick, 2011). The fruits are oval in shape weighing 9-10 g with 2-4 cm diameter. The immature fruits are green and on ripening turn yellow to brown colour. The edible part aril is white to yellowish in colour, has sour and sweet taste with 10°Brix TSS, 4.42 % total sugar and 2.1 % acidity (Pal *et al*., 2008). Yield of Burmese grape varies from 60-80 kg per plant per year. Apart from fresh consumption of fruits, pectin and annatto dye (coloring textiles) are also extracted.

The fruit is nutritious and can be used in our daily diet to combat hidden hunger. It is rich in vitamin C and minerals like iron, phosphorus, potassium, calcium and magnesium. The fruit as well as the other plant parts (bark, wood and root) has got potential health benefits. Traditionally, fruit juice is used to cure constipation, wounds, abscess and has got antioxidant property, while other plant parts have got antiviral and anti-inflammatory properties. Also, consumption of fruits is known to improve immunity, prevent osteoporosis and maintain blood pressure. The composition of the fruit flesh is given in Table 1.

Even though Burmese grape is nutritious and cure major ailments, their cultivation is limited to natural condition. Hence, there is need to conduct more research in this crop and create awareness among people to conserve, cultivate and consume this fruit.

Table 1. Composition of Burmese grape fruit (Source: Kermasha et al., 1987):

Component	Per 100 g dry weight of fruit pulp
Carbohydrates	30.6 %
Protein	5.45 %
Vitamin C	178 mg
Energy	4.28 kcal
Iron	100 mg
Potassium	1370 mg
Magnesium	105 mg

Phosphorous	117 mg
Calcium	169 mg
Zinc	4.41 mg

References

1. Abdullah, A.T.M., Hossain, M.A. and Bhuiyan, M.K. (2005). Propagation of latka (Baccaurea sapida Muell. Arg.) by mature stem cutting. Research J. Agric. Biol. Sci., 1(2):129-134.
2. Bhowmick, N. (2011). Some lesser known minor fruit crops of northern parts of West Bengal. Acta Hort., 890, 61-63.
3. Chakrabarty, T. and Gangopadhyay, M. (1997). The genus Baccaurea (Euphorbiaceae) in the Indian sub-continent. J. Econ. Tax. Bot., 21(3):525-534.
4. Deb, P. and Bhowmick, N. (2013). Physico-chemical Properties of Burmese Grape (Baccaurea Sapida Muell. Arg.)- An underutilized Fruit Crop of West Bengal. Int. J. Agric Food Sci. Technol., 5: 415-420.
5. Kermasha, S., Barthakur, N.N., Mohan, N.K. and Arnold, N.P. (1987). Chemical composition and proposed use of two semi-wild tropical fruits. Food Chem., 26(4):253- 259.
6. Mann, S., Satpathy, G.and Gupta, R.K. (2016). Evaluation of nutritional and phytochemical profiling of Baccaurea ramiflora lour. Syn. Baccaurea sapida (Roxb.) Mull. Arg. Fruits. Indian J. Tradit. Know., 15 (1): 135-142.
7. Pal, R.K., Bhowmick, N. and Suresh, C.P. (2008). Latka (Baccaurea sapida Muell. Arg.) - an under exploited minor fruit crop of West Bengal. Abstracted in 3rd Indian Horticulture Congress 2008: New R & D Initiatives in Horticulture for Accelerated Growth and Prosperity. November 6-9, 2008 held at OUAT, Bhubaneswar, Organized by the Horticultural Society of India, p.325.

Seaweed as a Biostimulant in Horticulture

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Seaweeds are marine macroalgae which are macroscopic and multicelluar in nature. Based on pigmentation these macroalgae are grouped into various type viz. Chlorophyta (green algae), Phaeophyta (brown algae) and Rhodophyta (red algae) etc. Of all the types, brown seaweeds (*Ascophyllum nodosum*, *Fucus* spp., *Laminaria digitata*, *Sargassum muticum*, and *Turbinaria* spp.) are abundantly used in agriculture/horticulture as a biostiumlant or biofertilizer for enhancing plant growth by stimulating growth activities. Biostimulants or metabolic enhancers are plant extracts with wide array of bioactive compounds which when applied in small quantity enhances nutrient use efficiency and improves tolerance level of plants against biotic (viral, fungal and bacterial pathogens) and abiotic stress (drought, salinity, flood and cold temperature). Some of the major categories of biostimulants include, humic and fulvic acid, seaweed extracts, chitin, mibrobes, plant extracts, protein hydrolysates and other N-containing substances.

In recent times, horticulture is mainly focused on reducing chemical fertilizer usage, production cost and improved quality of the produce. The maximum use of chemical fertilizer adversely affects health and the environment. In this context, biostimulants like seaweed has proven beneficial to sustainable horticulture as it plays a key role in enhancing yield and quality by improving plant metabolism in short span and reducing fertilizer consumption of the plant. These natural fertilizers are safe for human, animal and birds as these are free from toxicity, polluting factors and are biodegradable in nature (Dhargalkar and Pereira, 2005). A variety of commercial seaweed extract products are now available worldwide for use in agriculture and horticulture. In India, seaweeds are mostly grown in Andhra Pradesh, Tamil Nadu, Gujarat, Maharashtra, Goa, Karnataka, West Bengal, Orissa and Andaman and Nicobar Islands (Tandel *et al*., 2016). FAO (2006) has reported 15 million metric tons of annual production of seaweed, among this significant amount is used as biostimulant in recuperating plant growth and yield. Seaweeds are abundant in vitamins, cytokinin, auxin, gibberellic acid, abscisic acid and other chemical components. This on application to plants improves photosynthetic efficiency, chlorophyll content, stress tolerance, enhances antioxidants and induces flowering. While its application to soil, improves soil aeration, water retention, enhances lateral roots and plant growth promoting bacteria that ultimately aid in better plant growth and development.

Seaweeds role as a biostimulant has been studied in several crops. For instance, in strawberry, foliar spray of *Duvillaea potatorum* and *Ascophyllum nodosum* enhanced root length and feeder root density that was associated with enhanced yield indicating the association of seaweeds of in water and nutrient use efficiency (Mattner *et al*., 2018). In tomato, foliar spray of *Ecklonia maxima* reduced infestation of root knot nematode resulting in improved yield by enhancing growth of shoot and root (Featonby-Smith and Staden, 1983). In addition, endogenous cytokinin existing in seaweed is known to induce early flowering, yield large sized fruits with superior quality in tomato (Crouch and Van Staden, 1992). Besides, *Ecklonia maxima* is found to increase the number of flowers and seeds per flower head in marigold on immediate application after transplanting (Aldworth and Staden, 1987). Seaweed extracts have proven effective in enhancing fruit quality in strawberry by increasing TSS, fructose, sucrose and quercetin content (Kapur *et al*., 2018) and in Grape cultivars Pinot Noir and Cabernet Franc by enhancing anthocyanins, total phenols, and berry skin dry matter (Frioni *et al*., 2018). Furthermore, Seaweed extracts on grapes found to be effective in inducing water stress tolerance by maintaining higher leaf water potential and stomatal conductance during the stress period (Mancuso *et al*., 2006). Seaweed *Ascophyllum nodosum* application in Asparagus exhibited higher rate of photosynthesis transpiration and maximum chlorophyll content (Al-Ghamdi and Elansary, 2018). The increase in chlorophyll content in leaf is associated with betaines which plays significant role in inhibiting chlorophyll degradation.

Conclusion

Seaweed is gaining global importance owing to its bio stimulant property. With the modern world moving towards sustainable horticulture, seaweeds have proven their efficiency in overall development of the horticultural crops by reducing fertilizer consumption, increasing tolerance to abiotic and biotic stresses, improving fruit quality and yield and also by reduced environmental contamination as these are nontoxic, non-hazardous and biodegradable in nature. However, physiological and biochemical mechanism of seaweeds still needs to be studied at a deeper level to completely harness their usefulness in horticultural crops.

References

1. Aldworth, S.J. and Staden, J.V. (1987). The effect of seaweed concentrate on seedling transplants. S. Afr. J. Bot., 53:187-189.
2. Al-Ghamdi, A.A. and Elansary, H.O. (2018). Synergetic effects of 5-aminolevulinic acid and Ascophyllum nodosum seaweed extracts on Asparagus phenolics and stress related genes under saline irrigation. Plant Physiol. Biochem., 129:273-284.
3. Crouch, I.J. and Staden, J.V. (1992). Effect of seaweed concentrate on the establishment and yield of greenhouse tomato plants. J. Appl. Phycol., 4:291-296.
4. Dhargalkar, V.K. and Pereira, N. (2005). Seaweed: Promising Plant of the Millennium. Sci. Cult., 71:60-66.
5. FAO. (2006). Yearbook of fishery statistics, vol 98(1–2). Food and Agricultural Organisation of the United Nations, Rome.
6. Featonby-Smith, B.C. and Staden, J.V. (1983). The effect of seaweed concentrate on the growth of tomato plants in nematode-infested soil. Sci. Hortic., 20:137-146.
7. Frioni, T., Sabbatini, P., Tombesi, S., Norrie, J., Poni, S., Gatti, M. and Palliotti, A. (2018). Effects of a biostimulant derived from the brown seaweed Ascophyllum nodosum on ripening dynamics and fruit quality of grapevines. Sci. Hortic., 232:97-106.
8. Kapur, B., Saridas, M.A., Çeliktopuz, E., Kafkas, E. and Kargi, S.P. (2018). Health and taste related compounds in strawberries under various irrigation regimes and bio-stimulant application. Food Chem., 263:67-73.
9. Mancuso, S., Azzarello, E., Mugnai, S. and Briand, X. (2006). Marine bioactive substances (IPA extract) improve ion fluxes and water stress tolerance in potted Vitis vinifera plants. Adv. Hortic. Sci., 20:156-161.
10. Mattner, S.W., Milinkovic, M. and Arioli, T. (2018). Increased growth response of strawberry roots to a commercial extract from Durvillaea potatorum and Ascophyllum nodosum. J. Appl. Phycol., 30:2943-2951.
11. Tandel, K.V., Joshi, N.H., Tandel, G.M., Patel, M.R. and Tandel, J.T. (2016). Seaweed Cultivation in India, a New Opportunity of Revenue Generation. Adv. Life Sci., 5(7):2487-2491.

New-Generation Plant Growth Regulators (PGR's) in Fruit Crops

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Introduction

Plant Growth Regulators (PGR's) are those compounds which are responsible for upregulation or downregulation of factors responsible for growth, development and other physiological processes. PGR's can be natural or synthetic. PGR modifies or controls one or more specific physiological processes. Site and action of different PGR's are different in different plants. PGR's can be grouped in 2 categories based on how long they are being used significantly in horticulture sector. There are some PGR's which are well harnessed and used widely by farmers. These includes Auxins, Gibbrellins, Cytokinins, Ethylene and Abscisic acid. Apart from these there are PGRs whose efficacy and efficiency are known to us but due to technological gap they are not yet been harnessed at grass root level. These includes Brassinosteroids (BR), Jasmonate (JA) and Salicylic acid (SA). Brassinosteroids are class of plant polyhydroxysteroids which is present in almost every part of plants inc. Brassicaceae. Application of BR exhibited a decline fruit abortion and fruit fall. Increase pollen tube growth and fertilization. BR prevented premature abscission of fruit. BRs also regulate the activity of defense related enzymes which could develop strong defense mechanism against different microorganisms. It was reported found that altering the level of endogenous BRs, promotes fruit quality (Li *et. al.*, 2010; Lieselotte *et. al.*, 2014). Organic compound found in jasmine flower (*J. grandiflorum*) and chemical formula $C_{12}H_{18}O_3$. Can be biosynthesized from linolenic acid by the octadecanoid pathway. JA enhances embryo formation, determination and development of flowers and overall fruit set (Hink *et. al.*, 2008). JA and methyl jasmonate protect plants from herbivores and pest by synthesis of enzymes such as proteinase inhibitors and chitinases and volatile aldehydes and oxoacids. JA and MJa improves the total antioxidants and phenol content (Kohli *et. al.*, 2018). Salicylic acid ($C_7H_6O_3$) is a monohydroxy benzoic acid (type of phenolic acid and betahydroxy acid). Derived from the metabolism of salicin. SA have influence on photosynthesis, ion uptake, membrane permeability, enzyme activities, flowering and growth and development of plants.

What are Plant Growth Regulators (PGR's)?

1. PGRs are those compounds which are responsible for upregulation or downregulation of factors responsible for growth, development and other physiological processes.
2. PGR's can be natural or synthetic.
3. PGR modifies or controls one or more specific physiological processes.
4. Site and action of different PGR's are different in different plants.

PGR's Well Harnessed

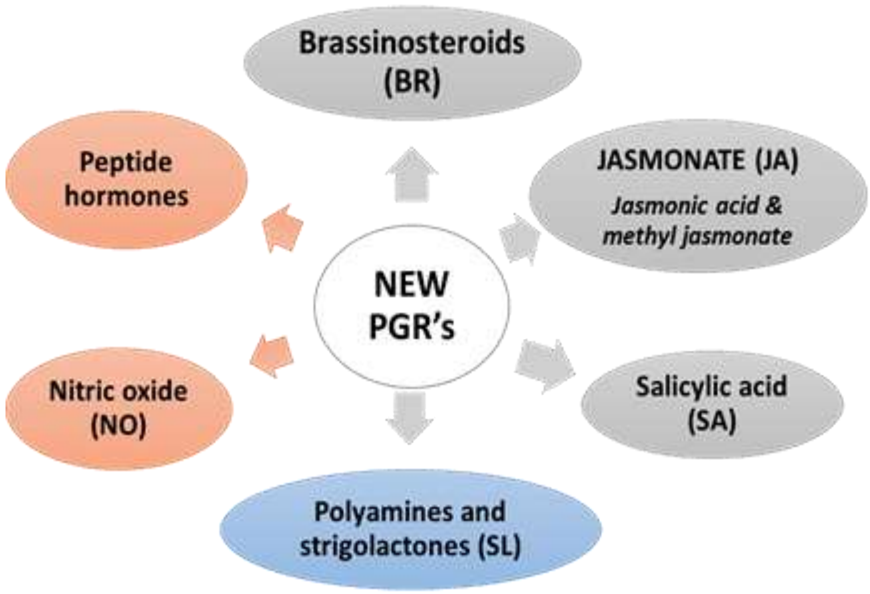
1. Plant Growth Promoters:

- a. Auxins.
- b. Gibbrellins.
- c. Cytokinins.

2. Plant Growth Inhibitors:

- a. Ethylene.
- b. Abscisic acid.

PGR's Yet to be Harnessed



Brassinosteroids (BRs)

1. Brassinosteroids are class of plant polyhydroxysteroids which is present in almost every part of plants inc. Brassicaceae.
2. Application of BR exhibited a decline fruit abortion and fruit fall.
3. Increase pollen tube growth and fertilization.
4. BR prevented premature abscission of fruit. BRs also regulate the activity of defence related enzymes which could develop strong defence mechanism against different microorganisms. It was reported found that altering the level of endogenous BRs, promotes fruit quality (Li et. al., 2010; Lieselotte et. al., 2014).

Crop	Dosage and type	Stage of application	Results
Prunus persica	24-epibrassinolide	Cold storage	Protected from chilling injury through changes in proline metabolism
Grape vines	BRs (0.0, 0.1, 0.5 and 1.0 mg L-1)	Pea Stage and Veraison	Maintain postharvest quality
Grapes	0.4 mg/l	At fruit development stage	Enhanced total anthocyanin
Grape	Exogenous application	Pea Stage	Enhance ripening
Strawberry	Exogenous application	Colour development stage	Enhance ripening
Mango	Exogenous application	Fully matured condition	Delaying ripening
Jujube	Exogenous application	Cefore colour break	Delaying ripening
Grape vines	EBR (24-epibrassinolide)	Any stage	• Increased the amount of antioxidant. • Decreased the damage caused by reactive oxygen species (ROS) and lipid peroxidation.
Sweet cherry.	0.75 mg/l	Pre-harvest application	Enhanced shelf life of variety Tak-Danehe Mashhad

Sweet Cherry	1.0 mg/l	Swollen bud stage	Application increased fruit yield, improved fruit quality, increased fruit weight, improved fruit colour, increase TSS and antioxidant potential.

Jasmonate / Jasmonic acid (JA)

1. Organic compound found in jasmine flower *(J. grandiflorum)* and chemical formula C12H18O3.
2. Can be biosynthesized from linolenic acid by the octadecanoid pathway.
3. JA enhances embryo formation, determination and development of flowers and overall fruit set (Zheng et. al., 2017).
4. JA and methyl jasmonate protect plants from herbivores and pest by synthesis of enzymes such as proteinase inhibitors and chitinases and volatile aldehydes and oxoacids.
5. JA and MJa improves total antioxidants and phenol content (Nafie et al., 2011).

Crop	Dosage and type	Stage of application	Results
Mango	Methyl jasmonate vapor (10–4 M)	Cold storage	Reduced chilling injury during storage at 7°C
Papaya	Methyl jasmonate vapor	Matured stage	Inhibited fungal decay Reduced chilling injury Retain firmness
Grape	Jasmonic acid	Veraison stage	Stimulate secondary metabolites such as stilbene in berries which enhance anthocyanin.
Peach	Jasmonic acid	Fruit development stage	
Apple	Jasmonic acid	Fruit development stage	
Blackberries	Jasmonic acid	Pre-ripening stage	Enhance antioxidant activity and flavonoid content.
Papaya	Jasmonic acid	After harvest	inhibitted getmination of Colletotrichum sp. spores.
Citrus	Jasmonic acid		*Penicillium expansum* and *P. italicum*.
Peach	MeJA	Developing stage	Reduce fruit endogenous ethylene Delayed softening of fruit Enhanced expression of anthocyanin.
Grape	Jasmonic acid	Veraison	Resistant against *Botrytis cinerea.*
Apple	n-Propyl dihydrojasmonate	Pre-ripening	Improved anthocyanin in apple.
Apples and pears	Jasmonate	Pre - ripening	Improve aroma volatiles production.
Citrus	Methyl Jasmonate		Ensured closure of stomata during water stress or UV radiation stress.
Fuji apple	Methyl Jasmonate	cold storage	Higher soluble solids and titratable acidity Fruit firmness was also higher.
Strawberry var. Selva	Jasmonic acid	Maturing stage	Improvement in soluble solids content and total antioxidant quantity.

Salicylic Acid (SA)

1. Salicylic acid ($C_7H_6O_3$) is a monohydroxy benzoic acid (type of phenolic acid and betahydroxy acid).
2. Derived from the metabolism of salicin.
3. SA have influence on photosynthesis, ion uptake, membrane permeability, enzyme activities, flowering and growth and development of plants.

Crop	Results
Strawberry	Marketability retention, decrease in ethylene production & fungal decay.
Pomegranate	Improve antioxidant potential retention of vitamin C content reduction of CI & EL.
Kiwifruit	Suppression of ethylene & superoxide free radical production, increase in total SA content.
Banana	Decrease in fruit softening, pulp/peel ratio, reducing sugar content, invertase activity & respiration rate, inhibition of cellulase, PG, xylanase, CAT & POX activity.
Peach	Increase in firmness and overall shelf life.
Sweet cherry	Increase in β-1, 3-glucanase, induction of disease resistance, direct antifungal activity.
Orange	Acceleration of H2O2 accumulation, decrease in lipid peroxidation & MDA and softening.
Apple	Decreased ethylene, softening & respiration rates.
Kiwifruit	Inhibition of ethylene production, ripening & decay control.
Sweet cherry	Decay control, increase in CAT, GPX, β-1, 3-glucanase & chitinase.
Watermelon	Increase in GPX, APX, CAT, SOD & GR activity, induction of resistance to CI.
Strawberry	Decay ripening & prevent weight loss.
Loquat	Inhibition of superoxide free radical production.
Pear	Induction of resistance to diseases, increase in Chitinase & β-1, 3-glucanase.
Fresh-cut Chestnut	Delayed discoloration, maintained edible quality, activity of PPO, POD & PAL (Phenylalanine Ammonia lyase).
Strawberry cv. Festival	Foliar spray at the 3 mM level significantly increased vegetative growth, number of flower clusters and earliness.
Jamun	Application during fruit development and postharvest stages significantly increased the Total Antioxidant potential.
Guava (Lalit)	Improvement in firmness, total phenolics and ascorbic acid content.
Apricot	1 or 2 mmol/l SA application reduced chilling injury and fruit decay of fruit, improve total polyphenolic content, antioxidant capacity and carotenoids content.

References

1. Hink, M. A, Shah, K., Russinova, E., de Vries, S. C. and Visser, A. J. W. G. (2008) Fluorescence fluctuation analysis of Arabidopsis thaliana somatic embryogenesis receptor-like kinase and brassinosteroid insensitive 1 receptor oligomerization. Biophys Journal. 94:1052–1062.
2. Kohli, S. K., Handa, N., Bali, S., Arora, S., Sharma, A., Kaur, R. and Bhardwaj, R. (2018). Modulation of antioxidative defense expression and osmolyte content by co-application of 24-epibrassinolide and salicylic acid in Pb exposed Indian mustard plants. Ecotoxicol. Environ. Saf. 147: 382–393.
3. Li J., Li Y., Chen S. and An L. (2010). Involvement of brassinosteroid signals in the floral-induction network of Arabidopsis. J Experi Botany. 61(15): 4221–4230.
4. Lieselotte, D. B., Hofte, M. and De Vleesschauwer, D. (2014). Connecting growth and defense: the emerging roles of brassinosteroids and gibberellins in plant innate immunity. Mol Plant 7:943– 959.

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Status of Organic Farming: - India v/s World

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Introduction

Organic Agriculture features a reputation of being controversial and is taken into account as an inefficient approach to food production. However, organic foods and beverages are a fast-growing segment of the global food industry. Here, we analyze the presentation of natural cultivation taking into account for key measurements of sustainability: efficiency, environmental impact, financial suitability and social prosperity (Agmarc 2013). Natural cultivating frameworks produce lower yields contrasted and customary agribusiness. However, they are more beneficial and harmless to the ecosystem and convey similar or more nutritious food containing less (or no) pesticide deposits, contrasting and regular cultivation. In addition, introductory proof demonstrates that natural rural frameworks convey more prominent environment administrations and social advantages (Aschermann et al., 2013). Although natural agribusiness has an undiscovered task to carry out when it includes the foundation of maintainable cultivating frameworks, no other method will securely take care of the earth, a blend of natural and other inventive cultivating frameworks is required Chung-Hui, T. 2016). Critical boundaries exist to embracing these frameworks, never the less a variety of strategy instruments will be needed to encourage their turn of events and usage. Natural cultivating might be a creation the board framework barring of all manufactured off-ranch inputs yet rely upon on-ranch agronomic, natural and mechanical strategies like harvest turns, crop buildups, animal composts, off-ranch natural waste, mineral evaluation rock added substances and organic arrangement of supplement preparation and plant assurance, which advances and improves biodiversity, natural cycles and agro-environment wellbeing (Cronbach, 1951).

About

Natural cultivating is a rural framework which began ahead of schedule inside the 20th century in response to quickly changing cultivating practice. Affirmed natural farming records for 70 million hectares around the world, with over a large portion of that absolute in Australia. Natural cultivating keeps on being created by different associations today (Hamzaoui et al., 2009). It's characterized by the use of manures of natural forms like fertilizer compost, excrement, and bone meal and spots accentuation on methods like harvest transformation. Natural principles are intended to allow the use of present substances while forbidding or carefully restricting engineered substances (Hamzaoui et al.,2009). For instance, present pesticides like pyrethrum and rotenone are allowed, while engineered manures and pesticides are precluded. Manufactured substances that are permitted incorporate, for example, copper sulphate, natural sulphur. Hereditarily adjusted creatures, non-materials, human sewage ooze, plant development controllers, chemicals, and anti-microbial use in animal's cultivation are denied. Natural cultivating advocates guarantee points of interest in supportability, receptiveness, independence, self-governance/freedom, wellbeing, food security and sanitation. While as Natural agrarian strategies are globally directed and lawfully upheld by numerous countries, situated in huge part on the principles set by the International Federation of Organic Agriculture Movements (IFOAM), a world umbrella association for natural cultivating associations set up in 1972. Natural agribusiness is frequently characterized as "a coordinated cultivating framework that makes progress toward maintainability, the improvement of soil fertility and natural variety while, with uncommon special cases, forbidding manufactured pesticides, anti-infection agents, engineered composts, hereditarily changed living beings, and development chemicals". Since in 1990, the commercial centre for natural food and different items has developed quickly, coming to $63 billion worldwide in 2012. This interest has driven an indistinguishable expansion in naturally oversaw farmland that developed from 2001 to 2011 at a building pace of 8.9% annually. Starting at 2018, roughly 71.5 million hectares overall were cultivated naturally, speaking to around 1.5 percent of absolute world farmland (Hamzaoui et al.,2013).

World's Food Security

In 2007, the United Nations Food and Agriculture Organization (FAO) said that natural horticulture frequently brings about greater costs and consequently an obviously better pay for ranchers, so it ought to be advanced. Never the less, FAO focused on that by natural cultivating one couldn't take care of the current human kind, even for the bigger future prospects. Both information and models indicated then that natural cultivating was far away from adequate. Hence, synthetic manures were expected to stay away from hunger (Hamzaoui et al.,2013). Other examination by numerous agribusiness chiefs, horticultural and ecological researchers and global agribusiness specialists uncovered the assessment that natural cultivating wouldn't just build the world's food supply, yet could be the sole gratitude to annihilate hunger. FAO focused on that composts and other substance data sources would much be able to build the get together especially in Africa where manures are presently utilized 90% however in Asia it was not. For example, in Malawi the yield has been supported utilizing seeds and composts. FAO likewise includes utilizing biotechnology, since it can help little holder ranchers to improve their pay and food security. While as NEPAD, advancement association of African governments reported that taking care of Africans and forestalling lack of healthy sustenance requires manures and upgraded seeds. As per a recent report in Science Digest, natural best administration rehearses shows a mean yield just 13% yet customary. Inside the world's less fortunate countries where a large portion of the world's eager reside and where regular agribusiness' costly information sources aren't moderate by the heft of ranchers, embracing natural administration really builds yields 93% all things considered, and will be an essential a piece of expanded food security.

Food Quality and Security

While there could likewise be a few contrasts inside the measures of supplements and enemies of supplements when naturally created food and expectedly delivered food are analyzed, the variable idea of food creation and taking care of makes it hard to sum up outcomes and there's lacking proof to shape asserts that natural food is more secure or more grounded than traditional food. Cases that natural food tastes better aren't upheld by proof (Hamzaoui et al.,2013).

India

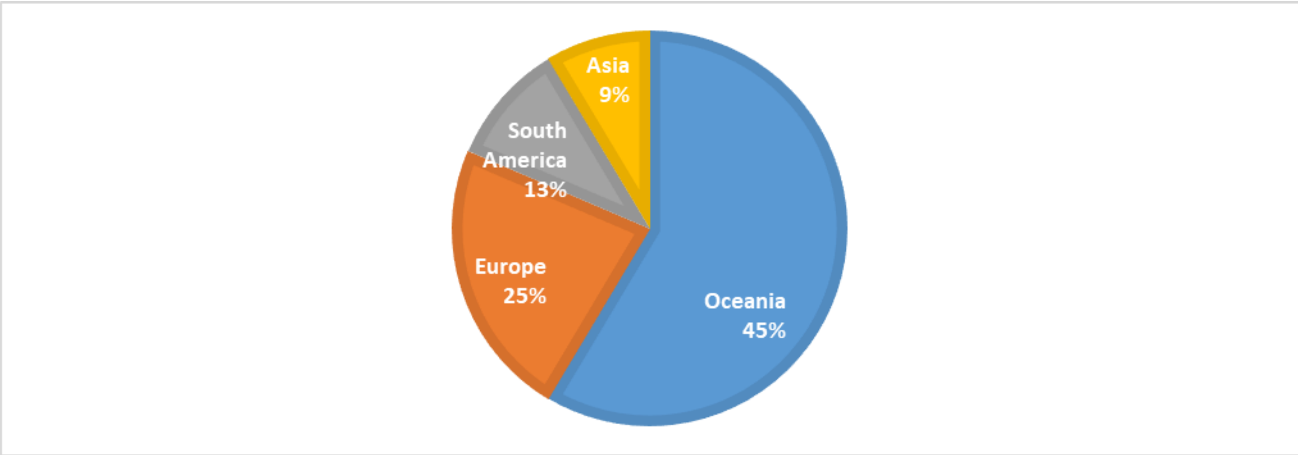
India ranks first in the number of natural ranchers and ninth in the natural cultivation area. In India, the northern province of Sikkim achieved its target of switching over to 100 percent natural cultivation in 2016. Different conditions of India, including Tripura, Uttarakhand have set comparable targets. It additionally announced their goals to move to totally natural development. Madhya Pradesh tops with the rundown with 0.76 hectare of zone under natural development that is more than 27% of India's all-out development territory. The best three states Madhya Pradesh, Rajasthan, Maharashtra represent about a large portion of the territory under natural development (Husic et al.,2017). The South Indian state Andhra Pradesh is furthermore advancing natural cultivating, particularly Zero Budget Natural Farming (ZBNF) which might be such a regenerative horticulture. Starting at 2018, India has the main number of natural ranchers inside the world and establishes very 30% of the natural ranchers universally. India has 8,35,000 ensured natural makers. In the monetary year 2020, more than 2 % of the net region in India was under natural cultivating. In association with financial plan 2020-21, Rs. 687.5 crore has been designated for the natural and common cultivating area was 461.36 crore in the earlier year. As on 31st March 2020 all out territory under natural affirmation measure (enlisted under National Program for natural Production) is 3.67 million hectares (2019-20). This incorporates 2.299 million ha cultivable territory and another 1.37 million hectares for wild reap assortment (Husic et al.,2017).

Natural Producers Worldwide

In 2018, 2.8 million natural farmers were accounted for such farming. India keeps on being the country with the most noteworthy number of makers (1,149,000), trailed by Uganda (2,10,000), and Ethiopia (2,04,000). As indicated by most recent FIBL review on natural horticulture around the world, natural farmland expanded by 2.0 million hectares. Worldwide, 1.5% of farmland is natural. The nations with the biggest natural portion of their complete farmland are Liechtenstein (38.5%), Samoa (34.5%) and Austria (24.7%). Natural makers in Asia (1.3 million), Europe (4,18,000), Latin America and the Caribbean (2,28,000), Oceania (21,000) (Husic et al.,2017).

Steady Increase of Organic Farmland

In 2018, a total of 71.5 million hectares was naturally supervised, referring to an increase of 9 % or 2 million hectares compared to 2017.Australia has the main natural agrarian zone (35.7 million hectares), trailed by Argentina (3.6 million hectares), and China (3.1 million hectares). Because of the huge territory of natural farmland in Australia, a large portion of the overall natural agrarian land is in Oceania (36.0 million hectares). Europe has the second biggest region (15.6 million hectares), trailed by Latin America (8 million hectares). The natural zone expanded through and through landmasses contrasted with 2017 Husic et al., (2017).



The Contribution of Organic Agriculture to the Sustainable Development Goals

As per Dr. Monica Rubiolo from SECO, "Admittance to great quality information on natural cultivating not just assists with living accomplishment toward accomplishing the Sustainable Development Goals yet additionally to situate chiefs and different partners along the whole worth chain."

Joseph Wozniak from ITC accepts that "This distribution gives key experiences to those that join significance to ecological conditions behind the items delivered in their nations or sold in their country's shops." The worldwide natural measurements have demonstrated helpful for advancement projects and supporting techniques for natural farming and advertises and that they are vital for observing the effect of those exercises (Husic et al.,2017). This distribution shows our continuous commitment with straight forwardness inside the natural area.

References

1. Agmarc (2013), "Organic food trends profile – a study by World Organic Agriculture 2012", retrieved from: http://www.agmrc.org/markets__industries/food/organic-food-trends-profile/ (accessed 31st January 2018).
2. Aschemann-Witzsel, J., Maroscheck, N. and Hamm, U. (2013), "Are organic consumers preferring or avoiding foods with nutrition and health claims", Food Quality and Preference, Vol.30, No. 3, pp.68-76.
3. Chen, Mei-Fang. (2007), "Consumer attitudes and purchase intentions in relation to organic foods in Taiwan: Moderating effects of food-related personality traits", Food Quality and Preference, Vol.18, pp.1008-1021.
4. Chung-Hui, T. (2016), "The effect of price discounts on green consumerism behavioural intentions", Journal of Consumer Behaviour, Vol. 15 No. 4, pp.325-334.
5. Cronbach, L. J. (1951), "Coefficient alpha and the internal structure of tests", Psychometrika, Vol. 16 No. 3, pp.297-334.
6. Gottschalk, I. and Leistner, T. (2013), "Consumer reactions to the availability of organic food in discount supermarkets" International Journal of Consumer Studies, Vol.37, pp.136-142.

7. Hamzaoui-Essoussi, L. and Zahaf, M. (2009), "Exploring the decision-making process of Canadian organic food consumers: Motivations and trust issues", Qualitative Market Research: An International Journal, Vol. 12 No. 4, pp.443-459.
8. Hamzaoui-Essoussi, L., Sirieix, L. and Zahaf, M. (2013), Trust orientations in the organic food distribution channels: A comparative study of the Canadian and French markets", Journal of Retailing and Consumer Services, Vol.20, pp.292-301.
9. Hjelmar, U. (2011), "Consumers' purchase of organic food products. A matter of convenience and reflexive practices", Appetite. Vol.56, pp.336-344.
10. Husic-Mehmedovic, M., Arslanagic-Kalajdzic, M., Kadic-Maglajlic, S. and Vajnberger, Z. (2017), "Live, Eat, Love: life equilibrium as a driver of organic food purchase", British Food Journal, Vol. 119 No. 7, pp.1410-1422,
11. Kavaliauske, M. and Ubartaute, S. (2014), "Ethical behaviour: Factors intention", Economics and Management, Vol. 19 No. 1, pp.72-83.

Role of Chelating Agents on Availability of Micronutrients in Soil to Plants

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Introduction

Plant nutrients are one of the environmental factors essential for crop growth and development. Hence, Nutrient management is crucial for optimal productivity in commercial crop production. Micronutrients are key elements in plants growth and development. These elements play very important role in various enzymatic activities and synthesis.

Also help in the uptake of major nutrients and play an active role in the plant metabolism process starting from cell wall development to respiration, photosynthesis, chlorophyll formation, enzyme activity, hormone synthesis, nitrogen fixation and reduction (Das, 2003). Nutrients in concentrations of ≤ 100 parts per million (ppm) in plant tissues are described as micronutrients and include iron (Fe), zinc (Zn), manganese (Mn), copper (Cu), boron (B), chlorine (Cl), molybdenum (Mo) and nickel (Ni).

The requirement of micronutrients is only in traces, which is partly met from the soil or through chemical fertilizer or through other sources. The three main classes of micronutrient sources are inorganic, synthetic chelates and organic complexes. Inorganic sources such as sulphates of Cu, Mn, Fe and Zn are the most common metallic salts used in the fertilizer industry because of their ready plant availability and water solubility. In the past 35-40 years, it has been recognized that compounds containing chelated metals could supply many of the micronutrient requirements of plants.

These chelates find use in a wide variety of agricultural crops. Applications for chelates vary from fertilizer additives, seed dressing to foliar sprays and hydroponics. Micronutrient deficiencies are major constraints in crop production in the present day agricultural programmers. The major causes for micronutrient deficiencies are intensified agricultural practices, unbalanced fertilizer application including NPK, depletion of nutrients and no replenishment.

Micronutrients such as Fe, Mn, Zn, and Cu are easily oxidized or precipitated in soil and their utilization is not efficient. In view of the above, chelated fertilizers were developed to increase micronutrient utilization efficiency and refer to inorganic nutrients bonded to an organic molecule (i.e., chelating agents), protecting them from oxidation and precipitation.

Chelates

The word chelate is derived from the Greek word chelé, which refers to a lobster's claw. Hence, chelate refers to the pincer-like way in which a metal nutrient ion is encircled by the larger organic molecule (the claw), usually called a ligand or chelator (Sekhon, 2003) or chelate refers to a ring system that results when a metal ion combines with two or more electron donor groups of a single molecule. Also, a chelate describes a kind of organic chemical complex in which the metal part of the molecule is held so tightly that it cannot be 'stolen' by contact with other substances, which could convert it to an insoluble form.

Chelating Agent

Chelating agents are organic molecules that can trap or encapsulate certain metal ions like Ca, Mg, Fe, Co, Cu, Zn and Mn and then release these metal ions slowly so that they become available for plants to take them up. In general, chelating agents are molecules with metal-complexing groups arranged to produce a number of maximum stabilities chelate rings. Actually, unidentate water molecules, which are coordinated with a metal ion are replaced by the most stable bi-, tri or poly dentate groups of the chelating agent. This results in the ring formation.

Metals bound in chelate rings have essentially lost their cationic characteristics. In this form they are less prone to precipitation in some chemical reactions. This is the characteristic feature that makes these compounds useful in agriculture. The plant availability of certain micronutrient fertilizers reduces by transformation of the added micronutrient into forms that plants are unable to absorb. For example, if the inorganic iron salt (iron sulphate) is supplied to some soils, much of the iron is transformed into forms that are not readily assimilated. They are converted to 'plant unavailable' forms. This problem can be overcome by using chelates.

Types of Chelate: Chemical or Synthetic Chelating Agent

The ligands EDTA (Ethylene diamine-tetra-acetic acid), DTPA (Diethylene-tri amine penta-acetic acid) and HEEDTA N-(hydroxyethyl) ethylene-diamine-tri acetic acid (also known as EDTA-OH) are often used in chelated fertilizer. The abundance of metal-complexing groups in EDTA, DTPA and HEEDTA permits a multiple number of metal-enclosing chelate rings to form a condition promoting stability.

All of the chelate rings which form include the metal in a five membered ring, a condition that imparts maximum stability.
1. EDTA is the most common synthetic chelating agent and is used for both soil and foliar applied nutrients.
2. DTPA is used mainly for chelates applied to alkaline soils. It is more effective than EDTA but is usually more expensive.
3. Iron chelates made with HEDTA and EDDHA are the most effective iron fertilizers on high pH soils but are also the most expensive.

Natural Chelating Agents

The natural chelates are very small molecules and consequently pass through the plant's barriers including the cuticle, cell walls and cell membranes maximizing absorption and assimilation. There are many naturally occurring chelating agents that are products of organic matter decomposition such as organic acids, amino acids, ligninosulfonates, ligninpolycarboxylates, sugar acids and derivatives, phenols, poly flavonoids, siderophores and phyto siderophores.

Natural Chelating Agents Includes

1. Fulvic acid: is the most powerful natural chelating agent. They are more chemically reactive. There small size means that they can rapidly enter the plant. Fulvic acid is a very effective carbon containing chelation agent which makes it ideal for a foliar additive.

2. Amino acids: are all capable of chelation but the single most effective is Glycine. Glycine is the smallest amino acid and it can deliver minerals into the plant incredibly rapidly due to its tiny size.

3. Kelp: contains mannitol another powerful chelating agent.

Advantages of Chelates Over Tradition Forms

The chelated forms of micro nutrients have a number of advantages over more traditional forms of trace elements such as oxides and sulphates:
1. Much lower quantities are necessary compared to inorganic compounds because they are completely assimilable by crops. Chelates are thus cost effective even though they are a little more expensive.
2. Chelates are much more easily absorbed by plant roots or leaves because chelates are of organic nature.
3. Chelates are more easily translocated within the plant as their action is partly systemic.
4. Chelates are easily assimilated within the plant system.
5. The chances of 'scorching' of crops while using chelates is less because they are organic substances.

6. Under alkaline conditions, chelated iron, zinc, manganese and copper is a better way to provide micronutrients to a crop.
7. Chelates are not readily leached from the soil as they adsorb on to the surface of soil particles.

Conclusions

Due to the complex and heterogeneous nature of soil, availability of nutrients is reduced or increased. Some of the traditional micronutrients gets oxidized or precipitated. Hence, synthetic or natural chelating compounds are widely used in cropping systems to correct micronutrients deficiencies. The chelated fertilizer not only increase the bioavailability of micronutrients (such as Fe, Cu, Mn and Zn) but also increase the productivity as well as profitability of commercial crop production by improving micronutrient use efficiency and make micronutrient fertilization more cost effective.

References

1. Sekhon, B. S. (2003) Chelates for micronutrient nutrition among crops. Resonance 8 (7), 46-53.
2. Das, D. K. (2003) Micronutrients: Their behaviour in soil and plant. Kalyani publication, Ludhiana, 1-2.

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Production Technology of Opium Poppy

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Botanical name: *Papaver somniferum*
Family: Papaveraceae
Chromosome no: n= 11
Origin: Eastern Mediterranean

Introduction

Opium poppy *(Papaver somniferum)* is a biennial herb. As a crop it is grown as a cold weather annual in subtropical parts of north India. This is a dual-purpose crop where seed is edible and highly nutritive. The latex extracted from fully grown mature capsules contains 40 alkaloids, of which morphine and codeine are best known for their sedative, analgesic and other properties. It is the best-known pain killer. The latex and seed both are high income generating items.

Classification

1. Opium poppy belongs to Papaveraceae family and its genus is Papaver.
2. This genus possess about 50 species, which are grown to produce opium and seed as well as for the decoration in gardens.
3. In India, 6 species are found.

Climate

Poppy prefers moderately cool weather and open sunny location; severely cold spell, frost, dull cloudy weather, high winds and very heavy rainfall during the lancing period adversely affect the yield.

Soil

1. The crop is grown on well-drained, fertile, clayey loam to rich sandy - loam soils.
2. Soil having pH of 7 are best for its cultivation.
3. Soil should also have adequate quantities of organic matter and plant nutrients.

Field preparation

1. Land is prepared to a fine tilth to a depth of 20-25 during September and the fields are laid out into beds of convenient size.
2. Twenty-five to thirty-seven cartloads of farmyard manure are mixed with the soil during the preparation of land, penning of sheep or goats is preferred.
3. There should be enough moisture in the soil for seed germination.
4. If sufficient moisture is not available, give a pre-sowing irrigation for obtaining good germination.

Improved Varieties

Varieties grown in Madhya Pradesh and Rajasthan: Bhadphoria or Dhaturia, Ranjhatak, Telia, Galania, Gothia, Chaglia, Kasturi or Tejoni, Kantia, Gebra and Jawahar Aphim 16.

Seed and Sowing

1. The seed rate is 4-6 kg/ha.

2. The seeds are minute weighing 0.25-0.5 g/100.
3. They are mixed with sand and sown thinly in rows 30 cm apart during mid-October till early November.
4. The rows are covered with a thin layer of soil and are given a light irrigation, followed by another irrigation after 8-10 days when the seeds start germination.

Plant Protection Methods

1. The crop is attacked by the leaf minor (*Phyllocnistis* sp.), which can be kept under control by spraying with 0.2% Metasystox or Rogor.
2. Sometimes, cutworms (*Agrotis suffura* Hubn), cause damage to the young plants, the flooding of the fields makes these worms float on the water and they are ultimately picked by birds.

Irrigation

The crop is given about 15 irrigations in all, depending upon the structure of soil and the variety sown, moisture deficiency at the time of capsule formation affects the yield adversely.

Hoeing and Weeding

The crop seedlings are thinned out to 22-25 cm apart when they grow 5-7 cm tall.

Manure and Fertilisers

The poppy crop needs a heavy nutrient supply and 50 kg N/ha is applied during the preparation of land and another application of an equal quantity is given as top dressing in two split doses, when the crop is one month old and at the time of flag 2 leaf stage.

Diseases

1. Downy mildew *(Peronospora arborescens)* sometimes causes serious damage to the crop at the time of capsule formation.
2. It is controlled by the application of 0.2% Dithane Z-78.
3. Root rot due to Rhizoctonia is also reported in the crop.

Harvesting

1. Lancing is done longitudinally in bright sunlight and the latex (crude opium) which oozes from the wounds dries during the following night and is scraped with the sharp kitchen-knife in the early hours of the succeeding morning.
2. Lancing is performed in the afternoon with a special knife, capable of making 4 incisions at a time, each at about 1/12th cm apart.
3. Each capsule is lanced for 4-6 times.
4. A deep incision causes the collection of the latex inside the capsule and spoils the seeds.
5. The crude opium is stored in earthen-pots and dried under the sun to obtain the raw opium of a uniform consistency.
6. The entire produce goes to the Excise and Narcotics Department which pays attention to its consistency and purity.

Yield

1. The average yield of raw opium varies from 13 to 33 kg/ha though much higher yields are recorded under good agronomic practices.
2. The crop also yields 3-4 quintals of seeds/ha.
3. The seeds contain 50% of a golden yellow fatty oil which is devoid of narcotic properties.

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Farmers Bills 2020: Boon or Bane

Article ID: 10385

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Abstract

Agriculture Sector is the backbone of Indian economy. Farmers and farming community are considered as important pillars for growth of our country. The Central Government by passing Farmer's Bill, 2020 has created the right direction for providing them the large platform to get the desired amount of their agricultural produce beyond the APMC market yards. The bills collectively endeavour to provide farmers with multiple marketing channels and provide a legal context for farmers to enter into pre-fixed contracts amid other things. The bill will not only accelerate the growth through the investment of private sector but will also construct new agricultural infrastructure and this will generate an employment. The Farmer's Bill, 2020 has not only strengthened the economy but has freed the farmers from the traders for selling of their produce at designated places. Farmers in Punjab are protesting against these Bills because as they think that the Central Government has left them at the mercy of big corporates and Agribusiness Companies.

Introduction

India is and has been an agrarian economy. After India gained Independence in 1947, farmers used to sell their products direct to the consumers. But due to prevailing system of Zamidars or money lenders, farmers were trapped in perpetual debt. Farmers need to buy seeds, fertilizers and other things required for growing a crop, for buying all these things you need money so farmers took loans from Zamidars or money lenders who used to charge a very high interest rate on the principal amount. Farmers were unable to pay such a hefty amount and, in such cases, to get their money back money lenders or the Zamidars used to buy the whole produce of the farmers but, they paid very less amount to farmers because farmers did not have the bargaining power. Now to again sow their fields farmers required money so this cycle continued, and farmers were always in debt.

The introduction of three new Farmer's Bill, 2020. The Farmers Produce, Trade and Commerce (Promotion and Facilitation) Bill, 2020, The Farmers (Empowerment and Protection) Agreement of price Assurance and Farm Bill Services, 2020. The Essential Commodities (Amendment) Bill, 2020. Farm bills passed in Lok Sabha and the Rajya Sabha on17th September 2020 and 20th September 2020. On September 27, 2020, The Honourable President of India Mr. Ram Nath Kovid gave his assent to the three farm reform bills. Our Prime Minister Mr. Narendra Modi hailed by passage of these bills by saying "A watershed moment in the history of Indian agriculture!" Farmer's Bill 2020 concept is basically based on "One India, One Agricultural Market". Farmer's Bill is to create an environment where farmers and traders will enjoy their freedom of selling and purchase without any barriers and middleman. Farm Bills opened the gates for the farmers to the corporate world like retailers for creating better trading opportunities which could extend beyond the APMC market yards. These new laws related to the Farmer's Bill, 2020 provide farmers not only with more choices but also with the completion of better prices.

Major Highlights of the Bills Related to Agriculture Reforms with Pros & Cons

1. The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Bill, 2020:

a. Pros:

i. Farmers can sell their produce at a place of their choice even beyond the APMC market yards at a better price than the Mandi's, thus increasing the number of potential buyers.

ii. There will be no trade barrier for the farmers for doing their business outside the physical boundaries of markets.

iii. The bill ensures to perform trade electronically.

iv. For the sale of agricultural produce cess or levy were exempted.

v. The bill resolved dispute mechanism for the farmers for speedy trial thus leading to avoidance of court litigation.

b. Cons:

i. Loss of revenue to the states if the farmers agree to sell their produce beyond the APMC market yards.

ii. Middle man will cease to exist as farmers will be able to sell their produce directly to the registered trader.

iii. The new bill will end the Minimum Support Price (MSP) regime.

2. The Farmers (Empowerment and Protection) Agreement of Price Assurance and Farm Services Bill, 2020:

a. Pros:

i. It aims at facilitating contract farming, where a private buyer contracts to purchase a crop at a certain price at the beginning of a season, transferring the risk of market unpredictability from the farmer to the corporate sponsor.

ii. It will reduce cost of marketing and improve income of farmers.

iii. This Bill includes farm services like provision for supply of seed, feed, fodder inputs for farming etc., by the wholesaler or retailer who is called as 'sponsor' under an agreement. Bill shows that the entire agriculture produce of a farmer is under the control of the business man / corporate bodies who are called as 'sponsor'

iv. The bill facilitates the farmers to enter into a direct commercial agreement with the corporate producing food products, exporters, retailers etc. This would provide disclosure to the global markets thus eliminating the fear of exploitation.

v. A network has been created for contract farming between a farmer and a buyer through a contract. This could provide transparency and fair price framework to the farmers.

b. Cons:

i. The corporate will have an upper hand over the farmers as they have weak negotiation skills.

ii. The small and marginal farmers might be deprived of any such sponsors.

iii. The bill gives freedom to the corporate instead of the farmers as MSP has not been mentioned anywhere in the bill.

3. The Essential Commodities (Amendment) Bill, 2020:

a. Pros:

i. It aims to deregulate agricultural commodities like cereals, pulses, oilseeds, onions and potatoes.

ii. It will help harnessing of economies of scale and attract private sector/foreign direct investment into agriculture sector helping modernization of food supply chain.

iii. It will help both farmers and consumers while bringing in price stability.

iv. Empowers the Government to consider certain commodities such as food items, fertilizers, and petroleum products as essential commodities.

v. Enables the private investment in the agricultural sector.

vi. Helps both the farmers as well as the consumer to bring the price stability.

vii. The bill seeks to increase the competition in the market thus providing better opportunities.

viii. Removes fear of excessive regulatory interference from the minds of the private players.

b. Cons:

i. The freedom to stock commodities may lead to exploitation as big companies will charge excessive prices.

ii. The price limit set for the "extraordinary circumstances" are so high that it is likely never to be triggered.

Conclusion

Farmers Bills 2020 envisage to bring change in some of the key aspects of the farm economy trade in agricultural commodities, price assurance, farm services including contracts, and stock limits for essential commodities. These Acts sought to bring much needed reforms in the agricultural marketing system such as removing restrictions of private stock holding of agricultural produce or creating trading areas free of middlemen and take the market to the farmer.

References

1. https://en.wikipedia.org/wiki/2020_Indian_agriculture_reform
2. https://magnificentnutgraf.com/2020/09/24/farm-bills-2020/
3. https://farmerreform.blogspot.com/
4. http://www.legalserviceindia.com/legal/article-3903-farm-bill-2020.html
5. https://politicsinindia.net/farmer-bills/
6. https://www.jagranjosh.com/general-knowledge/farm-bills-indian-farm-reforms-2020-1606901455-1.
7. https://swaritadvisors.com/learning/farmers-bill-2020.
8. https://www.tribuneindia.com.

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Effects of Different Weather Parameters and Climate on Sugarcane

Article ID: 10386

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Introduction

Sugarcane (*Saccharum officinarum* L.) is considered as an important crop throughout the world for sugar and bio-energy contributing to gross domestic product (GDP) of a nation. It is a perennial crop cultivated on approximately 20 million ha in subtropical and tropical region (FAO, 2005) with annual yield of almost 1325 million tons stalks for sugar, energy, rum and chemicals. Sugarcane is one of the world's major food producing crops, providing about 75% of sugar produced in the world for human consumption (Souza et al., 2008). The escalating greenhouse gas emissions and global warming resulted from climate change led to the increased frequency and intensity of extreme weather events. Climate change is anticipated to impose several negative consequences on sugarcane production in the world, especially in the developing countries due to comparatively low adaptive capacity, high vulnerability to natural hazards, poor forecasting systems and mitigating strategies. Sugarcane plants may adapt a number of acclimation and avoidance mechanisms against different environmental stress.

Influence of Climate on Sugarcane

Sugarcane is a crop mostly growing in tropical countries. It grows more successfully in those regions where the climate is more or less tropical but it can be also grown in sub-tropical regions as in case of north India.

1. Climatic elements play a vital responsibility in determining the productivity of crops more specifically sugarcane as it remains on the field for approximately one year.

2. Due to its long duration on the field, the crop has to face the changing climatic parameters of all seasons in a year.

3. Climate influences considerably the crop stand, crop growth and yield, quality of juice and finally sugar recovery.

4.Sugarcane needs specific weather conditions during different growth phases.

5. In active vegetative growth period, weather must be advantageous to support vegetative growth and during ripening phase, weather should be favourable for accumulation of huge quantity of sucrose.

6. An ideal climate for sugarcane cultivation should have two distinct weather conditions:

   a. Growing season which is long and warm with adequate rainfall or irrigation, long hours of bright sun shine and higher relative humidity which permits rapid growth to build up adequate yield.

   b. Ripening season consisting of almost 2-3 months possesses warmer days, clearer sky, cooler nights and relatively a drier weather without precipitation and larger variability in case of day (maximum) and night (minimum) temperatures for accumulation of sugar.

7. In order to get suitable climatic conditions during different physiological phases, the planting should be done in the month of February, although the young and tender plants have to face higher temperatures during hot summer.

8. If there are summer showers the crop establishment is extremely good.

9. A crop with required growth and dry matter by May can only best utilise the climatic conditions existing in June-July to September-October and such crop can give higher cane yield coupled with higher sugar recovery.

Influence of Weather Parameters on Sugarcane Growth and Yield

The important weather parameters affecting sugarcane growth and yield are discussed below:

1. Temperature:

a. Temperature stress is a major environmental stress that limits the sugarcane growth, productivity and metabolism worldwide.

b. Numerous biochemical reactions are involved in plant development, and these biochemical reactions are very sensitive to temperature stress.

c. Optimum cane growth is achieved within temperature range between 24^0C and 30^0C.

d. Temperature less than 5^0C is disadvantageous even to tolerant cultivars.

e. Temperatures above 38^0C reduce the rate of photosynthesis and increase respiration.

f. At temperatures above 35^0C, sugarcane plants become wilted irrespective of water supply.

g. A minimum mean temperature of 20^0C is needed during active growth stage.

h. Cane variety, irrigation and cultural practices can modify the influence.

i. Temperature fluctuations impose extreme impact on sucrose accumulation.

j. Mean day temperature of 12-14^0C is very much beneficial for appropriate ripening.

k. Reversion of sucrose into fructose and glucose may happen including enhancement in photorespiration thereby leading to less sugar accumulation at higher temperature ranges.

2. Rainfall:

a. In India sugarcane is grown in regions where rainfall varies between 600 mm to 3000 mm.

b. Sugarcane can thrive with the normal variation of 1200 mm in mean rainfall to obtain higher production.

c. Evenly distributed precipitation of approximately 2000 to 2500 mm per annum is considered ideal.

d. Rainfall stimulates rapid growth and elongation of cane as well as formation of internode during active growth period.

e. During ripening, high rainfall is not desirable as it leads to poor quality of juice, excessive vegetative growth, formation of water shoots and increased moisture content in tissue.

f. High precipitation hinders harvesting and transport operations.

3. Humidity:

a. Relative humidity does not create much impact, provided that the supply of water is not limiting.

b. Moderate values of relative humidity ranging between 45 to 65 per cent coupled with limited water supply are favourable during ripening phase.

c. High RH associated with warmer weather condition favours vegetative growth.

4. Sunshine:

a. It is mainly a sun loving crop; therefore, larger portion of incident solar radiation assists in achieving greater cane and sugar yields.

b. About 7 to 9 hours of bright sunshine is very much beneficial both for active growth and ripening.

c. Areas with short growing period get benefits from closer spacing to intercept higher amount of solar radiation thereby obtaining higher yields.

d. Wider spacing is better to avoid mutual shading and mortality of shoots particularly in regions with long growing season.

5. Frost:

a. In some parts of the North West India, the problem of extreme cold weather conditions is confronted.

b. Excessive cold weather prohibits the sprouting of buds in ratoons and also arrests cane growth.

c. At temperature of -1 to 2^0C, the leaves and meristematic tissues are killed.

6. Wind:

a. High velocity winds with more than 60 km/hour speed are hazardous to grown up canes ultimately resulting in lodging of plants and breakage of canes.

b. Leaves get damaged even at early stages due to high-speed wind.
c. Winds can enhance moisture loss from plants and aggravate the ill effects of moisture stress.

Relationship Between Sugarcane Yield, Sugar Recovery and Climate in India

The productivity of sugarcane, sugar recovery or higher sugar accumulation and quality of juice are markedly impacted by weather elements during different growth phases.

1. Among three cane growing states such as Uttar Pradesh, Maharashtra and Tamil Nadu, Maharashtra records higher sugar recovery.
2. In Maharashtra the main crushing period from November to March is dry with very less rainfall, low humidity, lower daily mean temperature, cooler nights and greater bright sunshine hours.
3. The diurnal variations in temperature are also fairly wide.
4. Ideal climatic conditions are met with higher sucrose levels between 150 and 200N or S latitudes.
5. Maharashtra occupies the third position and achieves the highest recovery in the country.
6. Both Tamil Nadu and Uttar Pradesh are not in favourable latitudinal positions.
7. In Tamil Nadu, the mean temperatures throughout the year are more favourable for vegetative growth and the yield are the highest in the country.
8. The ripening phase has a higher mean temperature and during this phase, the diurnal temperature variations are narrow, the relative humidity is higher and the duration of sunshine is minimum.
9. In Uttar Pradesh, weather extremes are observed, e.g., very cold winter period follows very hot summer months.
10. The length of growing season is strictly restricted to South West monsoon and autumn months (June-November) which results in lower yields.
11. Very low temperature restricts sugar accumulation also.
12. Therefore, productivity levels are much less in sub-tropical regions; hence, thermo insensitive varieties, if could be developed, are highly useful.

Summary

Sugarcane production has been and will continue to be directly or indirectly affected by changes in weather as well as climatic situations. The negative effects of climate change on sugarcane production are very likely to worsen after 2050, especially if greenhouse gas emissions still remain high. Therefore, agricultural scientists and decision makers must work closely to mitigate the potential negative impacts of climate change on agriculture and to improve sugarcane productivity by multidisciplinary approaches, such as consistently developing new sugarcane cultivars through breeding and molecular biology, refinement of best management practices and improvement of new technology transfer thereby ultimately increasing profitability.

References

1. FAO (Food and Agriculture Organization of the United Nations), (2005). Major Food and Agricultural Commodities and Producers.
2. Souza A. P., Gaspar M., Silva E. A., Ulian E. C., Waclawosky A. J. and Nishiyama M. Y. J. R., (2008). Elevated CO2 increases photosynthesis, biomass and productivity, and modifies gene expression in sugarcane. Plant, Cell & Environment. 31(8):1116-1127.

Strategies or Technological Options for Enhancing Carbon Sequestration in Soil

Article ID: 10387

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Introduction

Carbon is found in many forms, predominately as plant biomass, soil organic matter and as carbon dioxide in atmosphere and dissolved in seawater and it is the major building block for life on earth. Although oceans store most of the earth's carbon, soils contain approximately 75% of the carbon pool on land which is almost three times more than the amount stored in living plants and animals. The difference in partial pressure of CO_2 results in the absorption of this gas into the oceans (Raghuvanshi et al., 2006). Nevertheless, soil plays a major role in maintaining a balanced global carbon cycle. Carbon sequestration is the long-term storage of carbon in oceans, soils, vegetation especially forests, and geologic formations. It is defined as the transfer of atmospheric carbon dioxide into long lived pools and storing it securely so that it is not immediately remitted. Promotion of soil C sequestration is an effective strategy for reducing atmospheric CO_2 and improving soil quality. Indeed, quantification of soil organic carbon or SOC in relation to various crop management practices is of importance in identifying sustainable systems for C-sequestration in soils and increasing crop productivity in semi-arid and sub-tropical environments. Various crop management practices like tillage, cropping system and fertilization influence potential C sequestration and storage in soil.

Strategies for Enhancing C-Sequestration

Land use and soil management systems, which enhance the amount of biomass returned to the soil, may accentuate the terrestrial C pools. Different technological options for carbon sequestration are as follows:

1. Afforestation and restoration of degraded ecosystem.
2. Bio-energy plantations with a large potential for biomass production.
3. Perennials with a deep and prolific root system.
4. Growing species containing high cellulose and developing land use systems.
5. Adoption of conservation tillage and mulch farming techniques.
6. Maintenance of soil fertility and adoption of mixed crop rotations.
7. Soil and water conservation and adoption of appropriate farming systems.
8. Prevention of land use changes leading to reduction of forests and grasslands.
9. Returning of crop residues, animal wastes and other biomass to soils.
10. Use of cover crops provides option of C-sequestration within terrestrial ecosystems.

Substitution of traditional and arable farming by other land utilization practices having greater C inputs or reduced disturbances such as bio-energy crop production, conversion to grassland, natural regeneration etc. may improve the stocks of soil carbon content. The SOC density can be enhanced by planting deep rooted species with greater below ground biomass production. Proper land use, various soil or vegetation management options, restoration of deteriorated land and ecosystem, erosion control and conversion of marginal soil into a restorative land are some of the significant approaches of carbon sequestration.

There are three principal components of soil and water management in relation to C sequestration in soil.

Soil surface management involves:

a. Seedbed preparation through varying frequency, intensity, and type of tillage operations.
b. Crop residue management and return of organic by-products to the soil surface.
c. Efficient use of resources.

Conservation Tillage and Cycling

1. Conservation tillage practices reduce frequency and intensity of tillage, retain crop residues as mulch on soil surface, reduce risks of runoff and soil erosion, and increase SOC content of the surface soil leading to carbon sequestration.
2. The amount of soil carbon content rely upon conservation tillage and quantity of crop residues retained on the soil surface, and may be linearly related to crop residue returned to the land.
3. Conservation tillage usually has a positive impact on activity and species diversity of soil fauna.
4. Earthworm activity is notably improved by conservation tillage.
5. Activity of soil fauna usually has beneficial effect on SOC due to mixing and deep placement.
6. The burrowing activities of fauna present in soil can facilitate the translocation of soil organic carbon content/SOC from surface to subsurface soil.

Nutrient Management and Cropping Systems

1. Fertility maintenance may involve use of organic wastes and other by products; supplemental use of inorganic fertilizers to balance soil nutrient reserves; and biological nitrogen fixation.
2. Agricultural practices with a profound positive effect on SOC content are cover crops and fallowing, agro-forestry and agro-pastoral systems, rotations with deep rooted crops, and crop residue management or mulch application.
3. Cultural practices with proven positive effect on SOC are of two categories: those that increase biomass production and those that increase humification.
4. Management practices such as application of fertiliser and manure play an important role in soil C sequestration and thereby greenhouse gas mitigation.

Cover Crops and Fallowing

1. Growing of vigorous cover crops and well managed fallows may improve the SOC content.
2. Growing grasses and leguminous cover crops continuously increase SOC content of a degraded Alfisol.
3. Fallow based systems restore more SOC compared to intensive cropping system but had low total system productivity.

Plant Roots and Carbon Sequestration

1. Plant root acts as a medium for transfer of atmospheric carbon into the soil in the form of carbon containing compounds, viz. organic acid, phenolic acid, amino acid etc.
2. Root lysis and root exudates may provide considerable amounts of C to be stored in the subsurface soil that have greater potential for contribution in long term carbon sequestration due to slow oxidation than surface soil.

Agro-Forestry and Agro-Pastoral Systems

1. The value of forests and trees in sequestering carbon and reducing carbon dioxide emission to atmosphere is increasingly being recognized throughout the world.
2. Agro-forestry has importance as a C sequestration strategy due to carbon storage potential in its wide diversity of plant species and enriched soil as well as owing to its broad applicability in restoration of agricultural lands and in afforestation.
3. Agroforestry possesses an indirect impact on sequestering carbon whenever it reduces the burden on natural forests, the greatest sink of terrestrial C.
4. Deep rooted crops with capacity to produce biomass in large quantities may enhance soil organic carbon in sub-soil horizons, where it is not readily mineralized or degraded/decomposed.
5. Ley farming systems with controlled grazing and low stocking rate are effective in reducing losses and improving SOC pool.

6. Pastures can improve soil hydro-physical characteristics and biological activity by increasing SOC and decreasing erosion.

Residue Management and Mulching

1. Farming systems that produce a large quantity of biomass and return it to the soil support more SOC pool than those that produce less.
2. Improving the humus content is an important strategy to enhance SOC pool.
3. Management practices to enhance humification include no or controlled burning, crop residue mulch and returning other biomass to soil, and preventing losses through conservation practices.
4. Deep incorporation of humus or non-labile fraction beneath the plough layer is an effective strategy for C sequestration.
5. Activity of soil fauna, vertical mulching and deep-rooted annuals and perennials may have the capability to improve SOC.

Water Management

1. Soil water management affects SOC content by optimizing the soil moisture regime for plant growth.
2. Three aspects of water management in relation to SOC content are in-situ conservation, water harvesting and supplemental irrigation, and drainage.
3. Both in-situ conservation and supplemental irrigation are important for improving biomass production and increasing SOC in arid and semi-arid eco-regions.
4. Drainage of excessively wet soils may decrease SOC content by increasing soil temperature and increasing the rate of mineralization.
5. Sub-surface drainage may reduce the soil organic carbon content and soil aggregation.

Cropping Systems and Crop Diversification

1. Pulses are known to play an important role in maintaining soil health and enhancing soil organic carbon though leaf drop and root biomass.
2. Legumes in crop rotation restore SOC due to the combined impact of C and nitrogen on SOC pool.
3. It is very difficult to increase the soil organic matter content of the cultivated soil, unless legumes or hay crops are included in the rotation or organic matter is added from external sources.
4. Pulse crops have dual benefits i.e.; they constitute an economically viable component of the system and conserve the natural resources.
5. Growing of pulses can serve as an alternative option and must be included in intensive cereal-cereal systems.

Conclusion

Over the past 150 years, the amount of carbon in atmosphere has increased by 30%. Most of the scientists believe that there is a direct relationship between increased level of CO_2 in atmosphere and rising global temperature. One proposed method to reduce the atmospheric CO_2 is to increase the global storage of carbon in soils through carbon sequestration. An added benefit to this solution is the potential for simultaneous enhancement in agricultural production. But there is still much to learn about carbon sequestration. Current research is addressing issues that include the impacts of land use and land management on soil carbon sequestration and ways to increase the storage time of carbon in the soil; the underlying mechanisms controlling soil structure and storage of carbon involving various chemical, physical, biological, mineralogical, and ecological processes as well as relationship between biodiversity, atmospheric CO_2 level, and increased nitrogen deposition in carbon storage.

References

Raghuvanshi S. P., Chandra A. and Raghav A. K., (2006). Energy Conver. Manag. 47, 427.

Supply Chain Management Start-ups in Agriculture

Article ID: 10388

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Introduction

India is a country of agriculture, about 70% of rural population in the country are dependent on agriculture. Farming not only helps for livelihood but also plays key role in boosting the national GDP. Agriculture sector provides 18% of total GDP every year. After understanding the importance of agribusiness current government took few initiatives like new farm bills, subsidies, agriculture start-ups etc... Among these plans start-up is the most underrated and less discussed topic in the country. Thousands of agriculture students are being passed out every year but very are ended up as successful in agribusiness sector this is due to lack of information on established agriculture companies in India. One of the best and successfully proved idea in stat-up plan is supply chain management.

Supply Chain Management in Agriculture

1. Ninja cart.
2. Cro farm.
3. Waycool.

Ninjacart

Ninja cart is a Bangalore based agriculture start-up company. It was established in 2015 in the view of changing the marketing system at that time. This company was established by Ashutosh Vikram, Kartheeswaran, Sharath Loganathan, Vasudevan and Thirukumaran Nagarajan. Initially it was started as a grocery company but later transformed as fine supply chain company.

Business model: Ninja cart is a Business-To-Business (B2B) model.

Funding and revenue: Investors like Accel and syngenta ventures are part of this company and the revenue is estimated to $1.8m.

Overview: Basically, after harvesting of vegetables and fruits farmers should make a deal with the middlemen who sells the produce in markets or to the retailers. To make the process more convenient and profitable to farmers ninja cart came up with an idea through which farmers can sell their vegetables and fruits directly to the retailers and consumers and they are paid immediately through bank transfers. In a nutshell ninja cart acts as a bridge between farmers and retailers, it also educates the farmers about marketing system and exact prices in the country.

Indian marketing system: Farmer-middlemen-retailer.

Ninja cart marketing system: Farmer-transport-retailer.

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After the success of Bangalore start-up ninja cart extended its branches to three major cities in the country. Over 25000 Bangalore rural farmers are enrolled in ninja cart. Although several Agritech companies are originating in India ninja cart remained irreplaceable.

Cro Farm

Cro farm is an Agritech start-up established by Varun Khurana and Prashant Jain in May 2016. Primary operations of the company are monitored from Delhi.

Aim: Primary aim of the company is to assist farm women in selling their agricultural produce.

Business model: Business-Business-To-Consumer.

(B2B2C) Overview: The company is currently working with more than 500 resellers across Delhi-NCR by selling fresh farm produce to 50000 consumers. Recently Cro farm had launched a mobile application which makes the process simpler. Company buys fresh products from farmers and sells in to the resellers which are later transferred to consumers within 8 hours. Factor(e) ventures, Ashish Chand and Yukti securities are investors in this start-up.

Revenue: Even after facing pandemic, Cro farm managed to generate 10crs alone in Delhi and planning to gain 40cr turn over in Delhi in the upcoming years. After huge success in Delhi the Gurgaon based start-up expanded its branches to Mumbai and Bangalore. Farmers from Haryana, Maharashtra, Gujarat, Karnataka and Himachal Pradesh are source of the company.

Way Cool

In 2015 it was started as B2C fruits and vegetables supply chain but later in 2017 it was transformed into B2B farm-to-fork model.

Overview: The primary aim of company is to reduce food wastage, so it started using end to end technology right from the input supply to harvesting. After harvesting the produce company provides different channels to farmers to sell their produce. It is the top funded agriculture start-up in the year 2019.

Revenue: According to crunch base data, way cool generated $70m in funding so far, including debt. It also raised funds of $114m from a Grant round governed by FMO.

Conclusion

Apart from these supply chain AgriTech companies there are many start-ups related to AI, organic farming, tractor supply, urban gardening, hydroponics is being established in the country, recently in 2019 a Vishakhapatnam based AgriTech named Farm 19 established in Andhra Pradesh. It is the first urban gardening and micro green producing start-up in the state.

Problems Faced by Nuzvid Mango Farmers and Precautions to be Taken

Article ID: 10389

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Introduction

Nuzvid a small town in Andhra Pradesh is famous for its mango varieties. Almost 70% of agricultural land around Nuzvid is used for mango cultivation. This town is often referred to as the city of mangoes in the state, about 2500 families around the Nuzvid are dependent on mango cultivation.

Varieties Found in Nuzvid

Banganapalli, Thothapuri, Yanamandala, and Chinna Rasalu which is the primary attraction of the town.

Problems Faced by Farmers

Although the town is one of the leading producers of mangoes in the state, farmers are still less educated on the cultivation problems and losing 20% of mango production every year. The problems are being faced by the problems are:
1. Diseases.
2. Storage Facilities.
3. Marketing.

Diseases

Mangoes that are grown in the rural areas of the town are susceptible to two major diseases as Powdery Mildew and Anthracnose. Along with these diseases in the years 2017 and 2019 witnessed a new disease called sooty mould (munugu thegulu) in Andhra Pradesh that destroyed 25% of the crop production which resulted in the high losses

1. Powdery mildew: *Odium mangiferae*

Symptoms: Powdery mildew is an extreme disease that affects almost all parts of the plant body. Greyish and white powdery growth on the leaves and inflorescence is the main symptom of the disease. The disease initially starts with the inflorescence and spreads to all parts of the plants. Highly infected fruits drop-off from the plant prematurely.


Control measures:

a. Remove the infected fallen plant parts and fruits.
b. Clean the field regularly.
c. Regular pruning should be done.
d. Spray the crop with wettable sulphur 80wp or carbendazim 50wp(0.1%) or Tridemorph as soon as the incidence is noticed.

2. Anthracnose of mango: *Colletotrichum gleosporioides.*

Symptoms: Anthracnose generally infects leaves, twigs, petioles, petioles, and fruits. Small lesions of black colour are formed on the leaves and slowly spreads all over the leaf, sometimes the highly infected leaves drop-off from the plants. Although the leaf anthracnose is less harmful to crop production anthracnose that infects the harvested fruits cause a huge loss in crop production. Sunken, dark, and brown spots are formed on the surface of the infected ripen fruits, and these fruits drop-off from the plants prematurely.



Management:

a. Pruning should be done once a year

b. Remove the fallen infected fruits and leaves regularly.

c. Spraying of fungicides in regular intervals (15-20 days) i.e., carbendazim (50wp) or Bordeaux mixture 1%.

3. Sooty mould: *Capnodium mangiferae.*

Symptoms: It is a fungus-infected disease. Fungi generally produce a mycelium that grows on old tender leaves, stems, and fruits. Mycelium is black and forms a black coating on leaves after their development. During the flowering stage, it affects the fruits and makes the fruit fallen from the plants, a black coat is found on the plant parts.

Control Measures:

a. Unlike the other mango diseases, sooty mould requires a system of management practices

b. Initially, the insects are controlled by spraying carbaryl 0.3% followed by spraying a dilute solution of starch 5%.

c. In few days starch breaks and comes from the plant parts along with the black coat of mould

d. Later wettable sulfur + acacia is sprayed every 15days interval to reduce the sooty mould incidence.

Storage Facilities

Nuzvid is a busy town and 50kms away from the current capital city Vijayawada. Due to high mango cultivation and the huge demand for Nuzvid mangoes in the market, harvested fruits are immediately sent to different parts of the state so storage facilities are never been a problem until the effect of covid19. Covid19 completely changed the fate of mango farmers, because of lockdown and less demand of mangoes in the state mangoes are subjected to storage.

Due to the unavailability of proper storage and ethylene gas supplier in the town mangoes were sent to the nearby city for storage purposes. This resulted in the damage of many fruits. Although Nuzvid is one of the leading producers for mango production in the state storage and post-harvest management facilities in the town are yet to be constructed.

Marketing

The marketing system in the Nuzvid is 4 Step marketing system.

Farmer - Middleman- Retailer – Consumer.

No proper marketing facilities are available in the town. Mandis and mango markets are yet to be introduced. Due to the lack of mandis and mango markets, harvested fruits are immediately transported to the retailers with the help of a middleman which results in low income to the farmers.

After understanding the problems of Nuzvid farmers Agricultural and Processed Food Export Development Authority (APEDA) came forward and for the first time in Indian history Nuzvid mango fruits are exported to London from Vizag seaport through sea route, after the success of this transport Andhra Pradesh government launched an application through which farmers can register and sell their produce to the government. Apart from that government also planning to introduce go downs and post-harvest technology for mangoes in the Nuzvid town area.

Role of Paramparagat Krishi Vikas Yojna (PKVY) in India

Article ID: 10390

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Paramparagat Krishi Vikas Yojna (PKVY)

The Paramparagat Krishi Vikas Yojana (PKVY), launched in 2015. "Paramparagat Krishi Vikas Yojna" a sub-component of Soil Health Management (SHM) scheme under National Mission of Sustainable Agriculture (NMSA) aims at development of sustainable models of organic farming through a mix of traditional wisdom and modern science to ensure long term soil fertility build-up, resource conservation and helps in climate change adaptation and mitigation.

It primarily aims to increase soil fertility and thereby helps in production of healthy food through organic practices without the use of agro-chemicals. PKVY also aims at empowering farmers through institutional development through clusters approach not only in farm practice management, input production, quality assurance but also in value addition and direct marketing through innovative means.

Participatory Guarantee System under PGS-India programmed will be the key approach for quality assurances under the PKVY. The farmers will have option to adopt any form of organic farming in compliance of PGS-India standards.

While adopting a system it must be ensured that the system adopted is compatible to the area and crop and assures optimum yield and provides adequate measures to manage nutrients, pests and diseases. Farmers will have the flexibility to use appropriate package of practices best suited to their situations.

Objectives

1. To promote natural resource based integrated and climate resilient sustainable farming systems that ensure maintenance and increase soil fertility, natural resource conservation, on-farm nutrient recycling and minimize dependence of farmers on external inputs.

2. To reduce cost of agriculture to farmers through sustainable integrated organic farming systems thereby enhancing farmer's net income per unit of land.

3. To sustainably produce chemical free and nutritious food for human consumption.

4. To protect environment from hazardous inorganic chemicals by adoption of eco-friendly low-cost traditional techniques and farmer friendly technologies.

5. To empower farmers through their own institutional development in the form of clusters and group with capacity to manage production, processing, value addition and certification management.

6. To make farmers entrepreneurs through direct market linkages with local and national markets.

Expected Outcome the Scheme Envisages

1. Promotion of commercial organic production through certified organic farming.
2. The produce will be pesticide residue free and will contribute to improve the health of consumer.
3. It will raise farmer's income and create potential market for traders.
4. It will motivate the farmers for natural resource mobilization for input production.

Programme Implementation

1. Groups of farmers would be motivated to take up organic farming under Paramparagat Krishi Vikas Yojana (PKVY).

2. Fifty or more farmers will form a cluster having 50-acre land to take up the organic farming under the scheme. In this way during three years 10,000 clusters will be formed covering 5.0 lakh acre areas under organic farming.

3. There will be no liability on the farmers for expenditure on certification.

4. Every farmer will be provided Rs. 20,000 per acre in three years for seed to harvesting of crops and to transport produce to the market.

5. Organic farming will be promoted by using traditional resources and the organic products will be linked with the market.

6. It will increase domestic production and certification of organic produce by involving farmers.

Major Features of the Scheme

The cluster chosen for Organic Farming shall be 20 ha or 50 acres in extent and in as contiguous a form as possible.

1. Total financial assistance available for a 20 ha or 50-acre cluster shall be a maximum of Rs. 10 lakhs for farmer members and Rs. 4.95 lakh for mobilization and PGS Certification with a subsidy ceiling of one hectare per farmer.

2. Of the total number of farmers in a cluster, a minimum of 65 percent farmers should be allocated to small and marginal category, to be fulfilled at cluster level as far as practicable and where not possible to be satisfied at Mandal/Block/ Taluka or District level.

3. At least 30% of the budget allocations need to be earmarked for women beneficiaries/ farmers.

Procedure and Timelines for Submission and Approval of Annual Action Plans

1. The tentative allocation for the states for the next financial year will be intimated by INM division by end of February every year.

2. State Government will prepare cluster wise annual action plan on a project basis with details of area to be taken up in each cluster; organic farming system/ cropping systems to be adopted; sources of organic inputs (on-farm/off-farm); possible surplus produce for marketing; value addition requirement marketing strategy along with details of agencies involved, by first week of April every year.

3. This Annual Action Plan (AAP) duly approved by SLEC along with the minutes of SLEC, shall reach DAC&FW for examination, deliberation and final approval by first week of April every year. Post facto approvals from SLSC can also be considered to facilitate the approvals of SLEC in time.

4. INM Division in DAC&FW will examine AAP before it is placed before the EC for consideration and sanction of AAP. Action plans will be approved by EC by April and shall be intimated to States.

5. Funds will be released to States by 1st week of May every year.

Fund Flow Mechanism

1. Funds will be released to states after approval of annual action plan by national Executive Committee in May of each year.

2. Incentives to farmers for organic conversion, organic inputs, on-farm input production infrastructure etc shall be provided as Direct Benefit Transfer (DBT) to their respective bank accounts of farmers/ group of farmers. States may define the policy guidelines for utilization of such funds, but it will be the choice of the farmers to select the input/ input production infrastructure.

3. States/ Implementing agencies will furnish utilization certificate (UC) in the prescribed format (Form GFR 19-A) and physical & financial progress report containing physical and financial targets of the previous grants-in-aid, along with State share, before requesting for release of subsequent instalment.

4. All implementing agencies are required to maintain subsidiary accounts of the grants-in-aid and get the same audited from a Chartered Accountant.

5. Grants in aid will be released as per provisions regarding release of funds contained in GFR 2017 and instruction issued in this regard by Government of India from time to time.

6. The project is to be executed over a period of 3 years, every year audited report (GFR 19-A) duly signed by Chattered Accountant along with physical report is to be submitted to DAC&FW, Ministry of Agriculture and Farmers Welfare, Govt. of India. State that requires additional time to implement the project, beyond 3 years may seek prior permission before the end of the project period during first 2 years subject to the condition that they should not exceed the overall per hectare and per farmer cost ceilings.

7. As far as possible, all the activities should be funded through PKVY as per guidelines. Convergence with other schemes like RKVY, MIDH, NFSM etc. of the DAC&FW and schemes of other ministries like MSME, MOFPI for value addition, marketing can be done.

Monitoring and Evaluation

1. At the national level regular monitoring of the scheme will be done by NCOF, RCOFs and National Project Management Team. Monitoring formats will be developed for the same.

2. At State and district levels also the Project Management Teams engaged will do regular monitoring of the implementation of the scheme.

3. Information and communication technology will be deployed extensively for ensuring transparency in the implementation process and effective monitoring of the programme.

4. A dedicated MIS will be developed to capture the information from planning of project, approval, execution to progress report.

5. States will send quarterly progress reports to MIS and in hard copy also.

6. Geo-tagging: The clusters taken up under PKVY will be geo tagged for monitoring purpose as well as for facilitating marketing mechanism based as the crops grown.

7. DAC&FW will evaluate efficacy of this Scheme through a "third party". The agency will assess the efficacy, performance, outcome and shortcomings of the Scheme and recommend suitable corrective measures. Concurrent, midterm and final evaluations will be conducted by DAC to incorporate midterm corrections and final evaluation of the scheme implementation.

8. States shall also take up third party based concurrent, midterm and final evaluations from time to time.

Capacity Building

1. After formation of a cluster, state Government in consultation with Support agency shall draw up a strategy for capacity building of farmers on organic farm management, organic input production and use, organic approaches for pest management, adoption of PGS standards in field practices, PGS certification procedures at group level documentation requirements for PGS and peer appraisal procedures through trainings, exposure visits and on-hand data management systems for data uploading.

2. Every year a minimum of 3 trainings shall be done at a cluster level, covering all the groups. In cases, where cluster is spread over large area (as in hills), trainings may be done at group level comprising members from 3 groups. In first year, farmers shall also be exposed to PGS certification systems through exposure visits to existing PGS groups.

3. For mobilization of farmers in groups and clusters, their capacity building, day-to-day handholding in standards implementation, assisting farmers in peer appraisal and documentation and data management and data uploading Local Resource Persons (LRPs) shall be deployed.

4. Training of Officers /Executives of PKVY Team: Officers/Executives of PKVY Team, members of PMUs at different levels, and Regional Councils, to be trained on Sustainable Agriculture System and Governance Management of FPOs/PCs.

References

1. https://pgsindia-ncof.gov.in/pkvy/Index.aspx
2. Development Role Manual – Paramparagat Krishi Vikas Yojana (PKVY)
3. Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India.

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