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INDEX

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INDEX

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INDEX

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INDEX

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INDEX

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Nuances of Theory Building in Social Science

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Introduction

An inquisitive mind searches for answers for various curious questions in Science. The quench for clueless questions arises both in social and physical science field. Thus, a sin-qua non for scientific exploration and interpretation is Theory Building. A theory is a set of interrelated constructs (concepts), definitions, and propositions that present a systematic view of phenomenon by specifying relations among variables with the purpose of explaining and predicting the phenomenon. While, Theory building is the ongoing process of producing, confirming, applying, and adapting theory. In social research, the level of abstraction increases as the researcher gets closer to theory. The conceptual clarity of theory is obtained by subjecting the phenomenon under study to repeated experimentation, disproving, reflexive thought process including deductive and inductive reasoning. The various phases of theory building such as conceptual development, operationalization, application, confirmation/ disconfirmation and continuous refinement and development add credibility, augment validity, and generalizability to the theory to be developed.

Methods of Knowing

According to Charles Pierce the four methods of knowing are Method of tenacity, method of intuition, method of authority and method of science. A person starts seeking answers to her curious questions once they develop reflexive thought process as soon as they step into these four methods of knowing, primarily, method of science which is the most credible form of knowing.

Building Blocks of Theory

1. Constructs: Constructs are concepts which are created deliberately with some specific meaning. It has intact theoretical scheme, reflects relation to other constructs, are observable and measurable. In social science ,we often use constructs as variables with operationalization to ward off any possible misinterpretations. Examples: Leadership, Social responsibility, Efficiency, Empowerment.

2. Concept/ (Abstraction): Concepts are abstract reality. They are formed after generalizing particular events/subject/objects. Concrete events are expressed in words that refer to various events or objects in reality. As one moves the ladder of abstraction, one moves from concrete representation of things to one in which things exist in thoughts and expression. Research operates at abstract and empirical level linking concepts together as we begin the journey to construct theory.

3. Propositions: Concept being the middle pillar. propositions propose the linkages between these concepts. Facts are being converted into concepts which are transformed to constructs with specifi meaning and linked meaningfully to elicit the answer of problem under consideration.

4. Variables: Variables are the property that is been measured or studied for the effects of and onto. As the name suggests variables never possess a constant value; variables are invariably varying. Variables are the central core of research and its measurement is vital part of research work. Often, it can be said that research is more of a measurement game between independent and dependent variable.

Criteria of Theory

Theories start out as ideas. How much these ideas conform to the basic demands of proposition formulation that determines whether or not they will assume the status of theory.

The criteria to be met by the set of ideas for conforming theory status are:
1. They must be logically consistent.
2. They must be interrelated.
3. The propositions should be mutually exclusive.
4. They must be capable of being tested through research.

Into the Nuances of Theory Building

Basically, a good social theory should explain, why things happen rather than just describe or predict the phenomenon. It should explain the explicitly the phenomenon under study. Theory building is the ongoing process of producing, confirming, applying, and adapting theory. Theory building can be described as "the purposeful process or recurring cycle by which coherent descriptions, explanations, and representations of observed or experienced phenomena are generated, verified, and refined". Good theory and theory building should reflect two important qualities: rigor and relevance , in other words, validity and utility. Just like any other form of scholarly inquiry, theory building can involve varied and various logics-in-use and can be engaged in from multiple research paradigms. There is no one supreme method of theory building, and nor should there be.

What Makes a Good Theory?

Theory should be objective, verifiable, falsifiable / disprovable, valid, generalizable and replicable.

Good theory should be free of bias, it should have verifiability, in case of contradictions of the phenomenon under consideration; a theory proposed should disapprove that phenomenon. It should have wide generalizability and the credibility is further enhanced by its validity and reliability.

Process of Theory Building

Process of theory building is characterized by three process which are theorising, theory building and theory testing. Theorizing involves, systematically formulating and organizing ideas to understand a particular phenomenon which is the most neglected part in scientific research. Theory building involves formulating theory based on the core constructs developed. Theory testing is the process in which the developed theory is put into test, for e.g., using mediation analysis or structural equational modelling in social research.

Levels of Theory Building Research (Alvesson, M., & Deetz, S. ,2000):

Table 1: Levels of theory building

Sl. No	Levels	Basic idea	Example
1	Informed by theory	Theoretical framework identified; but no or limited application of the theory	Effectiveness of multimedia information or expert systems
2	Applied theory	Theoretical framework specified; several constructs were applied	Adoption of innovations.
3	Testing theories	Theoretical framework specified Over half dozen theoretical constructs measured and explicitly tested, or two or more theories were compared	ICT utilisation study.
4	Building/creating theory	New or revised/expanded theory is developed using constructs specified, measured, and analysed	New theory

Five Distinct Phases of Theory Building (Fig:1)

1. Conceptual development.
2. Operationalization.
3. Application.

4. Confirmation or Disconfirmation.
5. Continuous refinement and development (of the theory).

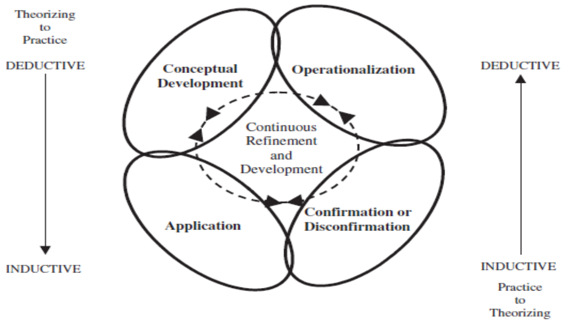

Figure 1: Distinct Phases of Theory Building (Dubin, R. (1978). Theory building)

Techniques of Creativity for Theorizing

A multitude of creativity-based techniques are in use for theorizing process, that include attribute listing, the technique of forced relationships, setting up provocations, visualization, writing techniques theorizing – metaphors, theorizing – simile, theorizing - analogies

1. Attribute listing: List all attributes of an object or idea. Then match each attribute with the problem to find relevant ones

2. The technique of forced relationships: Forcing a relationship between two or more unrelated ideas e.g., Matching components of communication process to explain impact

3. Setting up Provocations: Creativity can be spurred by provocative statements - impossible, contradictory, or logical and Nonsense e.g., television violence is beneficial to young people

4. Visualization: Visualization, drawing, and sketching diagrams of ideas. It is Useful in solving problems where shapes, forms, or patterns are concerned. E.g., Double helix structure of DNA by Watson and Crick

5. Writing Techniques: Write down before they disappear.

6. Theorizing - Metaphors: Things are compared with unsimilar objects and the researcher tries to find commonality between them.

7. Theorizing – Simile: Things are compared or expressed with words using like, as, resemble etc.

8. Theorizing - Analogies: Comparing two objects, or systems by indicating the aspect in which they are thought to be similar (systematic relationships).

Theory Development Process

Phase 1. Theorising – Descriptive Theory Development:

- **a. Observation:** Observe and then choose something interesting to study.
- **b. Naming:** Name the phenomenon and formulate the one or several central concepts.
- **c. Categorisation:** Build out theory with the help of classification, a typology etc.
- **d. Association:** Complete the tentative theory, by defining relationships among parts of a phenomenon.

Descriptive theories: Descriptive theories can be formed in two ways. By either suspension of judgment so that new ideas can flow or generation of as many ideas as possible, for e.g.; Choosing a name for a concept or coming up with new concepts, coming up with possible causes or explanations of a phenomenon or concept, coming up with possible effects or consequences due to a concept or variable (Cohen, B. P. ,1991).

Phase 2: Normative Theory Development:

- a. Draw up the research design.
- b. Execute the research design.
- c. Write-up the results.

N**ormative theory development - Scientific method:**

a. The use of a set of prescribed procedures for establishing and connecting theoretical statements about events and for predicting events yet unknown.

b. Goals of scientific research - Understanding, explaining and predicting.

Types of Theory Building Social Research

1. Inductive: Grounded Theory building.

2. Deductive: Modifying Existing theory. Putting existing theory in new context. It follows axiomatic approach.

3. Composite / Hybrid: Combination of both.

Inductive Theory Building

Grounded Theory: GT was developed by Glaser and Strauss (1967) and further development in this field was done by Strauss and Corbin (1998). This type of theory formation has its roots in Sociology. For research to be scientifically meaningful, theoretical positions should be analytically/logically derived from set of assumptions (e.g., math theorem) or be verifiable (observation & experiment). Social work researcher should be neutral and not be an advocate (arguments that no research is neutral). Purpose of GT was to advance qualitative research by making it "systematic research." (systematically developing theory from data).

Deductive Theory Building

It involves moving from general ideas to particular ideas. But it seems that we are trying to fit the theory on the findings. To overcome this shortcoming, negative case analysis can be applied in the due process of theory building.

Negative Case Analysis

Negative case analysis guides researchers to purposefully seek data that undermines their initial theory and their emerging findings, rather than seek data that support the theory with which they began and which they are in the process of developing.

Composite Approach

To conduct exploratory empirical research, develop a generalization, then cycle among theory construction, testing, and theory reformulation. It has the advantage of not wasting resources collecting vast amounts of data in search of an elusive theory while not inventing theories without any empirical basis.

Theoretical Models

After developing theory, researchers develop theoretical models to explain the relation between various core variables under consideration. For eg. Given below are the models of communication theory and theory of planned behaviour (Fig :2).

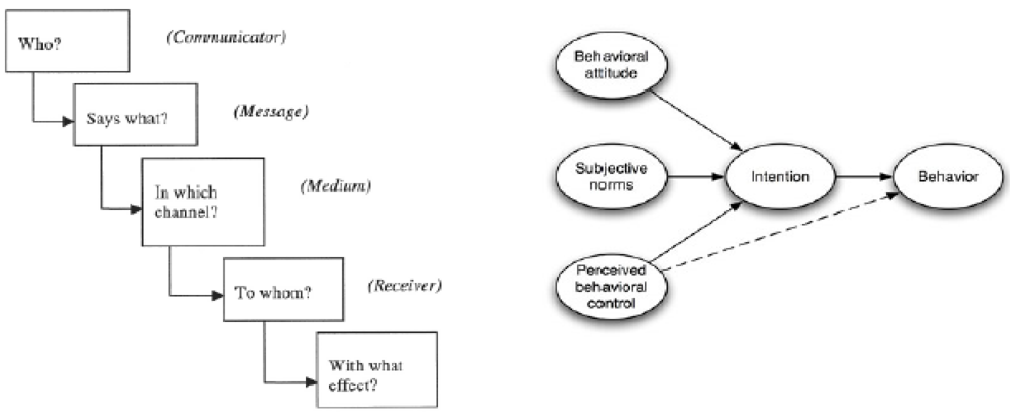

Figure 2: Theory of Planned Behaviour

Phase 3: Theory Testing

1. Testability.
2. Falsifiability – Disprove.
3. Parsimony – Simplicity.
4. Explanatory Power.
5. Predictive Power.
6. Scope.
7. Heuristic Value.

Why Theory Building Research is Seldom Used in Extension

1. Expediency – Easy to do descriptive research than theoretical research.
2. Inadequate training – Lack of quality training opportunities.
3. Lack of clear definition or identification of theoretical problems in a particular discipline.
4. Lack of precedent - Many extension theories are not well developed.
5. Absence of a clearly defined research paradigm.

Conclusion

The three T's of theory building are Theorizing, Theory (operationalization) and Theory Testing. The three "T"s consume substantial time period, but the result will be a paradigm shift in the field of science. A social scientist focuses on this paradigm shift from multiple angles which inculcates idiographic, nomothetic and composite approaches. Absence of any thumb rule in social science (theory building) throws open a plethora of opportunities to develop apt theories. Theory building in social research should have strong edifice on logical thinking and visualisation (Campbell, J. P. ,1990). As far as Extension Science is concerned, the theory building arena is still at its infancy due to several lacuna such as absence of better affective, cognitive and psychometric techniques of theory development. Social research: still an evolving field should incorporate mixed and hybrid methodologies to study the various nuances of social phenomenon. The road ahead is quite uneven but the role of social scientists can be well executed in building theories in social research.

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Agricultural Robotics - New Trends in IoT Applications for Smart Farming

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Smart Farming

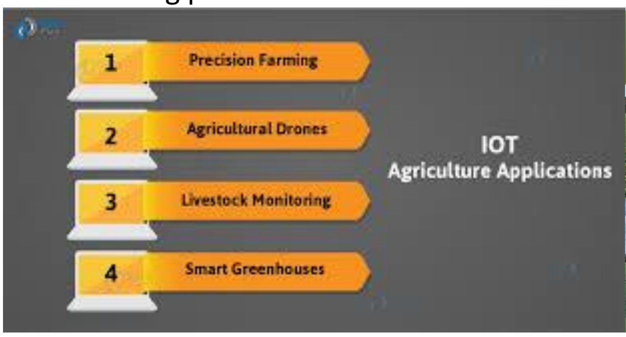
Smart agriculture is a broad term that collects ag and food production practices powered by Internet of Things, big data and advanced analytics technology. The most common IoT applications in smart agriculture are:

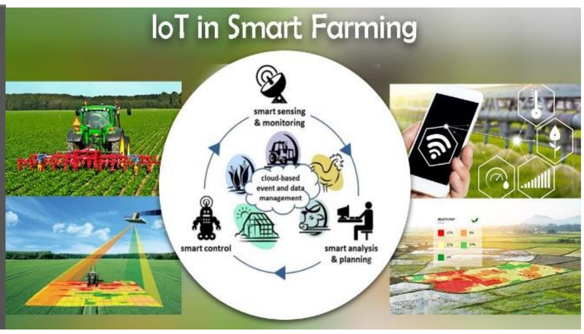
1. Sensor-based systems for monitoring crops, soil, fields, livestock, storage facilities, or basically any important factor that influences the production.
2. Smart agriculture vehicles, drones, autonomous robots and actuators.
3. Connected agriculture spaces such as smart greenhouses or hydroponics.
4. Data analytics, visualization and management systems.

Internet of Things (IoT) in Agriculture

The applications of IoT in farming target conventional farming operations to meet the increasing demands and decrease production loses. IoT in agriculture uses robots, drones, remote sensors and computer imaging combined with continuously progressing machine learning and analytical tools for monitoring crops, surveying and mapping the fields and provide data to farmers for rational farm management plans to save both time and money.

The ever-growing global population would touch around 9.6 billion by 2050. So, to feed this immense population, the agriculture industry needs to embrace IoT. The demand for food has to meet overcoming challenges such as, rising climate change, extreme weather conditions and environmental impact that results from intensive farming practices.





Sensor data analytics drives transparency into agricultural processes, as farmers get precious insights on the performance of their fields, greenhouses, etc. However, this is not the only data farmers work with. As in any other industry, ag professionals have to deal with certain paperwork, which is usually a timely manual process. Smart systems for document workflow analytics and management help automate this process and provide better efficiency.

Smart agriculture and precision farming are taking off, but they could just be the precursors to even greater use of technology in the farming world.

The rise of blockchain technology is making its way to the IoT, and could be important in the farming sector due to its ability to provide companies with important data on crops. Farmers can use sensors to gather data about crops, which is written onto blockchain, and includes identifying factors as well as salt and sugar content and pH levels.

Drones can spray fertilizer 40 to 60 times faster than doing so by hand. Drones in action.

Given all of the potential benefits of these IoT applications in agriculture, it's understandable that farmers are increasingly turning to agricultural drones and satellites for the future of farming.

Drones allow farmers to monitor how far along crops are in their respective growth periods. Additionally, farmers can spray ailing crops via drones with substances to bring them back to life. DroneFly estimates that drones can spray fertilizer 40 to 60 times faster than doing so by hand.

Robotics Application in Agriculture

These smart agribots use digital image processing to look through the images of weeds in their database to detect similarity with crops and weed out or spray them directly by their robotic arms. With increasing number of plants becoming resistant to pesticides they are a boon to the environment and also to farmers who used to spread the pesticides throughout the farm-an estimated 13000 kgs (3 billion pounds) of herbicides applied at a cost of 1725 crores ($25B) each year, thus reducing their overall cost.

Machine Navigation

As remote-controlled toy cars are enabled with a controller, tractors and heavy ploughing equipment’s can be run automatically from the comfort of home through GPS. These integrated automatic machines are highly accurate and self-adjust when they detect difference in terrains, simplifying the labour-intensive tasks. Their movements as well as work progress can be easily checked on smartphones. With advancements in machine learning these tech driven motors are becoming smarter and independent with features such as automatic obstacle detection.

Harvesting Robotics

Utilizing agribots to pick crops is solving the problem of labor shortages. Working the delicate process of picking fruits and vegetables these innovative machines can operate 24/7. A combination of image processing and robotic arms is used by these machines to determine the fruits to pick hence controlling the quality. Due to high operational costs crops that have an early focus on agrobot harvesting are orchard fruits like apples. Greenhouse harvesting also finds applications with these bots for high value crops like tomatoes and strawberries. These bots can work in greenhouses to aptly determine the stage of crop and harvest them at the right time.

Material Handling

Robots can perform dreaded manual labour tasks working alongside the labours. They can lift heavy materials and perform tasks like plant spacing with high accuracy therefore optimizing the space and plant quality, and reducing production costs.

IoT Based Remote Sensing

IoT based remote sensing utilizes sensors placed along the farms like weather stations for gathering data which is transmitted to analytical tool for analysis. Sensors are devices sensitive to anomalies. Farmers can monitor the crops from analytical dashboard and take action based on insights.

1. Crop Monitoring: Sensors placed along the farms monitor the crops for changes in light, humidity, temperature, shape and size. Any anomaly is detected by the sensors is analysed and farmer is notified. Thus, remote sensing can help prevent the spread of diseases and keep an eye on the growth of crops.

2. Weather conditions: The data collected by sensors in terms of humidity, temperature, moisture precipitation and dew detection help in determining the weather pattern in farms so that cultivation is done for suitable crops.

3. Soil quality: The analysis of quality of soil helps in determining the nutrient value and drier areas of farms, soil drainage capacity or acidity, which allows to adjust the amount of water needed for irrigation and the opt most beneficial type of cultivation.

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Fruit of New Word: Dragon Fruit

Article ID: 10602

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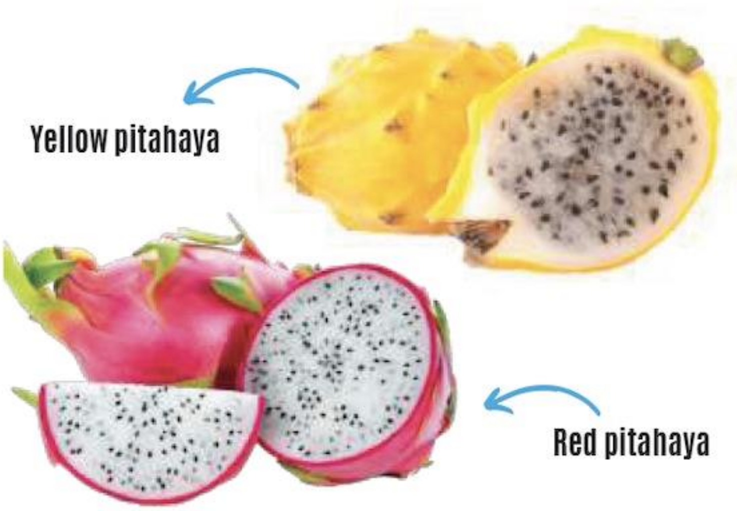
Dragon fruit, kamalam, pitahaya or pitaya (*Hylocereus* spp.) is an emerging exotic crop in the Indian market, not only due to its attractive colour and unique, peculiar appearance but also because of its nutritional and therapeutic value. It is an herbaceous perennial climbing cactus having its originated in Southern Mexico and introduced in India during the late `90s. Its increasing reputation for profitability leads to the gradually increasing number of farmers who engage in dragon fruit production. Farmers in the Indian states of Karnataka, Kerala, Tamil Nadu, Maharashtra, Gujarat, Orissa, West Bengal, Andhra Pradesh and Andaman & Nicobar Islands have been established its plantation. Majority of the dragon fruits presently available in Indian markets are imported from Vietnam, Thailand, Malaysia and Sri Lanka. Widely cultivated and mostly available species are *Hylocereus undatus* which bears fruit with red peel and white flesh, and *Hylocereus polyrhizus* with fruit having red peel and white flesh.

Table1: Nutritional value of dragon fruit:

Nutrition	Quantity per 100g edible portion	Nutrition	Quantity per 100g edible portion
Water		82.5- 83 g	
Protein	0.159- 0.229 g	Vitamin C	8.0- 9.0 mg
Fat	0.21- 0.61 g	Thiamin	0.28- 0.30 mg
Fiber	0.7- 0.9 g	Riboflavin	0.043- 0.044 mg
Carotene	0.005- 0.012 mg	Niacin	1.297- 1.30 mg
Calcium	6.3- 8.8 mg	Ash	0.28 g
Phosphorus	30.2- 36.1 mg	Other	0.54- 0.68 g
Iron		0.55- 0.65 mg	



Climate and Soil

Although a member of the family Cactaceae requires adequate water because they originated from tropical rainforest unlike other cacti which are of desert origin. Hence, it is very ideal to be grown in most parts of the India except the area less rainfall. The reported rainfall requirement of dragon fruit is 1145- 2540 mm/year.

Generally, an altitude up to 1500 m altitude is suitable for the cultivation. Very high temperature and very low temperature is not suitable for the growth of the plant. Dragon fruit plant prefers a dry tropical climate with an average temperature of 20-29ºC, but can withstand temperatures of 38-40ºC, and as low as 0ºC for short periods. The plants will be damaged at temperatures above 40°C, cause yellowing of the stem. Heavy rain fall areas are not suitable for the crop, as excessive rain causes flower drop and fruit drop (Karunakaran and Arivalagan, 2019).

Dragon Fruit could be grown in wide range of soil types. However, the most ideal soil type is rich in organic matter and slightly acidic with pH ranging from 5.5 to 6.5. Since the area to be used is sub-marginal, organic fertilizer will be applied to patch up the lacking number of organic substances in the soil. Dragon fruit plants prefer sandy loam with high organic matter and grow well in soil having good drainage.

Varieties

Dragon fruit is mainly of three type. The first species has Red colour fruit coat with white colour flesh, the second species has Red colour fruit coat with red colour flesh and third species has yellow colour fruit coat with white colour flesh. The most popular species is red colour fruit coat with white colour flesh.

Propagation

Dragon fruit is propagated by seed as well as vegetative method.

Seed Propagation

Dragon fruit can be propagated by seeds which are sown immediately after extraction. The seed are black in colour and small. The seed are sown in trays and pots for better germination. It takes almost one month for germination. The small seeding is planted in pots after 2 months of sowing in polyethylene bags. The seedlings take longer time to become ready for planting. The seed propagation studies shown that seedlings remain smaller with thin stem even after one year of sowing. Further the plants produced from seeds are not true to type and shows lot of variability. Thus, seed are generally not used for commercial multiplication of dragon fruit.

Vegetative Propagation

Dragon fruit plants can easily multiply through stem cutting. Cutting may permit the production of plants with identical characteristics to the parent plant. Furthermore, cuttings reach production earlier. Generally, 20-25cm long stem cuttings are used for planting but limiting the cutting material of dragon fruit has generated interest in small cuttings for asexual propagation. The cutting should be prepared one–two days prior to planting and the latex oozing out of cut is allowed to dry. The cutting should be taken from elite mother plants after the fruiting season. The cutting should be treated with fungicides to prevent diseases. These cuttings are planted in 12 x 30 cm size polyethylene bags, filled with 1:1:1 ratio of soil, farmyard manure and sand. The bags are kept at a shady place for rooting. Rooting on cuttings was stimulated by IBA treatments. Excess moisture should be avoided for prevention of rotting of cutting. These cutting roots profusely and become ready for planting with 5-6 months. The seed propagation studies carried out that seedlings remain smaller with thin stem even after one year of planting. On the other hand, produced from seeds are not true to type and there is their lot of variability among the plants. Thus, seed are generally not used for commercial multiplication of dragon fruit (Tripathi, et.al., 2014).

Planting

Being a member of family cactaceae, dragon fruit prefers full sunlight for cultivation. The plants of dragon fruit resemble with others cactus with angular fleshy, thorny weak stem and require support for growth. The planting distance depends on the size, slope of field and type of trellis used. Generally, in single post system planting is done at 3x3 m distance and the pair row system plating may do at 6x2-2x6x 1 m distance. In single post vertical height of pole 1.5 m to 2 m at which point they are allowed to branch and hang down. For planting, Pit of 60 x

60 x 60cm are dug. These pits are filled by top soil, farmyard manure or compost with 100 g of super phosphate. To improve the drainage, add small brick pieces and some amount of sand to bottom of the pit. Generally planting should be done in rainy season i.e., June and July for better establishment. The best time of planting is late afternoon or early evening.

The Dragon fruit planted near the poles to enable them to climb easily. Number of plants per pole may be 2 to 4 plants depending on the climatic condition. Limited lateral shoots and 2-3 main stems are allowed to grow. Because lateral shoots must be removed time to time. For support round metal/concrete frame is used to maintain the hanging shoots in balance way. The media consisted of the soil enriched with organic inputs like farmyard manure, coir compost and vermicompost along with bio-fertilizers. The growth of dragon fruit vines was so fast that an average growth rate of 8.2 cm was observed per week. In about 8 months after planting the dragon fruit forms a thick dense mass of vines on top of the trellis which lies drooping to the ground.

Training Systems

The Dragon fruit plants are fast growing vines and requires a vertical pole support to grow support for optimum growth and fruiting. It has a life span of 15-20 years and weight of one plant may be goes up to 100kg. Therefore, the selection of support material and type of trellis used is important. Generally wooden logs, cement poles and metal frameworks are used for support.

Dragon fruit plant produce thick dense branches during the initial stage and lateral branches should be pruned to grow towards stands. Once vines reach up to the top of the stands the branches are then allowed to grow. The removal of tip of main stem is done to allow growth of new shoots to grow laterally and climb at the ring to form an umbrella like structure of vines where flowers will emanate and develop into fruits which would induce lateral branching. This pruning referred as structural pruning or making a structure on the trellis. The well grown vine may produce 30 to 50 branches in one year and may be more than 100 branches in-four years.

In India, single pole system showed better performance in growth and yield when comparatively other trellis system. Single pole with ring type of trellis that can support the weight of the plants and allow easy access to flower and fruit will work for commercial production. The wooden poles are hard but their durability is least comparing to cement poles. It is not possible to change the poles in between because of the growth and entangled branches. Therefore, it is better to go with concrete poles its cost may be high for cement pole but they are durable.

Flowering

The flowers start with on small spiral button type attract structures at the stem margins. These develop to flower buds in 10-15 days. The beautiful hermaphrodite nature flowers length (25-30cm), white inside and greenish yellow with purple dyes on the outside. They are scented and only blooming at night and last one only night. Flower production generally takes place during May - August and fruit harvest 30-40 days after fruits set. Quality of the fruit does vary between varieties, but harvest time has a much greater effect on quality than varietal differences. There are self-compatible and self-incompatible varieties. There is considerable variation in fruit size and shape between the varieties. At present, very little knowledge available on varietal and production aspects ((Karunakaran and Arivalagan, 2019).

Nutrient Management

Dragon fruit plant root system is superficial and can rapidly assimilate even the smallest quantity of nutrients. The fertilizer doses where is depending on the climatic conditions. . In India there are no recommended days for fertilizer is recommended. Generally, 1 to 2 old plants should be given 10 to 15kg of farm yard manure, 200 g nitrogen, 50 g phosphorus and 50 g of potash. This should be divided in three equal doses and applied in 3 times in a year. The plant of 3 and more year is should be given 20 kg farm yard manure, 500 g Nitrogen , 750 phosphorus and 300 g of potassium. These should be applied in four equal splits doses after harvesting and during growth, before flowering and after fruit set every year (Table2). The Dragon fruit can be grown organically without applying chemical fertilizers and pesticide. The farm yard manure and poultry manure may be used for supplementing nutrients. These organic fruits have more demands in the market. Regularly pruning leads to an open and manageable umbrella shape canopy which will induce new shoots for the next cropping season. Dragon plants can survive with very low rainfall, many months of drought, when good quality fruits are required regular water supply is needed. Regular irrigation is important, because it enables the plant to build sufficient reserves not only to flower at the most favourable time but also to ensure the development of the fruits.

Table2 : Fertilizer doses for dragon fruit Age of plants:

Recommended doses/ plant/year				
	FYM (kg)	N (g)	P (g)	K (g)
1 year	15	200	50	50
2 year	15	200	50	50
3 and more	20	500	750	300

Irrigation

Dragon fruit root system is shallow and distributed in 15 to 30 cm depth. Hence irrigation should be insured to provide sufficient water during dry season. Excessive irrigation may cause fungal disease. Therefore, proper drainage should be provided in rainy season. Frequent dry period without irrigation reduces the yield and quality of fruits. The dry period before flowering is required for production of more fruits. Local drip irrigation found beneficial for better yield and growth. Irrigation by flooding is not recommended as it wastes water and increases work of weeding. Approximately 2-4 litres of water weekly twice per plant is sufficient during the summer/dry days. Water requirement may increase or decrease depending upon soil, climate and plant health.

Harvesting

The juvenile period of dragon fruit is lower than the other fruit crops. The plant start yielding after 12-15 months from the date of planting and the fruit maturity could be optimized with the change of fruit epicarp colour from green to red. Proper time of harvesting was found after seven days of colour transition. The plants yield the fruits in the months between June to September, and harvest could be done three to four times in a month. The fruit weight ranged between 300-800g, and the average yield from the single post is realized about 30 to 35 kgs from the three years old planting.

Processing

Dragon fruit processed as jam, jelly, RTS and other beverages etc. Dragon fruit pulp and juice contain 1.5 per cent pectin, 55% sugar and 0.9 per cent citric acid that improve the colour as well as other organoleptic characteristics of dragon fruit jam and jelly. In case of dragon fruit RTS beverage 14 per cent pulp, 12 per cent sugar and 0.9% was found to be most suitable. The prepared product was found to be organoleptically acceptable. Prepared products can be stored for the period of more than three months at ambient storage condition without microbial spoilage or any considerable loss in quality.

Sun Burn Injury

Sun burn injuries were noticed in majority of the plantations in many parts of India. Symptoms appeared during in the month of March and April when the day and night temperature recorded wide variation, particularly the region temperature crosses above 38ºC. In this regard, trail has been attempted for growing dragon fruit under shade net house and spraying antitranspirants to control the sun burn injury on dragon fruit plants. Further, filler crop also attempted to control the physiological injury.

Diseases and Pests

Dragon Fruit is almost free of pests and diseases. Prevalence of common insects like ants, scale insects, mealy bugs and the like will be controlled through the application of common insecticide. In general dragon fruit is tolerant to major pests and diseases. Important diseases that affect dragon fruit crop are anthracnose, brown spots and stem rots. Heavy rainfall and overwatering or waterlogged conditions predispose the crop for these diseases. Anthracnose is caused by *Coletotrichum siamense* symptoms appear as reddish-brown concentric lesions near ribs attack fruits too (Balendres and Bengoa 2019). Spray with Chlorothalonil / mancozeb at 2g/L and curative spray with carbendazim at 1g/L effectively control the disease. Wilt is another disease caused due to fungal pathogen *Fusarium* species. The symptoms include the drying or loss of turgidity. Sun burns and Ca deficiency aggravates the disease. Copper oxy chloride (at 0.2%) can be used for managing this disease.

Conclusion

There is a potential for off season production of Dragon fruit in India, and the market price remains as high as INR 150.00 to 250.00 per kg during off season. It is a fast return perennial fruit crop with economic production in the first year after planting, and full production within three to five years. It was also noted to initially produce in its first years on wards provided desirable cultural management practices are applied. Although the initial investment is relatively high, profit is substantial within 4-5 years. In the future, production is expected to rise; hence, marketing strategies need to be critically examined. In case of any market glut, there is a strong need to explore the avenues of value addition through processing, so that the production will be continue to increase and the surplus produce shall be processed. Available sources of information on crop management and multiple cropping schemes integrating Dragon fruit to other crops cultivation in location specific areas are still unavailable. Hence, there is an urgent focused effort on R and D is prominently flagged as area under dragon fruit cultivation is steadily increasing. Unfortunately, there are challenges associated with dragon fruit production that limits its maximum production potential.

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Agriculture in 2050

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Introduction

From days immemorial agriculture has been the part and parcel of people around the globe and should be so as nothing can replace and provide the three basic requirements of man namely food, clothing and shelter. Each requirement is the elaborate provision of the selfless, hardworking, untiring and patient occupation called farming or agriculture. Early civilizations hence were all at the banks of surplus rivers or water sources to initiate cultivation of food grains thereby forwarding a shift from non-vegetarianism to vegetarianism. Dependence of more than 50 per cent of the Indian population directly or indirectly on agriculture necessities the review of this subject in accordance to time frame split as agriculture in the past, present and future. The flow ideas cover all these developments emphasizing more on futuristic agriculture i.e., agriculture in 2050.

Agriculture in the Past

After the early days of civilisation, there were far reaching efforts to develop agriculture. Those were the days with resources. Everyone had everything to do peaceful farming. Still there were droughts and famines rattling the pillars of food production. Sad phases of agriculture lead to several predictions, forecasts and nomenclatures such as begging bowl. The tireless efforts of researchers from world wide lead to exchange and dissemination of scientific know how setting in the wonderful results such as, "Green revolution.

Agriculture at Present

We are in the shadow of green revolution. Alas, the situation is dark and grim. Unfortunately, the revolution utilized the maximum resources. The shortfalls and shortages of resources were not anticipated. Studies are ongoing in all fields of modern technology overcoming several lacunae like, small land holdings, shift of farmers from agriculture, ineffective communication and lack of recognition to farmers technology.

Agriculture in Future-High Tech Agriculture

In this alarming situation, there is need of sensible thought towards developing rural livelihood and food supply. In a country like India, with the second highest population the reach of information should be faster and perhaps the fastest especially for agrarians for whom agriculture cannot wait. Effective and efficient communication between the stake holders and researchers leads to confident building and quicker adaptation of technologies. Information technology has immense power to accumulate knowledge from several sectors and provide it to the needy for application.

Extremely small sized nano particles can revolutionize specific and narrow usage of resources. Nano technology is there to add new dimensions to sustainable agriculture. Integrated farming can be a sure way to progress. The media and scientific community have equal responsibility to bring light the advantages of biotechnology through genetically modified (GM) crops. Remote sensing, geographic information system and precision farming technologies are picking up in agriculture. Mechanisation can improve the efficiency of agricultural operations. Prediction of weather, pest and disease attack is of prime importance that can be done using advancements in space technologies. Quality sorting and processing are areas where robotics can be sought.

Policy measures and extension activities play an important role in agricultural development. Let's not politicise everything, let's not bring the green fields under the shadow of buildings and bridges, let's not inject in farmers helplessness, let's not drive rural from their home lands in search of slums, let's not turn ourselves near spectators of farmers suicide, let's not add to global warming, let's not try to bring wrong policy makers to posts meant to serve the poor, let's not forget the real stakeholders for whom the research is all meant, let's not forget that they the farmers are the real gurus of agriculture.

Conclusion

Respect and dignity of farmers in that sense is essential. The country like India, with ample human resource in agriculture is now looking with melancholy. Let's give a helping hand to uplift them and their occupation. There is no substitute for food but just food. Let me imagine my kisan with modern gadgets and above all a smiling face.

"Science for society, Society for science"

Oak Tasar Host plants: Raising of *Quercus serrata* Seedlings through Propagation Techniques in Sub-Himalayan Belt

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Abstract

Oak tasar silkworm *Antheraea proylei J*. is a poly-phytophagous insect thriving on a number of oak plants through species specificity varies from region to region and altitude to altitude, because of availability a specific species of food plant at a particular altitude only. *Quercus serrata,* and *Q. semicarpifolia* are two main food plants exploited for Oak tasar silkworm rearing in North-east and North-west respectively. *Quercus serrata* is fast growing as compared to other oak species. Oak species can be propagated by seeds (Sexual) and vegetative (asexual). Propagation through seed is most commonly used in India. Vegetative (macro-propagation) propagation techniques like stem cutting grafting, budding and air layering were used for regeneration of Oak tasar host plants.

Keywords: Oak, Quercus, Anthereae and propagation.

Introduction

Oak belonging to beech family Fagaceae, Order Fagales and genus *Quercus* is the only food plant of Oak Tasar silkworm *Antheraea proylei J*. Many plants commonly called 'Oak' are not belonging to *Quercus* species e.g., Tanbark oak, Tasmanian oak, Tulip Oak, Silver Oak etc. Oak tasar silk worm *Antheraea proylei J*. is a poly-phytophagous insect thriving on a number of oak plants through species specificity varies from region to region and altitude to altitude, because of availability a specific species of food plant at a particular altitude only. *Quercus incana* food plant is called as 'Bhanj' (Altitude: About 500 m above MSL) in local language. Likewise, *Quercus serrata* food plant is called as 'Manipur ban' (Altitude: About 1100 m above MSL), *Q. semicarpifolia is* known as 'Kharsu'(Altitude: 2400-3700 m above MSL) and *Q. himalayana* is called as 'Moru'(Altitude: 2100-2700 m above MSL).

Table 1: Inter- relationship between Oak tasar silkworm and their food plants:

Country	Silkworm	Host plant/ Food plants
India	*Antheraea proylei, A. roylei, A. pernyi, A. frithii*	*Quercus serrata, Q. Semicarpifolia, Q. incana, Q. himalayana, Q. griffithii and Lithogarphus dealbata*
Japan	*Antheraea yamami*	*Quercus acutissima, Q. dentate, Q. fabri, Q. mongolica, Q. myrainaefolia, Q. liaturgenesis*
China	*Antheraea pernyi and Antheraea yamami*	*Quercus mangolica, Q. liatungenis, Q. dentate, Q.oxyloba, Q. acutissima, Q.variabilis*
Taiwan	*Antheraea yamami*	*Quercus acutissima*
North & South Korea	*Antheraea yamami*	*Quercus mongolica*

Table 2: Altitude wise availability of Primary food plants in North-West India:

Sl. No.	Altitude	Height	Food Plants
1	Low altitude	About 500 m above MSL	*Quercus leucotricophora (Banj) & Q. serrata*
2	Middle altitude	About 1100 m above MSL	*Quercus leucotricophora & Q. serrata*

3	High altitude	2400-3700 m above MSL	*Quercus semecarpifolia (Kharsu)*
4	High altitude	2100-2700 m above MSL	*Quercus himaliyana (Moru/Tiloj)*

Propagation of Oak Species

Almost all oak species are propagated by seed & vegetative method, sexual propagation (propagation through seeds) is common in oaks and they can be grown well in rich moderately moist or dry sandy soils. Oak plants pollinate by wind in the earliest part of the spring season. Naturally, they reproduce by seeds but some vegetative propagation techniques (asexual propagation) are also employed for getting speedy multiplication of plant material and maintenance of desired genotype and phenotype of the plant. Most common vegetative propagation technique in oak is air-layering. Propagation through *Quercus serrata* stem cuttings and budding has also been carried out to a limited extent.

1. Propagation of Oak species through Seeds: *Quercus serrata,* and *Q. semicarpifolia* are two main food plants exploited for Oak tasar silkworm rearing in North-east and North-west respectively. *Quercus serrata* is fast growing as compared to other oak species. The nursery techniques for raising their plantation through seed have been standardized (Lal *et.al*, 1999) and package of practices for raising and maintenance of plantation has been developed (Mishra *et al*, 2004).Consequently, a large area has been brought under systematic plantation of *Q.serrata* not only in North-east but also North-west (Bahel & pandey, 1989). Package of practices for raising and maintenance of *Q. serrata* plantation includes selection of viable seeds, soaking of seeds followed by seed germination in heaps, putting germinated seeds in polythene tubes (4x6 inch size with 1:2:3 Sand: Soil: FYM Mix.) or direct germination of seeds in nursery beds, seedling raising in nursery for 6 months to 1 year, transplantation of seedlings during monsoon season in the pits (1x1x1 feet size) with adequate dose of FYM/ Vermi-compost, timely cultural operations viz., basin formation, watering, weeding, application of FYM, Watch & Ward etc., application of chemical and /or bio-fertilizers, and pruning of plants. With these methods optimum growth can be obtained within 5-6 years of transplantation of seedlings. However, plantations of *Q. incana* and Q. *semecarpifolia* take longer duration.

Table 3: Cost of raising 50,000 *Quercus serrata* seedling using FYM:- four-month Maintenance in (Rs):

SL. No	Particulars	Qty.	Rate Rs	Cost Involved Rs
1	Seed Cost	300 Kg	20.00	6000.00
2	Seed treatment & preservation 1 Mandays	01 Mandays	368.00	368.00
3	Seed selection & soaking etc. 2 Mandays	02 Mandays	368.00	736.00
4	Viable seed observe @ 60%	63,200	-	0.00
5	F.Y.M. one Truck 200 CFT	01 Truck	6000.00	6000.00
6	River Silt (Send)	01 Truck	3000.00	3000.00
7	Polythene Bag 4 x 6” size	179 kgs	200.00	35,800.00
8	Filling of Routing Media FYM Send& Soil @ 400 Polytheene Tubes per man days	134 Mandays	368.00	49,312.00
9	Cost of erection of frame for false roofing	02 Mandays	368.00	736.00
10	Seed transportation for heaping and watering	04 Mandays	368.00	1472.00
11	Germination and observe @ 85%= 53,700-00	85%	0.00	0.00
12	Sowing of seed @ 1500 sprouted seed a Mandays	36 Mandays	368.00	13248.00
13	Watering weeding etc. alternate days for 120 days ½ = 30 Mandays	30 Mandays	368.00	11040.00
14	Cost of organic insecticide /fungicide for seed & ½ Mandays	-	-	500.00
15	Spraying of fungicide for 6 times @ ½ Mandays per spraying	03	368.00	1104.00

16	Seedling mortality	3500		00.00
17	Total seedling raised	50000		00.00
	Total cost			1,29,316.00
	Cost benefit ratio (1 seedling @ Rs.6.00)			1:2.31

Note- Labour cost calculated as per central labour commission New Delhi rate.

Table 4: Cost of raising systematic plantation of Quercus serrata in North-west region. (1 ha, 2500 plants required at spacing 2x2 m OR 6 x 6 feet):

Sl. No.	Particulars	Unit	Quantity (No's)	Rate (Rs)	Amount (Rs.)
1.	Cost of seedlings*	No's	2750	6	16500.00
2.	Pit digging (30x30x30 cm size) @ 50 pits per manday	Mandays	50	368.00	18400.00
3.	Cost of FYM @ 2kg/pit	Quintal	50	200	10000.00
4.	Transplantation and filling up of pits @ 200 seedlings per Mandy's	Mandays	34	368.00	12512.00
5.	Cost of insecticide and fungicide	litre	1	1000	1000.00
6.	Cultural operations viz. basin formation, watering, weeding, FYM application, watch and ward etc	Mandays	30	368.00	11040.00
	Total cost				**69452.00**

2. Vegetative Propagation of Oak species: Several authors (Chandra & Mahendru, 1977, Srivastav et al 2000) have studied various vegetative (macro-propagation) propagation techniques like stem cutting grafting, budding and air layering for regeneration of Oak tasar host plants. Through these techniques are suitable for raising homogenous plantations but their applicability for large scale plantation needs further study.

Conclusion

Raising of *Quercus serrata* seedlings through propagation techniques like seed and vegetative methods may act as paradigm shift in Oak tasar (Temperate tasar) activities. Because of its special character like fast growing, it is suitable for block plantation and has vast opportunity to raise economic plantations for oak tasar rearing. *Quercus serrata* plantation can be maintained at 5-6 feet height, which leads to reduction of drudgery in oak tasar rearing activities. Other suitable oak species like *Quercus semicarpifolia, Q.incana,* and *Q.himalayana* were slow growing species, which may grow up to 50 to 60 feet height. Harvesting shoots for oak tasar rearing is very cumbersome and take more time by the farmers. Therefore, raising of *Quercus serrata* seedlings through propagation techniques is economical and suitable for oak tasar rearing activities.

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Impact of KVK Training on Knowledge and Adoption Levels of Soybean Growers in Maharashtra State

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Abstract

The study was conducted in ten selected villages of Washim District of Maharastra to study the impact of training programs conducted by KVK, Karda on knowledge and adoption levels of soybean growers. A sample size comprised of 150 trainees and 150 non-trainees from the KVK operated villages. The results of the study revealed that the trainee farmers had greater knowledge and adoption levels on improved soybean cultivation practices than the non-trainee farmers. The knowledge and adoption indices for various soybean cultivation practices were also found to be more for trainee farmers than their counterparts. The impact of training organized by KVK was found to be 48.15 per cent. This indicates that KVK played a significant role in promoting the knowledge and adoption levels of soybean growers.

Keywords: Impact, Training , knowledge level, Adoption level and Soybean growers.

Introduction

Soybean (Glycine max *L. Merril*) is the world’s most important seed legume, which contributes to 25% of the global edible oil and about two-thirds of the world’s protein concentrate for livestock feeding. In India, Soybean is cultivated in an area of 11.00 million ha and the production of 9.30 million tonnes with a productivity of 8.65 q / ha under rainfed crop system in Madhya Pradesh, Rajasthan, Karnataka, Chhattisgarh and Telangana. There persists wide variation in the productivity ranges from 9.5 q / ha in Karnataka and Chhattisgarh to 14.8 q / ha in Telangana. Pricing is to farm level of efficiency. In Maharashtra, soybean is cultivated in an area of 3.73 million ha with production of 3.94 million tonnes and productivity of 10.55 q / ha with second rank in India (SOPA Databank, 2019). However, low productivity of the crop remains a major problem of soybean cultivation.

KVK conducts training programs for farmers to update their knowledge and skill on modern technologies. They provide several farm support activities like providing technology dissemination to farmers training, awareness, etc. They play a vital role in conducting on farm testing to demonstrate location specific agricultural technologies. KVKs conduct demonstrations to prove the potential of various crops at farmers’ fields. They also conduct need based training programs for the benefit of farmers and farm women, rural youths. KVKs are creating awareness about improved agricultural technologies through large number of extension programs. KVK, Karda organizes regular training programs for soybean growers on improved soybean production technology. In order to study the impact of training on knowledge and adoption levels of soybean growers, the present study was undertaken.

Methodology

The study was conducted in Washim district of Maharastra state during 2018-19. A list of farmers attended training on improved soybean cultivation practices was obtained from KVK, Karda. Out of six taluks of Washim district, three taluks namely, Risod, Washim and Malegaon were selected as these taluks had highest number of soybean trainees. Six villages from Risod, two villages from Washim and two villages from Malegaon were selected based on the availability of maximum number of trainees. The selected villages were Bhapur, Tandalwadi, Belkhed, Gobhani, Warud Tofa and Karda from Risod taluk, Shelgaon bagade and Tiwali from Malegaon taluk, Hiwara rohila and Sawargaon jire from Washim taluk. A sample size of 150 trainee farmers was selected from all these ten villages by following the proportionate random sampling technique and considered as an experimental group. In order to study the impact of training among the trainees, a sample size of 150 non-trainee farmers were also selected to have them as control group. The non-trainees were also selected from the same villages again following the proportionate random sampling method. Thus, a total of 300 farmers were selected for the study.

The improved soybean production technologies imparted during training organized by KVK, Karda were selected to study the knowledge and adoption levels of both the trainees and non-trainees. The data were collected with the help of pre-tested and structured interview schedule by personal interview method. Independent 't' test was applied to test the significant difference between mean knowledge and adoption scores of trainees and non-trainees.

The impact index was worked out with the help of following formula:
1. Impact Index = [MKI of trainees – MKI of non- trainees] [MAI of trainees – MAI of non- trainees].
2. MKI - Mean Knowledge Index.
3. MAI - Mean Adoption Index.

Results and Discussion: Knowledge of Trainee and Non-Trainee Farmers on Improved Soybean Cultivation Practices

Knowledge was crucial factor for an adoption of an innovation so the extent of knowledge among trainee and non-trainee farmers was studied and the results are presented in table 1.

Table 1 . Distribution of respondents on their knowledge about improved soybean cultivation practices:

S. No.	Category	Trainee farmers (n=150)		Non-trainee farmers (n=150)	
		Number	Per cent	Number	Per cent
1.	Low	-	-	71	47.33
2.	Medium	45	30.00	54	36.00
3.	High	105	70.00	25	16.67
Total		**150**	**100.00**	**150**	**100.00**
Mean			77.60		45.50
Difference between the means			32.1		
't' value			34.49**		
** - Significant at 0.01 level of probability					

Table 1 shows that the mean knowledge score of trainee farmers was more than that of non-trainee farmers. Further, the difference between the means of trainee and non-trainee farmers was highly significant. Based on the mean scores, it may be stated that the trainee farmers possessed higher knowledge than non-trainee farmers. Hence, it may be concluded that the trainee farmers were with more knowledge about improved soybean cultivation practices, while the non-trainee farmers were with low knowledge about the same. The general hypothesis on difference between the trainee and non-trainee farmers on their knowledge about improved soybean cultivation practices is supported by this finding.

It may also be seen from table 1 that majority of the trainee farmers (70.00 per cent) were with high level of knowledge, whereas majority of non-trainee farmers (47.33 per cent) were with low level of knowledge. The table further shows that the proportion of respondents found under medium level of knowledge was 30.00 per cent for trainee farmers and 36.00 per cent for non-trainee farmers. No trainee farmer was found to have low level of knowledge.

The trainee farmers have attended training programs organized by Krishi Vigyan Kendra on improved soybean cultivation practices. This would have enabled them to gain more knowledge about soybean cultivation. On the contrary, the non-participation of non-trainee farmers in the training program on soybean cultivation may be the major reason for their lower knowledge.

Extent of Adoption

The adoption level of trainee and non-trainee farmers on improved soybean cultivation practices are presented in table 2.

Table 2. Distribution of respondents on their extent of adoption of improved soybean cultivation practices:

S. No.	Category	Trainee farmers (n=150)		Non-trainee farmers (n=150)	
		Number	Per cent	Number	Per cent
1.	Low	17	11.33	84	56.00
2.	Medium	39	26.00	43	28.67
3.	High	94	62.67	23	15.33
Total		**150**	**100.00**	**150**	**100.00**
Mean			77.30		47.20
Difference between the means			30.10		
't' value			25.31**		
** - Significant at 0.01 level of probability					

It is interesting to see from table that majority of the trainee farmers (62.67 per cent) were found to be the high adopters of improved soybean cultivation practices, whereas majority of the non-trainee farmers (56.00 per cent) were found to be the low adopters. Around 30.00 per cent of the trainee farmers (26.00 per cent) and non-trainee farmers (28.67 per cent) were found in the medium category. Only less than one-fifths of the non-trainee farmers (15.33 per cent) were high adopters and only 11.33 per cent of non-trainee farmers were low adopters.

The table 2 further shows that the mean score of trainee farmers was more than that of non-trainee farmers. The difference between the means was significant at 5.00 per cent level. Based on the mean scores, it may be concluded that the trainee farmers were high adopters, while the non-trainee farmers were relatively low adopters. This supports the general hypothesis namely there will be difference between the trainee and non-trainee farmers in their adoption levels of improved soybean cultivation practices.

The higher adoption level of trainee farmers compared to their counterparts needs no explanation. The trainee farmers undergone training program on soybean cultivation practices organized by Krishi Vigyan Kendra, they have gained more knowledge from those training programs. The higher knowledge level of respondents coupled with their best extension contact, media exposure, scientific orientation, economic motivation and innovativeness would have enabled the trainee farmers to adopt more practices. On the contrary the non-participation of non-trainee farmers would not have enabled them to acquire knowledge and hence would have led to poor adoption. Similar findings were also reported by Malabasari and Hiremath (2016) and Mankar et. al., (2014).

Impact of Training

In order to study the impact of training, the mean knowledge and adoption indices were worked out for all the selected technologies. The mean knowledge and adoption indices were also worked out for both the trainees and non-trainees. The results are presented in table3.

Table 3 - Knowledge and adoption indices of trainees and non-trainees for soybean cultivation practices:

S. No.	Soybean cultivation practices	Knowledge Index (%)		Adoption Index (%)	
		Trainees (n=150)	Non-trainees (n=150)	Trainees (n=150)	Non-trainees (n=150)
1.	Recommended varieties	100.00	45.33	100.00	42.67

2.	Seed germination test	94.67	14.00	87.33	0
3.	Chemical seed treatment	98.00	34.67	95.33	22.67
4.	Bio-fertilizer seed treatment	98.67	32.00	95.33	22.67
5.	Seed rate	100.00	48.00	100.00	46.67
6.	Spacing	100.00	46.67	100.00	46.67
7.	Broad bed and furrow system	100.00	80.67	100.00	93.33
8.	Weed management	98.67	43.33	92.67	39.33
9.	Application of FYM	100.00	94.67	100.00	71.33
10.	Application of chemical fertilizer	94.67	82.67	98.00	69.33
11.	Pest management	92.00	39.33	90.00	28.00
12.	Disease management	92.00	36.00	90.00	28.00
13.	Time of harvest	100.00	84.00	100.00	73.33
Mean Index		**97.59**	**52.41**	**96.05**	**44.92**

Knowledge

The mean knowledge index was found to be higher for the trainee farmers (97.59 per cent) rather than non-trainee farmers (52.41 per cent).

The data furnished in table 3 reveals that cent per cent of the trainee farmers had knowledge on the practices namely, recommended varieties, seed rate, spacing, broad bed and furrow system, application of FYM and time of harvest, whereas the corresponding knowledge level for the same practices for the non-trainee farmers were 45.33 per cent, 46.67 per cent and 80.67 per cent, 94.67 per cent and 84.00 per cent respectively.

Table 3 further shows that a vast majority of trainee farmers had knowledge on the remaining practices namely, seed germination test (94.67 per cent), chemical seed treatment (98.00 per cent), bio-fertilizer seed treatment (98.67 per cent), weed management (98.67 per cent), application of chemical fertilizer (94.67 per cent), pest management (92.00 per cent) and disease management (92.00 per cent). In case of non-trainee farmers, less than half the proportion of the respondents had knowledge on recommended varieties (45.33 per cent), seed rate (48.00 per cent), spacing (46.67 per cent) and weed management (43.33 per cent). About 40.00 per cent of the respondents had knowledge on pest management. The practices namely, chemical seed treatment (34.67 per cent), bio-fertilizer seed treatment (32.00 per cent) and disease management (36.00 per cent) were found to be known by only less than 40.00 per cent of the respondents. Only a smaller proportion of the respondents had knowledge on seed germination test (14.00 per cent).

Adoption

The mean knowledge index calculated was greater for the trainee farmers (96.05 per cent) compared to the non-trainee farmers (44.92 per cent).

In case of adoption, the practices namely, recommended varieties, seed rate, spacing, broad bed and furrow system, application of FYM and time of harvest were adopted by all the trainee farmers, whereas in the case of non-trainee farmers, these practices were found to be adopted by 42.67 per cent, 46.67 per cent, 46.67 per cent, 71.33 per cent and 73.33 per cent of the respondents.

Majority of the trainee farmers had adopted the remaining practices namely, seed germination test (87.33 per cent), chemical and bio-fertilizer seed treatment (95.33 per cent), weed management (92.67 per cent), application of chemical fertilizer (98.00 per cent) and pest and disease management (90.00 per cent). In the case of non-trainee farmers, about 70.00 per cent of the farmers adopted application of chemical fertilizer.

Only a lesser proportion of the non-trainee respondents had adopted chemical and bio-fertilizer seed treatment (22.67 per cent) and pest and disease management (28.00 per cent). None of them had adopted the seed germination test.

Impact of Training on Knowledge and Adoption of Improved Soybean Cultivation Practices

The mean knowledge and mean adoption indices were calculated for both the trainees and non-trainees and the impact index was also computed. The results are furnished in table4.

Table 4. Impact of training on knowledge and adoption levels of trainee and non-trainee farmers:

S. No.	Particulars	Trainees	Non-trainees	Difference
1.	Mean Knowledge Index	97.59	52.41	45.18
2.	Mean Adoption Index	96.05	44.92	51.13
Total		**193.64**	**97.83**	**96.31**
3.	**Percentage of Impact** = $\frac{\textbf{Sum of differences of indices}}{\textbf{2}}$ = $\frac{96.31}{2}$ = 48.15			

The impact of training program imparted by the KVK as a whole was computed as the sum total of the differences of both the indices namely, Mean Knowledge Index (MKI) and Mean Adoption Index (MAI) divided by two. The data thus obtained have been presented in table 4.

Table shows that the mean knowledge index and mean adoption index were found to be 98.59 per cent and 96.05 per cent for the trainee farmers, whereas for the non-trainee farmers the mean knowledge index was 52.41 per cent and mean adoption index was 44.92 per cent. It clearly shows that the trainee farmers had greater knowledge and adoption levels compared to the non-trainee farmers.

It could be further observed that there was an impact of KVK training up to 48.15 per cent over the existing knowledge and adoption by the trainee farmers which were found to be substantial over the non-trainee farmers. Therefore, it could be stated that there was a remarkable impact of training on those respondents who attended the training program conducted by KVK, Washim in terms of knowledge and adoption of improved soybean cultivation practices as compared to their counterparts.

This shows a positive and significant impact of training programs conducted by KVK on knowledge and adoption levels of trainees. Similar findings were also reported by Savitha Singhal and Lalita Vatta (2017), Sowmya and Bindu(2017) and Deshmukh et.al.(2020).

Conclusion

The study shows that the trainee farmers had greater knowledge and adoption levels with regard to improved soybean cultivation practices compared to the non-trainee farmers who were relatively lesser in their knowledge and adoption levels. The mean knowledge index and mean adoption index were found to be higher for the trainee farmers rather than their counterparts. The impact of KVK training was observed to be 48.15 Per cent. Hence it may conclude that the Krishi Vigyan Kendra contributed positively in enhancing the knowledge and extent of adoption of improved soybean cultivation practices among the trainee farmers. The knowledge imparted during training by KVK scientists and follow up extension activities would have helped in enhancing the knowledge level of trainee farmers and in turn would have led to higher level of adoption of improved soybean production practices. Hence it could be suggested that a greater number of training programs on soybean production may be organized for all the non-trainee farmers in the KVK operated villages so as to ensure better knowledge and adoption among all the farmers.

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Growing of Vegetables in Container

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Introduction

Vegetables are parts of plants that are consumed by humans or other animals as food. Vegetables play an important role in human nutrition, can be eaten either raw or cooked. Most are low in fat and calories but are bulky and filling. They supply dietary fiber and are important sources of essential vitamins, minerals, and trace elements. Particularly important are the antioxidant vitamins A, C, and E. When vegetables are included in the diet, there is found to be a reduction in the incidence of cancer, stroke, cardiovascular disease, and other chronic ailments. In current situation, as the population is increasing, demand for food also increasing parallel. We are seeing the apartment culture is going up especially in cities and even in towns. People are dreaming of growing of vegetables on their own which can be healthy, can save a good amount. Pots can be placed on roofs/ terrace, a patio, deck, parking space, balcony. It all depend on what kind of vegetables are we growing. This is a micro model of farming where a family unit or household is producing vegetables in special containers for personal consumption to improve the income, health and well-being of its family members.

Pot and Container Sizes for Growing Vegetable Crops

Pots and containers for growing vegetables and herbs on patios, balconies and roof tops must be large enough for the crop to mature. A container must hold the soil and moisture that deliver nutrients to growing plants allowing them to leaf, flower, and fruit. The pot must be large enough to accommodate the plant's roots. And a pot should be large enough that the height and weight of the above ground growth of the plant does not tip the container. Some plants are small enough that can be grown more than one plant in a container; other plants grow so large that cannot grow more than a single plant in a container.

Mixture in Containers

Soil is the foundation for growing healthy plants, so it's very important that always use high quality soil for container plants.

1. The medium is light and fluffy.
2. It has good drainage, but also holds moisture.
3. It's porous so that water and air can easily reach the roots of the plants.
4. There aren't any weed seeds germinating in the bag, or tiny bugs flying around it.
5. There's not a large amount of bark or sand in the mix.
6. It's moist but not soggy, and the smell is pleasant.

For planter boxes & hanging baskets: soil-less mixes are usually made with peat moss or coco coir as the base ingredient, and they don't contain compost or sand.

Planting of Vegetables in Containers

Most vegetables have similar care needs (full sun and well-drained soil), but it's also good to double-check that their needs are similar, especially if plant multiple veggies in one container. If seeds are sown in container for germination it is necessary to put container in light. After germination water is applied. The quantity of applied water should be optimum if more water is there it led to damping off disease in plants. Water should be applied with fine nozzle watering can. Vine vegetables like ridge gourd, bitter gourd, cucumber etc. in these when vine start to grow position of container should be fixed and give support to plants.

Care & Maintenance of Plants

Watering needs: During rainy season when plants receive enough water from the rain, there might be not need to water the containers at all. However, during the drier months, watering should be done in the morning. If the weather is not too hot, one watering in the morning is enough for the plants to grow healthily. If it very hot and the plant demand is high, one additional watering should be done in the afternoon.

Cultivating and weeding: Cultivating the soil at a depth of 2 to 3 inches below the surface of the potting medium will encourage maximum air flow around the roots, which encourages bigger and healthier root growth and subsequently better water and nutrient uptake. Weeding allows the plants to benefit the nutrients and water that is provided by the medium.

Feeding the plants: For better production of vegetables fertilizer should be applied like urea 5-19g/pot in 7-10 days interval from 2 weeks after transplanting or 3 weeks after showing.

Controlling pests and diseases: By increasing the biodiversity and growing vegetables from different botanical families including herbals which may act as repellents to certain pests. Foot rot disease and Sclerotium wilt cause more damage in vegetables. Use of fungicides 2g/lit for the control of diseases. Up root and destroy the plants which affected by virus. Spray 2ml/lit malathion to control sucking pest. Prevent the use of vegetables up to 7-10 days after treating with insecticides.

		
Chilli *(Capsicum frutescens)*	**Tomato *(Solanum lycopersicum)***	**Cherry tomato in hanging basket**
		
Carrot *(Daucus carota)*	**Cucumber *(Cucumis sativus)***	**Green leafy vegetables**

Suitable Varieties of Vegetables

Name	Variety	Sowing and Transplanting	Harvesting
Brinjal	Pusa Purple Long, Pusa Purple Cluster Pusa Kranti, Azad Kranti, Pant Riruraj Pant Samarat, Pusa Anupam	Sowing : February-march, July	45-90 days
Tomato	Pusa Ruby, Rocky, Pusa Early Dwarf, Pusa Gaurav	Transplanting: February August	60-65 days

Chilli	Pusa Jawala, Sadabhar, N. P.- 46 A	Transplanting: October-December	90-100 days
Carrot	Pusa Yamadagni, Pusa Meghali, Pusa Kesar, Nantes	Sowing: October-December	25-30 days
Radish	Pusa Reshmi, Pusa Himani, Japanese white, Chinese Pink	Sowing: October-December	25-30 days
cowpea	Co-1, Co-2, Co-3	Sowing: February-march, July-August	20-25days
Okra	Pusa Sawani, Punjab Padmini, Pusa Kranti, Parbhani Kranti, Pusa Komal	Sowing: February-march, July-August	50-60 days
Spinach	Pusa Jyoti, All Green, Pusa Harit, Jobner Green	Sowing: September-December	50-60 days
Lettuce	Great Lakes, Chinese Yellow	Transplanting: October	60-70 days
Cluster bean	Pusa Sadabahar, Pusa Navbahar	Sowing: February-March, July	55-60 days
Cucumber	Japanese Long Green, Khira Poona	Sowing: February-March, July	45-60 days
Bitter Gourd	Pusa Vishesh, Arka Harit, CO-1	Sowing: February-March	50-60 days
French Bean	Pusa Parvati, Contender	Sowing: February-September	50-55 days
Fenugreek	Pusa Early Bunching, Pusa Kasuri	Sowing: September-December	75-80 days

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Effect of Climate Change on Plant Disease Development and Management Strategies

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Introduction

Climate change in the recent times have become a major concern for the agricultural practices worldwide. Over a long period of time of a region climate change is described by the change in the conditions like temperature, humidity, rainfall, wind etc. It is attributed directly or indirectly by the human activities because of which the natural concentration of CO_2 is increased resulting in amplifying the earth's natural greenhouse effect. The physiological, morphological and biochemical processes are directly affected by the climate changes. The global atmospheric CO_2 in 2018 was 407.4 ppm which was higher than any point in at least past 800,000 years (Lindsey, 2020).

Food system as a whole contributed 37% of total greenhouse gas emission and that the figure would increase by 30 – 40% by 2050 was estimated by The Europeans Unions Scientific Advice Mechanism. These changes would also affect the spread, severity and reproduction of many plant pathogens; thus, the food health and security are affected.

For sustainable food production, the integrated disease management strategies should be redirected to the changing climatic conditions. Any pathogenic agent or environmental factor that leads to development of disease symptoms caused by continuous irritation of the malfunctioning of host cells and tissues. The interaction of environment, pathogen, host and time results in disease pyramid formation.

Effect of Various Components of Climate Change on Plant Diseases

1. CO_2 Concentration: The carbon dioxide concentration on plant disease has both positive and negative effect. An increase in CO2 may lead to the increased plant growth (Jones and Curtis, 2000; Loladze, 2002) which in turn causes increase in photosynthetic rate and decrease in transpiration rate (Li et al., 2003). The increase in plant biomass production means more tissues can be affected by pathogens such as rusts and powdery mildew (Manning and Tiedemann, 1995). It promotes the growth of bio-trophic rust fungi. The biomass automatically results in increase in carbohydrate which provides food for the pathogens. The increase in CO2 concentration can cause increase in canopy density and plant size which promote growth of spores and leaf infection. The increase in root biomass can increase the number of tissues that could be infected by soil borne pathogens and mycorrhiza. Host pathogen relation can also be altered due to high CO2 concentration (Braga et al., 2006).

2. Temperature: Certain types of temperatures are required by plants and pathogens to grow. The high and low temperature affects the disease cycle like, survival, dispersal, development etc. Germination, proliferation, wintering of sexual propagules etc. (Tapsoba and Wilson, 1997; Agrios, 2005; Pfender and Vollmer, 1999). Because of change in temperature, cereal crops become more susceptible to rust diseases. The change in temperature causes development of different races of pathogens.

3. Moisture: With the increase in temperature there is an increase in frequent rainfall because of which the plants develop healthy leaves and canopy which results in the retainment of the pathogens and diseases like blights and rots. High moisture causes foliar diseases as well such as Pythium, Phytopthora etc.

4. Vector borne diseases: Climate change affect both host plant and insect vector populations (Jones, 2009). The plant viruses mostly function with interaction of hosts and vectors. Climate change also affect the phenology and physiology of the host, thereby affecting susceptibility of the viruses because of which virus transmission is also affected. Spread in plant virus can be caused by the change in the host plant or vector due to climate (Canto et al., 2008).

Plant Disease Management Strategies

It involves the different strategies and practices towards growing healthier crops and minimizing the effect of disease and pathogens.

1. To manage the disease and pathogen interaction by plant pathosystems models have been made. Such as powdery mildew is an important disease of grapevine, in this phenological models of grapevine is made with phenological model of disease are applied the climate change scenarios to reduce the effect of the disease severity (Caffarra et al., 2012).

2. The climate change differs in different plant pathogen species. The increase in temperature and rainfall may alter the use of fungicides residues on crop residues. Because of which more fungicides or chemical treatment is required for disease control.

3. The pathogen which has become a threat to the current scenario will be quarantined by different agencies using tools like Geographical Information Systems and Climate matching tools at different climates.

4. The cultivars may be become more effective in being resistance against pathogens and diseases due to change in physiological, biochemical and morphological process. Because of which the pathogens also become durable and there is more formation of more aggressive pathogen races.

Conclusion

1. Rise in CO_2 levels results in increase or decrease in plant disease due to changing physiological and biological effects.
2. Increased CO_2 levels also cause high photosynthetic rates and low transpiration by changing the pathosystem genetically and phenotypically.
3. Similarly, temperature and moisture also affect the plant metabolism because of which the pathogens survive.
4. Climate change affects the host pathogen interaction because of which pathogens and disease develop severity.

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Nutrient Management in Conservation Agriculture Under Rice Based Cropping Systems

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Introduction

Pressure for crop intensification has steadily increased in India due to the high population growth rate, reduced arable land, depletion of natural resources, declining response to inputs, declining profitability and productivity, rising farm costs, poor resource efficiency, hidden unemployment, and low crop yields. Intensive tillage resulted in higher soil erosion, resulting in more agricultural land degradation. One of the major causes of low rice yields, a major staple for farmers, is high soil erosion rates. Thus, the loss in soil fertility due to erosion and decreased organic matter application has had a negative effect on the system's production and sustainability. In addition, the effects of global climate change have recently added new challenges to sustainability. The main causes of soil degradation include not only intensive cultivation, but also removal or burning of crop residues, improper crop rotations that do not maintain vegetative cover on the soil surface or allow for an appropriate build-up of organic matter, as well as deforestation and poor land management. As a result, there is an immediate need to introduce alternative technologies to stimulate sustainable agricultural intensification while at the same time preventing further land degradation.

Conservation Agriculture (CA) emerged as one of the alternatives to soil protection and sustainability. Few studies have indicated the potential of CA practices but there is a dearth of information about its feasibility on marginal production environments. Therefore, an attempt is made to collect the available literature about CA systems on rice and maize-based farming system.

Principles of Conservation Agriculture

Conservation Agriculture (CA) is a concept for optimizing crop yields, and economic and environmental benefits. The key elements of CA have direct and indirect bearing on the nutrient supplying/ availability of soil which are described as below.

1. Minimum soil disturbance	2. Permanent soil cover	3. Cropping diversification with legumes
Optimum proportions of respiration gases in the rooting-zone.	Buffering against severe impact of solar radiation and rainfall.	Minimal rates of build-up of populations of pest species, through life-cycle disruption.
Moderates organic-matter oxidation.	Act as a substrate for micro-organisms.	Biological N-fixation in appropriate conditions, limiting external costs.
Porosity to water movement, retention and release at all scales	Raised cation-exchange capacity for nutrient capture, retention and slow-release.	Prolonged slow-release of such N from complex organic molecules derived from soil microorganisms.
Limits re-exposure of weed seeds and their germination.	Considered as erosion controlling measure.	Prolonged slow-release of such N from complex organic molecules derived from soil microorganisms.

The key elements of CA include no-tillage, residue retention, innovative cropping systems and measure to reduce soil compaction through controlled traffic. Conservation Agriculture (CA) systems are not only about precision planting using seed drill or significantly reduced tillage. But, is also about management practices (weed, water, nutrient and IPM etc) that make no-till technology successful and provide added advantage to the farmers. The CA system is flexible in nature, operation and based on locally available resources, allowing farmers to benefit from them under diverse situations.

Integrated Nutrient Management and Soil Fertility Improvement in CA

The issues of plant nutrient management in NT farming can be is addressed through integrated nutrient management (INM)and considered as basic principle of conservation agriculture (Rattan Lal., 2015). The vicious cycle of low nutrient input causing low crop yield, which results in lower biomass input into soil, lower humification efficiency, and a lower SOC pool, can only be broken by the strategy of INM and the creation of a favourable multi-elemental balance.

Conservation Agriculture and Rice-Maize Based Cropping Systems in World Prospective

In 1973-74, the area under CA was only 2.8 M hectares worldwide, currently worldwide it is estimated to spread around 180 m hectares. In South American countries the paraphrase button is pressed. South American countries (e.g., Brazil, Argentina, Colombia, etc.) engaged in conservation agriculture reported positive effects on water infiltration, soil moisture and runoff reduction, increased nutrient supply, sustained crop yield, weed management and reduced input. CA technologies in India, unlike in the rest of the world, spread mainly in irrigated zones of the plains of Indo-Gangetic plains (about 5 mha), where rice-wheat (R-W) cropping system dominates (WCCA Report, 2009).

Table: Area under conservation agriculture:

Region CA Cropland Area	Per cent of global CA cropland area	Per cent of Cropland area in the region
South America	69.90	38.7
North America	63.18	35.0
Australia & NZ	22.67	12.6
Asia	13.93	7.7
Russia & Ukraine	5.70	3.2
Europe	3.56	2.0
Africa	1.51	0.8
Global total	180.44	100
		(Kassam et al, 2018)

R-M systems currently occupies 3.5 Mha in Asia (Timsinaet al. 2010). The highest acreage is in India. The area under R-M system is less in Bangladesh and Nepal but it is increasing rapidly over the past 5-6 years (Ali et al. 2009). Rice-maize systems are practiced mostly in the South Indian conditions (Andhra Pradesh, Tamil Nadu, and Karnataka) and in the northeast (Bihar and West Bengal) parts of India. More than 0.5 Mha Andhra Pradesh (undivided) has the highest acreage under R-M system in South India where this system is rapidly increasing under resource-conserving technologies, mostly zero tillage (Jatet al. 2009). It might be due to demand for maize, especially by poultry sector, and tightening world export-import markets rising.

Nutrient Management Under Conservation Agriculture

South Asian agriculture is currently facing twin challenges of resource fatigue and decelerating productivity (Jatet al., 2011, Jatet al., 2014). Adequate information on nutrient management is not much available especially from Indian subcontinent. There is a need to develop recommendations and application strategies for nutrient management CA. Utilizing the precision nutrient management (applying right source and right rate of nutrients at right time and right place) for cultivating rice and maize and its associated or based cropping systems in conservation agriculture. Nutrient management practices in CA systems are simply physical input-output model. While there is much new work that needs to be done to formulate nutrient management strategies in CA like method, type, time and how nutrients behave in the system. It's also important that strategies should ensure the soil health and ecological balance.

Nutrient Management Strategies in Conservation Agriculture

Proper crop residue management; management of soil physical and biological health; reduction of loss of nitrogen and increasing NUE; management of other nutrients; adoption of efficient Crop rotation through managing nutrient balance; site specific nutrient management; adoption of integrated nutrient management practices in conservation agriculture; relating 4Rs of nutrient with CA system and managing access to a balanced nutrient supply.

Nitrogen Use Efficiency (NUE) in Conservation Agriculture

State of the art: Only a few recent studies on NUE and N fertilizer management in CA systems are available. In CA, effects of N fertilizer can be noticed in the following cropping seasons over several years. This is especially the case when fertilizer is applied in combination with residue retention since this can increase temporary immobilization of fertilizer, which is released in the following years.

Adjusting N Fertilizer Management in CA

To improve NUE management Nitrogen fertilizer management can be divided into four different components: amount, type, timing, and placement of N fertilizer.

N Application Rate

The quantity of applied N fertilizer is the most yield determining factor, followed by N source, timing and application method. The optimum amount of fertilizer N can be calculated by pre-planting soil samples or sensor-based N management and varies within the intensity and yield potential of the CA production system. A valid N rate assessment takes into account: the productivity potential of the soil; previous crop; ratio of the price of N fertilizers to the crop value and minimizing environmental losses.

Type of Fertilizer

Nitrogen fertilizers vary in their concentrations of N and the choice of fertilizer depends on soil pH, soil moisture content, available soil N, availability of fertilizer, application equipment and costs per unit of N ha^{-1}. Urea is a very common fertilizer, but it can cause greater N losses under CA due to increased urease activity in crop residues. Animal manure can be an alternative on-farm resource to compensate for increasing costs of mineral N and therefore help to reap value from farm wastes. More research is needed to optimize application methods and timing to reduce volatilization losses when using animal manure in CA systems.

Timing of N Application

N losses can be reduced by a better synchronization of N application and crop uptake needs. If mineral N fertilizer is applied during the peak plant N demand, immobilization and losses from the soil-plant system can be reduced and hence NUE can be increased. The timing and rate of N fertilization significantly affects yield, NUE and its components such as N losses. Crop residues that help to increase soil moisture could also contribute to improving N fertilizer distribution in the soil and N uptake by the plants unless residues immobilize N.

Fertilizer Application Method

Subsurface N banding in CA appears to be an efficient application method to improve fertilizer recovery compared to N application by broadcast application. The reduced NUE in CA found due to broadcast application of N fertilizer. There is a lack of fertilizer equipment for subsurface application in CA. Scientists and local machinery manufactures should combine their efforts to develop the necessary machinery and to promote new

N fertilizer application methods. Subsurface application by shallow disk injection, chisel injection, aeration infiltration or pressure injection of cattle and swine manure can reduce NH_3 volatilization and decrease nutrient losses in runoff but could potentially increase N_2O emissions.

Conservation Agriculture and Nutrient Use Efficiency

Conservation agriculture resulted in improved fertilizer use efficiency (10-15%) in the rice-wheat system, mainly as a result of better placement of fertilizer with the seed drill as than broadcasting. Microorganisms tying up the mineral N (immobilization) in the crop residues which increase the NUE.

In longer-term experiments, release of nutrients increased with time because of microbial activity and nutrient recycling that leads to greater availability of both native and applied nutrients to the crops. Nitrogen applied as split doses improves NUE. Minimum tillage and FYM with 60 kg N ha^{-1} over deep tillage shows superiority. Furrow irrigated raised bed planting system has proved good system under conservation agriculture for NUE and WUE.

There is limited experimental findings with respect to P sorption. Adsorption sites of goethite can be blocked by organic matter fractions such as humic acids, reducing P sorption. Compounds of low molecular weight such as oxalate and malate can also have similar effects in blocking the P-sorption sites, but these effects are only transient. Compared to low-molecular weight organic acids, humic substances can be more efficient because of their higher stability and persistence in agricultural soils.

Despite considerable evidence on the positive effects of organic amendments on the decrease in P sorption by soils, there is very little field-based research to determine whether the results from more basic studies under controlled conditions are applicable to field conditions. Inclusion of legumes in CA leads greater to nutrient availability to plants. Highest levels of exchangeable K, calcium (Ca), and magnesium (Mg) in systems with pigeon pea and lablab (*Dolichos lablab*) was recorded by many researchers.

Similarly, higher C, N, K, and lower sodium (Na) concentration with residue retention compared to residue removal in a rained permanent raised bed planting system in the subtropical highlands. However, increased infiltration may translate into percolation and increased leaching of mobile nutrients, which may counterbalance advantages of retaining them in situ though ‘‘by-pass flow'' may occur so that most applied N is retained in the topsoil and N leaching is limited.

Site-Specific Nutrient Management / Precision Nutrient Management

It is dynamic, plant-based, farm-specific management of nutrients in a particular crop or cropping system to optimize the supply and demand. SSNM based on principles of 4R i.e., right source, right amount, right time and right place. Sensor-based N management relies on precision CA which refers to the combination of minimum soil movement residue retention, crop rotation and planting of improved varieties with spatial technologies such as GPS, remote sensing and GIS to adjust fertilizer application to plant demand based on monitoring crop growth to augment NUE and yield. An NDVI sensor can be utilized to follow crop development throughout the season such as the GreenSeeker®-handheld sensor.

Limitation of Nutrient Management in Conservation Agriculture

1. Non-availability of needed inputs and difficult to handle crop residues during sowing and other operations.
2. Nitrogen loss due to volatilization and leaching and runoff losses of P and K.
3. Nutrient immobilization in the initial phase.
4. Presence of surface residues which limit contact between the soil and the fertilizer.
5. Uncontrolled grazing by animals.
6. Resource poor farmers of India drag them back from conservation agriculture.
7. Lack of awareness about CA and especially nutrient management approaches, Lack of proper technology like type of nutrient should use in CA, Machinery, fertilizer itself etc.

Conclusion

CA promotes soil quality, by an increase in physical, chemical and biological quality and hence warrants differential nutrient managements than CT.

1. Fertilizer sources having slow-release properties if band placed found beneficial in CA.
2. The external fertilizer inputs in CA can be decreased in cereal system.
3. Site specific nutrient management in CA is needed for scaling of its adoption.

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Value-Added Selling and Ideas for Increasing Selling Products

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The concept of value-added selling has been a popular one for a number of years. The real issue, though, is that in today's market place where so many products and services are viewed as a commodity, the ability to add value to your product or service is a supreme necessity. There is no doubt that in the absence of value-added components virtually any product or service can be driven down to the most bottom lines - price. When you are only selling price, you'll not at all be able to sell any degree of high margin sales and that is where profitability, long term intensification and sales success resides.

Providing Expert Advice and a Tremendously High Level of Professionalism

Lots of consulting organizations, accounting firms and even medical professionals are paid a tidy sum for the level of advice that they provide. However, for you as a sales professional, in order for you to be able to provide value, what you need to do is to understand that you have to provide a level of advice that is significantly higher, more sophisticated and a lot more valuable than that of your competition.

Bundling and Packaging

I'm not only talking here about the way your product or service actually looks, I'm also talking about being able to put together desirable packages, purchasing levels and a series of added benefits that are significant in value and are, themselves, a whole lot more valuable than simply the product is by itself.

Service Levels

It is possible for you to differentiate yourself not only by providing a higher level of service but by adding different levels of service based upon someone's size, regularity or amount of purchase. For example, you may want to have gold or platinum or silver levels of service that people qualify for, are willing to pay for, and receive when they do business with you.

Frequent Buyer Programs

This is tied into the concept that the more an important person buys from you the more valuable service, pricing, benefits and related items they receive. It is somewhat like numerous flyer miles with an airline. I familiar with people who actually fly thousands of miles out of their way to stay on one exacting airline only because they want to build up the miles!

Transition and Education

As new customers come on stream with your business you may want to provide action or conversion teams to help them to be improved proficient to utilize the products or services that you sell them. By the same token, the more education they have connected to those products or services the more capable they'll be at utilizing them.

Recognition and Reward Levels

This is somewhat different from frequent buyer programs in that with this particular concept behind value-added you actually provide recognition to clients or customers based upon their talent to utilize your product or service, maximize its potential, buy certain levels from you, etc. What this means is that they themselves are predictable for being outstanding customers. Several years ago, we included a Hall of Fame in our newsletter and we had lots of consumers very paying attention in appear and becoming a part of our Hall of Fame. It's a fantastic way to utilize good relationships and good will.

Qualitative Preference

Based upon someone's level of purchase, involvement or interaction, you provide higher quality of products, perhaps a more primitive level of service, devoted personnel, devoted phone lines, fax lines, or the like, that gives them a greater opportunity to be treated better than the run of the mill customer happens to be. You may even be able to use this for introductory customers as a value-added component.

Devoted Personnel

It is not difficult to understand that the more someone is familiar with another person's account, products, machinery, equipment or way of doing business; it is far easier to do business with that organization. In this scenario, you simply assign dedicated account people to handle your customer's accounts personally.

Speed of Service or Delivery

One of the ways to differentiate you is to guarantee some sort of one time or faster delivery. It is very well known and accepted that on time delivery is a key component for charging full or maximum pricing. It is also element as it relates to providing value-added services and products.

Insider Information

This is very common when people are selling information as it relates to stocks, bonds, financial in sequence or anything related to information or time specific data. Utilizing this process, you may want to believe a regular newsletter (electronic or printed) that updates customers on a regular basis as it relates to very key and significant information that they have to have.

Ten ways in which add value in your day-to-day sales activity. There is little doubt that it requires creativity or creative idea, novelty and willingness to competition.

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Achieving Nutritional Security by Means of Kitchen Garden

Article ID: 10610

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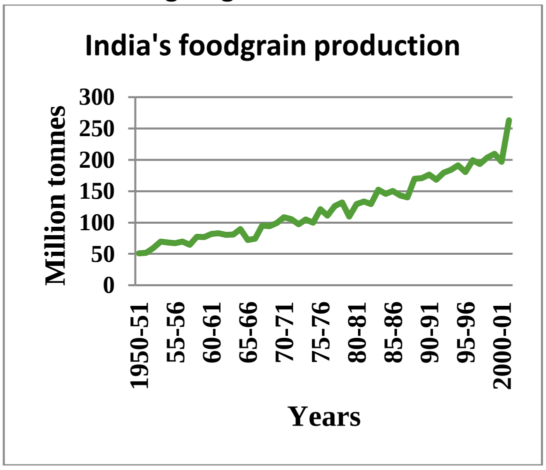
Introduction

Agriculture status in India from Independence to now: Agriculture is integral part of economic development of developing countries like India. Indian agriculture growth increases from 1% to 2.6% from pre – Independence to post-Independence era with main focus on increase in agricultural productivity (output and yield) rather than expansion of area. Along with this, our dependence on imported food grains has eradicated (Tripathi and Prasad, 2010). Food grains production increases from 51 million tonnes to 252 million tonnes from 1950 to 2016 (Fourth Advance Estimates) and is expected to reach 300 million tonnes by 2025 (29th Report). Agriculture system in India is undergoing a structural transformation, thus, accelerating the food production pattern.



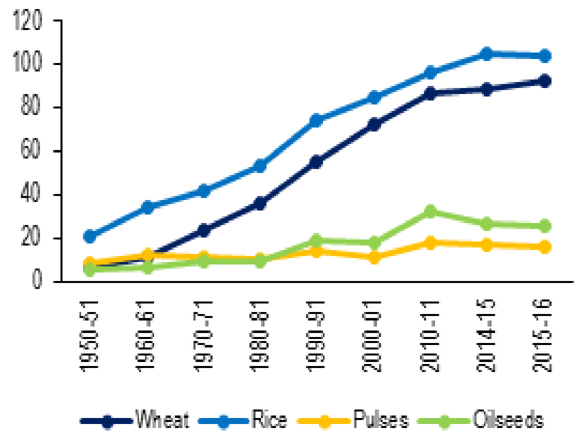


Figure1: Trends in food grain production since independence. Source: Economic Survey 2013-14 Figure 2: Agricultural production of food grains (million tonnes) Source: Ministry of Agriculture; PRS

Nutritional Status in India

Nutrition is central to the achievement of other National and Global Sustainable Development Goals. Despite of various policies, plans and programmes such as the National Food Security Act 2013, high levels of undernutrition in India is still persistent. Malnutrition refers to deficiency, excess or imbalance of a wide range of nutrients, resulting in adverse effects on body composition and function (Saunders et al., 2011). Malnutrition, including micronutrient deficiencies, is a serious public health problem among women and children throughout Asia. Macro- and micronutrient deficiencies have serious consequences on individual health and national develop¬ment, as undernutrition during early stages of life often leads to stunted growth, impaired intellectual (Yan et al., 2017) and physical development and increased risk of mortality and morbidity from infections (Ramokolo et al., 2017). In addition, maternal malnutrition especially during period from pregnancy to 24 months of age has a significant effect on nutritional status of children (Bryce et al., 2008). Poor quality of maternal diets, particularly low in micronutrient content during pregnancy adversely affect fatal growth and development and ultimately the child's growth potential in later life.

Anaemia prevalence in India is highest in the world with higher among pregnant women and preschool children (Kalaivani, 2009). Anaemia during pregnancy adversely affects mother and the foetus health. Iron deficiency anaemia during pregnancy is associated with poor intrauterine growth, increased risk of preterm births, low birth weight child (Sharma and Shankar, 2010), poor mental development of the child especially when iron is deficient during the third trimester of pregnancy (Chang et al., 2013). Contributory factors can be inadequate dietary intake of iron, folate and/or B12 and poor bioavailability of dietary iron. These health outcomes will ultimately hinder development at a national level. Underweight is common among children of rural areas, while children in urban areas are facing burden of overweight (Monyeki et al., 2015).

Food security is defined as when all the people at all the time have access to sufficient, safe and nutritious food to maintain healthy and active life (WHO). Food security deals with availability, access and utilisation of food. Macro-level food security is achieved to a large extent with accelerated growth in agriculture since independence. Problem of hunger (resulting from insufficient food) is overcome to large extent but low and lower middle-income group are able to not able to meet their demand for nutrients. Hidden hunger (micronutrients deficiency) that may leads to increase vulnerability to infectious disease, physical and mental impairment ultimately reducing productivity is still persistent in the population. So, Kitchen garden can be part of solution to this problem.

Kitchen Garden

Home gardens/ kitchen garden are the oldest cultivation systems used in the world. A kitchen garden is a typically small cultivated areas that involves utilization of physical, social and economic resources on the area of land adjacent to homes generally in the backyard of the house (Beckford and Campbell, 2013) for production of wide diversity of fruits and vegetables to meet family needs and for achieving household food security (Sharp & Som, 2014).

Kitchen garden helps in achieving dietary diversity, improving household food availability, increases household access to micronutrient rich food and thus serves as base material for overall improvement in nutritional status, for poverty alleviation (Aworinde and Erinoso, 2013) and for achieving nutritional and food security at household level.

Management of kitchen garden needs knowledge regarding fruits and vegetables that can be planted according to different parameters such as illumination, harvest time, irrigation time etc. (Vergara-Lozano et al., 2017). Proper arrangement of plants is very important for efficient and maximum utilisation of available light (Gillespie et al., 1993).

Steps involved in development of kitchen garden: Area selected for home garden were 0.025 hectare (250 m2) or 0.08 to 0.16 hectares (Singh et al., 2016) and 0.75 hectare to 1.82 hectares (Egharevba et al., 2004) for the average family size of 4-6 members and family members were considered as working members for home garden.

Cropping was done in three seasons namely rainy, winter and summer and whole area was divided in three groups i.e., ground layer, lower storey and top storey. Ground layer includes seasonal and gourd-type vegetables, small shrubs, root and tuber crops. Lower storey constitutes small to medium size trees such as papaya, lemon whereas top storey includes big trees of coconut, mango and jackfruit. Vegetables and fruits were covering 50% and 25% of total area. Spices plus tuber crop covers 15 % of total cultivable area. Vegetables commonly grown were okra, bitter gourd, cucumber in one season, cowpea, chilli, brinjal in second season and tomato, cauliflower, carrot in third season. Commonly grown spices were ginger, turmeric and tuber crops such as yam, tapioca, colocasia etc. (Singh et al., 2016).

Types of Kitchen Garden

1. Traditional garden: Traditional gardens are grown on scattered plots. Production is seasonal in nature on which few traditional fruits and vegetables such as pumpkins are grown.

2. Improved garden: Production of improved garden is seasonal in nature. Improved gardens are grown on fixed plots so, production is more than traditional garden.

3. Developed garden: These are grown on fixed plot and production is throughout the year. In this type of kitchen garden, more varieties of fruits and vegetables are grown as compared to that of traditional and improved garden.

Nutritional Benefit/ Outcome of Kitchen Garden

1. Improvement in nutritional status: The health indicators such as weight-for-age ratio of children under five years of age, percentage prevalence of illnesses, percentage of chronically ill adults and percentage malnutrition in children were used to determine the effects of kitchen gardens on nutritional status and were found to be statistically significant (Mutambara et al., 2013).

2. Average increase in consumption: A minimum of 400g of fruit and vegetables per day (excluding potatoes and other starchy tubers) is recommended by WHO as fruits and vegetables are important for the prevention of chronic diseases such as heart disease, diabetes as well as for the prevention and alleviation of several micronutrient deficiencies (World Health Organization, 2014). Awasthi et al., 2016 found that before planting of kitchen garden, average vegetable consumption was less than RDA and consumption of roots and tubers was more in comparison to green leafy vegetables. Per day consumption and calorie intake of vegetable by household increases gradually after planting kitchen garden (Awasthi et al., 2016)(Food, c. T. I. H., 2010). Development of kitchen garden in 0.16 hectares area was able to provide 630.14 g/person/day that contains 638.36 kcal against the minimum requirement of 400 gm per person/day (WHO). Along with this, demands of iron and vitamin C were completely met along with 47 % of vitamin A, 20 % of calcium requirement as suggested by RDA (Singh et al., 2016). Kitchen garden also decreases the prevalence of anaemia among children of 6-59 months and non-pregnant mothers of children 6-59 months (Food, c. T. I. H., 2010).

3. Income generation: Kitchen garden helps in income generation of the household by sale of surplus fruits and vegetables.

Conclusion and Recommendation

The kitchen garden/ home garden serves different goals from leisure and recreation to self-consumption, healthy production, family savings and community integration. So, special emphasis should be given on promotion of Kitchen garden in rural areas. Households should be empowered and encouraged through governmental and non- governmental organizations for improving their practice of home gardening for achieving household food security. Promotion and development of kitchen garden can be done through National/ state level project and KVKs(Krishi Vigyan Kendra). Agriculture scientist (knowledge regarding farm) and home scientist can work together for promotion of kitchen garden in the backyard of house. Along with this, nutrition education emphasizing the importance of eating nutritious food, teaching mothers how to improve their household's dietary diversity and micronutrient consumption through locally grown foods should also be promoted.

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Amino Acid Therapy in Hepatic Failure

Article ID: 10611

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Introduction

The liver plays a central role in the maintenance of metabolic homeostasis. The biochemical functions in which the liver plays a major role include:

1. Intermediate metabolism of carbohydrates.
2. Regulation of fatty acid, triglyceride, and cholesterol metabolism.
3. Amino acid and ammonia metabolism.
4. Synthesis and degradation of proteins and glycoproteins.
5. Metabolism and degradation of drugs and hormones.
6. Metabolism of porphyrins, bilirubin.

Amino Acid and Ammonia Metabolism

The liver is the major site of amino acid conversion. Amino acids utilized for hepatic protein synthesis are derived from dietary protein, metabolic turnover of endogenous protein (primarily from muscle) and direct synthesis in the liver.

Most of the amino acids entering the liver via the portal vein are catabolized to urea (Except branched chain amino acids). A lesser amount is released into the general circulation as free amino acids. In addition, amino acids are utilized for synthesis of liver intracellular proteins, plasma proteins, and special compounds, such as glutathione, glutamine, taurine, and creatine.

Disruption of normal amino acid metabolism may be reflected in altered plasma amino acid concentrations. In general, levels of aromatic amino acids, normally metabolized by the liver are elevated, while those of BCAAs, largely utilized by the skeletal muscle, tend to be normal.

Hepatic catabolism of amino acids involves two major reactions: transamination and oxidative deamination. Transamination is catalysed by aminotransferases. These enzymes are found with very high activity in the liver. Deamination, which releases the amino group of the amino acids in the form of free ammonia, is catalysed mainly in liver. With severe liver damage amino acid utilization is impaired, free amino acids in the bloodstream increase, and an "overflow" type of aminoaciduria may occur.

The final step of Urea cycle i.e., the formation of urea by arginase, is irreversible. In advanced liver disease, urea synthesis is often depressed, leading to accumulation of NH3, usually with a significant reduction of blood urea nitrogen (BUN), an ominous sign of liver failure.

The intestinal production of NH_3 also occurs from bacterial deamination of unabsorbed amino acids and of protein derived from the diet, exfoliated cells, or blood in the gastrointestinal tract. Gut NH_3 is absorbed and transported to the liver via the portal vein where it is again converted to urea. Elevated level of blood ammonia correlates with the degree of encephalopathy.

Low Fischer Ratio

During hepatic failure, plasma levels of BCAA i.e., Leucine, Isoleucine and Valine decreases while level of aromatic amino acids (AAA) i.e., phenylalanine, tyrosine, and tryptophan increases. These changes in plasma levels are caused by increased BCAA catabolism in muscle and decreased AAA breakdown in the failing liver.

Accumulation of AAA in the circulation in combination with increased breakdown of BCAA, particularly in skeletal muscle give rise to a decrease in the BCAA/AAA ratio, which was called the Fischer-ratio (BCAA/AAA ratio). The increase in plasma AAA in combination with an increased blood brain barrier permeability for neutral amino acids contribute to an increased influx of AAA in the brain. This, in turn, would lead to imbalances in neurotransmitter synthesis and accumulation of false neurotransmitters, such as octopamine in the brain, which may contribute to hepatic encephalopathy (HE).

During liver failure, increased breakdown of BCAA occur in muscles and brain. The increased cerebral release of glutamine facilitates the rapid exchange of glutamine for neutral amino acids, i.e., AAA, by the large neutral amino acid carrier. This increased influx of AAA in the brain would raise the availability of precursors for neurotransmitters. In addition, increased uptake of tryptophan by the brain contributes to accelerated synthesis of the neurotransmitter serotonin, whereas phenylalanine and tyrosine may disturb brain neurotransmission by promoting the synthesis of cerebral catecholamines and the false neurotransmitters phenyl ethanolamine and octopamine.

Reversal of the disturbances was anticipated to occur upon restoration of a normal Fischer ratio, e.g., by the administration of supplemental BCAA.

Consequences of Decreased BCAA (Branched Chain Amino Acid)

During liver failure, decreased level of branched chain amino acid (BCAA) is seen resulting in following consequences:

1. BCAAs activate synthesis of albumin. Albumin has a strong tryptophan-binding capacity and therefore plasma free tryptophan levels are inversely correlated with plasma albumin levels. Low albumin levels during chronic liver failure, may lead to increased brain uptake of tryptophan because of increased availability of free tryptophan. BCAA supplementation in patients with advanced cirrhosis prevented progressive hepatic failure and increasing serum albumin level to 3.5-3.9 g/dL and increasing total hepatic parenchymal cell mass.

2. Decreased level of BCAA includes decrease the level of isoleucine also. Absence of isoleucine in the haemoglobin molecule increases upper gastrointestinal bleeding contributing to uremia and hyperammonemia. Several of the metabolic abnormalities caused by the upper gastrointestinal bleed, including hyperammonemia, can be corrected by simultaneous intravenous administration of isoleucine, which corrects the abnormal BCAA pattern.

Protein and Amino Acid Therapy in Hepatic Failure

Moderate restriction depending on protein tolerance (0.5 - 1.2 g/kg body weight/day), with the possible addition of branched chain amino acids (BCAA), has been recommended in patients depending upon the stage of liver disease.

Proteins of plant origin are theoretically superior to animal proteins (Ambühl, 2011). The type of protein consumed may be as important as the total amount of protein ingested. Vegetable protein diets contain more dietary fibre than isonitrogenous meat protein diets. Fibre increases the rate of transit of food through the intestines, resulting in increased faecal ammonia excretion, and reduces the pH of the colonic lumen, which may result in a favourable microbiota (Nguyen and Morgan, 2014). Compared with meat-based protein, vegetable protein is poor in the sulphated amino acids methionine and cysteine, which are precursors of the mercaptans and indole and/or oxindole compounds which have been implicated in the pathogenesis of hepatic encephalopathy. Vegetable proteins are high in ornithine and arginine, which facilitate ammonia disposal through the urea cycle.

Amino acid formulations for administration to human patients with liver disease consist of mixtures of essential amino acids (in relative proportions) and small amount of non-essential amino acids. It should also include BCAA (Branched chain amino acid).

Combined molar proportions of isoleucine, leucine, and valine should be from 40 to 300 times the molar proportion of tryptophan and from 15 to 135 times the molar proportion of phenylalanine, or phenylalanine and tyrosine. Sulphur containing AA and aromatic amino acid should be restricted.

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Natural Medicine "*Momordica charantia*" Used in the Treatment of Diabetes Mellitus

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Introduction

Momordica charantia or Bitter Gourd is commonly called as kugua, karela, bitter gourd or gourdin belonging to family cucurbitaceae. Ayurvedic medicine uses the extract, which was found to activate in inactive insulin present in the blood as well as rejuvenate the pancreas, thus being beneficial to patients with diabetes.

Momordica charantia and Diabetes Mellitus: Mechanism of Action

Two medicinal compounds extracted from M. charantia include, momocharin or charantin, a steroidal saponin agent with insulin-like properties and momordicin, an alkaloid responsible for the bitterness of the fruit (Pitipanponga et al., 2007). Charantin, insulin-like peptides and alkaloids possess hypoglycemic properties. It also contains Gurmarin, a polypeptide (similar to bovine insulin) that has a positive sugar regulating effect by suppressing the neural response to sweet taste stimuli.

1. Preservation of pancreatic beta cells and insulin secretion: Oral administration of *M. charantia* fruit juice could lead to increases the mitosis of pancreatic cells (increase in number of beta cells), recovery of partially destroyed beta cells (Lakshmi et al., 2012) and prevented further pancreatic beta cell death by decreasing the oxidative stress. *M. charantia* is a fruit and will likely contain anti-oxidants (vitamin C). Antioxidants presumably help in preventing pancreatic beta cell death by neutralising the free radicals. It also stimulates insulin secretion from the endocrine pancreas (Welihinda et al., 1982), and elicit glucose uptake in the liver. In this way, *M. charantia* exerts its hypoglycemic effects.

2. *M. charantia* and glucose metabolism: *M. charantia* and its extracts can directly regulate blood glucose via two mechanisms.

a. Firstly, it can regulate how much glucose is absorbed by the gut into the blood following a meal. The glucose metabolism starts in the gut. Carbohydrates and sugars are metabolized to glucose before glucose is transported from the gut to the blood (Rani et al., 2014). Alpha-glucosidase is a glucosidase located in the brush border of the small intestine that acts upon α (1→4) bonds (wikipedia.org/wiki/Alpha-glucosidase). Bitter gourd causes inhibition of α-glucosidases that break down disaccharides to two monosaccharides and Na+/K+ dependent glucose uptake from intestine. This means it suppresses gastric emptying and inhibits glucose transport at the brush border of small intestine (Matsuda et al., 1999). There is about 80% reduction in the glucose uptake by *M. charantia*.

b. Secondly, it can stimulate glucose uptake into skeletal muscle cells (Garau et al., 2003) just like insulin. The pancreas reacts to increasing blood sugar levels by secreting insulin into the blood. Insulin helps to transport the sugar from the blood to the skeletal muscle and the fat tissue where it's used to produce energy. Insulin will also stop the liver to produce sugar from glycogen storages and to release the sugar into the blood. Thus, insulin is necessary to lower high blood sugar levels. In Type I diabetes, also called insulin-dependent diabetes, the pancreas does not produce or secrete enough insulin to keep blood sugar levels low (Rani et al., 2014). *M. charantia* may have a direct effect in inducing a reduction in blood glucose level as it has 'p – insulin' or 'v – insulin', having effect similar to that of human insulin and thus, stimulates peripheral cell glucose uptake.

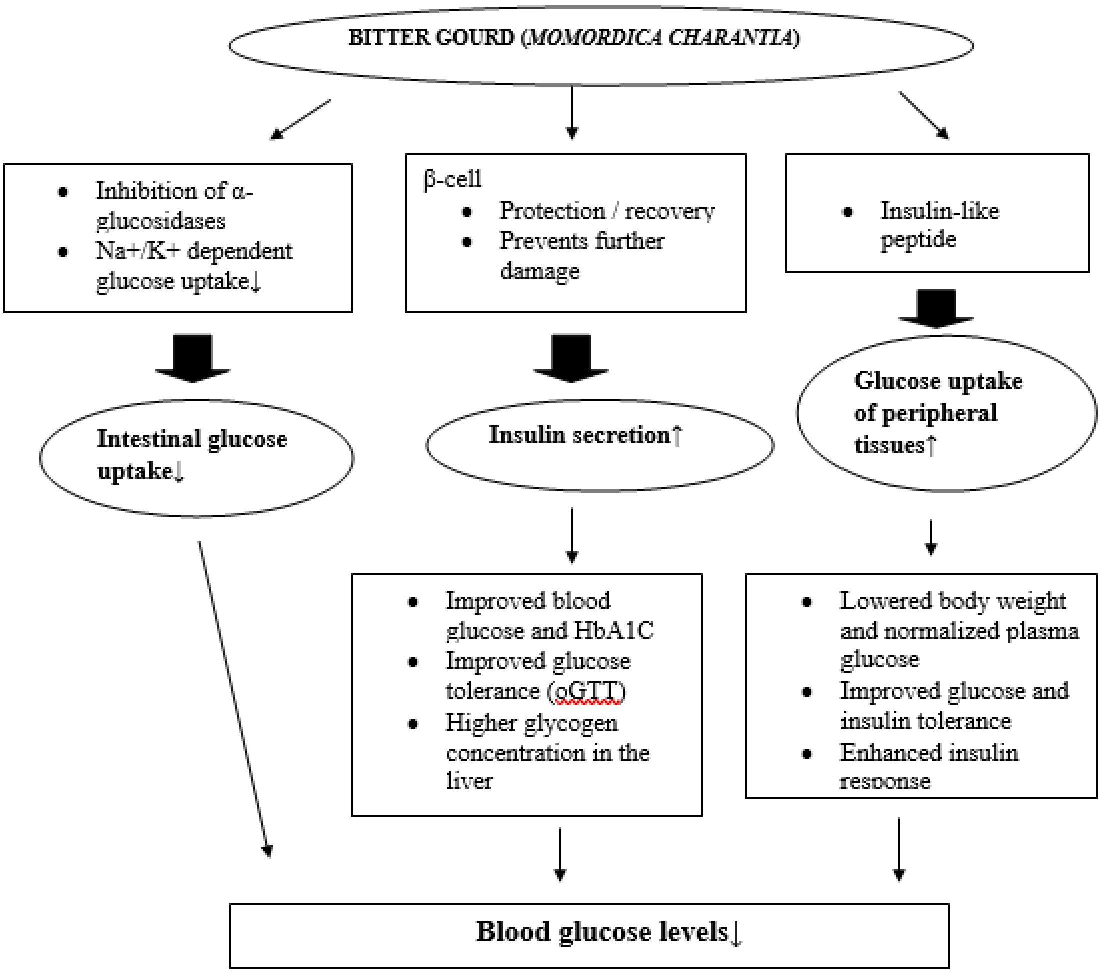
c. Anti – neuropathic effect of *M. charantia* fruit juice: The administration of *M. charantia* fruit juice not only reduced blood glucose level but also corrected the structural abnormalities of peripheral nerves. *M. charantia* possesses growth factor-like properties just like insulin (Singh et al., 2011).

Dose

Saponins isolated from *Momordica charantia* shows insulin releasing activity in beta cells at concentration of 10 and 25 microgram/ ml (Keller et al., 2011). Bitter gourd "Karela" juice when it is administered, it is documented to lower sugar levels 15 min after intake.

One-half of one cup of a standard leaves or whole herb concoction, 1-2 times daily is adequate for a hypoglycemic effect. Many people liquidize two to three green fruits with water to juice and drink 10 to 20 ml twice per day prior to meal (Singh et al., 2011) was found to be beneficial in treating diabetes. Consumption of 50 ml of raw Karela juice daily improves blood glucose tolerance in type II DM.

Bitter melon herb contains plant chemicals which have the same effects as those produced by the commonly prescribed anti-diabetic drugs but without the side effects. An interaction may occur between a commercially available hypoglycemic drug and *M. charantia* or its hypoglycaemic extract as both of them helps in lowering blood sugar. For people with T2DM there is no harm in using *M. charantia* alone, but this should be combined with regular physical exercise and modification of daily diet (Basch et al., 2003). *M. charantia* is an alternative herbal therapy that has been used primarily to reduce blood glucose level for thousands of years in patients with DM.



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E. Coli

Article ID: 10613

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Introduction

Escherichia coli (commonly abbreviated *E. coli*) is a Gram-negative, facultative anaerobic, rod-shaped bacterium of the genus *Escherichia* that is commonly found in the lower intestine of warm-blooded organisms (endotherms).

Most *E. coli* strains are harmless, but some serotypes can cause serious food poisoning in their hosts due to food contamination. The harmless strains are part of the normal flora of the gut, and can benefit their hosts by producing vitamin K_2, and preventing colonization of the intestine with pathogenic bacteria.

Some strains cause serious poisoning in humans by making a toxin called Shiga toxin. These bacteria are called "Shiga toxin-producing" *E. coli* or STEC in short. The most commonly identified STEC is *E. coli* O157:H7, according to the Centres for Disease Control and Prevention (CDC). Cattle are the main sources of *E. coli* O157:H7, but these bacteria are also in other domestic and wild mammals.

The bacteria often cause bloody diarrhoea and can lead to kidney failure, especially in young children or in people with weakened immune systems. Most illness has been associated with contaminated food or water, contact with an infected person, or contact with animals that carry the bacteria.

Types of *E. coli* on their Ability to Cause Disease

Based on disease syndromes and characteristics and also on their effect on certain cell cultures and serological groupings, five virulence groups of *E. coli* are recognized:

1. Entero aggregative *E.coli* or Facultative entero pathogenic *E.coli.*
2. Entero hemorrhagic *E. coli* (EHEC).
3. Entero invasive *E. coli* (EIEL).
4. Entero pathogenic *E. coli* (EPEC).
5. Entero toxigenic *E. coli* (ETEC).

   a. **Entero pathogenic *Escherichia coli* (EPEC):** They do not produce entero toxins but causes diarrhoea.

   b. **Entero invasive *Escherichia coli* (EIEC):** It does not produce entero toxins. It causes ulceration and inflammation in the epithelial cells of the colon. It causes symptoms of invasive bacillary dysentery normally associated with Shigella.

   c. **Entero haemorrhagic *E. coli* (EHEC):** Produces two basic toxins. Usually, they are called shiga like toxin SLT-I SLT-II. Also known as Vero toxin producing *E. coli* (VTEC).

   d. **Entero toxigenic *E. coli* (ETEC):** Primary enterotoxins which are heat labile and stable are produced.

   e. **Facultative entero pathogenic *E. coli* (FEEC):** It is associated with sporadic diarrhoea out breaks.

Most *E. coli* are commensals, that is, they reside in the intestine but are not harmful for the host animal. Only a small proportion of strains are pathogenic, producing virulence factors permitting them to cause disease. Some E. coli possess virulence genes in combinations not known to be associated with disease, and may be considered as potentially pathogenic. All E. coli may carry genes for resistance to antimicrobial agents.

Ecology of Pathogenic *E. coli*

E. coli bacteria are constantly being shed into the immediate environment of the animals via the faeces, and contaminate litter, and floor of animals being housed indoors and the soil for outdoor animals. They can persist for long periods, possibly more than 10 weeks, and be spread via the slurry and manure to fertilised fields and crops, and to ground and surface water.

E. coli is transmitted to other animals via contaminated feed, handlers, and drinking water, and possibly farm to farm by vehicles such as transport trucks. Infection occurs by the oral. E. coli from animals may be transmitted to humans by direct contact, or ingestion of food or water contaminated following spread of manure, or ingestion of meat following contamination of carcasses at the slaughterhouse. Intestinal infections are often contagious. The faecal microflora is a reservoir for extraintestinal infections such as mastitis, and urogenital tract infection. Similarly, EPEC (entero pathogenic E.coli) are commonly found in the intestines and faeces of normal animals, but may cause disease in immune-compromised animals.

Symptoms

Shiga toxin-producing *E. coli* (STEC) can cause the following symptoms:
1. Nausea.
2. Severe abdominal cramps.
3. Watery or very bloody diarrhoea.
4. Fatigue.

STEC can also cause low-grade fever or vomiting. Symptoms usually begin from 2 to 5 days after eating contaminated food or drinking contaminated liquids. Symptoms may last for 8 days, and most people recover completely from the disease.

Prevention

According to the Centres for Disease Control and Prevention, to prevent Shiga toxin-producing *E. coli* (STEC) infection, one should:
1. Wash hands thoroughly after going to the bathroom or changing diapers.
2. Wash hands thoroughly after handling animals, animal bedding, or any material contaminated with animal faecal matter.
3. Eat only thoroughly cooked ground beef, pork, sheep meat, or sausage.
4. Cook ground meat products to an internal temperature of 160ºF.
5. Avoid drinking unpasteurized milk and juices.
6. Wash fresh fruits and vegetables thoroughly before eating raw.
7. Prevent cross contamination in food preparation areas by washing hands, counters, cutting boards, and utensils after they touch raw meat.
8. Keep raw meat separate from ready-to-eat foods.

Diagnosis

It includes: Anyone who suddenly develops diarrhoea with symptoms of bloody stool. Lab tests are also available to identify Shiga toxin-producing *E. coli* in stool samples.

To identify the reservoirs of STEC and the routes of transmission to man, sensitive methods are needed as these pathogens may only be present in food, environmental and faecal samples in small numbers.

Cultural methods for the enrichment, isolation and confirmation of O157 STEC are still evolving. Several selective enrichment media have been described, of which modified tryptone soy broth with novobiocin and modified *E. coli* broth with novobiocin, seem to be the most appropriate. These media are minimally-selective broths that give a somewhat limited differential specificity favouring isolation of O157 STEC, as opposed to other Gram-negative bacteria, in the sample. An incubation temperature of 41-42 degrees C further enhances selectivity.

The most widely used plating medium for the isolation of typical sorbitol-non-fermenting strains of STEC of serogroup O157 is sorbitol MacConkey agar with cefixime and tellurite (CT-SMAC).

Immunomagnetic separation (IMS) following selective enrichment, and subsequent spread-plating of the concentrated target cells onto CT-SMAC agar, appears to be the most sensitive and cost-effective method for the isolation of *E. coli* O157 from raw foods. Cultural isolation of O157 STEC from foods and faeces is time-consuming, labour-intensive and hence, costly, rapid immunological detection systems have been developed which significantly reduce the analysis time.

These methods include enzyme-linked immunosorbent assays (ELISAs), colony immunoblot assays, direct immunofluorescent filter techniques, and several immunocapture techniques. Many of these test systems are able to detect less than one O157 STEC cell g(-1) of raw meat after overnight enrichment. Presumptive results are available after just one day, but need to be completed with the isolation of the organisms. The primary use of these procedures is therefore to identify food and faecal samples that possibly contain O157 STEC.

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Natural Medicine *"Moringa oleifera"* Used in the Treatment of Diabetes Mellitus

Article ID: 10614

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Introduction

Moringa Oleifera or Drumstick is a member of the Moringaceae family. Moringa oleifera is an edible plant. A wide variety of nutritional and medicinal virtues have been attributed to its roots, bark, leaves, flowers, fruits, and seeds (Mbikay, 2012). The leaves, young shoots, are eaten in vegetable curries, as pickles and as salads. The leaf can be eaten fresh and cooked, or as reported that if leaves are stored as dry powder for many months without refrigeration then there is no loss of any nutritional value. It is an effective remedy for diabetes and malnutrition.

Nutritional Benefits

Moringa is rich in nutrition. In fact, gram-for-gram comparisons of M. oleifera leaves (fresh and dried) reveals that M. oleifera provides 7 times more vitamin C than oranges and 10 times more vitamin A than carrots (Rockwood et al., 2013).

Phytochemicals like phenolic compounds are usually related to several biological activities, including antioxidant potential and radical scavenging, which is relevant for therapeutics and nutraceutical applications. Pakade et al. (2013) compared the antioxidant activity of the leaves and flowers of the *Moringa oleifera* plant with selected vegetables (cabbage, spinach, broccoli, cauliflower and peas).

The total phenolics content of moringa was almost twice that of the vegetables and the total flavonoids content was three times that of the selected vegetables. The order of scavenging activity (from low to high) was peas ≤ cabbage < cauliflower ≤ spinach < broccoli < Moringa leaf< moringa flower. Therefore, the moringa samples showed higher scavenging activity than the selected vegetables. The scavenging ability of moringa was also higher than that of ascorbic acid, a known antioxidant.

The reducing power of moringa was higher than that of the vegetables and the percentage of free radicals remaining was lower in compared with the vegetables. It is known that phenolic and flavonoid contents are directly linked to antioxidant properties. Therefore, moringa exhibited greater antioxidant activity than the selected vegetables.

Siddiq *et al* (2005) evaluated antioxidant activity of different solvent extracts of *Moringa Oleifera* Leaves. Results of the study shows that 80% of methanolic extract of *Moringa Oleifera* Leaves was having least contents of conjugated trienes during oxidation and thus has higher antioxidant activity.

Moringa oleifera and Diabetes Mellitus

Moringa has been shown to cure both Type 1 and Type 2 diabetes. Moringa can act as an anti-diabetic agent. In diabetes, high glucose enters the mitochondria and releases reactive oxygen species. Since beta cells have low number of antioxidants, this in turn causes apoptosis of the beta cells. This reduces insulin secretion leading to hyperglycemia and in turn diabetes mellitus Type-2.

The flavonoids like quercitin and phenolics have been attributed as antioxidants that bring about a scavenging effect on ROS (reactive oxygen species). The flavonoids in Moringa scavenge the ROS released from mitochondria, thereby protecting the beta cells and in turn keeping hyperglycemia under control (Gopalakrishnan et al., 2016).

Antioxidants of Moringa Oleifera reduces potassium ferricyanide, scavenging superoxide radicals, preventing peroxidation of lipid membranes in liposomes, inhibiting peroxidation of linoleic acids and preventing bleaching of carotenoids (Razis et al., 2014).

Presence of terpenoids in the leaves of Moringa oleifera are involved in the stimulation of beta cells and the subsequent secretion of preformed insulin, thus, contributes to hypoglycemic and anti-hyperglycemic activity (Tende et al., 2011).

Diabetes leads to several complications such as retinopathy, nephropathy and atherosclerosis etc. Moringa can be used to prevent such ailments. When there is hyperglycemia, the blood glucose reacts with proteins and causes advanced glycated end products (AGEs). These AGEs bind to RAGE which gets expressed on the surface of immune cells. At the same time, the cell adhesion molecules are expressed on the surface endothelium of arteries.

This facilitates transendothelial migration which causes inflammation in the arteries and leads to atherosclerosis. Moringa is used as an anti-atherosclerotic agent. The anti-atherogenic nature can be accounted for by the antioxidant properties of moringa (Gopalakrishnan et al., 2016).

Kumar and Mandapaka (2013) found that Moringa oleifera leaf powder when administered with the food decreases the serum glucose levels and concluded that the leaves of Moringa oleifera have definite hypoglycemic and hypocholesterolemic activity in type II diabetes mellitus in obese people. Ples and Ho stated that one cup of tea given to hyperglycemic individuals prepared from Moringa oleifera significantly dropped the blood sugar levels after 2 hours. Tea was prepared by mixing one tablespoon of leaves into a cup of hot water brewed for 5 minutes. A mean drop of 28.15 mg/dl in the blood sugar levels was observed among the hyperglycemic patients.

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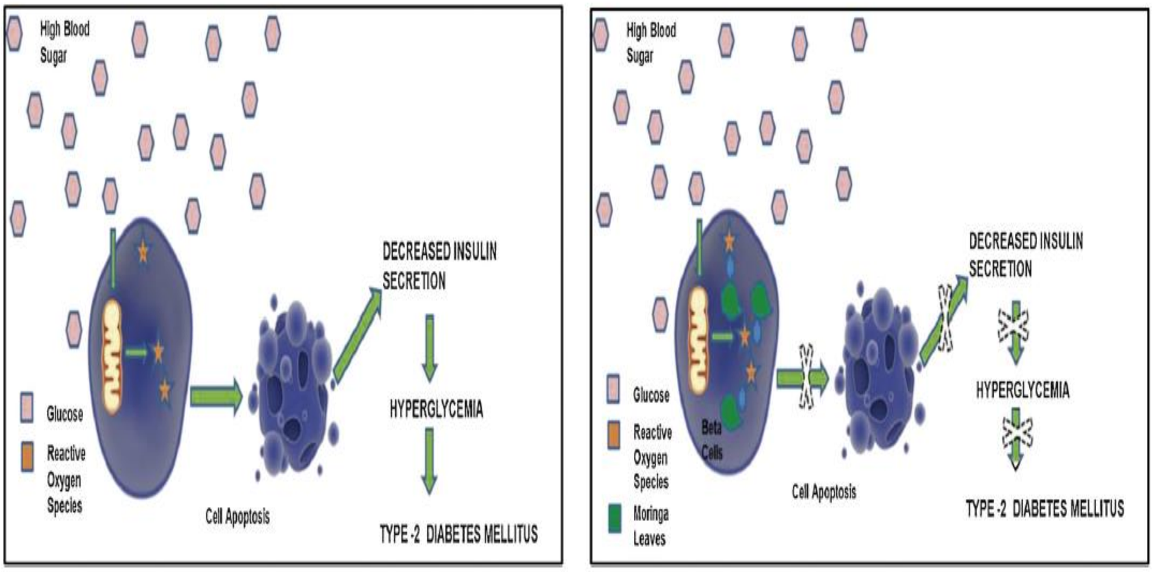

Figure 1: Mechanism of high glucose leading to diabetes and the effect of Moringa on progression of Diabetes.

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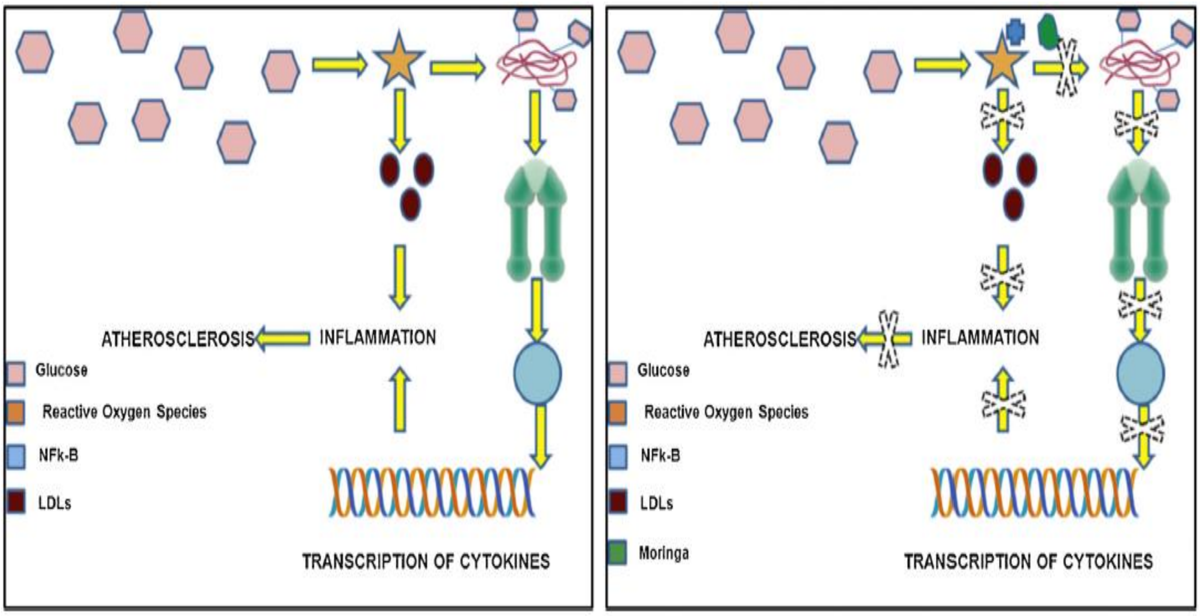

Figure 2: Mechanism of Diabetes leading to atherosclerosis and effect of Moringa on progression of atherosclerosis.

Hypertension

Article ID: 10615

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Introduction

Blood Pressure: Blood pressure (BP) is the pressure exerted by circulating blood upon the walls of blood vessels. “Blood pressure" usually refers to the arterial pressure of the systemic circulation. It is measured at a person's upper arm. It is expressed in terms of the systolic (maximum) pressure over diastolic (minimum) pressure and is measured in millimetres of mercury (mm Hg). Normal resting blood pressure for an adult is approximately 120/80 mm Hg.

Blood pressure is a measurement of the force against the walls of arteries as heart pumps blood through body. Blood pressure that is low is called hypotension, and pressure that is pathologically high is hypertension. High blood pressure (hypertension) is when blood pressure is 140/90 mm Hg. If blood pressure numbers are 120/80 or higher, but below 140/90, it is called pre-hypertension.

Hypertension: Hypertension (HTN or HT), also known as high blood pressure or arterial hypertension, is a condition in which the blood pressure in the arteries is elevated. Blood pressure is expressed by two measurements, the systolic and diastolic pressures. The systolic pressure occurs when the left ventricle is most contracted; the diastolic pressure occurs when the left ventricle is most relaxed prior to the next contraction. Normal blood pressure at rest is within the range of 100–140 mmHg systolic and 60–90 mmHg diastolic.

Etiology

Primary (essential) hypertension: Over 90% people with hypertension have no identifiable cause of hypertension and are called essential hypertension or primary hypertension, tends to develop gradually over many years. The factors for primary hypertension include:

a. Advancing age: Blood pressure risks rises with age. People with normal blood pressure at age of 55 years have 90% lifetime risks of developing hypertension.

b. Heredity: Family history of hypertension is a strong predictive factor.

c. Obesity: People with a BMI of 30 kg/m3 or higher are more likely to develop high blood pressure.

d. Eating too much salt: High sodium intake increases blood pressure in some people.

e. Lack of physical activity: A sedentary lifestyle is associated with overweight and increased blood pressure.

f. Drinking too much alcohol: Heavy and regular use of alcohol increases blood pressure.

g. Low education and income level: Low education and income level is also responsible for essential hypertension.

h. Stress: Stress may contribute to sustained high blood pressure. When stress occur to a person, either internal or external , it activates sympathetic nervous system, heart rate increases, arteries constrict and blood exerts greater force on artery wall. Chronic stress has been implicated in heart disease.

Secondary hypertension: Approx. 4 to 8% of people with hypertension tend to have identifiable causes for elevated blood pressure and are called secondary hypertension.

It includes: Renal disease that accounts for hypertension in 40 % cases. It includes glomerulonephritis (acute inflammation of kidney), chronic pyelonephritis(inflammation of kidney as a result of bacterial infection), polycystic kidney disease(cystic genetic disorder), obstructive uropathy(structural or functional hindrance of normal urine flow).

Other factors for secondary hypertension include use of oral contraceptive in women, Endocrine diseases like acromegaly, hyperaldosteronism, cushing's syndrome, hypothyroidism etc., Certain defects in blood vessels that can be congenital, Illegal drugs, such as cocaine and amphetamines and chronic alcohol use.

Pathophysiology of Hypertension

In essential (primary) hypertension, increased resistance to blood flow (total peripheral resistance) accounts for the high pressure while cardiac output remains normal. The increased peripheral resistance in established hypertension is mainly due to structural narrowing of small arteries and arterioles.

In some younger people with pre-hypertension or 'borderline hypertension' have high cardiac output, an elevated heart rate and normal peripheral resistance, termed hyperkinetic borderline hypertension. These individuals develop the typical features of established essential hypertension in later life as their cardiac output falls and peripheral resistance rises with age.

Pulse pressure (the difference between systolic and diastolic blood pressure) is frequently increased in older people with hypertension. This can mean that systolic pressure is abnormally high, but diastolic pressure may be normal or low — a condition termed isolated systolic hypertension. The high pulse pressure in elderly people with hypertension or isolated systolic hypertension is explained by increased arterial stiffness, which is due to aging and may be exacerbated by high blood pressure.

Endothelial dysfunction and vascular inflammation may also contribute to increased peripheral resistance and vascular damage in hypertension. Essential hypertension (EHT) is the most common cardiovascular disorder. It is associated with functional and morphological alterations of the endothelium. Due to its position between blood stream and smooth muscle cells (responsible for peripheral resistance), the endothelium is thought to be both target and mediator of arterial hypertension.

The endothelium of blood vessels produces an extensive range of substances that influence blood flow and, in turn, is affected by changes in the blood and the pressure of blood flow. The increased vascular resistance in essential hypertension is related to the imbalance of action of vasodilators and vasoconstrictors. In patients with essential hypertension, the balance between the vasodilators and the vasoconstrictors is upset, which leads to changes in the endothelium and sets up a "vicious cycle" that contributes to the maintenance of high blood pressure.

It is found that disturbances in the kidney salts and water handling (particularly abnormalities in the renin-angiotensin system) that may leads to hypertension.

Renin is a circulating enzyme that participates in maintaining extracellular volume, and arterial vasoconstriction, thus, it helps to maintain blood pressure. Renin hydrolyzes angiotensinogen (secreted from liver) into the peptide angiotensin I. Angiotensin l is further cleaved by an enzyme called angiotensin converting enzyme (ACE) that is located primarily but not exclusively in the pulmonary circulation bound to endothelium, producing angiotensin II, the most vasoactive peptide. Angiotensin II is a potent constrictor of all blood vessels. It acts on the musculature of arteries and so elevates blood pressure. Angiotensin II also acts on the adrenal glands too and releases Aldosterone, which stimulates the epithelial cells of the kidneys to increase re-absorption of salt and water leading to raised blood volume and raised blood pressure.

Enzyme renin is associated with some cases of essential hypertension. The enzyme promotes the formation of angiotensin protein that causes arteries to constrict. Some people with essential hypertension have higher than normal level of renin in their blood. People with high renin level have an increased incidence of heart attacks, strokes, and kidney failure.

Other people with essential hypertension have lower than normal levels of renin in their blood. Their hypertension may be caused primarily by increased blood volume. This condition could result either from decreased sodium excretion by kidney or from increased secretion of aldosterone, a hormone that causes kidney to retain sodium and water.

Metabolic Anomalies of Hypertension

If person suffering is from hypertension, following metabolic anomalies are seen:

1. Elevations in fasting or post plasma glucose concentrations: mild elevation is seen in both fasting and post prandial glucose level in person having hypertension because hyperinsulinemia is seen in person. As a result, glucose tolerance tends to decline.

2. Serum triglycerides, total cholesterol, HDL cholesterol levels: there is raised level of serum triglycerides and total cholesterol content in the blood. And an HDL cholesterol level tends to decline in blood.

3. Hyperinsulinemia: Hyperinsulinemia i.e., excess of insulin is found circulating in blood than expected level of glucose both in the fasting and the glucose-stimulated state. But this insulin is not being utilised for converting glucose to glycogen so, there is also elevated level of glucose in the blood. There is presence of insulin resistance.

Clinical Manifestation of Hypertension

Heart: The left ventricle responds to the persistent hypertension with hypertrophy aiming to decrease wall tension. Excessive hypertrophy compromises diastolic filling leading to a reduced stroke volume (volume of blood pumped from left ventricle of heart per beat). The hypertrophy may be associated with poor capillary blood flow to the myocardium and result in dysrhythmias (abnormality in physiological rhythm of heart) and reduced cardiac function.

Kidney: Hypertension damages the blood vessels in the kidneys, which impairs the kidneys' functioning, including their ability to dispose of excess fluids from body. In the kidneys a persistent increase in glomerular pressure results in glomerulosclerosis(fibrosis and scarring of renal glomeruli) and loss of functional nephrons. This may lead to proteinuria and elevated blood urea and creatinine.

Eye: Chronic hypertension damages the small blood vessels in the retina and contributes to disease of the larger blood vessels of the eye that is of the retinal artery and vein. Hypertensive retinopathy that is damage to retina of eye occurs. So, Vision loss can occur. If blood pressure rises suddenly to very high levels, a condition known as malignant hypertension, swelling of the optic disk may occur, and can be accompanied by headache, vomiting and changes in the person's mental state.

Diagnosis

High blood pressure is often called a "silent disease" as there may be no outward symptoms or signs but can cause several other diseases, so monitoring of blood pressure is important. Blood pressure can be measured with a blood pressure cuff (sphygmomanometer).

Blood pressure measurements fall into four general categories:

1. Normal blood pressure: Blood pressure is normal if it's below 120/80 mm Hg. However, some doctors recommend 115/75 mm Hg as a better goal. Once blood pressure rises above 115/75 mm Hg, the risk of cardiovascular disease begins to increase.

2. Pre-hypertension: Pre-hypertension is a systolic pressure ranging from 120 to 139 mm Hg or a diastolic pressure ranging from 80 to 89 mm Hg. Pre-hypertension tends to get worse over time.

- **a. Stage 1 hypertension:** Stage 1 hypertension is a systolic pressure ranging from 140 to 159 mm Hg or a diastolic pressure ranging from 90 to 99 mm Hg.
- **b. Stage 2 hypertension:** More severe hypertension, stage 2 hypertension is a systolic pressure of 160 mm Hg or higher or a diastolic pressure of 100 mm Hg or higher.

Both numbers in a blood pressure reading are important. But after age 60, the systolic reading is even more significant. Isolated systolic hypertension occurs when diastolic pressure is normal but systolic pressure is high and is a common type of high blood pressure among people older than 60.

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Cyanogenic Glycosides

Article ID: 10616

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Introduction

Cyanogenic glycosides are chemical compounds contained in plant foods and may be hydrolysed chemically or enzymatically to yield hydrogen cyanide. The act of chewing or digestion leads to hydrolysis of the substances, causing cyanide to be released.

Food Sources of Cyanogenic Glycosides

Cyanogenic glycosides are present in apples, apricots, cherries, peaches, plums, and quinces, particularly in the seeds of such fruits. The chemicals are also found in almonds, sorghum, lima beans, cassava, corn, yams and chick-peas. Cassava and sorghum are especially important staple foods containing cyanogenic glycosides.

There are approximately 25 cyanogenic glycosides known. The major cyanogenic glycosides found in the edible parts of plants used for human consumption are summarized in Table below.

Cyanogenic glycosides	Plant species
Amygdalin	Almonds
Dhurrin	Sorghum
Linamarin	Cassava lima beans
Lotaustralin	Cassava lima beans
Prunasin	Stone fruits like apricot, cherry, peach, and plum.
Taxiphyllin	Bamboo shoots

How Cyanogenic Glycosides Interfere with Metabolism in Body

The first aspect is the processing of plant products containing cyanogenic glycosides. When the edible parts of the plants are macerated, the catabolic intracellular enzyme ß-glucosidase can be released, coming into contact with the glycosides.

This enzyme hydrolyses the cyanogenic glycosides to produce hydrogen cyanide and glucose and ketones or benzaldehyde. The hydrogen cyanide is the major toxic compound causing the toxic effects. Plant products (especially cassava), if not adequately detoxified during the processing or preparation of the food, are toxic because of the release of this preformed hydrogen cyanide.

The second aspect is the direct consumption of the cyanogenic plant. Maceration of edible parts of the plants as they are eaten can release ß-glucosidase. The ß-glucosidase is then active until the low pH in the stomach deactivates the enzyme. Additionally, it is possible that part of the enzyme fraction can become reactivated in the alkaline environment of the gut. At least part of the potential hydrogen cyanide is released, and may be responsible for all or part of the toxic effect of cyanogenic glycosides in the food's rich in cyanogenic glycosides.

The third aspect is that the cyanogenic glycosides taken up intact with the food are (partly) hydrolysed by the ß-glucosidase activity of the bacteria of the gut flora of humans. Cyanide, released from a cyanogenic glycoside in food by ß-glucosidase either of plant or from gut microflora origin and taken up, follows the known cyanide metabolic pathway and toxicokinetic both for animals and man. Cyanide is detoxified by the enzyme rhodanese, forming thiocyanate, which is excreted by urine.

Absorption, Distribution, and Excretion

Absorption and distribution: Hydrogen cyanide is readily absorbed. After absorption, cyanide is rapidly distributed in the body through the blood. The concentration of cyanide is higher in erythrocytes than in plasma. It is known to combine with iron in both methaemoglobin and haemoglobin present in erythrocytes. The cyanide level in different human tissues in a fatal case of HCN poisoning has been reported: gastric content; 0.03, blood; 0.50, liver; 0.03, kidney; 0.11, brain; 0.07, and urine; 0.20 (mg/100 g).

Excretion: Urinary excretion was the main route of elimination of the cyanide. The major metabolite of cyanide excreted in urine is thiocyanate. A very small amount is found to be excreted through expired air. Of the total excretion in expired air, 90% is excreted as carbon dioxide and rest as cyanide.

The major defence of the body to counter the toxic effects of cyanide is its conversion to thiocyanate mediated by the enzyme rhodanese. The conversion of cyanide to the less toxic thiocyanate by rhodanese was discovered by Lang (1933).

The rhodanese-catalyzed irreversible conversion of cyanide to thiocyanate, in the presence of thiosulfate, provides a means for the treatment of cyanide poisoning. Since the enzyme, which is usually localized in the mitochondria in different tissues, is relatively abundant, but in sites which are not readily accessible to thiosulfate, the limiting factor for the conversion of cyanide is thus thiosulfate.

The Overall Rate of in Vivo Detoxification of Cyanide may be Influenced by Several Minor Reactions

Cystine may directly react with cyanide to form 2-imino-thiazolidine-4-carboxylic acid which is excreted in saliva and urine. Traces of hydrogen cyanide may be found in expired air, saliva, sweat and urine. A minor amount may be converted into formic acid which may be excreted in urine or participate in the metabolism of one carbon compound.

One minor detoxification route is the combination of cyanide with hydroxycobalamine (vitamin B12) to form cyanocobalamine which is excreted in urine and bile. It may be reabsorbed by the intrinsic factor mechanism at the level of the ileum allowing effective recirculation of vitamin B12. Methaemoglobin effectively competes with cytochrome oxidase for cyanide and its formation from haemoglobin, affected by sodium nitrite or amylnitrite, is exploited in the treatment of cyanide.

It has been reported that other species have lower rhodanese activity than the rat and hence the rat may be able to convert cyanide to thiocyanate more easily than other species.

The highest activity of rhodanese is found in kidney, followed by liver, brain, lung, muscle, and stomach. Other tissues studied did not show significant rhodanese activity. Human liver contains lower rhodanese activity compared with ruminants and non-ruminants, except for dog which has comparable hepatic activity with human. Human kidney contains significant activity.

Effects on Enzymes and Other Biochemical Parameters

Cyanide causes a decrease in the utilization of oxygen in the tissues, producing a state of anoxia. This occurs through inactivation of tissue cytochrome oxidase by cyanide, which combines with Fe^{3+}/Fe^{2+} contained in the enzyme.

Cyanide can inhibit several other metalloenzymes most of which contain iron, copper or molybdenum (e.g., alkaline phosphatase, carbonic anhydrase), as well as enzymes containing Schiff base intermediates (e.g., 2-keto-4-hydroxyglutarate aldolase).

Cyanide causes an increase in blood glucose and lactic acid levels and a decrease in the ATP/ADP ratio indicating a shift from aerobic to anaerobic metabolism.

Cyanide apparently activates glycogenolysis and shunts glucose to the pentose phosphate pathway decreasing the rate of glycolysis and inhibiting the tricarboxylic acid cycle.

1. Symptoms: The clinical signs of cyanide poisoning include headache, dizziness, mental confusion, breathlessness, gasping, paralysis, muscle weakness, stupor, cyanosis with twitching and convulsions, followed by coma and death.

2. Toxicity in humans: Cyanide content in the range of 10-20 mg /100 gm of pulses is considered to be safe. The green pod shells of rajmah contain traces of cyanogenic glycosides. Many legumes except lima beans contain cyanide within this limit.

Because the body rapidly detoxifies cyanide, an adult human can withstand 50-60 ppm for an hour without serious consequences. However, exposure to concentrations of 200-500 ppm for 30 minutes is usually fatal.

How to eliminate cyanide from food: The roots of cassava are rich in carbohydrates, mainly starch. Cassava is consumed in a variety of ways, including eaten as whole root, grated root or root chips.

Linamarin, a cyanogenic glucoside, can be removed from cassava by leaching out with water. In fact, cassava is consumed only after treatments like soaking, fermentation and drying which will minimize the amount of toxin in the root. It can be detoxified by chopping and grinding in running water prior to preparation. One of the traditional ways to prepare bitter cassava roots is by first peeling and grating the roots, and then prolonged soaking in water to allow leaching and fermentation to take place, followed by through cooking to release the volatile hydrogen cyanide gas. Cutting the roots into small pieces, followed by soaking and boiling in water is particularly effective in reducing the cyanide content in cassava. While fresh cassava requires traditional methods to reduce its toxicity, adequately processed cassava flour and cassava-based products have very low cyanide contents and are considered safe to use.

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Phytoestrogen and Cancer

Article ID: 10617

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Introduction

Estrogens are hormones that are important for sexual and reproductive development, mainly in women. They are also referred to as female sex hormones. In women, estrogen is produced mainly in the ovaries, but it is also produced by fat cells and the adrenal gland.

Functions of Estrogen

1. Involved in the onset of puberty.
2. Role in the development of secondary sex characteristics, such as breasts, and pubic and armpit hair.
3. Regulate the menstrual cycle, controlling the growth of the uterine lining during the first part of the cycle. If the woman's egg is not fertilized, estrogen levels decrease sharply and menstruation begins. If the egg is fertilized, estrogen works with progesterone, another hormone, to stop ovulation during pregnancy.
3. Controls lactation and other changes in the breasts, including at adolescence and during pregnancy.
4. During pregnancy, the placenta produces estrogen, specifically the hormone estriol.
5. Helps in bone formation, working with vitamin D, calcium and other hormones to effectively break down and rebuild bones according to the body's natural processes. As estrogen levels start to decline in middle age, the process of rebuilding bones slows, with postmenopausal women eventually breaking down more bone than they produce. This is why postmenopausal women are four times more likely to suffer from osteoporosis than men.
6. Plays role in blood clotting, maintaining the strength and thickness of the vaginal wall and the urethral lining, vaginal lubrication.
7. Affects the brain, and studies also show that chronically low estrogen levels are linked with a reduced mood.

Postmenopausal Problems

Menopause is a normal part of aging. Postmenopausal women face problems such as hot flashes, vaginal atrophy — thinning, drying and inflammation of the vaginal walls, sleeping disorders, vaginal dryness, joint pain, mood swings, reduced bone density and cardiovascular disease due to a decrease in level of estrogen.

Menopausal Hormone Therapy and Cancer Risk

The hormones that are most commonly used to treat symptoms of menopause are estrogen and progesterone. (Progesterone and drugs that act like it are called progestins). Often, these two hormones are used together, but some women are given estrogen alone. Treating menopausal symptoms with estrogen and progestin together is known as estrogen-progestin therapy (EPT) or combined hormone therapy. Although estrogen alone improves the symptoms of menopause, it increases the risk of cancer of the uterus (endometrial cancer). Adding a progestin to the estrogen lowers the risk of endometrial cancer back to normal.

Estrogen and breast cancer: A woman who experiences menopause after age 55 has an increased risk of ovarian, breast, and uterine cancers. The risk is greater if a woman also began menstruating before age 12. This is because a woman who menstruates longer than normal during her lifetime is exposed to more estrogen and has more ovulations. A longer exposure to estrogen increases a woman’s risk of uterine and breast cancers, and having more ovulations than normal increases a woman’s risk of ovarian cancer.

Phytoestrogen: These are nonsteroidal, naturally occurring plant phenolic compounds that are structurally and/or functionally similar to mammalian estrogens.

Classification of Phytoestrogens

1. Isoflavones (Genistein and Daidzein): Food Sources - Soybeans (tempeh, Soy flour, Tofu, fermented soy products such as miso, etc., Soy milk), Lentils, Dried beans (broad, kidney, lima) and Chickpeas.

2. Lignans (Enterolactone, Enterodiol): Food Sources - Flaxseed, Whole grain cereals (wheat, wheat germ, barley, hops, rye, rice, beans, oats), Fruits (apricot, strawberries), cruciferous vegetables, sesame, red wine.

3. Coumestans: Food Sources - Broccoli and sprouts.

Phytoestrogen and Breast Cancer Prevention

Phytoestrogens are somewhat similar to human estrogen, and even act like human estrogen in the body. Lignans (phytoestrogens in flaxseed) can change estrogen metabolism. In postmenopausal women, lignans can cause the body to produce fewer active forms of estrogen. This is believed to potentially reduce breast cancer risk. There is evidence that adding ground flaxseeds into the diet decreases cell growth in breast tissue and so, expected to decrease breast cancer risk.

All cells have the ability to go through a process called apoptosis, or programmed cell death. It is believed that through this process, the body can prevent damaged cells from reproducing, and eventually developing into cancer. Researchers have shown that flaxseed sprouts can increase apoptosis (programmed cell death). Studies have shown that two specific phytoestrogens found in lignans, named enterolactone and enterodiol, may help suppress breast tumor growth. This suggests that flaxseeds may have anti-cancer benefits.

Phytoestrogen and Endometrial Cancer

Phytoestrogens have been shown to lower endogenous estrogen levels, stimulate the production of sex hormone–binding globulin (SHBG) by the liver and also bind to estrogen receptors, thereby blocking binding by estradiol and other estrogens.

The development of endometrial cancer is largely related to prolonged exposure to unopposed estrogens. Unopposed estrogens increase mitotic activity in endometrial cells. Phytoestrogens are structurally similar to endogenous estrogens, but capable of showing both estrogenic and antiestrogenic effects. Phytoestrogens do not elicit a strong estrogenic response due to weak estrogenic potential and thus have an antiestrogenic effect that inhibits the growth and proliferation of estrogen-dependent cancer cells. Isoflavone and lignan consumptions were inversely related to the risk of endometrial cancer and associations were stronger in postmenopausal women. In Hawaii's multiethnic population, greater consumption of tofu alone or in combination with other soy products was associated with a 50% reduction in endometrial cancer risk.

Importance of Phytoestrogen in Nutrition

Dietary phytoestrogens play a beneficial role in obesity and diabetes. Ingestion of soy protein associated with isoflavones and flaxseed rich in lignans improves glucose control and insulin resistance. *Isoflavones and lignans appear to act through various mechanisms*: by modulating pancreatic insulin secretion, through antioxidative actions and act via estrogen receptor-mediated mechanisms.

The diversity of cellular actions of isoflavones and lignans supports their possible beneficial effects on various chronic diseases. Phytoestrogens has decreased risk of breast cancer in women with high phytoestrogen consumption. Exposure to phytoestrogens in childhood or early adolescence may be protective in breast cancer.

Conclusion

Estrogens or female sex hormones are hormones that are produced mainly in the ovaries, but it is also produced by fat cells and the adrenal gland. During menopause, estrogen level decreases. So, estrogen or estrogen-progestin therapy (EPT) is used to treat menopausal symptoms. Although estrogen improves the symptoms of menopause, it increases the risk of breast cancer and cancer of the uterus (endometrial cancer). So, phytoestrogen can be given to prevent postmenopausal symptoms as well as to prevent cancer also. Phytoestrogens are somewhat similar to human estrogen, and even act like human estrogen in the body. Dietary phytoestrogens play a beneficial role in obesity and diabetes.

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Food Safety and Consumer Protection

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Introduction

Food safety: "About 2.2 million people in the world, including many children, die annually due to food-borne diseases. Unsafe food, containing harmful bacteria, viruses, parasites or chemical substances, causes more than 200 diseases, ranging from diarrhoea to cancer" by Nata Menabde. So, food safety is of public health importance. Food safety should be given top priorities as it is about minimizing the risks. Food safety is making the food free from microbes, chemicals and viruses through proper handling, preparation, storage and consumption of food in order to avoid health hazards.

Food Safety from Farm to Fork

There is no such thing like zero risk but food safety should be followed from farm to fork so as to minimize the risks of health hazard. Problem of food safety starts from farm. Farmers use excessive number of agrochemicals in their fields to increase the production and feed the increasing population. It results in slow accumulation of toxin in water, air, soil, food. Pesticide residues remain in food and it gets magnified at every trophic level, that directly or indirectly affect human health and responsible for causing lots of diseases like leukaemia, testis, ovary, breast and prostate cancer, cerebral palasy etc.

From the farm, food passes through many food handlers and middleman that increases the risks of exposing the food to unhygienic environment, contamination and adulteration. Inadequate infrastructure and storage facility leads to attack of food by rodents, insects and microbes that affect both quality and quantity of food.

Food processing industry in India ranges from cottage industry to large industry. Large industries are well equipped with better technologies and follow food safety laws. But small industries have limited resources and lack of infrastructure in the producing areas that result in variability in overall quality of food products. These industries don't undergo for certification of their food products. This does not mean that all food from such sources is unsafe but not 100 % safe as food products are not checked before it reaches to customer.

Food safety is a major concern with street foods. These foods are generally prepared and sold under unhygienic conditions, with limited access to safe water, sanitary services, or garbage disposal facilities. Hence, street foods pose a high risk of food poisoning due to microbial contamination, as well as improper use of food additives, adulteration and environmental contamination. Also, food handler prepares the food, takes money and returns change to customer and then prepares food for the next customer. Here, currency also serves as vehicle for transmitting potential pathogen to hand and food.

Improper food labelling and lack of consumer awareness regarding food safety is also a major concern pertaining this issue.

Customers know seriousness of food borne illness but they lack information on safe food handling and storage of food products. There are various food handling mistakes made by customer at home like cooking or heating food inadequately, obtaining food from unsafe sources, allowing more than twelve hours gap in between preparation and eating of food, diseased person handling the food etc. Another factor is consumer belief. They think that foods like meat, poultry, eggs, seafood and food prepared somewhere other than home are only responsible for food borne illness.

Managing Food Safety

1. Although there are various organizations working for food safety both at national and international level but consumers' participation is equally important. In India, current laws regulating food safety is Food Safety and Standards Act, 2006. Food safety and standard authority of India (fssai) has been established under this act. BIS (Bureau of Indian standards) or ISI provide certification of food safety for about 450 different food products. Performance and reliability is assured when product is ISI marked. AGMARK seal ensures quality and purity, found on commodities like spices, milk products, etc. At international level, Codex Alimentarius is available for food safety.

2. But along with all these, there is need for educating and sensitizing food handlers, food processors and customers to ensure maximum food safety from farm to fork.

3. Farmers should be given financial support, information and encouraged to use organic manures like green manures, vermicompost and biopesticides in their fields as they are safe for human and environment and also do not leave any residue in farm produce.

4. Environment protection, rural development, sustainable production and animal welfare should be promoted as it indirectly affects food safety.

5. Proper storage of food is essential. For this, adequate facilities and infrastructure like proper electricity, storage facility, and proper transport facility should be made available.

6. Along with large food processing industries, small industries should also be given adequate infrastructure facilities in producing areas to avoid variability in food products that they produce and they should also undergo for certification of their food products.

7. Many countries are having food handler certification system to ensure food safety in street foods. Food handler certification courses should also be started in India to provide food handlers with knowledge of safe food handling practices.

8. Labelling is another important factor that should be taken into consideration. People have right to know what they are eating. Food labelling should contain information regarding composition, nutritive value, method of storage and preparation and manufacture and expiry date of the product. If a particular food product is making any nutritional claims like low fat food, high fibre food etc. then there must be setting up of an authorization system for these food products as it is directly related to consumer health. Better labelling help people to avoid foodstuff or ingredients to which they are allergic and cause reactions in their body. Food labelling should also indicate if product comes from or contains genetically modified materials.

Consumer Awareness

Along with all these, ultimate user of the food product is consumer. So, consumer needs to be made more aware about food hygiene. Media can be used as one of the means to create consumer awareness. Advertisement is made on food products that helps customer to know which product is safe, better and advantageous over other food products. 'Jago Grahak Jago' shown on T.V. is an initiative towards Consumer Education and Awareness. Multi-media publicity campaigns are being undertaken through print and electronic media on the issues that are directly relevant to the role of the Department such as ISI, Labelling, MRP, Weights and Measures etc. Each advertisement is released through a network of national as well as regional newspapers throughout the country. Realizing that more than 70% population under the age of 35 years are using the internet in a big way, a major initiative is now being taken to spread consumer awareness regarding food safety through the internet. All the print advertisements as well as the Videos related to food safety are being uploaded on the website for internet user. So, media play very important role in creating consumer awareness among both urban and rural people regarding food safety.

Even after purchasing safe food, it can get contaminated at home if not handled carefully. So, consumer needs to be made more aware regarding how to process, preserve food at home in a safe way.

Preventive Measures

For this, few important points must be taken into consideration:

1. Cook food thoroughly at 70^0C temp. in order to completely kill all pathogens.
2. Safely cooked food can also get contaminated even by slight contact with raw food. So, cross contamination should be avoided between raw and cooked food especially in case of non-vegetarian foods.
3. Store cooked food carefully: If foods have been cooked in advance, they must be stored out of the danger zone i.e., either hot above 63^0C in warming unit or below 5^0C in refrigerator.
4. Reheat cooked food thoroughly such that food should reach at least 70^0C.
5. Serve cooked food as early as possible. Touching food with hands should be avoided and tongs, spoons etc. should be used for touching food.
6. Use pure water: water used for food preparation and drinking should be free from contamination.

Conclusion

Food safety is a shared responsibility and it needs multi-sectoral and multi-disciplinary action. Besides this, consumer sensitization and awareness towards food safety is also very important.

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Goitrogens

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Introduction

Goitrogens are naturally occurring substances that suppress the function of the thyroid gland by interfering with iodine uptake which is a critical nutrient for hormone production. If the thyroid gland is having difficulty producing hormones due to lack of iodine, it may increase in size (goitre) in an effort to filter more blood to get more iodine and can result in an enlargement of the thyroid, i.e., goitre. If eaten in excess, they can interfere with the healthy function of thyroid gland, also known as the master gland because it controls and regulates the other glands.

e.g Thiocynates, Isothiocyanates, glucosinolates, cynogenic glycosides , flavanoids, and thiourea are considered as goitrogens.

How Goitrogen Interfere with Iodine Metabolism in Body

Goitrogen interfere at various stages of thyroid hormone homeostasis. The steps include uptake of iodine, its oxidation followed by formation of thyroxine (T_4) and triiodothyronine (T_3). The corresponding enzymes for these steps are NADPH- oxidase, thyroid peroxidise, and 5, deiodinase. Inhibitions of any of these enzymes disturb the normal balance leading to deficiency of iodine.

Soy: Isoflavones -- especially genistein found in soy block TPO (Thyroid Peroxidase), an enzyme critical to the transformation process that results in the creation of thyroid hormones from iodide.

Brassica: Isothiocyanates in the Brassica vegetables also block TPO. The cyanogenic glucosides, glucosinolates, and thiocyanates all seem to be important. Thiocyanates block the NIS symporter, interfering with iodide uptake to the thyroid and breast (keeping the iodide from the breast milk).

Foods Containing Goitrogens

There are two primary categories of food that are commonly seen as goitrogenic: (1) soy products and (2) vegetables of the Brassica family (e.g., broccoli, cauliflower, kale, cabbage, collard greens, kohlrabi, radish, turnips, mustard greens, Brussels sprouts, and rutabagas).

Other foods: A variety of other foods are also generally seen as goitrogens: e.g., millet, rape seed (Canola Oil), pine nuts, peanuts, cassava, and bamboo shoots.

Goitrogens are also found in clover and alfalfa (biochanin A -- a TPO inhibitor), grasses, and water. Goitrogens eaten by animals can affect the iodine in animal products such as milk, butter, cheese, eggs, meat, etc.

Foods Containing High Amounts of goitrogens: Broccoli, Tapioca, Cabbage, Cauliflower, Kale, Mustard greens, Rutabaga, Turnips, Brussels sprouts.

Foods Containing Small Amounts of goitrogens: Sweet potatoes, Bamboo shoots, Peaches, Peanuts, Almonds, Radishes, Spinach, Strawberries, Groundnuts, soyabean.

Note: Foods of cabbage family contain a heat labile substance called pregoitrin and a heat labile activator able to convert pregoitrin to goitrin and it interferes with iodine use.

Goitrin is found in raw foods but not in cooked foods. Groundnuts contain arachidoside which interfere with iodine use.

The antibiotic sulphonamide reduces the conversion of iodine to iodide. The vitamin like substance Para amino benzoic acid has a similar potential goitrogenic effect.

How to Eliminate Cyanide from Food

The enzymes required for production of goitrogens in the plants are destroyed by cooking. Cooking seems to reduce the chemicals in the Brassica family, but does not completely eliminate them. Goitrogens are also lost through leaching into cooking water.

Fermentation is also thought to reduce goitrogens.

The effects of these chemicals are significantly worse if iodine is deficient. However, adequate iodine does not seem to completely protect against them.

Other Effects of Goitrogens

In addition to their effects on goitre, hypothyroidism, and hyperthyroidism, goitrogenic foods also appear to be related to thyroid cancer and autoimmune thyroid diseases.

Hypothyroidism

Hypothyroidism, often called underactive thyroid or low thyroid and sometimes hypothyreosis, is a common endocrine disorder in which the thyroid gland does not produce enough thyroid hormone. It can cause a number of symptoms, such as tiredness, poor ability to tolerate cold, and weight gain.

In children, hypothyroidism leads to delays in growth and intellectual development , and is called cretinism . The diagnosis of hypothyroidism, when suspected, can be confirmed with blood tests measuring thyroid-stimulating hormone (TSH) and thyroxine levels.

People with hypothyroidism need to be careful. Goitrogen interfere with iodine metabolism, lead to decrease in thyroid hormone. So, people with hypothyroidism should avoid consuming goitrogenic foods. However, if thyroid hormone is taken, there is no need to avoid goitrogenic foods.

Hyperthyroidism

Hyperthyroidism, also known as overactive thyroid, is the condition that occurs due to excessive production of thyroid hormone by the thyroid gland. Thyrotoxicosis is the condition that occurs due to excessive thyroid hormone of any cause and therefore includes hyperthyroidism. Signs and symptoms vary between people and may include irritability, muscle weakness, sleeping problems, a fast heartbeat, poor tolerance of heat, diarrhoea, enlargement of the thyroid, and weight loss.

Some sources suggest that people with hyperthyroidism should eat a good amount of goitrogenic foods. The rationale behind this is that since hyperthyroidism involves an excess of iodine production, and because goitrogens inhibit the production of thyroid hormone, then it would make sense to “load up” on these thyroid inhibiting foods. Some researches support this and some don’t. The reason for this is because simply taking goitrogenic foods isn’t going to cure the hyperthyroid condition. Care should be taken to restore the health of the person’s thyroid gland back to its normal state rather than increasing consumption of goitrogenic foods.

So, someone with a hyperthyroid disorder should not intentionally consume an abundance of goitrogenic foods in order to inhibit thyroid activity, as for most people with hyperthyroidism, a natural thyroid treatment protocol can restore their health back to normal without having to consume large quantities of goitrogens.

Why to Include Goitrogens in Our Diet

Some of the vegetables that are classified as goitrogens also happen to be very nutritious foods and have qualities that would make us want to go out of our way to include them in our diets.

Cruciferous vegetables like broccoli, cabbage, and kale are known for their anti-cancer and antioxidant properties. Root vegetables like sweet potatoes, turnips, and rutabaga provide a rich source of complex carbohydrate, which can be difficult to obtain on a grain-free diet. Cruciferous vegetables as well as sweet potatoes and strawberries contain carotenoids, which are precursors to vitamin A. In addition, a lot of the fruits and vegetables on this list are a good source of the B vitamins, vitamin C, vitamin K, calcium, magnesium, potassium, zinc and sulphur. By avoiding these foods, we may be having nutritional deficiencies.

According to one research, consuming these foods in moderate quantities actually supports thyroid function. For thyroid patients, it is necessary that they should consume sufficient amount of zinc, iodine, and selenium.

Also, these foods taste great. Many people get great pleasure from eating cruciferous vegetables, root vegetables like sweet potatoes, and fruits like pears and strawberries.

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Greenhouse Gas Mitigation Technologies for Climate Smart Agriculture

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A number of methods and practices were adopted to address these challenges. For example, production systems adapted by altering cropping patterns, planting dates and farm management techniques. The embankments built to protect rice farms from floods and new drought and submergence tolerant varieties of rice were produced and distributed by the government institutions and the private sector.

Beside farmers were diversifying their production systems, growing other cereals, vegetables and rearing fishes and animals (such as pigs and chickens). The residues and waste from each system were converted into composted and used as manure, thereby reducing the need for external inputs. This diversification enhanced incomes, improved nutrition, built resilience to shocks and minimized financial risks. The development of advanced modelling techniques, mapping the effect of climate change on rice growing regions and providing crop insurance were other examples of managing risks and reducing vulnerability. Research on rice cultivation identified that emissions mainly occur in the few months of the year when the ground was waterlogged. A more integrated approach to rice paddy irrigation and fertilizer application was found to substantially reduce emissions.

Rice is fundamental for food security with approximately 3 billion people, about half of the world population, eating rice every day. Approximately 144 million ha of land is cultivated under rice each year. The water logged and warm soils of rice paddies make this production system a large emitter of methane (CH_4). Rice production will be affected by changes in climate. Irregular rainfall pattern, drier spells in the wet season (damaging young plants), drought and floods showed adverse effect on yields. This has also caused outbreaks of pest and diseases, with large losses of crops and harvested products. Peng *et al.* (2004) analysed 6 years of data from 227 irrigated rice farms in six major rice-growing countries in Asia, which produced more than 90% of the world's rice. They found that rising temperatures especially in night had a severe effect on yields causing losses of 10 to 20% of harvests in some locations. Globally agriculture accounts for 50% and 60 % of totally anthropogenic CH_4 and N_2O emissions respectively. Within agriculture, intensified rice production system is one of the major anthropogenic sources of atmosphere CH_4 and N_2O. emissions are predicted to increase by 35 to 60% by 2030 as result of the increasing application of chemical fertilizers (FAO, 2003).

1. *Azolla,* green manure application technology to mitigate greenhouse gas emission*:* Green manures are widely used in rice production and may influence methane (CH_4) efflux. Influence of application of *Azolla (A. Caroliniana)*, a widely used biofertilizer for rice (*Oryza saliva* L.) on CH_4 efflux from a flooded alluvial soil planted to rice and select soil and plant variables were investigated in a field experiment at Cuttack, India. Azolla was either incorporated as green manure at the beginning of the experiment or grown as a dual crop in the standing water along with the rice crop. Dual cropping of Azolla in conjunction with urea considerably reduced CH_4 efflux without affecting the rice yields and can be used as a practical mitigation option for minimizing CH_4 flux from flooded paddy. The study showed that dual cropping of Azolla reduced CH_4 flux and yet increased grain yield similar to that of urea application. The decrease in CH_4 efflux in plots with a dual crop of Azolla could be related to the release of oxygen in the standing water by the growing Azolla dual cropping for sustaining the environment by minimizing the CH_4 flux from flooded rice paddies.

2. Water management strategies to mitigate greenhouse gas emission from paddies: Both soil types and water regimes play important roles in the process of methanogenesis and methane emission from rice soils. In view of wide spatial and seasonal variability and the importance of moisture on the process of methane emission, it is pertinent to evaluate the role of soil type and moisture interaction on methane efflux from soils planted to rice.

3. Use of Agrochemicals to mitigate greenhouse gas emission from rice paddy ecosystem: Agrochemicals including pesticides were widely used as agronomix practices to enhance crop productivity, however, their influence on soil microbial mediated greenhouse gas emmion are not well understood. Pesticides like Tridemorph even at field application rate could influence CH_4 production while the herbicide butachlor inhibits CH_4 production and emission by 20% from paddy ecosystem. Thus, use of such agrochemicals enhanced crop growth and productivity simultaneously mitigated greenhouse gas emission from paddy studied.

4. Biochar accounting and emission trading for climate smart agriculture: It is possible to combat greenhouse gases emission and reinvigorate rural and agricultural communities simultaneously through the use of biochar, (name given to charcoal produced for agronomic and other ecosystem applications). Besides, stably sequestering the carbon in the biochar for periods of time estimated to be estimated to be several hundred to several thousand years biochars can be applied to crop land to increase crop yields, decrease runoff, decrease fertilizer and lime use, increase soil fertility and minimize nitrous oxide and methane emissions, which are also potent greenhouse gas. Biochar acted as an absorber of NH_3 and water soluble NH_4 + and might, therefore, reduce losses of N during composting of manure. Biochar's porous structure allowed oxygen (O_4) to move through the material, and maintaining these air passageways enhanced microbial activity and provides for a faster and odor-free decomposition. Studies showed a significant reduction in N-P-K loss during the decomposition process as nutrients and minerals bond to the biochar. In using biochar, commercial composters find the reduction in greenhouse gas emissions and ability to sell their compost as an enhanced N-P-K fertilizer quite significant.

Summary

The climate smart agriculture aims to improve food security, help communities adapt to climate change and also contributes to mitigation of climate change effects by adopting enabling policies and institutions and mobilizing needed finances. Climate smart agriculture helped to overcome as well as cope-up with climatic vulnerabilities such as drought, prolonged dry-spell, water logging, floods ect. The climate-smart agriculture related interventions helped farmers to face the climate vulnerability more 'smartly, swiftly and successfully' in minimize losses due to climate aberration.

Amino Acid Therapy in Surgical Trauma

Article ID: 10621

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Introduction

Metabolic response to trauma: The relationship between trauma and metabolic response and mortality are well known. The body responds to trauma with tachycardia, an increase in the use of oxygen, an increase in respiratory rate, body temperature and negative nitrogen balance, i.e., catabolism. 20–25% increase in metabolic rate occur after trauma and size of the metabolic response was associated with the severity of trauma.

The Metabolic Response to Trauma in Humans has Been Defined in 3 Phases

1. Ebb phase or decreased metabolic rate in early shock phase: The Ebb phase develops within the first hours after injury (24–48 hours). It is characterized by reconstruction of body's normal tissue perfusion and efforts to protect homeostasis. In this phase, there is a decrease in total body energy and urinary nitrogen excretion. An early increase is detected in endocrine hormones such as catecholamines and cortisol. Generally, there are hemodynamic disturbances (hypotension) due to the decrease in effective circulating volume.

2. Flow phase or catabolic phase: The flow phase is an early period catabolism provides compensating response to the initial trauma and volume replacement, except most minor injuries. In this phase, the metabolic response is directly related to the supply of energy and protein substrates in order to protect tissue damage repair and critical organ functions. The increased body oxygen consumption and metabolic rate are among these responses. In the early catabolic stage, mainly catecholamines (adrenaline) are responsible from the increase in energy production and consumption.

Note: The flow phase tried to prevent situations like bleeding, and infection. Although this response is necessary for survival in the short term, if it persists over a long period of time or if the response is severe it leads to the onset of body damage (2–7 days) as the adipose tissue, skin and other tissues are destructed.

3. Anabolic phase (if the tissue loss can be replaced by re-synthesis once the metabolic response to trauma is stopped).

Surgery affects metabolism and substrate utilization. Postoperatively, the utilization of glucose is reduced due to insulin resistance leading to hyperglycaemia that significantly affects postoperative outcome. Also, there is increase in triglyceride and free fatty acid break down due to an increase in catecholamine secretion. The catabolic effects usually develop in peripheral tissues such as muscle, fat and skin. This is used to create the necessary response to wound healing.

Metabolic Changes in Protein and Amino Acid after Trauma

Surgical trauma results in alterations in total body protein metabolism characterized by an increase in protein catabolism and negative nitrogen balance. The net changes in protein catabolism and synthesis are related to the duration and the level of injury.

In metabolic response to trauma, the catabolism is increased and excretion of urinary nitrogen rise up to 30 g/day accounting for approx. 1.5% daily loss in body mass. According to this, a traumatized individual with no oral nutrition is going to lose 15% of his body mass in 10 days. Therefore, amino acids and protein losses needed to be compensated.

Protein synthesis decreases and amino acid oxidation increases within the first two hours following surgery. In this case, if the patient does not receive nutritional support, he will rapidly lose muscle tissue, cannot be separated from mechanical ventilator and cannot heal. Protein catabolism is carried out by degradation of skeletal muscle. The amino acids released by muscle cannot be used again for protein synthesis in the critically ill. Therefore, a negative nitrogen balance occurs.

Muscle catabolism can be reduced and protein synthesis can be stimulated by nutritional support during flow phase and anabolic period. In the posttraumatic period, the absorption of glutamine and alanine from the intestine and the release from skeletal muscle cells into the bloodstream is increased.

Amino Acid Therapy in Surgical Trauma

Protein loads of more than approximately 2.0 g/kg/day are not efficiently utilized for protein synthesis and the excess is oxidized and contributes to azotemia. Clinical practice guidelines published by the American Society for Parenteral and Enteral Nutrition (ASPEN) and the Society of Critical Care Medicine, the European Society for Clinical Nutrition and Metabolism (ESPEN), and the German Association for Nutritional Medicine in 2009 recommend a parenteral nutrition amino acid dose range of between 1.2 and 1.5 g/kg/day for most adult catabolic patients with normal renal and hepatic function (e.g., 50–100% above the RDA of 0.8 g/kg/day).

Maximum rate of protein turnover is achieved with intake of the essential amino acid in order to maintain nitrogen balance. Amino acids play a major role in not only the synthesis of acute phase proteins, which are very important, but also in wound healing and successful recovery from a disease.

Following amino acid should be included in amino acid therapy:

1. BCAAs (branched chain amino acid): BCAAs are primarily oxidized in the peripheral tissue, in particular in skeletal (SK) muscle, whereas the other AA catabolizes in the liver. BCAAs may regulate rate of protein synthesis by inhibiting protein degradation and enhancing protein synthesis. BCAAs thus improve muscle protein metabolism. Hence, AAs supplementation enriched with BCAAs clinically is used for patients with liver diseases, renal failure, sepsis, and surgical injury.

There is an increasing demand for AAs, alanine, and glutamine in these clinical conditions and they can be synthesized in SK muscle from BCAAs oxidation. So, BCAAs can cover the elevated demands for alanine and glutamine by the body during these clinical conditions.

Initiation of mRNA translation is one of the key steps in protein synthesis. Amino acids may stimulate protein synthesis by enhancing this important step of protein synthesis. Deacylated tRNA reduces or inhibits protein synthesis by affecting the initiation step. BCAAs may lead to formation of aminoacyl-tRNA derivatives that enhance initiation of protein synthesis. Supplementation of BCAAs particularly leucine, enhances protein synthesis.

BCAAs are more energy efficient than glucose. For example, complete oxidation of leucine in muscle produces more energy than complete oxidation of glucose in the form of ATP.

2. Glutamine: Glutamine is a conditionally essential amino acid and the preferred fuel for rapidly replicating cells such as gastrointestinal mucosal cells (enterocytes and colonocytes) and immune cells (lymphocytes and macrophages).

It is a precursor for nucleotide synthesis, a substrate for hepatic gluconeogenesis, a precursor of the antioxidant glutathione, and essential to the renal handling of ammonia.

Patients under catabolic stress are at risk for glutamine deficiency. Glutamine is a potent regulator of protein turnover and its muscle concentration is consistently decreased following trauma. Glutamine becomes a conditionally essential amino acid in severe stress conditions such as critical illness, surgery, and trauma, when endogenous utilization exceeds endogenous glutamine production.

3. Dose: Parenteral nutrition supplemented with glutamine is found to be highly beneficial. Glutamine added to parenteral nutrition at doses up to 0.57 g/kg/day in adults also appears to be safe. In head trauma, 0.34 g/kg/20 h of glutamine should be given through parenteral nutrition.

Enterally fed to patients undergoing colorectal cancer resection surgery at dose of 1.0 g/kg/day for 11 days perioperatively, decrease in wound infection. Glutamine-supplemented beneficial in various forms of cancer including leukemia , patients undergoing chemoradiotherapy, cardiopulmonary bypass and cardiac surgery etc.

4. Arginine: L-arginine has numerous important roles in the transport, storage, and excretion of nitrogen; formation of nitric oxide (a potent vasodilator); mediation of macrophage function after injury; and regulation of wound healing.

Arginine is thought to be a conditionally essential amino acid in catabolic stress and critical illness where endogenous synthesis becomes insufficient to meet body demands.

Arginine is present in relatively high doses in all common amino acid formulations for parenteral nutrition used in both children and adults. Arginine-containing enteral nutrition formulas have demonstrated a decreased incidence of infectious complications, a shorter hospital length of stay, and fewer ventilator days.

5. Proline: In response to severe trauma, there is increased requirement for proline for collagen synthesis for healing.

6. Sulphur containing amino acid: Cysteine has dynamic effects in metabolism. It acts as a precursor for the synthesis of glutathione (GSH) and used in protein synthesis. It has beneficial role in critically ill patients as nitrogen retention was significantly increased by cysteine supplementation.

Small amounts of cysteine are present in some mixed amino acid formulas for parenteral nutrition use and larger doses of a cysteine product can be admixed into parenteral nutrition on the day of administration. Commercial mixed amino acid formulas do not contain appreciable cysteine because of instability in solution, but methionine, as an essential amino acid, is present in all mixed amino acid formulas.

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Traveller's Diarrhoea

Article ID: 10622

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Introduction

Traveller's diarrhoea (TD) is a stomach and intestinal infection that occurs as a result of unsanitary handling of food. As the name suggests, it is diarrhoea with other symptoms affecting mainly traveller. TD occurs equally in male and female travellers and is more common in young adult travellers than in older travellers. Traveller's diarrhoea is more common in young children than in adults, and they have a higher risk of dehydration and severe illness. Pregnant women may be at higher risk of traveller's diarrhoea than non-pregnant women because of lowered gastric acidity and increased gastrointestinal transit time.

Infectious Agent

Bacteria are the most common cause of TD. The most common pathogen is entero-toxigenic *Escherichia coli (ETEC).* ETEC are bacteria that attach themselves to the lining of our intestine, colonize the small intestine and release a toxin that cause severe diarrhoea, dysentery, abdominal cramps, and fever. ETEC can be life threatening due to significant fluid loss and severe dehydration. Bacteria are responsible for approximately 80% of cases and most of the rest are caused by viruses (including norovirus, rotavirus, and astrovirus) and protozoans. *Giardia* is the main protozoal pathogen found in TD. *Entamoeba histolytica* is a relatively uncommon pathogen in traveller's diarrhoea.

Symptoms

Most TD cases begin abruptly. The illness usually results in increased frequency, volume, and weight of stool. Generally, traveller experiences four to five loose or watery unformed stools each day. Other commonly associated symptoms are nausea, vomiting, anorexia, abdominal cramps, malaise, bloating. Blood or mucus in the diarrhoea can sometime be seen in serious cases. Traveller's diarrhoea usually lasts from 3 to 7 days and is rarely life threatening.

Prevention

Food and beverage selection: Street food, unpasteurized milk and dairy products, including ice cream, raw or undercooked meat and fish should be avoided as TD is fundamentally a sanitation failure, leading to bacterial contamination of drinking water and food.

Food should be cooked well and should be consumed hot because cooked foods that have been left at room temperature are particularly hazardous. Fruits and vegetables such as bananas, oranges that can be peeled should be consumed more and salads and unpeelable fruits, such as grapes and berries should be consumed by washing with luke warm water.

Consumption of water directly from tap without any treatment should be avoided. Water used for drinking and tooth brushing should be consumed at least after boiling it for three minutes or if it is filtered or chemically chlorinated. Boiled water should be used to mix baby formula.

In restaurants, bottled water with proper seal should be consumed. Dishes and utensils should be cleaned and dried properly before using them. Hands should always be washed before eating. So, Travelers often are advised to "Boil it, cook it, peel it, or forget it."

Treatment

Antibiotics are the principal element in the treatment of TD and are effective in cases caused by bacterial pathogens. Probiotics is also used as treatment for TD. Probiotics offer a safe and effective method to prevent TD.

Fluids and electrolytes are lost in cases of TD, and replenishment is important, especially in young children or adults with chronic medical illness. Replacement of fluid losses helps the traveller to feel better more quickly. For severe fluid loss, replacement is best accomplished with oral rehydration solution (ORS), prepared from packaged oral rehydration salts, such as those provided by the World Health Organization, which are widely available at stores and pharmacies. ORS is prepared by adding 1 packet to 1 litre of boiled or treated water. Dairy products should be avoided until diarrhoea has subsided, as these are often difficult to digest while the intestine is inflamed.

Development on Organic Farming Projects in India

Article ID: 10623

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Introduction

Organic farming is a method and way of crop and livestock production which involves much more than choosing no use of pesticides, fertilizers, GMOs [Genetically modified organisms], antibiotics and growth hormones.

Organic production is a holistic system designed to optimize the productivity and fitness of diverse communities within the Agro-ecosystem, including soil organisms, plants, livestock and people in society. The principal aim of organic production and farming is to develop enterprises that are sustainable and harmonious with the environment. Cultivable land area under organic farming has increased from 11.83 lakh hectare in 2014 to 29.17 lakh hectare in 2020 in the country.

Organic farming promotes the use of crop rotations and cover crops, and encourages balanced host/predator relationships. Organic residues and nutrients produced on the farm are recycled back to the soil. Cover crops and composted manure are used to maintain soil organic matter and fertility. Preventative insect and disease control methods are practiced, including crop rotation, improved genetics and resistant varieties. Integrated pest and weed management, and soil conservation systems are valuable tools on an organic farm. Organically approved pesticides include "natural" or other pest management products included in the Permitted Substances List (PSL) of the organic standards. The Permitted Substances List identifies substances permitted for use as a pesticide in organic agriculture like neem oil sprays and few medicinal extracts.

According to international resource data from Research Institute of Organic Agriculture (FiBL) and the International Federation of Organic Agriculture Movements (IFOAM) Statistics 2020, India stands at 9th position in terms of certified agricultural land with 1.94 million hectares (2018-19).

National Schemes

Government is promoting organic farming through various schemes/ programmes under National Mission for Sustainable Agriculture (NMSA)/ Paramapragat Krishi Vikas Yojana (PKVY), Rastriya Krishi Vikas Yojana (RKVY), Mission for Integrated Development of Horticulture (MIDH), National Mission on Oilseeds & Oil Palm (NMOOP), Network Project on Organic Farming of ICAR.

Government is implementing a Cluster based Programme to encourage the farmer for promoting organic farming called Paramparagat Krishi Vikas Yojana (PKVY).

1. Paramparagat Krishi Vikas Yojana (PKVY): It enhances cluster based organic farming with PGS (Participatory Guarantee System) certification. Cluster formation, training, certification and marketing are supported under the scheme. Assistance of Rs. 50,000 per ha /3 years is provided out of which 62 percent (Rs. 31,000) is given as incentive to a farmer against organic inputs.

a. Groups of farmers would be motivated to take up organic farming under Paramparagat Krishi Vikas Yojana (PKVY). Fifty or more farmers will form a cluster having 50 acres land to take up the organic farming under the scheme.

b. In this way during three years 10,000 clusters will be formed covering 5 lakh acre area under organic farming. There will be no liability on the farmers for expenditure on certification.

c. 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.

d. Organic farming will be promoted by using traditional resources and the organic products will be linked with the market.

e. It will increase domestic production and certification of organic produce by involving farmers

f. In order to implement the Paramparagat Krishi Vikas Yojana in Paramparagat Krishi Vikas Yojana in the year 2015-16, an amount of Rs. 300 crores have been allocated.

2. Mission Organic Value Chain Development for North Eastern Region (MOVCDNER): The scheme encourages third party certified organic farming of niche crops of north east region through Farmer Producer Organizations (FPOs) with focus on exports. Farmers are given help of Rs. 25,000 per hectare for 3 years for organic inputs including organic manure and bio-fertilizers among other inputs. Support for formation of FPOs, capacity building, post-harvest infrastructure up to Rs. 2 crores are also provided in the scheme.

3. Capital Investment Subsidy Scheme (CISS) under Soil Health Management Scheme: Under this scheme, 100 percent aid is provided to state government, government agencies for setting up of mechanized fruit and vegetable market waste, Argo waste compost production unit up to a maximum limit of Rs. 190 lakh per unit (3000 Total Per Annum TPA capacity). Similarly, for individuals and private agencies help up to 33 percent of cost limit to Rs. 63 lakh per unit as capital investment is provided.

4. National Mission on Oilseeds and Oil Palm (NMOOP): Financial assistance at 50 percent subsidy to the tune of Rs. 300 per hectare is being allotted for various components including bio-fertilizers, supply of Rhizobium culture, Phosphate Solubilizing Bacteria (PSB), Zinc Solubilizing Bacteria (ZSB), Azotobacter, Mycorrhiza and vermi- compost.

5. National Food Security Mission (NFSM): Under NFSM, financial assistance is provided for promotion of bio-fertilizer (Rhizobium/PSB) at 50 percent of the cost limited to Rs.300 per hectare.

6. Bhartiya Prakritik Krishi Padhati (BPKP) of PKVY: Encouraging of natural farming under Bhartiya Prakritik Krishi Padhati (BPKP) of PKVY has been initiated to promote use of natural on-farm inputs for synthetic chemical free farming. Andhra Pradesh and Kerala have taken up 1 lakh hectare and 0.8 lakh hectare area respectively for promotion of natural farming under BPKP. Similarly, regular area certification and support for individual farmers for certification have also been initiated during 2020-21 to bring in default organic areas and willing individual farmers under the fold of organic farming.

National Agencies

1. Primary Agricultural Credit Societies (PACS), Farmer Producer Organizations (FPOs): State agencies, entrepreneurs among others can avail loans for setting up of post-harvest infrastructure for value addition to organic produce under 1 lakh crore Agriculture Infrastructure Fund (AIF) of Aatmanirbhar Bharat.

Government of India has implemented the National Programme for Organic Production (NPOP) in the year 2001. The national Programme involves the accreditation Programme for certification agencies, norms for organic production, promotion of organic farming etc. States like; Uttarakhand, Karnataka, Madhya Pradesh, Maharashtra, Gujarat, Rajasthan, Tamil Nadu, Kerala, Nagaland, Mizoram, Sikkim have been promoting organic farming.

2. All India Organic Farmers Society (AIOFS): Its's a Leading Organization in Organic Farming and Good Agriculture Practice Area. After constitution of Organization (AIOFS) in 2007, it has trained more than 10,000 farmers. AIOFS is constituted under Societies Act of 1860 under Govt. of India.

3. Organic Farming Association of India (OFAI): To encourage nature-friendly, scientific, farming systems and practices that are economically feasible, energy efficient, climate friendly and oriented towards the protection

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of the environment and empowering the rural societies, building upon indigenous and traditional knowledge, skills and practices. It will aim to help organize farm-households and families engaged in organic farming and connected activities into a recognizable entity that will effectively represent their interests at local, state, regional and national levels, to formalize and operate credible, scientific and publicly trusted systems for the recognition and registration of organic farms, to work with other organic farming associations in India and internationally in order to strengthen the organic farming movement, to undertake programmes that will increase farmers awareness of their rights.

4. National Centre of Organic Farming: National Project on Organic Farming (NPOF) is a continuing central sector scheme since 10th Five Year Plan. NITI Aayog approved the scheme plan as pilot project for the remaining two and half years of 10th plan period with effect from 01.10.2004 with an outlay of Rs. 57.04 crore. The scheme is continuing in the 11th plan with an outlay of Rs.101.00 crore. There objectives were: Capacity building for soil health assessment, organic input resource management, technology development through support to research and market development, Capacity Building for low-cost certification system known as “Participatory Guarantee System”.

Fig. NCOF

Boards and Accreditation Agencies in India

1. The Agricultural and Processed Food Products Export Development Authority (APEDA): Its function is to Fixing of standards and specifications for the scheduled products for the purpose of exports, improving of packaging of the Scheduled products, improving of marketing of the Scheduled products outside India, Promotion of export-oriented production and development of the Scheduled products, Training in various aspects of the industries connected with the scheduled products etc.

2. Coffee Board: The core activities are primarily directed towards research & development, transfer of technology, quality improvement, extending development support to growing sector, promotion of coffee in export and domestic markets. The activities of the Board are broadly aimed at:

a. Improving and enhancement of production, productivity & quality.
b. Export promotion for achieving higher value returns for Indian Coffee.
c. Supporting development of Domestic market.

3. Spices Board: Research, Development and Regulation of domestic marketing of Small & Large Cardamom, Post-harvest improvement of all spices, encouraging organic production, processing and certification of spices, Development of spices in the North East, Provision of quality evaluation services.

4. Tea board: Tea is one of the vast industries, which by an Act of Parliament comes under the control of the Union Govt. The emergence of the Tea Board India dates back to 1903 when the Indian Tea Cess Bill was passed. The Bill provided for levying a cess on tea exports - the proceeds of which were to be used for the promotion of Indian tea both within and outside India. The present Tea Board set up under section 4 of the Tea Act 1953 was constituted on 1st April 1954.

5. Coconut development board: Coconut Development Board (CDB) is a statutory body established under the Ministry of Agriculture, Government of India for the integrated development of coconut cultivation and industry in the country with focus on productivity increase and product diversification.

6. Directorate of cashew nut and cocoa: The Directorate of Cashew nut & Cocoa Development (DCCD) is a national agency primarily involved in the overall development of Cashew and Cocoa in India. It is also one of the supporters of Argo-based industry in India.

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Marketing of Organic Produce in India

Article ID: 10624

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Introduction

In frequent years, there has been many policies focusing on organic farming and trade at different stages in India, as the country is believed to be well positioned in this regard. Because of the problems in the supply chain of traditional or mainstream agricultural goods, organic produce is considered as a natural alternative by the buyers and ultimately by farmers in both foreign and domestic markets. Growing health issues and increasing non-tariff barriers such as foreign market sanitary and phyto-sanitary (SPS) (Naik, 2001), coupled with the non-viability of modern small-scale farming are some of the reasons behind the change from chemical-based to organic production and consumption systems.

The 10th five-year plan focuses on encouraging and promoting the use of organic waste for organic farming, integrated pest management (IPM) and integrated nutrient management (INM) (GOI), 2003). The promotion of organic produce in plantation crops, spices and condiments with the use of organic and bio inputs for environmental conservation and the promotion of sustainable agriculture were also emphasized in the 9th five-year plan (GOI, 2001). In Bangalore, Nilgiris, with 50 outlets in South India, supplies small farmers with supply-driven organic goods (Chengappa et. al., 2003). Ever since the 1970s, organic produce has been available. Natural standards of quality refer both to the cultivation of crops and animals and to processed foods. Organic farming values include topics relating to sustainable food production, the environment, animal health and social justice. As organic farming integrates human, economic and environmental aspects, sustainability and organic farming are closely related. (Lampkin, 1994; GOI, 2001; Michelsen, 2002).

Rules to Market Organic Products

1. About your product: A working knowledge of the production of the goods which is to be sold is important for anyone entering into organic production. Acknowledge the drawbacks of a commodity as well as its potential for marketplace differentiation. To boost your marketing, use this experience. Some organic goods have a shorter shelf life than their conventional counterpart. When processed and shipped efficiently, most items may have a longer shelf life. Where applicable, variations can be capitalized upon. It is unlikely that low product quality would attract repeat sales. So, make sure the product quality meets the needs of your target customers.

2. Aware of the regulatory requirements: There may be particular specific manufacturing, packaging and storage specifications for organic products. Aspects such as labelling, packaging and transportation materials, as well as retail arrangements, require thorough consideration and preparation to ensure that they comply with all regulatory requirements and follow protocols while retaining the product's unique marketability. It is important to know and understand the role that regulators play in the supply chain. There is national as well as international regulations for exporters which may require additional paperwork, testing or quality specifications. A significant feature of the brand would also be the option of the correct certifier for those not yet certified.

3. Acknowledge the customer: The organic market is vast and complex, not just across sectors but also across manufacturing regions and populations. A number of niches are involved in trade: local and direct, international, supermarkets and large processors. Visiting markets, talking directly to customers, keeping in contact with the end user on a regular basis, and seeking their feedback about the product are all part of sustaining markets as they evolve and expand. The internet service is an excellent place to keep everything updated.

International Organic Fruits and Vegetables Market Analysis (2020-2025)

During the forecast period, 2020-2025, the organic fruits and vegetables market is expected to record a muscular CAGR of 6.99 percent. The growing demand for organic fruits and vegetables is mainly attributable to increased production and rising and increasing global consumption. However, due to its high production cost, the availability of organic fruits and vegetables is limited in relation to their demand. Consumers are willing to pay more for organic foods, considering the high price of organic fruits and vegetables, due to reduced pesticide use and high nutritional value. It is anticipated that rising awareness among consumers about the health benefits of organic products would improve sales of organic fruits and vegetables. Increased demand for organic products is leading farmers worldwide to grow crops that include fruits and vegetables in this category. For example, according to a 2016 survey conducted by the Organic Trade Association (OTA), organic farms in the United States are 35% more productive than average farms. The sum charged to organic farmers could be in excess of non-organic prices by 29-32 percent.

Organic Production and Markets in India

In India, major organic products include plantation crops such as tea, coffee and cardamom, spices such as ginger, turmeric, chilies and cumin, cereals such as wheat, rice, jowar and bajra, pulses such as pigeon pea, chicken pea, green gram, red gram and black gram, oilseeds such as banana, sapota, custard apple and papaya, and vegetables such as tomatoes, brinjal and other leafy vegetables, in addition to honey, cotton and papaya. But there is still no organic production of meat products in India, such as poultry, livestock and fisheries. 5661 farms were certified as organic in India in 2003. In India, there are three types of organic producers: traditional organic producers that grow for their livelihood needs, commercial farmers that have surpluses and export their products through various channels, and private businesses that either have their own farms or organize broad conversion programs with growers (Yussef and Willer, 2003).

There are currently six accreditation agencies in India that are certified by the Ministry of Commerce for organic goods. These are the Production Authority of Agricultural and Processed Food Exports (APEDA), the Coffee Board, the Spices Board, the Tea Board, the Coconut Development Board and the Board of Cocoa and Cashew nut. There is also a board of 18 organic goods at the national level and another board at the state level (Uttaranchal Organic Commodities Board) (UOCB). In addition, certification agencies for organic farms are private (Indian and Foreign) (Kumar, et.al., 2003).

Export and Import

The overall export volume was 6,389 lakh MT during 2019-20. The realisation of organic food exports was around 4,686 crore INR. Organic goods are exported to the USA, Australia, Japan, Israel, the UAE, New Zealand, Canada, Switzerland, the European Union, Vietnam, etc. In terms of export value realisation, refined foods, such as soy meal (45.87 percent), are accompanied by oilseeds (13.25 percent), plantation crop products such as tea and coffee (9.61 percent), cereals and millets (8.19 percent), spices and condiments (5.20 percent), dried fruits (4.98 percent), sugar (3.91 percent), medicinal plants (3.84 percent), and others. Fruits, especially nuts, apples, and dates, worth nearly $700 million, were imported into India from the United States, Ivory Coast, Benin, and Afghanistan. Many apples are exported from the United States to India, cashew nuts are exported from the Ivory Coast and Benin, and dates are exported from Afghanistan.

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Characterisation and Management of Chemically Problematic Soils- Research Review

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Problematic Soils?

The soils which possess characteristics that make them uneconomical for the cultivation of crops without adopting proper reclamation measures are known as problem soils. There may be a number of problems due to which fertile and productive lands become un suitable for cultivation or non-productive or poorly productive. These reasons may be natural like climatological, geographical or pedological origin or there may be anthropogenic restrictions which are referred as wastelands and/ or degraded lands in the land records.

Problem soils can be grouped into 4 types:

1. Physical problem soils.
2. Chemical Problem Soils-Salt affected and Acid soils, Acid-Sulphate soils.
3. Biological Problem soils.
4. Nutritional problem.

Ecological Wastelands

Excessive exploitation and misuse of resources result into degraded forests, gullied and ravenous lands, naked hill slopes, saline and alkali soils, desert, sand dunes, shifting cultivation, etc. Ecological wastelands are reclaimable or treatable up to a certain extent on economical basis.

Developmental or Anthropogenic Wastelands

Changing priorities on the basis of the needs of the society are also important and essential evils for developing wastelands or degraded lands.

In this context, mine spoils and overburdens, waterlogged areas formed by seepage of canal irrigation, foreshores of irrigation reservoirs, industrial wastelands, land strips cleared for laying of electrical transmission lines, etc.).

Developmental wastelands are not easily reclaimable. The major categories of wasteland are presented in Table 1 which indicate that the lands suffering from serious water and wind erosion forms the major categories of the problematic soil followed by salt affected soils (saline and alkali soils) which occupy 7 million ha area and requires serious attention as they fall under ecological wastelands.

Table 1 Major categories of Wastelands in India:

S. N.	Land Categories	Area (million ha)
1	Serious Water & wind erosion	150.0
2	Shifting cultivation	3.0
3	Water-logging	6.0
4	Saline soils	4.5
5	Alkali soils	2.5
6	Riverine (Diara) lands	2.4
7	Other un-culturable wastelands fit for reclamation	6.6
	Total	**175.0**

Salt Affected Soils

The arid and semi-arid climate associated with certain elements of topography and groundwater hydrology are often responsible for the accumulation in situ or transport and deposition of salts in other places and manifestation of saline and alkali characters in the soils. Such soils form an important ecological entity in India. These soils become unproductive when the accumulation of salts is beyond a certain proportion so that the ecologically adapted plants fail to survive on them. Coastal soils, soils receiving saline seeps and saline springs, basin lands salty alluvial deposits and lower level, depressions have invariably affected by salinity. Thus, the problem of contemporary salinization predates human civilization.

In India, tank irrigation and well irrigation became prevalent during the Aryan Civilization Period (1500 BC). It is during Vedic and this period that the cultivable lands were distinguished between fertile (Urvara) and infertile (Anurvara) on the basis of productivity. The unproductive barren lands were called as Ushtra and the salt affected lands were called Usara. Medieval religious and other scripts have used usar as also kalar and other terms for salt affected lands.

Characteristic Features and Classification of Salt Affected Soils

These soils are characterized by higher concentration of electrolytes than other soil types. The electrolytes dominate the soil forming process i.e., their effect overshadows that of other soil forming factors. The fertility of the soil is adversely affected by high concentration of electrolytes through restricted availability and plant uptake.

The term saline, saline - alkali or saline - sodic and alkali or sodic (Table 2) has been used to describe salt affected soils which is based on the well-known definition of United States Salinity Laboratory (Richards, 1954) which has been revised by Soil Science Society of America (1979) in respect of sodium adsorption ratio (SAR). However, In India Bhargava et al., (1976) and Bhumbla (1977) have grouped salt affected soils in the saline and alkali categories.

Table 2. Classification of salt affected soils:

Soil Type	pHs	ECe dS m-1	SAR	ESP
Normal	< 8.5	< 4.0	< 13	< 15
Saline	< 8.5	> 4.0	< 13	< 15
Saline-alkali	> 8.5	< 4.0	> 13	> 15
Alkali	> 8.5	< 4.0	> 13	> 15
(pHs- pH of the saturated paste, ECe – EC of the saturation extract, SAR(Sodium adsorption ratio) = Na+ / √ (Ca2++ Mg2+)/2, ESP – Exchangeable Sodium Percentage.				

The value of 15 ESP to distinguish alkali soil from non - alkali soil has been considered too high in alkali smectitic soils by several research workers (Northcote and Skene, 1972). The threshold ESP as suggested by these workers (Table 3) for swell shrink clay soils (Vertisols) lie in between 6 - 10 and is found to be more appropriate for categorizing alkali soils.

Table 3. Classification of salt affected soils applicable for black soils:

Class	Salinity	NaCl %	Sodicity	ESP	Alkalinity	pH(1:5)
0	Non-saline	0	Non-sodic	< 6	Acid or insignificantly alkaline	< 8.0
1	Surface salinity	0.1-0.2	Sodic	6-14	Alkaline	8.0-9.5
2	Subsoil salinity	> 0.3	sStrongly sodic	> 14	Strongly alkaline	> 8.5

Salt Affected Soils in India

The main geographical regions of salt affected soils of India as reported by Yadav (1981) are:

1. Salt affected soils in the Indo-Gangetic plains – Salt affected 2.5 million ha.

2. Soils in the arid regions of Rajasthan and Gujarat – 1 million ha.
3. Salt affected soils in the arid & semi-arid regions of black cotton soil group–1.4 million ha.
4. Coastal saline soils – 2.1 million ha.

Causative Factors of Salt Affected Soils

The Causative factors of salt affected soils are mainly related to geological factors and climatic factors. Under arid and semiarid tropics type climatic conditions, soils have been developed from basic parent materials and salts are always present in the soil profile (geological Factors). There are certain factors which tend to accelerate the process of formation of salt affected soils.

These include:

1. Topography – Basin Type.
2. Deep clay soil, poor basic infiltration rate, hard clay pan, hard pan and impeded drainage.
3. Hydrological factors:
   a. Contemporary – improper drainage –water logging.
   b. Anthropogenic:
      i. Seepage from canals.
      ii. Un-judicious use of water.
      iii. Irrigation with saline waters.
      iv. Irrigation with poor quality (polluted) waters.

Problems Posed by the Salt Affected Soils?

Salt affected soils pose different kind of problems e.g.:

1. Soil physical conditions deteriorate severely due to high water retention capacity which result in difficulties in tillage operations and operation of agricultural machineries.
2. Availability of soil water to growing plant is reduced severely.
3. Due to reduced moisture availability, oxygen stress, salt injury and sodium toxicity crop productivity is reduced.
4. High salt concentration and high exchangeable sodium causes nutritional imbalance.
5. Toxicity of sodium, boron and in some cases of nitrates.
6. Reduction in active soil organic matter as a result of formation of Na-clay-humate complex which gives a black burnt organic matter look.
7. Reduction in microbial population.

Specific Features of Saline Soils

Some specific features of saline soils are:

1. Salts form white efflorescent crust on soil surface and are invariably present in large quantities determined by measuring ECe (electrical conductivity of the saturation extract) which is always > 4 dSm-1.
2. Salts are primarily the chlorides and sulphates of Na^+, Ca^{2+} and Mg^{2+}. Na / Cl or Na / (Cl + SO_4^{2-}) ratio is always < 1.
3. The soil paste pH (pHs) which is a measure of acidity / alkalinity is < 8.2.
4. Sodium adsorption ratio (SAR) a measure of soil sodicity hazard is variable (may be lesser or greater than 15).
5. Exchangeable sodium percentage (ESP) is less than 15.
6. Gypsum may be naturally present in the soil.
7. Underground waters in most saline areas are poor due to excessive salt load and / or high SAR.
8. These soils are locally known as Thur (Punjab and Haryana), Usar / Kallar / Reh (Uttar Pradesh), Kharcha (Rajasthan and Madhya Pradesh), Lona or khar land (Maharashtra), and uippu (Andhra Pradesh and Tamil Nadu).

Reclamation of Saline Soils

In India, reclamation of saline soils was practiced much before any scientific knowledge on the nature and properties of these soils actually became available. The farmers of Rajasthan having saline water are keeping their fields fallow for 2 – 3 yrs. for desalinization after every rabi crop so as to allow rain water leaching of the soluble salts accumulated during the period of salinization (Sharma and Dubey, 1994).

Leaching of Salts

The only practical way to reduce the salt content in the root zone or displace the soil solution of higher concentration to an acceptable level is to leach the excess salts out by-passing water of lesser salinity through the root zone. A well-designed surface drainage system must be provided at the tail end for efficient flushing of salts. For the reclamation of a saline soil which has already gone out of cultivation, the process could be completed in 5 stages viz., the preparatory stage, construction stage, leaching stage, leaching – cropping stage and normal cropping stage. Flushing and leaching are two ways by which salts in the root zone can be reduced. In the former, salts are removed by surface washing of the soil as compared to pushing of soluble salts below the root zone in the latter. Technically, in flushing, sufficient gradient in the downward direction is desirable for water to move faster. Such gradient may pose difficulties in design of the irrigation system and for uniform spread of water during leaching.

Field Preparation

It is essential to level and bund the fields for effective leaching. Tillage of land before and during leaching has been found beneficial as it reduces the time of reclamation as well as improves leaching efficiency. The best time for leaching of salts is the months of July and August when there is sufficient availability of water is there. If, some water is available in the beginning of this period, it could be used for leaching, as it would enhance the efficiency of leaching through rainfall as more and more sodium chloride will come in solution and the solubility of other salts will also increase.

Depth of Reclamation

The depth of reclamation depends largely upon the potential land use. It could vary from 60 cm for shallow rooted crops or pastures to more than 2 m for trees. For diversified cropping, the depth of reclamation usually varies from 1 to 1.5 m. It may be noted that these are the minimum recommended depths and appropriate methods against desalinisation should be adopted. There are certain practices which have been found to enhance the leaching efficiency of salts e.g., Sub-soiling, tillage with inversion, breaking hard pan (Auger hole piercing) and Irrigation practices

Amount of Water Required for Leaching

The actual amount of water required under practical leaching will, however, depend upon several factors such as:

1. Number of salts initially present in the profile.
2. Desired level of salt in the root zone.
3. Soil texture.
4. Type of salts.
5. Soil depth to be reclaimed.
6. Efficiency of the drainage system.
7. Method of leaching.

As a thumb rule, a unit depth of water will remove about 20% of the salts from a unit depth of the soil (Reeve et. al., 1955). For example, to reduce average salinity in the upper 60 cm of a soil to 20 % of its original value about 60 cm water will be required.

Choice of Crop and Cropping Sequence

It is always advised to adopt salt tolerant crops and their varieties for cultivation (Table 4). The recommended cropping sequence for saline soils are pearl millet – barley, pearl millet – wheat, pearl millet – mustard, sorghum – wheat or barley or mustard, cluster bean – wheat or barley and cotton – wheat or barley.

Table 4. Crop groups based on response to salt stress:

Sensitive Group		Resistant Group	
Highly Sensitive	Medium sensitive	Medium tolerant	Highly tolerant
Lentil, Mesh, Chickpea, Beans, Peas, Carrot, Onion, Lemon, Orange, Grape, Peach, Plum, Pear, Apple	Radish, Cowpea, Broadbean, Vetch, Cabbage, Cauliflower, Cucumber, Gourds, Tomato, Sweet potato, Sorghum, Millets, Maize, Clover, Berseem	Spinach, Sugarcane, Raya, Rice (drilled), Wheat, Pearl millet, Oats, Alfalfa, Blue Panic grass, Para grass, Rhodes grass, Sudan grass, Guava, Pomegranate, Acacia	Barley, Rice, Cotton, Sugarbeet, Turnip, Tobacco, Safflower, Taramira, Karnal grass, Date palm, Ber, Mesquite, Casuarina, Tamarix, Salvadora

Management Practices

Reclamation process must be accompanied with improved management practices and proper use of these soils. Some of the important practices are:

1. Where high water table exists, deep tillage and inversion have been found to be helpful in reducing salinity hazard. Wherever available, the pre-sowing irrigation should be given with good quality water.
2. Higher seed rate (125%) and closer spacing are advisable to counteract the inhospitable saline environment on germination.
3. In case of transplanted crops, the number of seedlings / hills should be increased.
4. If possible, the seed should be drilled with FYM so as to reduce the mortality due to crust formation.
5. The crops other than rice should be planted on the side of the ridges where initial salt concentration is low.
6. The upland crops should be more often irrigated so that the harmful salts are kept below the root zone.
7. Nitrogen is the most limiting nutrient for crop production in saline soils as they are poor in nitrogen and organic matter content. Thus 125% of the RDF should be applied in saline soils. The volatilization losses increase with the salinity of the soil. To minimize this sulphur coated urea or urea briquette should be used for rice.
8. Incorporation of phosphatic fertiliser is necessary in saline soils in the form of basal dose which increases the available soil P most of which remained in the top 30 cm soil.
9. The land should be continuously cropped as this will minimize or prevent salt accumulation in the root zone of the crop.
10. Apply 25 kg $ZnSO_4$ to every kharif crops in the first three years of reclamation.

Saline-Alkali / Alkali Soils

Causative factors, characteristics and management of Saline-Alkali or Alkali soils have been very nicely reviewed by Sharma and Dubey (1994).

Causative Factors for Natural Alkalization

The main causative factors are:
1. Aridity of the climate combined with great soil depth.
2. Topographic situations which affects the surface soils due to salt washings from the surrounding areas.
3. Nearness of saline sub-soil water.
4. Impervious sub soil conditions.
5. Salt bearing strata.

Specific Features of Alkali Soils

Main characteristics features of alkali soils are:
1. pH of soil paste is greater >8.2. In alluvial soil it reaches up to 10.5 but in black soil it seldom exceeds 9.3.
2. High sodium adsorption ratio (SAR) or ESP > 15 or 8-10 for illitic alluvial and black smectitic soils.
3. Soils have soda type of salts (CO_3 + HCO_3 of sodium) in alluvial region but may have Cl + SO_4 in black soils.
4. Salt encrustation marked with black colour near organic matter spots of sodium –clay-humate complex.
5. Water especially the rainwater does not infiltrate into the soil and stagnates for long periods, (vi) Na/Cl or Na/ (Cl+SO_4) ratio exceeds 1.
6. A layer of $CaCO_3$ is usually present in the subsoil (1-1.5 m depth) in alluvial soil zone.
7. Gypsum normally not detected.
8. Ground waters in alkali soil areas are generally good. In 20% situations may have high residual sodium carbonates (RSC) and /or high SAR.

Reclamation and Management of Alkali Soils

Reclamation of alkali soil requires removal of most of the exchangeable sodium and its replacement by calcium. This can be accomplished in different ways.

1. Physico-hydrotechnical method: Requiring deep ploughing or subsoiling and raising rice – wheat crop continuously – a slower method. Rice cropping helps in reducing exchangeable sodium due to dissolution of native calcium carbonate.

2. Biological methods: Incorporation of organic residues / FYM, taking green manure crop of *Sebania alba* (dhaincha), growing salt tolerant grasses viz., Karnal grass *(Leptochlora fusca)* or raising salt tolerant crops and varieities without the application of chemical amendment – a slower method. Trees (*Prosopis juliflora* - mesquite or Vilayati Babool and *Azardirachta indica* - Neem) can also be planted in the initial years of reclamation if the soil ESP is very high and farming is uneconomical.

3. Chemical methods: application of amendments which directly or indirectly supplies soluble calcium ions- a faster technology gives quicker results but high initial cost. For achieving higher efficiency of the applied chemical amendments, it is advisable to adopt all the three methods in a package by raising rice wheat cropping sequence for initial first 5 years. Addition of organic matter/ FYM with gypsum or any other amendment increases the efficiency of the amendment and also enhance microbial activity of Azotobacter, Nitrosomonas and Nitrobacter.

Selection of the Amendment

Alkali (sodic) soils contain excessive amounts of exchangeable sodium and alkalinity (CO_3^{2-}+ HCO_3^{-}). Their soil Na saturation is sufficiently high to interfere with the growth of several crops. To improve their productivity these soils, have to be reclaimed with the immediate objectives of:
1. Neutralization of excessive alkalinity.

2. Replacement of Na^+ on the exchange sites with soluble Ca^{2+} in order to improve the physico-chemical and biological properties of the alkali soils.

The inorganic amendments (Table 5) include calcium salts (gypsum, calcium chloride, phosphogypsum), acids and acid formers (sulphuric acid, sulphur, iron pyrites, iron sulphate and aluminium sulphate). Gypsum, being the cheapest and easily available, is most commonly used as reclaiming material. The quantity of gypsum ($CaSO_4.2H_2O$) required to be applied to reclaim an alkali soil depends on the factors like degree of soil deterioration, texture, degree of improvement desired, crops to be grown, leaching conditions, quality of irrigation water, etc.

Table 5. Equivalent proportions of different amendments to gypsum and sulphur:

Amendment	Tonnes equivalent to gypsum/ sulphur	
	1 ton Gypsum	1 ton Sulphur
Gypsum ($CaSO_4.2H_2O$)	1.00	5.38
Elemental Sulphur	0.19	1.00
Sulphuric acid (H_2SO_4)	0.57	3.06
$FeSO_4.7H_2O$	1.62	8.69
Pyrites (Fe S, 22. 5% sulphur)	0.83	4.44
Aluminium Sulphate	1.29	9.94

Research results suggests that sulphuric acid, sulphur and aluminium sulphate are more effective than gypsum in reclamation of saline alkali and alkali soils but their cost is too high. Moreover, sulphuric acid is a hazardous chemical and require special skill and training in its handling in the interior areas with no approachability. The efficacy of gypsum is better than pyrites.

Soils containing alkaline earth carbonates – (X) represents the soil exchange complex:

1. Gypsum: $Na(X) + CaSO_4 = Ca(X)2 + Na_2SO4$

2. Sulphur:

a. $2S + 3O_2 = 2SO_3$ (microbiological oxidation)

b. $SO_3 + H_2O = H_2SO_4$,

c. $H_2SO_4 + CaCO3 = CaSO4 + CO_2 + H_2O$, (d) $2Na(X) + CaSO_4 = Ca(X)2 + Na_2SO_4$

3. Iron Sulphate:

a. $FeSO_4 + H_2O = H_2SO_4 + FeO$.

b. $H_2SO_4 + CaCO_3 = CaSO_4 + CO2 + H2O$

c. $Na(X) + CaSO_4 = Ca(X)_2 + Na_2SO_4$

Gypsum can be procured from the mines situated in Rajasthan and the agricultural grade gypsum according to the Indian Standards (IS: 6046-1982) should be 70% pure. Apart from this, industrial by product phospho-gypsum is also available from the phosphatic fertiliser industries (GSFC, Vadodara, Hindustan Zinc Smelter, Udaipur; RCF, Mumbai) as boro-gypsum (from boric acid industries) can also be used for reclamation which otherwise is posing environmental problems in the vicinity of these industries. However, the fluorine content should be within the limits in phosphor-gypsum as mentioned in IS: 10170-1982. Cost wise phospho-gypsum is cheaper and more pure than mined gypsum.

Pyrites (FeS_2) is available from the mines situated in Amjhore (District Rohtas- Bihar) and being marketed by Pyrites, Phosphates and Chemicals Limited, New Delhi. This amendment is cheaper in Bihar and Uttar Pradesh but is costly in the western part of the country due to exorbitant transportation cost from the mines to the destination.

Requirement of Gypsum or any Other Amendment?

The quantity of gypsum ($CaSO_4.2H_2O$) required to be applied to reclaim an alkali soil depends on the factors like degree of soil deterioration, texture, degree of improvement desired, crops to be grown, leaching conditions, quality of irrigation water, etc. There is no thumb rule for the quantity of gypsum to be applied. The quantity of the amendment should be based on the desired level of quantitative replacement of exchangeable sodium from the soil by calcium. In practice, this should be based on the laboratory-based gypsum requirement. Normally, for alluvial soils of Punjab, Haryana, Rajasthan and Uttar Pradesh; gypsum @ 50% of the total gypsum requirement estimated by this method is recommended. However, in alkali swell shrink soils or sodic black soils, the gypsum should be applied @ 75% of the estimated gypsum requirement.

Frequency of Gypsum Application

Gypsum should be applied in a single dose of 50% in case of sodic alluvial soils and 75% in case of sodic black soils. Keep the land under continuous cropping and get the soil tested for exchangeable sodium content every year. If the ESP does not fall below 15 even after 4-5 years, apply a second dose of gypsum as per the soil test recommendations. Moreover, if the water is of bicarbonate type and having RSC (residual sodium carbonate) >2.5 me L-1 or high SAR, consult the soil testing laboratory and apply gypsum. Finer the amendment quicker will be the reclamatory effect. The fineness of the gypsum should be below 80 mesh and of pyrites below 5 mm.

Methods of Application of Amendments

For achieving good results, it is essential to apply any amendment using proper method.

1. Application of Gypsum/ phospho-gypsum:

a. Divide the field in smaller plots of ¼ acre or 1000 m^2.

b. Provide adequate surface drains which join a collector drain to carry the product of chemical reaction – Na_2SO_4 generated during reclamation process.

c. The calculated quantity of gypsum/ phospho-gypsum should be broadcasted evenly on the soil surface in the summer months when the winds are calm, followed by application of FYM.

d. Mix the gypsum in the upper 15 cm of the soil by harrowing / bakharing.

e. Submerge the field / plots with 5 cm water for a period of 15-20 days. If irrigation water is not available, rainwater should be conserved in the plots.

f. Drain the excess water through surface drains and allow the soil to attain workable soil moisture conditions.

2. Application of Pyrites:

a. Divide the field in smaller plots of ¼ acre or 1000 m^2.

b. Provide adequate surface drains, which join a collector drain to carry the product of chemical reaction – Na_2SO_4 generated during reclamation process.

c. Apply light irrigation to bring the soil at field capacity.

d. Pyrites being acid former should be applied evenly on the soil surface, followed by FYM application.

e. Allow the soil at field capacity for 7 – 10 days. The moisture conditions can be restored by application of light irrigation. This operation will enable oxidation of pyrites, which further reacts with native $CaCO_3$ to form soluble calcium sulphate.

f. Submerge the plots with 5-7 cm water for a period of 7-10 day. The excess water containing the product of chemical reaction – Na_2SO_4 generated during reclamation process should be drained through surface drains.

g. Two more such poundings and draining the reaction products enable faster lowering of ESP.

h. Due to poor drain-ability of sodic soils, surface flushing is the only way to flush out the soluble salts from the root zone.

i. Allow the soil to attain field moisture conditions before raising the crop.

j. If rice is to be planted then conserve the rainwater.

Grow Salt Tolerant Crops

It is advisable not to grow sensitive crops on these soils.

Salt tolerant and sodicity/ alkali tolerant crops and their varieties must be grown (Table 6). Rice – wheat crop rotation is generally recommended in the first five years of reclamation.

Table 6: Relative tolerance of crops to exchangeable sodium (alkali soil):

Category	Crops
Sensitive	
Field crops	Field bean, green gram, lentil
Fodders (Forage)	Red clover, white clover, guar (cluster bean)
Vegetables	Celery, radish (English var.), green bean
Fruits	Peach, apricot, pear, apple, plum, strawberry, blackberry
Semi salt tolerant	
Field crops	Oats, rice, sorghum, maize, pearl millet, wheat(improved var.), pigeon pea, gram, castor, flax, soybean, rye, castor bean
Fodders (forage)	Senji (*Melilotus* sp.), mentha, sorghum, maize, berseem, cowpea, ryegrass, sudan grass, oat
Vegetables	Tomato, cabbage, cauliflower, lettuce, potato, radish, carrot, onion, lady finger, pea, cucumber, pumpkin,sweet potato, squash
Fruits	Grape, olive, fig, guava, mango, banana, pomegranate, orange, grape fruit, lemon, almond, pineapple
Salt tolerant	
Field crops	Barley, dhaincha (*Sesbania* sp.) sugarbeet, tobacco, cotton, wheat (some local var,), sugarcane, rapeseed
Fodders (Forage)	Salt grass, dubgrass (*Cyanodon* sp.), Rhodes grass, Bermuda grass
Vegetables	Beetroot, asparagus, spinach, kale, turnip
Fruits	Date palm, coconut, falsa (*Grewia* sp,).

Agronomical Management Practices

Some tested land management practices help improving the productivity of crops on these lands. **A**lternate methods of planting to offset water logging effects have to be used. Planting of upland crops on the side of a ridge significantly improves crop yield in alluvial as well as black soil (Sharma, 1988). Raised and Sunken beds technique for rainfed areas: The concept of raise bed and sunken bed (RSBS) system was tested in which 7.5 m width perform best. About 62 – 70% of the rainwater could be conserved and that 25- 41qha^{-1} of paddy and 2.4 - 4.9 q ha^{-1} of seed cotton yields could be obtained (Verma and Sharma, 2001). Apply 25 kg $ZnSO_4$ to every kharif crops in the first three years of reclamation. In the first few years after reclamation the crops should be fertilised with > 20% N as compared to the recommended dose for normal soil. Apply organic matter, green manure (*Sesbania alba* – dhaincha) or organic residue in maximum possible quantity to increase the productivity. Irrigation should be applied in lower amount and more frequently. Continuous cropping using tolerant crops and their varieties is recommended after reclamation.

Acid Soils

Soil acidity refers to presence of higher concentration of H+ in soil solution and at exchange sites. They are characterized by low soil pH and with low base saturation. The soils having a pH range of 3-4, 4-5, 5-6, and 6-7 are referred as Very strong, Strong, Moderate, and Slightly acidic soils. Acid soils occupy approximately 60% of the earth land area and are arise under humid climate conditions from carbonaceous less soil forming rocks in all thermal belts of the earth. The total world-wide area under acidic soils is 800 M ha and in India it is 100 M ha. According to an estimate, 95% of soils of Assam and 30% of geographical area of Jammu and Kashmir are acidic. In West Bengal, 2.2 M ha, in Himachal Pradesh, 0.33 M ha, in Bihar, 2 Mha and all hill soils of erstwhile Uttar Pradesh come under acid soils. About 80% of soils in Orissa, 88% in Kerala, 45% in Karnataka and 20% in Maharashtra are acidic. The laterite zone in Tamil Nadu is covered with acid soil and about 40,000 ha are acidic in Andhra Pradesh. A total of 3.85 Lac ha acidic soils are found in the state of Madhya Pradesh. Soil acidity affected districts in M.P. are Mandla (2.16 Lac ha), Balaghat (0.83 Lac ha), Chhindwara (0.58 Lac ha), Sagar (0.15 Lac ha), and Vidisha (0.13 Lac ha).

Sources of Soil Acidity

In general, the main sources of soil acidity are Leaching due to heavy rainfall, Acidic parent material and alumina silicate minerals, Acid forming fertilizers, Humus and other organic acids, Carbon dioxide and hydrous oxides and Acid rains.

Production Constraints

Increased solubility and toxicity of Al, Mn and Fe, Deficiency of Ca and Mg, Reduced availability of P and Mo and Reduced microbial activity.

Management of Acid Soils

Management of the acid soils should be directed towards enhanced crop productivity either through addition of amendments to correct the soil abnormalities or by manipulating the agronomic practices depending upon the climatic and edaphic conditions.

Soil Amelioration

Lime has been recognized as an effective soil ameliorant as it reduces Al, Fe and Mn toxicity and increases base saturation, P and Mo availability of acid soils. Liming also increases atmospheric N fixation as well as N mineralization in acid soils through enhanced microbial activity. However, economic feasibility of liming needs to be worked out before making any recommendation.

Liming Materials

Commercial limestone and dolomite limestone are the most widely used amendments. Carbonates, oxides and hydroxides of calcium and magnesium are referred to as agricultural lime. Among, the naturally occurring lime sources calcitic, dolomitic and stromato litic limestones are important carbonates. The other liming sources are marl, oyster shells and several industrial wastes like steel mill slag, blast furnace slag, lime sludge from paper mills, pressmud from sugar mills, cement wastes, precipitated calcium carbonate, etc equally effective as ground limestone and are also cheaper. Considering the efficiency of limestone as 100%, efficiencies of basic slag and dolomite are 110 and 94 % respectively. Basic slag and pressmud are superior to calcium oxide or carbonates for amending the acid soils. Fly ash, a low- density amorphous ferro-alumino silicate, also improves pH and nutrient availability.

Lime Requirement

Lime requirement of an acid soil may be defined as the amount of liming material that must be added to raise the pH to prescribed value. Shoemaker et al. (1961) buffer method is used for the determination of lime requirement of an acid soil.

Crop Choice

Selection of crops tolerant to acidity is an effective tool to counter this soil problem and breeding of such varieties is of specific importance for attaining higher productivity, particularly in areas where liming is not an economic proposition. The crops can be grouped on the basis of their performance in different soil pH range (Table 7).

Table 7: Relative tolerance of crops to soil acidity:

S.N.	Crops	Optimum pH range
1. Cereals:	Maize, sorghum, wheat, barley	6.0-7.5

	Millets	5.0-6.5
	Rice	4.0-6.0
	Oats	5.0-7.7
2. Legumes:	Field beans, soybean, pea, lentil etc.	5.5-7.0
	Groundnut	5.3-6.6
3. Others	Sugarcane	6.0-7.5
	Cotton	5.0-6.5
	Potato	5.0-5.5

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Invitro Conservation of Plant Resources

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Introduction

Plant Conservation is a multi-faceted assignment requiring an assortment of devices. Securing plants in situ is of essential significance, but this isn't in every case enough to guarantee the endurance of a species. At the point when it isn't, different strategies can be utilized to upgrade, supplement and back up such security. A portion of these depend on conventional techniques for engendering. Seed banking is the great representation and the best in support up wild populaces with undeniable degrees of biodiversity ex situ. Biotechnology has achieved an upheaval in the manner that plant hereditary assets can be used. Clonal crops cover a wide scope of species from the root and tuber crops. There are two essential alternatives for in vitro stockpiling, moderate development for the short to medium term and cryopreservation as long as possible.

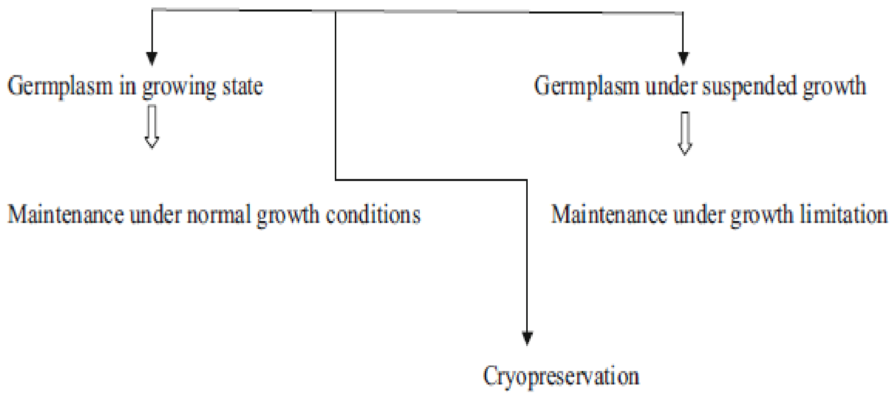
Conservation of Tissues

Six significant advances characterized in the preservation use cycle are assortment, isolate, engendering, portrayal, assessment, checking, stockpiling and conveyance. The part of in vitro protection methods in the general preservation systems ought to be characteristic of the way that it should supplement other preservation methodologies inside the complete program of a given populace. The techniques picked ought to be deliberately viewed as considering the attainability, reasonableness, economy and security.

For certain species, while in situ protection is the lone choice accessible, tissue culture frameworks offer favourable circumstances, which are recorded beneath:

1. High duplication rates.
2. Aseptic framework.

Storage



Technical approaches to *in vitro* storage

Challenges

Albeit general plant tissue culture strategies are grounded, each plant species is extraordinary and may react distinctively to any of the progressive phases of culture in vitro. To achieve fruitful spread, tissues should be started into culture aseptically, the way of life should develop and engender the two shoots and roots, and the subsequent plants should be effectively adjusted. What's more, if tissues are to be cryopreserved, they should make due in any event one of the strategies accessible for cryoprotection through openness to fluid nitrogen. A few animal groups effectively progress through these strategies, while others may require adjustments at any of these means. For instance, pollution or caramelizing of the underlying explant, inability to fill in culture, hyperhydricity, corruption, yellowing, or leaf-drop in shoots, disappointment of shoots to root or of substantial undeveloped organisms to sprout, shrivelling or trim of plants during acclimatization, disappointment of shoot tips or physical undeveloped organisms to endure cryoprotection or openness to fluid nitrogen are largely difficulties that can make in vitro proliferation and safeguarding additional time-and asset burning-through. Fundamental examination that gives extra comprehension of elements influencing development and endurance of in vitro-proliferated plants adds to making in vitro methodology all the more broadly appropriate.

Waste Water - A Source of Irrigation in Indian Agriculture

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Utilization of nutrient and organic matter rich waste water in agriculture can enhance crop yields provided minimum safe standards of major chunk of pollutants in not only waste water but also in surface water resource including rivers/stream is maintained for avoiding recycling of toxic and harmful pollutants in agriculture soils and food chain. Sewage water increases yield of grain crops and vegetable over ground water apart from increasing N,P, K and organic carbon status of soils. Wastewater utilization is tedious and challenging since its indiscriminate use can cause serious health and environment hazards that can extend from providing breeding grounds for mosquitoes and other disease vectors to diseases themselves (diarrhoea, dysentery, cholera, typhoid, acute skin and gastric disorders etc.) and nematode infections. Untreated wastewater can carry harmful and toxic chemicals potent to deteriorate water quality of water bodies and underground aquifers. Heavy metal (Cd, Cr and Cu) contamination of Sabarmati river at Ahmadabad has resulted in elevated levels of Cr and Cu in nearby water in wells and caused high Pb levels in wheat irrigated with polluted groundwater. Indiscriminate and long-term use of sewage effluent in agriculture can cause contamination up to phytotoxic levels or build-up of heavy metal levels in food stuffs beyond standards enumerated in prevention of Food Adulteration Act. One such example includes high heavy metal levels in commonly eaten vegetables irrigated with sewage water in Delhi. Instances of heavy metal contamination (Cu,Cd, Cr, Fe, Mn, Ni, Pb and Zn) of agriculture soils are there if wastewater is a discharge from small scale industries e.g., in Kanpur and Delhi. In heavily industrialised cities like Ahmadabad and Kanpur, hyman health hazards are being countered on consuming vegetables raised by using wastewater.

Sewage Water Treatment in India

Treatment capacity of existing sewage treatment plants (STPs) in India is much lower than total wastewater generation. Inefficient performance of existing STPs due to operation and maintenance problems together with inability of nearly 39% STPs to meet required general prescribed standards described under environmental (Protection) rules are further aggravating the pollution of water bodies in India. Among different states, Maharashtra has maximum contribution in total national wastewater generation (about 23%) while contribution of states in Ganga river basin is about 31%. Hill states generate comparatively less waste water than states in plains. With rapid urban growth in 495 Class-1 cities and 410 Class-II towns, current water supply (48,00 million liter/day or MLD) is furthue projected to increase. In 2011, wastewater generation in class-I cities and class II towns was more than 38,000 MLD, out of which only 35 % was treated. Further, cities located in major river basin catchments extract freshwater but discharge wastewater back into river which is polluting irrigation canals and making wastewater management more challenging for urban and rural planners. About 1,22,000 MLD wastewater generation is projected by 2050 and its treatment in country requires and investment plans. India has 35 metropolitan cities with more than 10 Lakh human population but they have only 51% treatment capacity (8040 MLD). Delhi has maximum treatment capacity (2330 MLD) but it just constitutes only 10.5% of total national sewage water generation. Similarly, Mumbai has treatment capacity of 2130 MLD but again it corresponds to just 9.1% of total sewage water generation. Fortunately, cities like Hyderabad, Vadodara, Ahmedabad, Ludhiana and Chennai have 100% sewage water treatment capacity where it is fully safe to use wastewater in agriculture.

According to international Water Management Institute (2013), irrigation Potential of municipal wastewater generated from class I and class II cities in India is about 11.01 lakh ha of agricultural land out of which share of treated waste water is just 0.71 lakh ha. total water use in India agriculture was 688 trillion litres in 2010 while waste water generation in class I and II cities corresponded to 14 trillion litres. As such, municipal wastewater use in agriculture through has a limited significance but under water stressed situations in peri urban agriculture it can be important. However, with increasing human population municipal wastewater generation is expected to register an increase of 50% by 2050, therefore, its reuse in urban and peri-urban agriculture can be of significance in near future. Central Pollution control board estimates for 2050 say that sewage generation from class I and II cities will exceed 100,000 MLD, so by improving agricultural waste use efficiency through use of sprinkler and drip irrigation systems in future, municipal wastewater can be a potential resource.

Summary

A brief appraisal of waste water generation, treatment and its present and possible use in Indian agriculture furnished above depicts that waste water can act as an alternative source of cheaper irrigation water over underground. Waste water has potential to maintain declining fertility of Indian soils in urban and peri-urban agriculture apart from reducing use of fertilizers and both these aspects needs to be precisely studied on agro-climate basis in different crops. However, ensuring cent per cent treatment of waste water for safeguarding our land and water resources, keeping healthy our human and livestock population and securing a safe environment is necessary.

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Cut Flowers - Post Harvest Problems

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Bent Neck

It is a common postharvest problem observed in roses and is due to:

1. Water deficiency in the neck tissue, which is controlled by the transpiration rate, the rate of water uptake and the ability of different organs on the cut flower shoot to compete for water.
2. An increase in the stem flow resistance of cut blooms due to vascular occlusions of metabolic origin.
3. Appearance of plugging materials like pectin, cellulose and microbes.
4. Lack of development of secondary thickening and lignification of the vascular elements in the peduncle area subtending the flower head.
5. It has also been found that the growth and rigidity of rose peduncles are due to gibberellins and auxins and the activity of phenyl alanine ammonia lyase in the peduncle tissue.
6. Extreme temperature during shipping or storage.

Control: Use of de-aerated and micro-organism-free water and wetting agents reduce the extent of bent neck.

Limp Neck

It is a type of disorder in roses caused by water stress in the area just below the flower head. The affected flower buds bend down due to the weight of the top. Insufficient stored energy of flower heads may be one of the reasons.

Bull Head

Thrips infestation, insufficient carbohydrate supply to developing buds and hard pruning cause bull head in roses. Affected roses have shorter shelf life.

Blind Shoot

Blind shoot in roses is due to failure of the shoot to initiate flower buds or due to flower bud atrophy or bud abortion.

Inadequate carbohydrate supply, unfavourable temperatures and light conditions during bud initiation at the early stages of development are associated with blind shoot production.

Calyx Splitting

Calyx splitting in carnation is a factor of quality. The sepals beneath the flowers are unable to form a cylindrical calyx tube, which support the base of the petals. During bud opening, the calyx may split either half or completely.

Sleepiness

A disorder in carnation, it is caused by exposure of the flowers to ethylene gas or water stress. The extent of this disorder is much higher when flowers are stored for long periods or when they are kept at high temperatures.

Topple

Topple in gladiolus is characterized by breaking of spikes after opening of the florets in the vase. The spikes harvested from calcium- deficient soil have higher incidence of topple.

Negative Geotropism

A postharvest disorder of gladiolus and antirrhinum, it occurs during storage and shipping. The spikes curve upward if they are placed horizontally.

Differential distribution of auxins is responsible for this phenomenon. Transport of cut flowers in upright position is the remedy.

Flower Bud Blasting

It is a disorder found in tulip and is caused by dry storage or forcing of bulbs. It has been reported that a change in the plant's hormonal status, which regulates the distribution in carbohydrates and other organic materials within the plant, is the main reason for blasting.

Petal Discolouration

Low night and day temperatures are correlated with accumulation of pigments and is accompanied by blackening of petals and often stimulated by penetration of ultraviolet radiation through the materials covering the greenhouse, bluing during storage is attributed to breakdown of proteins, release of free ammonia and a concomitant increase in pH. Bluing of red rose petals is increased by the use of AOA but reduced by the use of STS.

Flower Bud and Petal Abscission

This disorder is caused by ethylene evolution, formation of an abscission layer, a rising activity of cell wall hydrolytic enzymes, shaking, wounding and high temperatures, pollination and fertilization causing ethylene production.

Remedial measures are use of ethylene inhibitors, spray with NAA (30 to 50ppm), application of MH (200 to 400ppm) and citric acid (500ppm) through cut stem. Treatment with AOA or AIB reduces abscission.

Petal Wilting

The wilting of petals following ethylene exposure is a characteristic of only a limited number of plant families and the Caryophyllaceae is the family which displays petal wilting in response to ethylene. This family includes the commercial important flowers like carnation and Gypsophila. STS pulsing inclusion of AOA, cytokinin and AIB (α –amino isobutyric acid) in the vase solution reduces petal wilting.

Bud Drying

In Asiatic hybrid lilies, the apparent desiccation and shrivelling of flower buds followed by abscission is a common problem. This problem is solved by STS pulsing.

Scape Bending

This phenomenon of cut gerbera is caused by excessive bacterial growth in vase solution which reduces longevity. Different varieties respond to different extents.

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In Vitro Polyploidy Breeding in Ornamental Plants

Article ID: 10630

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Introduction

Polyploidy refers to the presence of more than two complete sets of chromosomes per cell nucleus, which has been considered a ubiquitous phenomenon in plant evolution and diversification (Soltis et al., 2009). The estimation of polyploidy incidence is widely variable in the literature, ranging from 30 to 35 per cent (Stebbins, 1971) to 70 per cent for angiosperms. Otto and Whitton (2000) developed a simple model to estimate the incidence of polyploidy based on transitions between odd and even basic chromosome numbers. Using such approach, they suggested that polyploidization occurs in approximately 2 to 4 per cent of speciation events in angiosperms and 7 per cent in ferns. In light of these results, the authors affirmed that polyploidy is likely to be one of the most predominant mechanisms of sympatric speciation in plants.

The remarkable advances in genomic studies have revealed ancient cases of polyploidy. Using phylogenetic analysis of expressed sequence tags (EST), Jiao et al. (2011) identified two events of whole genome duplication (WGD), which occurred around 319 and 192 million years ago, shortly before the diversification of extant seed plants and flowering plants, respectively. Therefore, it is accepted that all seed plants have experienced at least one round of WGD in their evolutionary history, characterizing a paleopolyploid ancestry. The elucidation of the causes and consequences of polyploidy has been the focus of several reviews in the last hundred years (Ramsey and Ramsey 2014).

The revelation that a large number of plant species have a polyploid genome, including several important crops, has attracted the attention of plant breeders for the application of artificial polyploidy as a tool for crop improvement. In this context, the work at hand presents a review focused on the numerous applications of polyploidy in plant breeding and the methods for polyploidy induction and detection, as well as some examples of successfully induced polyploidy in horticultural crops.

What is Polyploidy and how does it Arise?

A polyploid is simply an organism that contains more than two complete sets of chromosomes. For animals, this is a fairly rare occurrence (though a polyploid rat, the first polyploid mammal ever identified, was recently discovered in Argentina). In plants, however, polyploidy occurs naturally and is very common. The term “ploidy” or “ploidy level” refers to the number of complete sets of chromosomes and is notated by an “x.” An individual with two sets of chromosomes is referred to as a diploid (2x), three sets would be a triploid (3x), and so on with tetraploid (4x), pentaploid (5x), hexaploid (6x), etc. It is sometimes also important to identify if one is referring to the reduced (gametophytic) chromosome number following meiosis as would be found in egg and sperm (denoted as “n”) or in nonreduced (sporophytic) tissue (denoted as “2n”). Thus, for example, a tetraploid birch tree would be presented as $2n = 4x = 56$.

Role of Polyploidy in Plant Evolution

In contrast to the gradual evolutionary process whereby new species evolve from isolated populations, new species of plants can also arise abruptly.

1. The most common mechanism for abrupt speciation is through the formation of natural polyploids. Once a tetraploid arises in a population, it can generally hybridize with other tetraploids.

2. However, these tetraploids are reproductively isolated from their parental species. Tetraploids that cross with diploids of the parental species will result in triploids that are typically sterile. This phenomenon provides a "reproductive barrier" between the polyploids and the parental species a driving force for speciation. Various estimates suggest that as many as 47 % to 70 % of flowering plants are of polyploid origin for example, the plants in the rosaceous subfamily maloideae (*Malus, Pyrus, Photinia, Chaenomeles*, etc.) are believed to have originated from ancient allopolyploids since they have n = 17 base chromosomes whereas plants in other rosaceous subfamilies have n = 8 or 9.

3. In many genera, different species will have different ploidy levels (multiples of a base number) representing a series of polyploids.

4. In the genus *Chrysanthemum* (syn. *Dendranthema*), different species have chromosome numbers of 2n = 18, 36, 54, 72, 90, and 198 — all multiples of a base chromosome number of 9.

5. Haploid are weak and sterile.

6. Polyploids have gigantic plant parts, large cell and stomata.

7. Tetraploids are vigorous, show polyploids vigour and exhibit more vegetative growth, thicker leaves, bigger flowers and bigger fruit.

8. Polyploids have increased flower and fruit size and thus are of interest to ornamental and fruit breeders.

Advantages

1. There are a number of factors that may provide polyploids with adaptive and evolutionary advantages. Perhaps most importantly, polyploids can be significantly more heterozygous than their diploid counterparts.

2. Polyploids can have 4 different genes (alleles) present at any given locus (location on a chromosome).

3. The degree of heterozygosity may be a key factor in the growth, performance, and adaptability of a polyploid.

4. Allopolyploids can have a much greater degree of heterozygosity (dissimilar genes) which can contribute to heterosis or hybrid vigour. Furthermore, this heterozygosity is somewhat fixed (chromosomes that originated from a given species preferentially pair with similar homologous chromosomes during meiosis, ensuring that the genomes of both parental species will continue to be present).

5. On the other hand, the addition of multiple copies of homozygous chromosomes (as would be the case with autopolyploids), does little to enhance genetic superiority and can actually reduce vigour and fertility by creating a more "inbred" situation. Since all polyploids have a certain amount of genetic redundancy, extra copies of genes can mutate and diverge resulting in new traits without compromising essential functions.

Polyploid populations often demonstrate extensive genomic rearrangement including the origin of novel regions of DNA (Wendel, 2000). Ancient polyploids can eventually undergo such changes to the extent that they effectively become "diploidized" where diploid gene ratios are restored.

In Vitro Polyploidy

It is the phenomenon of artificial induction of three or more complete set of chromosomes under controlled environmental condition in an artificial nutrient medium by colchicine treatment.

Methodology for Mitotic in Vitro Chromosome Doubling

An in vitro chromosome doubling protocol consists of several sub-processes. The initial process is the treatment of the plant material with antimitotic agents. After one or several multiplication cycle(s), the efficiency of polyploidization can be estimated.

Besides the difference in antimitotic agents, in vitro chromosome doubling protocols vary in explant type, exposure time, concentration, application method and confirmation technique. Below, we will discuss these variables.

Explant Type

Different explant types have been successfully used in the past: plantlets or shoots, buds or shoot tips, callus, somatic or zygotic embryos, seeds, seedlings, nodal segments and tuber segments. In order to find a suitable explant type, several explants have to be tested per plant species. The efficiency of polyploidization depends on the type of explant. but also, within an explant type, differences of success in chromosome doubling can occur depending on the permeability of the tissue and transport capability of the antimitotic agent to the meristem. In addition to the effect of the explants, genotype dependent efficiency is also observed.

Concentration and Exposure Time

Concentration and exposure time are important parameters, but there is an evident interaction between them. Every crop thus requires testing. Low doses are not successful, while excessively high doses are lethal. Furthermore, high concentrations or exposure times can result in redoubling, which leads to cells with higher ploidy levels than desired the solvent in which the antimitotic agent is dissolved is also important. It contributes to the effect and toxicity of the treatment. In many studies, antimitotic agents are dissolved in DMSO (Allum et al., 2007). DMSO increases cell permeability and allows increased absorption of chemicals. However, it often induces plant mortality.

Treatments with colchicine dissolved in 2 or 4 per cent DMSO decreased the survival rate compared to colchicine controls dissolved in water; however, the number of tetraploids increased (Hamill et al., 1992). When excessive toxicity is observed, alternative solvents can be used.

Oryzalin can be dissolved in NaOH (1 M) (Dhooghe et al., 2009) or 70 % ethanol (Petersen et al. 2002, 2003), trifluralin in acetone (100 %) and colchicine in liquid culture medium or water (Dhooghe et al., 2009) or ethanol (96 %) (Greplova et al., 2009). When a solution of an antimitotic agent is directly used on plant tissue, a wetting agent is often added to enhance the contact surface. Different surfactants can be used, e.g., 0.05% Teepol (Eeckhaut et al., 2001) or any commercially available detergent.

Applications of in Vitro Chromosome Doubling in Plant Breeding

1. Although somatic chromosome doubling does not introduce new genetic material and produces only additional copies of existing genes and chromosomes, many genome alterations occur after mitotic polyploidization (Ranney 2006). Examples are loss of duplicated genes, gene expression alterations and epigenetic changes modulating gene expression.

2. These genetic changes often result in polyploid crops being superior to diploids with respect to morphological changes, genetic adaptability and tolerance to environmental stresses.

3. Mitotic chromosome doubling can directly lead to morphological and anatomical changes. Many examples can be found in the literature. Chromosome doubling resulted in increased leaf thickness, increased width/length ratio of the leaves, darker green coloration and bigger flowers in Rhododendron (Paden et al., 1990) *Spathiphyllum*.

Conclusion

Creation of new flower shape in ornamental plant is a major breeding target as increased its target value. Different flower shape including double flower can be developed by polyploidy breeding. Now a day's new techniques like RNAs and mRNA, other breeding techniques are being used to develop, altering flower shape & colour. Even though many techniques are available very few varieties have been developed for commercial purpose.

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Precision Agriculture: Modern Concept for Today's Farmer

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Summary

Precision agriculture (PA) is the science of improving crop yields and assisting management decisions using high technology sensor and analysis tools. PA is a new concept adopted throughout the world to increase production, reduce labour time, and ensure the effective management of fertilizers and irrigation processes. It uses a large amount of data and information to improve the use of agricultural resources, yields, and the quality of crops. GPS allows agricultural fields to be surveyed with ease. Moreover, the yield and soil characteristics can also be mapped.

Introduction

Precision Agriculture is a management strategy that gathers processes and analyses temporal, spatial and individual data and combines it with other information to support management decisions according to natural variability found within a field for improved resource use efficiency, productivity, quality, profitability and sustainability of agricultural production. In simple term, it refers to the precise application of agricultural inputs with respect to soil, weather and crop need in order to improve productivity, quality, and profitability in agriculture. The goal is not to obtain the same yield everywhere, but rather to manage and distribute inputs on a site-specific basis to maximize long term cost/benefit. Applying the same inputs across the entire field may no longer be the best choice. Modern technologies such as remote sensing, GPS and Geographical Information System (GIS) enables farmers to use crop inputs more efficiently including pesticides, fertilizers, tillage and irrigation water. More effective utilization of inputs will bring in more crop yield and quality without polluting the environment and will result in sustainable agriculture and sustainable development. Hence precision agriculture is about doing the right thing, in the right place, in the right way, at the right time.

In 1929, the concept of precision agriculture was introduced by C.M. Linsley and F.C. Bauer.

Need for Precision Farming in India

To meet the huge food grain requirement of 480 million tonnes (mt) by the year 2050, with the increasing challenges of biotic and abiotic stresses experienced by crops, introduction and adoption of modern technology in Indian agriculture is inevitable. The global food system faces formidable challenges and that will increase over the next 40 years. More radical changes to the food system and investment in research are required to cope up with future challenges and their solutions. The decline in the total productivity, diminishing and degrading natural resources, stagnating farm incomes, lack of eco-regional approach, declining and fragmented land holdings, trade liberalization on agriculture, limited employment opportunities in non-farm sector, and global climatic variation have become major concerns in agricultural growth and development. Therefore, the use of newly emerged technology adoption is seen as one key to increase agriculture productivity in the future.

Comparison with Traditional Agriculture

Precision farming distinguishes itself from traditional agriculture by its level of management wherein instead of managing whole fields as a single unit, management is customized for small areas within fields. This increased level of management emphasizes the need for sound agronomic practices. Before shifting to precision agriculture management, it is essential to have a good farm management system in place. Precision farming is an approach where inputs are utilised in precise amounts to get increased average yields, compared to traditional cultivation techniques.

Objectives of Precision Farming

1. Increased profitability and sustainability: Maximum profit can be obtained in each zone or site in a field by balancing precise amounts of inputs (seeding rate, variety, herbicide and insecticide) with crop needs, which can be determined by weather, soil characteristics (nutrient availability, texture and drainage) and historic crop performance.

2. Optimising production efficiency: In general, the aim of precision farming is to optimise returns across a field. The identification of variability in yield potential may offer possibilities to optimise production quantity at each site or within each "zone" using differential management.

3. Optimising product quality: Precision farming also aims at optimisation of product quality by way of using sensors which detect the quality attributes of the crop and thus inputs are to be applied accordingly.

4. Most efficient chemical and seed use: PA involves efficient use of inputs i.e., chemicals, seeds etc. according to the yield potential of the soil.

5. Effective and efficient pest management: One goal of precision farming is to cut crop production inputs, which result in cost and environmental savings. Whereas conventional farming methods apply herbicides, insecticides etc. to the entire field, site-specific variable rate application puts these chemicals (i.e., herbicides, insecticides) where the problem appears.

6. Energy, water and soil conservation: A comprehensive approach to PA begins from crop planning and thus includes such tillage practices which conserve the soil or disturb the soil to its minimum. Besides, water is efficiently applied by using techniques like drip irrigation etc. In all these cases, very less energy is used and thus PA leads to conservation of energy also.

7. Surface and ground water protection: PA aims at safeguarding the environment by way of efficient use of inputs like chemicals etc. This prevents their leaching through ground water or as runoff through surface water.

8. Minimising environmental impact: If better management decisions are being made to tailor inputs to meet production needs then by default there must be a decrease in the net loss of any applied input to the environment. Therefore, the risk of environmental damage is reduced.

Technology for Precision Farming

In order to collect and utilize information effectively, it is important for anyone considering precision farming to be familiar with the modern technological tools available. These are:

1. Global Positioning System (GPS) receivers.
2. Differential Global Positioning System (DGPS).
3. Geographic information systems (GIS).
4. Crop scouting.
5. Remote sensing.
6. Variable Rate Applicator.
7. Combine harvesters with yield monitors.

Advantages of Precision Farming

1. It will enhance agricultural productivity and prevent soil degradation in cultivable land resulting in sustained agricultural development.
2. It will reduce excessive chemical usage in crop production.
3. Water resources will be utilized efficiently under the precision farming.
4. GPS allows agricultural fields to be surveyed with ease. Moreover, the yield and soil characteristics can also be mapped.

5. Dissemination of information about agricultural practices to improve quality, quantity and reduced cost of production in agricultural crops.
6. It will minimize the risk to the environment particularly with respect to the nitrate leaching and groundwater contamination by means of the optimization of agro-chemical products.
7. Non-uniform fields can be sub-divided into smaller plots based on their unique requirements.
8. It provides opportunities for better resource management and hence reduces wastage of resources.

Constraints of Precision Farming

The major reasons for the limited implementation of precision agriculture in Asian countries in general and in India in particulars are:
1. High-cost technology.
2. Culture and perceptions of the users.
3. Lack of technical expertise.
4. knowledge and technological gaps.
5. Not applicable or difficult/costly for small land holdings.
6. Heterogeneity of cropping systems and market imperfections.

Conclusion

Precision agriculture must cover all phases of production from planning to post harvest. Information, technology and management are the key factors to increase productivity, improve product quality and allow more efficient chemical use. Technology and management practices such as field scouting, field mapping, variable rate control, yield mapping and post-harvest processing can readily be adapted to crop production. However, the technology related to precision farming needs refinement to realize benefits. Ultimately, the success of precision agriculture depends largely on how well and how quickly the knowledge needed to guide the new technologies can be found.

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Teeth: An Age Determinant in Livestock

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Summary

Age determination proves useful during purchasing and maintenance of stocks in the farm. Among various techniques requiring experience and skills, teeth examination is more accurate under field conditions. The degree of growth and wear of the teeth, the accentuation of their darker colour and their gradual loss reveals the approximate age of an animal. However, the wear in teeth may advance or retard depending on the dental care and nourishment received by the animal.

Introduction

Age refers to the length of time an animal has been existing and the duration of animal's life at a point in time. An animal's age is a critical part of its history and reflects the decisions that can be made regarding its care and management like, nutritional and restraining practices, treatment methods and anaesthetics and drug doses (Tobias et. al., 2000). Since most smallholder farmers do not keep records, it becomes difficult to estimate the age of animals. Under such situations, age is estimated primarily on the basis of dentition.

Age Determination in Livestock

Variety of age determining techniques are in existence, but since decades, the perfection of age determination through teeth examination could not be substituted. Principally, the incisors and the canines (in case of canines and felines) are observed during teeth examination. A concise study on age determination through teeth examination in various species of livestock is done below.

1. Dog: An adult dog has 42 teeth with 6 incisors, 2 canines, 16 premolars and 4 (upper jaw) and 6 (lower jaw) molars in each jaw. Incisors are tricuspid, while canines are fang-like, conical, elongated and slightly curved in shape. The incisors are divided into pincers, intermediate and corners. The teeth examination discloses (Barton, 1939):

Age of dog	Teeth eruption pattern
14-21 days	Deciduous incisors and canines erupt
2.5-3 months	All deciduous teeth grow to full; incisors show some wear
4-5 months	Deciduous incisors start falling followed by canines
6 months	Permanent incisors, canines erupt
7 months	Whole teeth erupt
12 months	Whole teeth grow too full
15 months	Lower pincers show some wear
1.5-2 years	Cusps on lower pincers disappear
2.5-3 years	Cusps on lower intermediates disappear; cusps on upper pincers show some wear
4 years	Cusps on upper pincers disappear; intermediates start flattening; teeth begin to yellow; tartar deposits seen at base of canines

5 years	All incisors are markedly worn
5-7 years	Canines gets greenish and mossy; all teeth become smooth or flat
8-10 years	Old age begins; some teeth fall; heavy tartar build-up

2. Cat: An adult cat has 30 teeth with 6 incisors, 2 canines, 6 (upper jaw) and 4 (lower jaw) premolars and 2 molars in each jaw. The teeth examination shows (Elliott, 2020):

Age of cat	Teeth eruption pattern
2-4 weeks	Deciduous incisors and canines erupt
1-1.5 months	Deciduous premolars erupt in lower jaw
2 months	Remaining deciduous teeth erupt and grow too full
3.5-5 months	All permanent teeth erupt
1 year	All permanent teeth grow to full and appear white and clean
1-2 years	Slight tartar build-up (yellowing) seen on back teeth
3-5 years	More tartar build-up on all the teeth and some signs of teeth wear
5-10 years	Teeth show increased wear, tartar build-up and pigment on gums
10-15 years	Teeth are worn, heavy tartar build-up and some teeth may fall

3. Cattle/ Buffalo: An adult cattle and buffalo has 32 teeth with 0 incisors on upper jaw (instead have dental pad) and 8 incisors (central, 1st lateral, 2nd lateral and corner incisor) on lower jaw and 0 canines, 6 premolars and 6 molars on each jaw. The incisors are chisel shaped and do not have flat tables and infundibulum. The premolars and molars are more or less chisel shaped. Teeth examination discloses (Banerjee, 2000):

Age		Teeth eruption pattern
Cattle	Buffalo	
At birth		Deciduous central incisors erupt.
3-4 weeks		All deciduous incisors, premolars and molars erupt.
5-6 months		All deciduous incisors grow too full.
10 months		Deciduous central incisors show some wear.
15 months		Both lateral incisors show some wear.
1.5 years		All deciduous teeth flatten.
2 years	2.5 years	Permanent central incisors erupt.
3 years	3.5-4.5 years	Permanent lateral incisors erupt.
4 years	5-6 years	Permanent corner incisors erupt.
5-6 years		All incisors grow too full.
6-7 years		Central incisors get worn out.
7-9.5 years		Both lateral incisors get worn out.
11 years		Corner incisors worn out; incisors turn smaller in size.
12 years		Dental pad becomes square instead of oval; gaps appear between teeth.

4. Sheep/ Goat: An adult sheep and goat has exactly the same teeth numbers as in cattle and buffalo; however, there are differences in eruption pattern that is studied below (Banerjee, 2000):

Age of sheep/Goat	Teeth eruption pattern
Birth to 1 week	Deciduous central incisors erupt
1-2 weeks	First deciduous lateral incisors erupt
2-3 weeks	Second deciduous lateral incisors erupt
3-4 weeks	Deciduous corner incisors erupt
2-6 weeks	All deciduous premolars erupt
3-5 months	First molar teeth erupt
9-12 months	Second molar teeth erupt

1-1.5 years	Permanent central incisors erupt
1.5-2 years	First permanent lateral incisors erupt; all permanent premolars and third molar teeth erupt
2.5-3 years	Second permanent lateral incisors erupt
3.5-4 years	Permanent corner incisors erupt; it is full mouth condition
6-8 years	Wide gaps between incisors observed; teeth show some wear and tartar build-up
8-12 years	Incisors worn out; teeth fall; it is broken mouth condition

5. Pig: An adult pig has 44 teeth with 6 incisors, 2 canines, 8 premolars and 6 molars in each jaw. Ageing in pig is mainly done by examining premolars and molars. These are tricuspid in shape. The teeth examination discloses (NPCA, 2020; Banerjee, 2000):

Age of pig	Teeth eruption pattern
Birth-1 week	Deciduous corner incisors, canines, 3rd and 4th upper jaw premolar erupt
2-4 weeks	Deciduous central incisors, 3rd and 4th lower jaw premolar erupt
1-2 months	Deciduous 2nd premolar erupt
1.5-3 months	Deciduous lateral incisors erupt
4-6 months	Deciduous 1st premolar and 1st molar erupt
8-12 months	Permanent central & corner incisors, canines and 2nd molar erupt
12-15 months	All permanent premolars erupt
16-20 months	Permanent lateral incisors erupt
1.5-2 years	3rd molar (first cusp) erupt
3.5 years	3rd molar (third cusp) erupt
4-4.3 years	1st, 2nd, 3rd (first cusp) molar show some wear
5 years	All molar show heavy wear, 1st molar becomes flat
6-7 years	All molar becomes flat

6. Horse: An adult horse has 40 (mare) to 44 (stallion) teeth with 6 incisors, 2 canines, 6 (mare) to 8 (stallion) premolars and 6 molars in each jaw. The teeth examination discloses (TROT, 2020):

Age of horse	Teeth eruption pattern
1 week	Deciduous central incisors erupt
2 weeks	Deciduous 2nd, 3rd and 4th premolars erupt
1-1.5 month	Deciduous lateral incisors erupt
5-6 months	Permanent 1st premolar erupts
6-9 months	Deciduous corner incisors erupt
9-12 months	Permanent 1st molar erupts
2 years	Permanent 2nd molar erupts
2.5 years	Permanent central incisors and 2nd premolar erupt
3 years	Permanent 3rd premolar erupts
3.5 years	Permanent lateral incisors erupt
4 years	Permanent 4th premolar and 3rd molar erupt
4.5 years	Permanent corner incisors erupt
4-5 years	Permanent canines erupt
6 years	Cups worn away on the lower central incisors; dental star is visible
7 years	Cups worn away on the lower lateral incisors; hook or notch appears on upper corner incisors
8 years	Cups worn away on the lower corner incisors; hook or notch disappears from upper corner incisors

9 years	Cups worn away on the upper central incisors; dental star appears on lower lateral incisors
10 years	Cups worn away on the upper lateral incisors; Galvayne's grooves appear on upper permanent corner incisors
11 years	Cups worn away on the upper corner incisors
10-12 years	Dental star appears in remaining incisors
13 years	Hook/ notch reappears on upper corner incisors and disappear after 1 year
15 Years	Galvayne's grooves extend half way down
20 Years	Galvayne's grooves extend full length down
25 Years	Galvayne's grooves recede and is halfway disappeared from the gum
30 Years	Galvayne's grooves completely disappear

Benefits of Age Determination in Animals

Knowledge of age determination in livestock leads to benefits conferred below:
1. It aids in purchasing the young stock and prevents getting fooled over old stock.
2. It assists in making decisions regarding mating and culling of stocks.
3. It assists in identifying the stocks of approximately the same age for accomplishing selection among them.
4. It assists in adjusting the age differences within farm. Lesser age difference among stocks limits variations in investigations caused due to higher age differences among groups.
5. It aids in predicting the age of peak performance of stocks.

Limitations

The age of animals of the same litter may vary subjected to different diets and dental care. The animals fed on straw will show more wear in teeth than the animals fed on greens. Similarly, the animals receiving dental care will look young than the animals lacking dental care.

Conclusion

Age determination is fruitful for the efficient management of livestock. The age can be determined by the date of delivery of new-born and maintenance of its records but in case where the records are not available, age determination through teeth examination have proven its worth.

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Turkey Tail - A Medicinal Mushroom

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Introduction

Turkey tail is one of the best mushrooms medically important for boosting the immune system are *Trametes versicolor* (turkey tail), *Grifola frondosa* (maitake), *Lentinus edodes* (shiitake) and *Ganoderma lucidum* (reishi). It (*Trametes versicolor)* contains a low fat and high fibre content. It also contains phenolic compounds like sterols, and chitosan. They are the mismatched source of healthy foods and drugs. They have very good attractive taste, aroma and good nutritional value, hence considered as functional foods, beneficial to our body not only in terms of nutrition but also for improving one's health. Medicinal mushrooms like turkey tail and their extract contains large number of bioactive components known as secondary metabolites along with polysaccharide-protein complexes. Mushroom extracts have wonderful therapeutic applications related to the human health such as anti-diabetic, anti-cancerous, anti-obesity, immune-modulatory, hypo-cholesteremic and hepato-protective nature along with anti-aging properties. It may improve the immune system's ability to fight infection due to viral, bacterial, and parasitic pathogens.

History

Trametes versicolor has been utilized therapeutically and it has been devoured for quite a long time in Asia as a component of traditional diet. The traditional remedies of turkey tail include the treatment of lung and liver infections. In China, turkey tail has been utilized as a preventive and curative agent for liver cancer and liver infections. In Japan, it is viewed as a panacea for an assortment of diseases. In general, the mycelium and fruiting body of the mushroom are considered to have insusceptible stimulatory and anti-carcinogenic exercises. Clinical research has focused on its immunotherapeutic efficacy in stomach, colorectal, lung, and breast cancers.

Botany

Trametes versicolor, are also known as *Polyporus versicolor* is a mushroom in the Basidiomycotina division (Basidiomycetes). Its growth is found all through North America, Asia, and Europe. Its fruiting bodies cover each other, framing a thick mass that develops on tree trunks, stumps, and fallen trees. The particular layers made by these bodies might be light to dull earthy colour or dark. The polysaccharides of the fruiting bodies are sweet and mellow in taste, and are economically advertised as a tea utilized in Asian and European conventional medication.

Benefits

The extracts of *Trametes versicolor* appear to work synergistically to modulate an immune response at numerous levels. Extracellular incitement of pattern recognition receptors can improve the maturation of macrophages and dendritic cells, activate cytotoxic CD8+ T-cells and natural killer cells. Incitement of intracellular microbe sensors has also been recorded and is a basic advance in enacting both intrinsic and versatile resistance. *Trametes versicolor* extracts have been utilized for quite a long time in Japan for treating a malignant growth treatment and as an adjuvant in chemotherapy.

Conclusion

Turkey tail mushrooms have immune boosting properties which support cancer treatment for humans.

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Transmission of Plant Viruses by Aphid Vectors

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Aphids

Aphids are small sap-sucking insects and members of the super family Aphidoidea. Common names include greenfly and black fly, although individuals within a species can vary widely in colour. The group includes the fluffy white woolly aphids. A typical life cycle involves flightless females giving living birth to female nymphs without the involvement of males. Maturing rapidly, females breed profusely so that the number of these insects multiplies quickly. Winged females may develop later in the season, allowing the insects to colonise new plants. In temperate regions, a phase of sexual reproduction occurs in the autumn, with the insects often overwintering as eggs.

The life cycle of some species involves an alternation between two species of host plants, for example between an annual crop and a woody plant. Some species feed on only one type of plant, while others are generalists, colonising many plant groups. About 5,000 species of aphid have been described, all included in the family Aphididae. Around 400 of these are found on food and fibre crops, and many are serious pests of agriculture and forestry, as well as an annoyance for gardeners. So-called dairying ants have a mutualistic relationship with aphids, tending them for their honeydew, and protecting them from predators.

Kingdom	Animalia
Phylum	Arthropoda
Class	Insecta
Order	Hemiptera
Suborder	Sternorrhyncha
Infraorder	Aphidomorpha
Superfamily	Aphidoidea
Kingdom	Animalia

Introduction

A majority of plant viruses are dependent on vectors for their transmission and survival. Insects, mites, nematodes and protests' all mediate the transmission of plant viruses. Insects are the most common of the vectors and, among these, aphids account for the transmission of 50% of the insect-vectored viruses. Aphids are exquisitely designed for their roles as vector. Piercing sucking mouthparts facilitate the delivery of virions into plant cells without causing irrevocable damage. With the option of asexual reproduction, aphid populations can increase at extraordinarily high rates, thereby potentiating disease epidemics and furthering the short- and long-distance spread of viruses. Additionally, aphids are globally distributed and there are more than 200 vector species identified, a number that is most likely a gross underestimate.

The viruses that are transmitted by aphids and discuss concepts and mechanisms underlying transmission. Most plant viruses are the result of a co evolution of virus and vector. A greater understanding of mechanisms behind the transmission process will be important in determining how these forces have played a role in shaping the evolution of plant viruses.

Aphid-Vectored Viruses

The selection of aphid-transmitted plant viruses listed in Table 1 includes representatives of all the plant virus families with aphid-transmitted virus members in addition to some taxonomically unaligned species. Among these, the family *Potyviridae*, genus Potyvirus is perhaps the most important based on the exceptionally large number of virus species. In 2000, there were 91 definitive and 88 tentative potyviruses. The genus *Potyvirus* contains a large number of virus species, often with relatively narrow host ranges. This contrasts with other prominent genera of plant viruses with only one or a few species of great importance due to their extraordinarily wide host range, e.g., genus *Alfamovirus*, species *Alfalfa mosaic* virus or genus *Cucumovirus*, species *Cucumber mosaic* virus.

Table 1. Examples of aphid-transmitted plant viruses from different families organized by their modes of transmission:

Mode	Family	Genus	No. of species	Virus
Noncirculative, Nonpersistent	Bromoviridae	*Alfamovirus*	1	Alfalfa mosaic virus
	Bromoviridae	*Cucumovirus*	3	Cucumber mosaic virus
	Cucumoviridae	*fabavirus*	4	Broad bean wilt virus-1
	Potyviridae	*Mocluravirus*	2	Mclura mosaic virus
	Potyviridae	*Potyvirus*	91	Potato virus Y
	Unassigned	*Carlavirus*	31	Carnation latent virus
Noncirculative, Semipersistentn	Caulimoviridae	*caulimovirus*	9	Cauliflower mosaic virus
	Closteroviridae	*Closterovirus*	8	Beet yellows virus
	Sequiviridae	*Sequivirus*	2	Parsnip yellows fleck virus
	Sequiviridae	*Waikavirus*	3	Anthriscus yellows virus
	Unassigned	*Unassigned*	1	Black raspberry necrosis virus
	Unassigned	*Unassigned*	1	Strawberry mottle virus
Circulative, Nonpropagative	Luteoviridae	*Enamovirus*	1	Pea enation mosaic virus-1
	Luteoviridae	*Luteovirus*	2	Barley yellow dwarf virus
	Luteoviridae	*Polerovirus*	5	Potato leaf roll virus
	Luteoviridae	*Umbravirus*	7	Carrot mottle virus
	Unassigned	*Nanovirus*	4	Banana bunchy top virus
	Unassigned	*Sobemovirus*	11	Blueberry shoestring virus
Circulative, Propagative	Rhabdoviridae	*Cytorhabdovirus*	8	Lettuce necrotic yellows virus
	Rhabdoviridae	*Nucleorhabdovirus*	7	Sonchus yellow net virus

The number of definitive species in the indicated genera as described in Virus Taxonomy: Seventh Report of the International Committee on the Taxonomy of Viruses (Van Regenmortel et al., 2000).

1. Examples of virus species for which aphid transmission has been clearly established are given for each genus in addition to aphid-transmitted virus species that are taxonomically unassigned.
2. Some virus families with members for which there are reports of aphid transmission are not represented, notably those for which the role of a helper virus has not been clearly established.
3. One member of the genus *Carlavirus* (Cowpea mild mottle virus) is transmitted by whiteflies.
4. Parsnip yellow fleck virus and Carrot mottle virus require the presence of a helper virus for their aphid transmission.
5. Other members of the genus *Waika virus* (Maize chlorotic dwarf virus, Rice tungro spherical virus) are transmitted by leafhoppers.
6. A majority of members of the genus *Sobemovirus* are transmitted by beetles (e.g., Southern bean mosaic virus); one member is transmitted by a myrid (Velvet tobacco mottle virus).

7. Other members of the genus *Cytorhabdovirus* (Barley yellow striate mosaic virus, Northern cereal mosaic virus, Wheat American striate mosaic virus) are transmitted by leafhoppers.
8. Other members of the genus *Nucleorhabdovirus* (Maize mosaic virus, potato yellow dwarf virus, Rice yellow stunt virus) are transmitted by leafhoppers.

Aphid Vectors

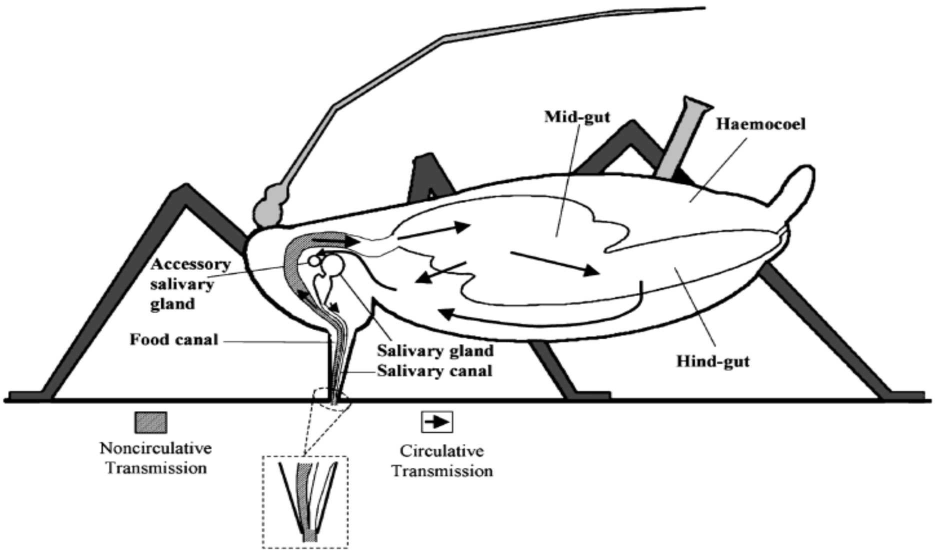
The majority of aphid vectors belong to the subfamily aphidinae (Order: Homoptera). Aphid vectors are also found in nine other subfamilies, but they account for only a very small proportion of those that are known to transmit viruses. A number of unique features contribute to the success of aphids as vectors of plant viruses.

These include:

1. A polyphagous nature for some aphid species (e.g., *Myzus persicae*) that allows them to feed on a wide range of plant hosts, a property important for the dissemination of viruses that infect a large number of plant species.

2. The ability to undergo parthenogenetic reproduction, thus facilitating the rapid production of large quantities of offspring.

3. The possession of a needle-like stylet capable of piercing plant cell walls and delivering viruses into a host cell. Feeding behaviour and host plant selection by an aphid will affect its potential as a vector. The extent to which these factors influence virus transmission (positively or negatively) will depend on the specific virus and its mechanism of transmission. From the standpoint of applied research, understanding the spread and control of viral diseases requires an understanding of the vector and its behaviour; vector transmission is paramount to epidemiology.



A schematic diagram of an aphid showing the course taken by noncirucultative and circulative viruses upon acquisition. Plant fluids are initially taken up into the food canal in the stylet bundle that runs down the centre of the proboscis. The food canal and foregut (hatched regions) are retention sites for noncirculatively transmitted viruses; bound virions are subsequently released during inoculation. Arrows represent the passage of circulatively transmitted viruses through the alimentary canal (food canal, foregut, midgut and hindgut), haemocoel and accessory salivary gland of the aphid prior to exiting via the salivary canal. The inset at the bottom of the figure shows an enlarged view of the tip of the stylet bundle where the salivary canal merges with the food canal.

Transmission Mechanisms

The most fundamental distinction with regard to the mode of virus transmission is whether ingested virions are circulative or non circulative in the vector, a distinction that focuses on the duration and/or site of retention of virions and the route of movement within the aphid. Circulative viruses are taken up into cells, cross multiple membrane barriers, are transported within the vector haemolymph and ultimately exit the aphid in its saliva.

Circulative viruses are further classified as circulative non propagative or circulative propagative, depending on whether the acquired virus replicates within the vector. Noncirculative viruses have a more superficial and transient relationship with the vector and are only associated with the mouthparts and foregut. These distinctions are most easily visualized within the context of the aphid feeding apparatus and digestive system (Fig. 1).

Non Circulative Transmission

Among the aphid-vectored plant viruses, a majority are transmitted in a noncirculative manner. These viruses are described as nonpersistent or semipersistent, depending on the length of time that an aphid remains viruliferous following feeding on an infected plant. If the aphid moults, virus is lost (does not 'persist').

Virus transmission consists of at least three step-wise processes: (i) The uptake of virus from an infected source (acquisition), (ii) the stable retention of acquired virions at requisite sites within the vector and (iii) the release of bound or retained virions and their delivery to a site of infection (inoculation).

Non persistent virus transmission is characterized by very short acquisition and inoculation times of seconds to minutes. Furthermore, aphids typically remain viruliferous for comparably short periods of time; once an aphid has left a virus-infected source plant and begun feeding on an uninfected plant, its ability to transmit virus is short-lived (minutes). Historically, this was referred to as 'stylet-borne', in part because it was thought that virus was merely contaminating the outside of the stylet. It is now recognized that virus destined for inoculation is retained at sites within the stylet and food canal or foregut, and recent studies indicate that virions retained at the distal tip of the stylet bundle are most likely to play a determining role in transmission. One of the conundrums in transmission is that the binding of virions within the vector must be readily reversible. Considering that the food and salivary canals merge at the tip of the aphid stylet, salivation may function to enhance the release of bound virions and their delivery into plant cells.

A primary determinant of both aphid transmissibility and specificity is the viral capsid protein. This is clearly demonstrated in studies of *Cucumber mosaic virus* (CMV), wherein virions can be reassembled *in vitro* from purified capsid protein (CP) and genomic RNAs. Using non transmissible and wild-type strains, the transmission phenotype of reconstructed virions follows that of the virus from which a CP is isolated. CMV is the only efficiently aphid-transmitted plant virus for which a high-resolution atomic structure is available (Smith *et al*., 2000); a lower resolution structure is available for the related *Tomato aspermy virus*. Mutations that disrupt transmission map to the surface of virions or to less exposed sites that influence the physical stability of virions. The CP of potyviruses is also a key determinant of transmissibility. Spontaneous mutants of many potyviruses have been recovered that are aphid-non transmissible. Capsid protein changes that confer a defective phenotype map to a region including a 'DAG' motif at the N-terminus of the CP. Serological evidence indicates that this 'DAG' motif is exposed on the surface of virions.

Circulative Transmission

In contrast with the noncirculatively transmitted viruses, the efficient transmission of circulatively transmitted viruses requires acquisition periods of hours to days. The longer acquisition and retention periods are attributed to the phloem-limited nature of many of these viruses and the extensive path they have to navigate through the aphid (Fig. 1). Depending on whether a virus replicates in the vectoring aphid, transmission is described as 'circulative, nonpropagative' or 'circulative, propagative'. Aphids remain viruliferous for extended periods; the virus persists and this mode of transmission has historically been referred to as 'persistent'.

Vector specificity, i.e., the transmission of a virus by one or a few specific aphid species but not by others, is a prominent feature of luteovirus transmission. Transmission is a function of compatible interactions between virions and factors in the aphid. Barriers to transmission reside in regions of both the gut and/or the accessory salivary gland of the vector, with evidence suggesting the more stringent selection is at the accessory salivary gland. A more detailed discussion and references can be found in the recent review by. As with all plant viruses studied to date, the CP is a primary determinant of transmission for circulative, nonpropagatively vectored viruses. In luteovirus transmission, it also determines vector specificity. This was illustrated in the seminal studies of Rochow (1970), in which he demonstrated transcapsidation and genomic masking. Plants can be dually infected by two luteoviruses with different vectors. If the RNA from one isolate is encapsidated by the CP of the second virus, the vector specificity follows that of the virus from which the CP was derived.

This second protein proved to be a CP translational readthrough protein that appears to be required for aphid transmission and may play a role in vector specificity. In addition, *in vitro* binding studies demonstrated that the CP translational read through protein binds symbionin, a protein homologue of the *Escherichia coli* chaperonin GroEL that is produced by the aphid endosymbiotic bacteria *Buchnera* spp. Symbionin is hypothesized to be an essential factor in transmission functioning to stabilize virions in the aphid haemolymph, but it seems unlikely that it plays a role in vector specificity because luteoviruses bind symbionins of both vector and nonvector aphids. Other aphid-specific proteins that bind luteoviruses have been identified in immunoblots with virus (BYDV-MAV) overlay assays. Using proteins extracted from the head of the aphid *Sitobion avenae*, Li *et al*. (2001) identified a number of proteins that are hypothesized to function as putative receptors mediating the transmission of BYDV-MAV.

Another biological property of luteoviruses is their role as helper/assistor viruses in the transmission of viruses belonging to the genus *Umbravirus*. Umbra viruses are mechanically transmissible, but their genomes do not encode a CP and they are aphid-nontransmissible. They achieve aphid transmission competence by associating with luteoviruses in plants dually infected by both viruses. The luteovirus helper virus contributes to the transmission of the umbravirus by encapsidating the latter's genomes with its CP. This transcapsidation is similar to that observed among isolates of BYDV and it allows the umbravirus to take on the aphid transmission characteristics exhibited by the luteovirus helper.

The circulative propagative plant viruses bear a striking resemblance to animal viruses transmitted by mosquitoes. In both cases, viruses replicate in the insect vector and exit via the salivary glands. The circulative propagative plant viruses are similar to the circulative nonpropagative viruses in many aspects of their acquisition and path of movement within the aphid. The primary difference is that once an infection in the aphid has been established, the association remains permanent for the rest of the life of the insect and virus may be transmitted to offspring through a transovarial route. The aphid-transmitted circulative propagative plant viruses are restricted to the family *Rhabdoviridae* . This family includes viruses that replicate in vertebrates, invertebrates and plants. Individual viruses can replicate in either mammals and insects or plant and insects; none has been shown to replicate in all three systems. Virus-encoded determinants for transmission have not been identified in plant rhabdoviruses, but by comparision with animal-infecting species, it is likely that the viral glycoprotein (G protein) governs receptor binding and infection of the insect vector.

Conclusion

Aphid vector transmission has been selected for in a diversity of plant viruses. The mechanisms of transmission can be strikingly different, and there is no correlation with genome type, replication strategy or particle morphology. One of the forefronts in the field of virus–vector relationships is elucidating the fate of virions within the vector, e.g., identifying ligands to which virions bind, their paths of movement and (where relevant) tissue tropisms. Ligands may be individual protein receptors mediating virion uptake via endocytosis or may prove to be complex (or less well defined) surfaces such as components of the cuticular lining of the stylet and foregut, a matrix of carbohydrates, proteins and lipids. Because salivation appears to play an essential role in the release of virions, an understanding of virus entry may ultimately require a better understanding of salivation. Just as there has been a co evolution of viruses with their aphid vectors, our knowledge of viruses will evolve with our insights into vector biology.

Major Potato Diseases and their Management

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The potato (*Solanum tuberosum* L.) has its place in the family Solanaceae. Potato ranks fourth in importance as food crop following wheat, rice and maize. Potato is a native of Peru and Bolivia (South America). Plant diseases are a major constraint of potato production. Potato yield can be influenced by roughly 160 diseases out of which 50, 10 and 40 are caused by fungi, bacteria and virus and others by non-parasitic organisms. The following major diseases are as follows:

1. Late blight of Potato: *Phytopthora infestans*

Symptoms: It is known as the "plant destroyer". Late blight is the potential disease of potato. All parts of the potato are susceptible. The disease often occurs in very wet weather conditions. On young leaves, irregular, water-soaked lesions appear. The lesions are dark brown to black with green halo around the lesions. Later, lesions enlarge into circular, necrotic patches. Lesions on stems are dark brown to black with water-soaked centres. In tuber brown, dry and granular region appear which later turn reddish brown to dark brown, granular tissue is apparent. On severe infection the plants die.

Management:
a. Proper field drainage.
b. Proper plant spacing for optimum air movement.
c. Proper sanitation is necessary like destroy cull piles and any infected material.
d. At planting, seed treatment fungicides should be used.
e. Deep hilling can be used to protect tubers.
f. Monitor irrigation so that leaves dry during the day.
g. Avoid excessive fertilization to prevent canopy overgrowth.
h. Fungicide management: Contact fungicides and Systemic fungicides can be used with varied levels. Some strains of potato are resistance to metalaxyl and mefenoxam.
i. Infected vines can be destroyed by burning.

2. Early blight of Potato: *Alternaria solani*

Symptoms: Larger lesions are present with surrounding concentric rings. Dark-coloured spores and mycelia of *A. solani* can survive amid growing seasons by overwintering on pest-ridden debris and susceptible weeds. Spores are disseminated by wind. Foliar lesions have dark spots. Lesions begin as circular, but later become too larger and angular. The lesions are constrained by veins. Diameter of lesions can be from pinpoint to ¼-inch. Brown or black elongated lesions may also form on petioles and stems.

Management:
a. Crop rotation.
b. Destruction of plant debris and weed hosts are used to reduce the sources of inoculum.
c. Rotation to non-hosts is efficient.
d. Avoid over irrigation i.e., allowing leaf tissue to fully dry.
e. Use of tillage practices to bury plant debris to reduces inoculum.
f. Fungicide: most protectant fungicides recommended for late blight also have efficacy against early blight. Spray as soon as symptoms appear (approx. 10 days old).

3. Common scab of potato: *Streptomyces scabies*

Symptoms: Many varieties will not exhibit overt symptoms if growers maintain greater than 80% field moisture capacity from tuber initiation until 6-8 weeks later, with the most critical time being until tubers are 1-1½ inches in diameter. The high moisture allows developing tubers to be surface colonized by microbes that are inhibitory to S. scabies. Growers should evade dispersal un-composted manure, as fresh manure can surge populations of S. scabies.

Management:

a. Maneb or mancozeb seed treatments can eliminate spread by infected seed tubers.
b. PCNB or azoxystrobin in-furrow with fludioxonil seed treatment will provide reduction of disease.
c. Avoid rotations with red clover.
d. Use of organic materials like ground barley or oats at 200lbs/Acre.

4. Alternaria brown spot: *Alternaria alternata*

Symptoms: Early symptoms consist of small, dark round necrotic lesions ranging in size from pinpoint to $^{1}/8$-inch in diameter, later they coalesce. Whole leaves may be affected like drying up but often remained attached to the stem. Lesions are unrestricted by large leaf veins. Lesions grow, the surrounding tissue becomes chlorotic, causing the edges of the leaf to curl up. *A. alternata* can survive on plant debris. They are often windblown and enter through potato leaf.

Management:

a. Cultural practices.
b. Rotation to a non-host crop.
c. Irrigation in cool, cloudy conditions should be avoided.
d. Provide adequate fertilization. Use contact fungicides with broad-spectrum activity. Avoid strobillurin fungicides.

Conclusion

Potato is an important food crop of the world which feeds most of the people. The disease caused in them are also increasing as the time passes by so, the potato crop can be kept healthy by planting disease free planting material, less irrigation, not planting closely etc. There is a need for the management by which the farmers economic condition can also be maintained.

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Moringa -The Miracle Tree of Life

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Introduction

1. *Moringa oleifera* is universally referred to as the miracle tree of life because of its potential to help with malnutrition around the world. The name derived based on its uses, particularly with regard to medicine and nutrition.
2. Moringa trees are commonly used as high value plants that belongs to the family called Moringaceae which consists of 13 species.
3. Moringa is a fast-growing tree and also known as the horseradish tree (from the taste of the roots, which resembles horseradish), ben oil tree, or benzoil tree (from the oil which is derived from the seeds), drumstick tree and mother's best friend.
4. The moringa is a tree, where it bears fruits, flowers and leaves; beyond medicinal usage, it has a large degree of potential as an herb due to its resistance to drought and very rapid growth.
5. *M. oleifera* and *M. stenopetala* are the most well-known species and documented compared to the other Moringaceae members and these two species have very high nutritional and medicinal properties in various parts of the world.

Nutritional Value of Moringa

Nutrients	Pods	Leaves	Leaf powder
Protein (g)	2.50	6.70	27.10
Fat (g)	0.10	1.70	2.30
Calories	26.00	92.00	205.00
Carbohydrates (g)	3.70	13.40	38.20
Fiber (g)	4.80	0.90	19.20
Moisture (%)	86.90	75.00	7.50
Minerals (g)	2.00	2.30	-
Ca (mg)	30.00	440.00	20003.00
Mg (mg)	24.00	24.00	368.00
P (mg)	110.00	70.00	204.00
K (mg)	259.00	259.00	1324.00
Cu (mg)	3.10	1.10	0.60
Fe (mg)	5.30	7.00	28.20
S (mg)	137.00	137.00	870.00
Vitamin A	0.10	6.80	16.30
Vitamin B	432.00	432.00	-
Vitamin B1	0.05	0.21	2.60
Vitamin B2	0.07	0.05	20.50
Vitamin B3	0.20	0.80	8.20
Vitamin C	120.00	220.00	17.30
Vitamin E	-	-	113.00
Oxalic acid	10.00	101.00	0.00

Health Benefits and Medicinal Uses

Moringa Pods: Pods act as a de-wormer if eaten raw and treat liver and spleen problems and pains of the joints. It also used for treating malnutrition and diarrhoea due to its high protein and fibre content. It has an ability for improving sexual function in men, it also contributes in sperm production and also increase blood circulation in human body including penis, for stronger erection.

Moringa Leaves: It acts as an anti-bacterial and anti-inflammatory effect when applied to wounds or insect bites. It can also use as a good fodder for cattle. The leaf tea treats gastric ulcers and diarrhoea. Eating food products of moringa is good for those who are suffering from malnutrition because of its high protein and fibre content. It also treats for fevers, bronchitis, eye and ear infections, inflammation of the mucus membrane. The leaves have high iron content, and they are reportedly prescribed for anaemia in the Philippines. In ancient times the leaves are used for Ayurveda medicine.

Moringa Flowers: The juice of flower improves the quality and flow of mothers' milk when breast feeding. The moringa tea which is prepared by boiling flowers act as a powerful cold remedy.

Moringa Seeds: It also used for their antibiotic and anti-inflammatory properties to treat arthritis, rheumatism, gout, cramp, sexually transmitted diseases and boils. Seed powder can be used to clarify honey without boiling, as well as in sugarcane. The seeds are effective against skin-infecting bacteria. The powder from the seeds is used for the treatment of scurvy skin diseases.

Moringa Roots, Bark and Gum: Both the roots and bark used as a tonic for inflammation, cardiac and circulatory problems. The bark is an appetizer and digestive ainment, it can be used in rope making. The alkaloid spirachin (a nerve paralysant) found in the roots. The gum which is used for diuretic, astringent, abortifacient and is also used against asthma.

Moringa Oil: The Ben oil is used for hysteria, scurvy, prostate problems and bladder troubles. It has anti-aging properties and is prized highly in the cosmetics industry. Moringa seed oil is used to clear pimples and remove wrinkles.

Seeds of the Tree Can Purify Water

Many of the Researchers have found out that Moringa seeds can give a more efficient purification process than conventional synthetic materials in use today. Crushed Moringa seeds contain best natural coagulants used for turbid water treatment and hence they clarify and purify water to suit domestic use and lower the bacterial concentration in the water making it safe for drinking.100 milligrams of crushed seeds required to purify 1 litre of muddy water.

Leaf Juice - Natural Plant Growth Promoter

1. It increased yields by 25-30% in a variety of crops including maize, onions, soya, sorghum, coffee and melon.
2. Zeatin is the natural plant hormone from cytokinin group, involved in increasing the yield of crops.

Biofuel Production

1. Moringa oil seed is a potential feedstock for biodiesel production.
2. Biodiesel derived from *M. stenopetala* seed oil, which can be acceptable substitute for petro diesel.

Animal Feed Fortification

1. Moringa leaves used as supplementary to livestock feed, which can increase up to 32% of daily weight gain.
2. Milk production can be increased by 58% with the supplementation of 2 kg dry matter feed.

Socioeconomic Values

1. Moringa plant is a strategic and unique food tree in drought prone areas.
2. Traditionally Moringa plants are cultivated in agro forestry and as an ornamental tree.

Any Side Effects?

1. The few chemicals which are found in the roots, flowers and bark could cause uterine contractions in pregnant women and which may increase the risk of a miscarriage.
2. The women who are breastfeeding should avoid moringa as some of the ingredients may not be good for infants.
3. The alkaloid spirachin found in the roots may cause paralysis.
4. Inspite of having many benefits, when consumed in large quantities and regularly can cause side effects
5. Because of laxative properties when eat too much, it can cause stomach upsets, gaseous distension, diarrhoea and heartburn. When taken directly with water or raw may cause heart burns, so better to cook it.

Culinary Uses

1. Fruits or seed pods, known as drumsticks, which are commonly used in soups and curries.
2. The drumsticks which are long are often cut into shorter lengths and stewed in curries and soups.
3. The outer skin is tough and fibrous, these are often chewed to extract the juices and nutrients, while the remaining fibrous material discarded.
4. Traditional dishes which are commonly included drumsticks in South Indian sambar where it is stewed with lentils.
5. The tender moringa leaves are finely chopped and used as garnish for vegetable dishes and salads, instead of or along with coriander.

Conclusion

1. It's time that we seriously consider the possibilities of Moringa, by sharing this information with others could help save millions of lives.
2. Moringa should be promoted for consumption to improve nutrition and medicinal functions and as well as for any climate change mitigation.
3. Demand in the market for snacks is high.
4. There should be well controlled and documented clinical studies were required to proof the medicinal aspects of this miraculous trees.
5. In future it becomes one of the world's most valuable plant.
6. Even though it is a miracle plant it should be consume too much regularly and to get it benefit better to eat in limited quantity.

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Diagnosis and Detection of Phytoplasmas

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Introduction

Phytoplasmas are the smallest (0.1–0.8 µm diameter, genome size 0.5–1.3 Mbp) known free-living and self-replicating plant pathogens. They are wall-less cells and surrounded by a single membrane (80–800 nm) (Doi et al. 1967).

Phytoplasmas as intracellular parasites inhabit the nutrient-rich cytoplasm of phloem sieve cells in infected plants and haemolymph of insect hosts. They are transmitted by phloem sap-sucking insects primarily leafhoppers and planthoppers of the order Hemiptera, family Auchenorrhyncha in a persistent propagative style.

Phytoplasmas are very difficult to study as, unlike many bacteria, fungi and other disease-causing agents, they cannot be cultured in cell-free media in a laboratory for any purposes. Traditionally, phytoplasma diagnostic was based on biological properties and microscopic techniques. Specific and sensitive detection of phytoplasmas has been routinely based on the 16S rRNA gene, mainly using conventional polymerase chain reaction (PCR) assays and alternative diagnostic methods such as heteroduplex mobility assays (HMAs), single stand conformation polymorphisms (SSCP), terminal restriction fragment length polymorphism (T-RFLP), real-time PCR and loop-mediated isothermal amplification (LAMP). Real-time PCR is becoming a popular method for phytoplasma detection and quantification.

Biological Methods

Determination of phenotypic and genotypic traits provided a basis for differentiation, identification and classification of the cultivable Mollicutes the first attempts to differentiate and classify phytoplasmas relied upon knowledge of certain biological properties such as symptomatology, plant host range, and transmission by dodder/graft or insect vectors. Symptomatology has been one of the major criteria for preliminary diagnosis of putative phytoplasma diseases. The symptoms shown by infected plants include yellowing and reddening of the leaves, reduced leaf size, stunting, proliferation of axillary shoots resulting in a witches'-broom appearance, virescence, phyllody, sterility of flowers, decline and death.

Microscopic Techniques

Light microscopy: Direct detection of phytoplasmas is difficult, because they are not visible through a normal light microscope. Two different methods can be used to localize and identify phytoplasmas in the infected tissues by means of light microscopy. Dienes-reagent which eventually gives a blue colour (Dienes et al. 1948), and DNA-binding fluorochrome, 4'-6-diamidino2-phenylindole (DAPI) is the stain most used for phytoplasma diagnosis both in herbaceous and woody host plants such as coconut palms, ash, pear and sandal trees. These procedures are simple, quick and relatively cheap, and can be used as a preliminary method to detect phytoplasmas in infected plants with high concentrations of the pathogen but not specific for the different phytoplasmas

Scanning electron microscopy (SEM): Phytoplasmas are described by SEM as short, branched, filamentous forms in sieve elements of infected plants. DAPI staining and SEM are not useful to differentiate the bodies of phytoplasmas from other microorganisms or cell components such as mitochondria and chloroplast.

Transmission electron microscopy (TEM): Phytoplasma cells are small and pleomorphic, so the magnification and resolution of an electron microscope is required to observe them directly, and study the morphological and structural characteristics within the diseased host plant sieve tubes. This technique has enabled not only the diagnosis, but also the study of plant-phytoplasma interactions

Confocal laser scanning microscopy: Confocal laser scanning microscope using vital dyes can be used for detecting phytoplasmas in living plant tissues. DiOC7(3) (3,3'-diheptyloxacarbocyanine iodide) and SYTO 13 (green fluorescent nucleic acid stain) are specific vital dyes for membrane potential and DNA, respectively.

Fluorescence in situ hybridization (FISH) technique: Non-radioactive oligonucleotides probes allow in situ detection of phytoplasmas in both host plant tissues and insect vectors. Primer sequences can be employed as hybridization probes in FISH. aFISH could be applied for the specific identification of phytoplasma taxonomic groups, subgroups and/or strains, studying phytoplasma colonization patterns, phytoplasma population dynamics in response to the environment, and phytoplasma-endophyte interactions.

Serology-based techniques: Serological diagnostic methods are primarily enzyme-linked immunosorbent assay (ELISA) employing polyclonal or monoclonal antibodies were applied for phytoplasma detection in the early 1980's. Antibodies have been raised against whole phytoplasma cells purified from infected plants, immunodominant membrane proteins (IMPs) and SecA membrane proteins. They provide more reliable detection of several plant pathogenic mollicutes than microscope-based techniques. However, serological techniques have not been widely employed in phytoplasma detection and identification due to lack of appropriate specificity and sensitivity in generating specific high titre polyclonal antisera.

DNA-Based Techniques

Molecular hybridization assay: Dot and Southern blot hybridization assays using cloned fragments of phytoplasma DNA from chromosomal or plasmid (extrachromosomal) DNA as probes facilitated detection and differentiation of various phytoplasmas in a wide range of host plants and insect vectors. Radioactive 32P or nonradioactive biotin and digoxigenin have been used to label these probes. Alfalfa witches' broom, clover yellow edge, X-disease, clover phyllody, eastern and western aster yellows phytoplasmas have been detected in different host plants and in aster yellows phytoplasma vector *Macrosteles fascifrons* using biotinylated DNA probes. Digoxigenin-labelled DNA probes have also been used for the detection of sweet potato witches' broom phytoplasma in infected sweet potato and periwinkle plants. The sensitivity, specificity and reliability of phytoplasma detection by nucleic acid-based techniques seem to exceed that of the ELISA method.

PCR amplification of phytoplasma-specific DNA: The nucleic acid technique based on polymerase chain reaction (PCR) technology has widely been employed for detecting many different types of phytoplasmas. PCR provides a sensitive, specific, quick and cheap system in detection of phytoplasmas. Conventional detection of phytoplasmas is based on phytoplasma-specific universal (generic) PCR primers designed on the basis of the highly conserved 16S ribosomal RNA (rRNA) gene sequences, 16S-23S rRNA intergenic spacer (ITS) regions with more variation than in the 16S rRNA genes and 23S rRNA genes. Phytoplasma group specific primers were designed on ribosomal protein genes elongation factor tuf gene sequence, nitroreductase gene and gyrase genes. Highly conserved 16S rRNA gene is present in all the prokaryotes and has been applied to identify and classify unidentified phytoplasmas. PCR has considerably proven to be more sensitive and specific than microscopic, serological and hybridization methods for detecting phytoplasmas in plant and insect hosts.

Heteroduplex mobility assay (HMA): Heteroduplex mobility assay (HMA) is a reliable, fast and inexpensive technique in detecting and determining genetic diversity among phytoplasmas. HMA is based on the principle in which DNA fragments from non-identical but closely related samples are denatured and re-annealed prior to electrophoresis. The structural deformations in hybrid double-stranded DNA formed between related sequences resulted from mismatched base pairs, nucleotide insertion or deletion cause a reduced mobility in polyacrylamide gel electrophoresis. HMA is reported as a reliable technique for distinction and classification of phytoplasmas.

Terminal restriction fragment length polymorphism (T-RFLP): T-RFLP has been employed for identification of phytoplasmas in plants and for assigning them to phylogenetic groups. Terminal-Restriction Fragment Length Polymorphism (T-RFLP) analysis is a technique based on the restriction endonuclease digestion of fluorescently end-labelled PCR products of the 16S rRNA gene with an appropriate enzyme. Labelled terminal restriction fragments (TRFs) of various lengths are separated by gel electrophoresis and can be analysed on an automated DNA sequencing analyser. The T-RFLP technique provides distinct profiles (fingerprints), and it is a culture independent, sensitive, reproducible and rapid method of assessing microbial communities without the need for any genomic sequence information.

Single-Strand Conformational Polymorphism (SSCP): PCR based single-strand conformation polymorphism (SSCP) analysis is a sensitive and rapid method for the detection of genetic variations in PCR amplified fragments. The technique was based on the principle in which PCR products are denatured to produce single stranded DNA molecules and then separated on polyacrylamide gel according to their different primary structure fold. The technique has been used with primers for the 16S rRNA, tuf gene, dnaB and hflB genes.
Real-time PCR: Real-time PCR has been applied to diagnose and quantify numerous phytoplasmas from different groups. SYBR green and TaqMan-based real-time PCR approaches have been up to now developed for both universal and specific detection of phytoplasmas. TaqMan allelic discrimination assay based on a single nucleotide polymorphism would be of great value for studying the epidemiology of phytoplasmas.

Loop-mediated isothermal amplification (LAMP) assay: Loop-mediated isothermal amplification (LAMP) is a single tube technique for the amplification of DNA which uses a single temperature incubation ranging from 60 to 65°C. LAMP is a relatively simple, rapid (no time loss due to thermal cycling) and powerful technique which allows DNA amplification with a high level of specificity and sensitivity. The technique is based upon an autocycling strand-displacement DNA synthesis performed by the Bacillus subtilis-derived (Bst) DNA polymerase, which has strand displacement activity, using a set of four to six oligonucleotides (two inner primers, two outer primers, and two loop primers) that recognise six to eight distinct regions within the target genomic DNA, respectively, and form a loop-structured amplicon. It produces high titre of DNA and amplified products can be inspected with the naked eye by 3 different methods including photometry for turbidity resulting by increasing quantity of magnesium pyrophosphate in solution, color changing with addition of intercalating dyes such as SYBR Green or hydroxynaphthol blue and manganese loaded calcein which starts fluorescing upon complexation of manganes by pyrophosphate during in vitro DNA synthesis.

Conclusion

As we know phytoplasmas are obligate symbionts of plants and insects and need both hosts for their dispersal managing this will be difficult if it is not detected early. So, the diagnosis and detection of phytoplasmas are very important which give accuracy. So, the various methods of detection are important to manage these diseases.

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Foot and Mouth Disease: Clinical Presentation and Diagnostic Techniques

Article ID: 10638

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Introduction

Foot and mouth disease, also known as hoof and mouth disease (HMD) or an aphthous fever is caused by an apthovirus belongs to family Picornaviridae. The disease usually affects the cloven-footed animals (cattle, water buffalo, sheep, goats, pigs). FMD virus occurs as seven serotypes, specifically A,O,C, SAT-1, SAT-2, SAT-3 and Asia-1. Australia and New Zealand has been consistently free from FMD. The epidemics mainly occur in Africa and Asia whereas FMD cases are rarely reported from South America and some parts of Europe. The disease is transmitted via inhalation, ingestion and direct or indirect contact with the infected animals and fomites. Characteristic feature of disease is formation of vesicles and blisters in the mouth which further causes drooling of saliva and pustules in feet which ultimately leads to lameness and lassitude. The most prominent necropsy findings in FMD is the presence of streak in the ventricular walls of heart with the marks of yellow tissue which develops classical “tiger heart” appearance. The disease can be detected by clinical findings and various types of serological test like ELISA, Complement Fixation Test, Solid-phase, Competitive ELISA, Liquid-phase blocking ELISA and Indirect ELISA. Real Time PCR and Multiplex PCR can be used alternatively to detect the virus in the infected animals. There is no specific treatment for FMD. Hence, only symptomatic treatment can be provided to the affected animals. The spread of FMD should be reduced. Main focus should be on preventing the disease from occurrence as it affects large number of animal though it remains a major challenge across the world. FMD can be controlled with killed vaccine in endemic areas. FMD is included in the list of disease notifiable to the world organization for Animal health (OIE). FMD is one of most common and costly disease worldwide which has great impact on animal well-being.

Definition

Foot and Mouth Disease is a highly communicable/ infectious disease in aritodactyls or cloven-hoofed animals caused by small, non-enveloped virus which belongs to the family Picornaviridae and genus Aphthovirus characterized by vesicles and blister formation in mouth and feet, drooling of saliva and lameness.

Etiology

Foot and Mouth disease virus (FMDV) is a single stranded positive sense RNA virus which belongs to family Picornaviridae and genus Apthovirus. There are seven well-defined serotypes of FMDV which are represented as A, O, C, SAT-1, SAT-2, SAT-3 and Asia-1. Serotype O is most commonly occurring serotype worldwide as compared to other serotypes. Serovar O and A are widespread in Southeast Asia and Asia respectively and SAT-1, SAT-2, SAT-3 are most prevalent in Southern African Territories.

Modes of Transmission

FMD can be transmitted in animals in various ways. These include inhalation, ingestion, direct or indirect contact with the infected animals and fomites. Further, the transmission of FMDV can also occur through semen of infected bulls. The animal handlers transmit the virus from their clothes and skin to the healthy animals. The spread of the virus in endemic areas occurs by direct contact between the infected animals which are transported or moved across the National and State boundaries. The dissemination of the virus, can also occur through consumption of the contaminated meat scraps. In non-endemic areas like Europe, the virus penetrated in pigs via ingestion of infected meat scraps containing virus.

Epidemiology

The first outbreak was reported from United States in 1870. The most destructive outbreak occurred in the year 1914 which affected about 3,500 livestock herds. In 2001, an outbreak occurred in Great Britain due to illegal import of contaminated meat products to United Kingdom. In 2010-2011 another outbreak reported from Republic of Korea and throughout the outbreak over and above 3 million animals were demolished. An outbreak occurred in Japan in 2010 which infected pigs and cattle and about 300,000 animals were culled. By 2009 OIE has officially recognized 70 countries as from FMD either with or without vaccination. But still in addition to normal about 100 countries were observed as endemically or sporadically affected with the outbreak.

Pathogenesis

Most common route of infection in a healthy animal is through the inhalation of droplets. But in some cases, virus may transmit through infected food, contaminated semen, contaminated clothes etc.

Virus enters through respiratory tract and initially multiplies in pharynx. From pharynx, virus spread to other organs and tissue through blood. Excretion of virus usually occurs before the onset of clinical symptoms and can be excreted for several days. Highest concentration of virus excreted present in the aerosols and thus it is most common route of infection and spread of disease. In addition to aerosols, milk also contains high titre of virus. In some cases, even after recovery virus is present in pharynx for prolonged period of time thus forming a carrier state.

Clinical Signs

The severity of the disease depends upon the serotype of the virus. The incubation period of the disease is 2-8 days whereas it may increase upto 2-3weeks. The mortality in the indigenous cattle is low as compared to purebred and crossbred cattle but the morbidity rate is 100%. The disease is characterized by high fever, temperature is increased upto 40-41$^{\theta}$C along with decreased milk production, emaciation, anorexia subsequently presence of acute painful stomatitis. Formation of vesicles, their size may vary from 1 to 2 cm in diameter in the buccal mucosa, dental pad, tongue, feet, inter-digital space and udder accompanied by profuse salivation and lameness due to presence of blisters in the mouth and feet. As the wall of the vesicles are thin therefore the vesicles rupture easily, containing a straw-coloured fluid. The rupture of the vesicle of buccal cavity and feet results in drooling of roapy and foamy saliva and lameness in animal. Besides drooling of saliva, protrusion of tongue and smacking of lips is also seen. Due to pain in buccal mucosa affected animals are reluctant to eat and drink water. The animals become recumbent and are unwilling to move due to the pain and swelling of the coronet.

Cow having Nasal Erosion

Necropsy Findings

If secondary bacterial infection persists, the lesions in the oral cavity, feet and udder are eroded and become ulcers and occasionally the vesicles may expand to pharynx, oesophagus, fore stomach, intestines, trachea and bronchi. Swelling of the udder and teats are visible in the infected animals.

Grossly, in neonates the malignant form of the FMD shows haemmorhage in the inner layer of pericardium. Histologically, there is appearance of mild leucocytic infiltration on all sides of the erosions and ulcers. Acinar necrosis and mild Interstitial cellular infiltration can be detected histologically in epithelium of the mammary gland.

In chronic cases, the heart lesions are identified by hyaline degeneration, necrosis and sometimes calcification of myocardial fibres and increase in interstitial infiltration by mononuclear cells along with pancreatic islets in the affected animals.

Diagnosis

FMD virus spread rapidly and outbreak causing huge loss to livestock and farmers. Therefore, it is very important to diagnose disease as soon as possible to prevent the epidemic and loss. Various tests have been invented for diagnosis of FMD. These can be divided into viral isolations, serological tests and molecular diagnosis of virus. Control is mainly based on rapid diagnosis and quick actions.

1. **Based on clinical symptoms:** Infected animal show weakness, lethargy, unwillingness to rise or move (in some cases lameness). Vesicles are prominently seen on hoofs, dental pads and on tongue. In some cases, lesions are also seen on udder. Other clinical signs include high fever, salivation, sharp decrease in milk yield, ulcers between the digits due to which animal is unable to move and death in young animals (myocarditis).

2. **Virus Isolation:** Vesicular fluids is collected for the isolation of the virus. This method is very effective for diagnosis when concentration of virus is very less but only drawback is that it is time consuming. Virus isolation is done on primary lamb kidney cell lines and primary thyroid cell lines. Cytopathic effect is seen after 36-48 hours.

3. **Virus Neutralization Test:** It is gold standard technique for diagnosis of disease. This test is required for trade certification of animals and animal products from one country to another. Different cell lines have different sensitivity thus on that basis sensitivity of viral neutralization test also varies.

4. **Sandwich ELISA:** One of the most rapid and easy tests to diagnose FMD in field. Often considered to be primary test for diagnosis of disease. It is based on antigen-antibody interactions. Theoretically, it is considered to be 80% sensitive and 100% specific.

5. **Complement Fixation Test:** CFT is based on presence of bound or unbound complement in serum of suspected animals. If there is no lysis of sensitized sheep RBC's it is considered to be positive. Only drawback of this test is that it lacks sensitivity.

6. **Reverse Transcriptase PCR:** Being an RNA virus, RT-PCR is considered for molecular or nucleic acid detection methods. It involves the magnification of VPI gene.

7. **Reverse Transcription Loop Mediated Isothermal Amplification:** RT-LAMP can also be used for RNA virus's diagnosis. It can be used for rapid detection of FMD virus and seems to be more sensitive than conventional PCR.

8. Other test like **Multiplex PCR** and **Real Time PCR** can also be considered for diagnosis of FMDV on the molecular level.

Differential Diagnosis

It is very important to differentiate FMD from other diseases as some diseases have similar clinical presentation of the infected or suspected animal. These diseases include Blue Tongue, Vesicular Stomatitis Viruses, Mucosal Disease, and Malignant Catarrhal Fever.

Treatment

Being a viral disease there is no such treatment of FMD. Only supportive or symptomatic treatment can be done. Antibiotics should be administered to prevent secondary bacterial infections. As due to viral infection, immune system of the animal become weak thus, giving an opportunity to bacteria to cause further complication. Flunixin and other NSAIDS can also be used.

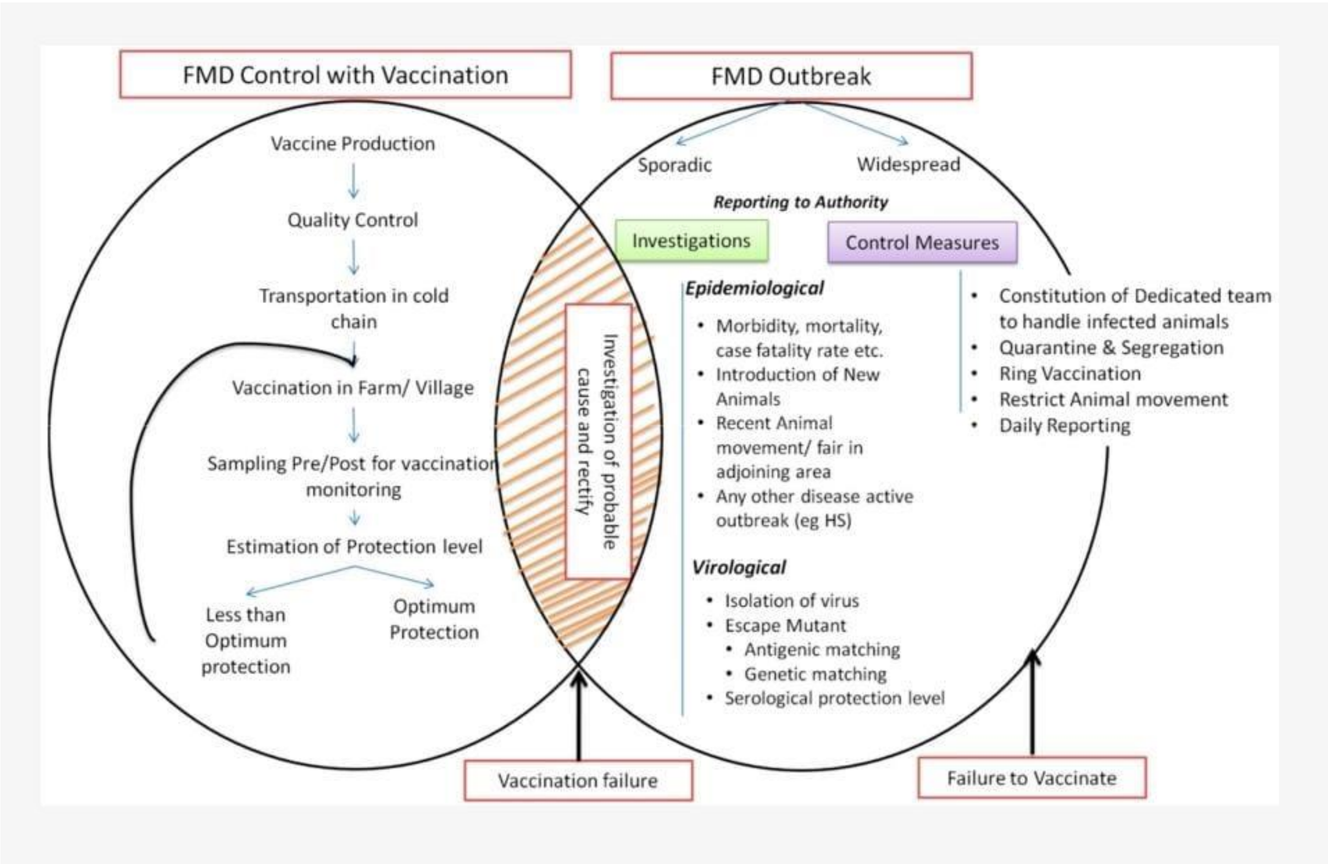
Control and Prevention

Best method for control of diseases is early diagnosis and quick quarantine of infected animals. There should be complete monitoring of disease and a quick action from response team. Ring vaccination is the best method for control of disease. In this method healthy animals are vaccinated around the 30 km zone or area in which outbreak has occurred thus preventing the spread of disease. Replanned method should be there to cope up with the outbreak. All infected things including clothing, instruments etc should be destroyed. Carcass should be disposed of properly and systematically. Time to time surveillance should be done of the area where outbreak has occurred. Disinfection of all farm equipment and premises should be done.

Proper biosecurity practice helps in prevention of disease. There should be restricted movement of vehicles inside the farm. Proper hygiene should be maintained and time to time disinfections should be done. Quarantine of newly brought animals should be done before introducing them into the herd.

Vaccination

It is the only way to prevent and control the disease. BHK suspension culture technique is used for the manufacture of FMD vaccine. Raksha and Raksha O Vac are two most commonly used vaccines in India against FMDV. Both the vaccines are manufactured by Indian Immunologicals. Components of Raksha vaccine include inactivated FMD virus strains O, A, Asia-1 absorbed on Al(OH)3 gel and adjuvant is saponins. It is administered at dose of 3ml, subcutaneously in the middle portion of neck. Initial dose is administered age of 4 months with successive booster after 2-4 weeks.



FMD Outbreak control with vaccination

Then revaccination has to be done every 6 months. Raksha O Vac includes inactivated O, A and Asia-1 strains. It is administered at the dose of 2ml in the middle part of neck (deep I/M). Initial dose is administered at 4 months of age and booster is given after 9 months. Revaccination is done annually.

Conclusion

FMD is an infectious viral disease which mainly affects cloven footed animals. Virus contains 7 different serotypes with serotype O being most common and most prevalent. Infectivity of virus varies with the serotype of virus. Transmission usually occurs through inhalation, ingestion or through contact with infected animals and fomites. As the virus replicate in pharynx so, inhalation of droplets is considered to be most common route of infection. The disease has some characterized features such as vesicles formation on tongue, feet, inter-digital space and udder, drooling of saliva, lameness and smacking of lips. These signs help in diagnosis of disease in field, where as for laboratory diagnosis various serological and molecular techniques are there. Viral Neutralization Test (VNT), Indirect Sandwich ELISA are some serological techniques for identification. Molecular techniques include RT-PCR, RT-LAMP etc. Being a viral disease, treatment is not as such available. More emphasis is done on control and prevention of disease. Vaccination is key step in control and prevention of disease. Time to time adequate vaccination should be done so that there is no loss to livestock.

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Artificial Intelligence: A New Face to Agriculture

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Artificial Intelligence

1. Artificial intelligence (AI) is an area of computer science that emphasizes the creation of intelligent machines that work and reacts like humans.
2. Artificial Intelligence is a way of making a computer, a computer-controlled robot, or a software think intelligently, in the similar manner the intelligent humans think.
3. Some of the activities computers with artificial intelligence are designed for include:
    a. Speech recognition.
    b. Learning.
    c. Planning.
    d. Problem solving.

Artificial Intelligence in Agriculture

1. Yet in a world with a finite amount of arable land, and a population that is expected to grow from 7.7 billion to nearly 10 billion by 2050, producing enough food to eat is a challenge today and a potential crisis in the future. As the population expands and diets change, farmers will need to increase food production by about 70 percent. The question is: how? AI can be part of the solution.

2. Agriculture is seeing rapid adoption of Artificial Intelligence (AI) and Machine Learning (ML) both in terms of agricultural products and in-field farming techniques.

3. Cognitive computing in particular is all set to become the most disruptive technology in agriculture services as it can understand, learn, and respond to different situations (based on learning) to increase efficiency.

Scope of AI in Agriculture

1. Image-based insight generation:
    a. Disease detection.
    b. Crop readiness identification.
    c. Field management.
2. Identification of optimal mix for agronomic products.
3. Health monitoring of crops.
4. Automation techniques in irrigation and enabling farmers.

Forms of Artificial Intelligence Used in Agricultural Industry

1. Agricultural Robots: Companies are developing and programming autonomous robots to handle essential agricultural tasks such as harvesting crops at a higher volume and faster pace than human labourers.

2. Crop and Soil Monitoring: Companies are leveraging computer vision and deep-learning algorithms to process data captured by drones and/or software-based technology to monitor crop and soil health.

3. Predictive Analytics: Machine learning models are being developed to track and predict various environmental impacts on crop yield such as weather changes.

Challenges in AI Adoption in Agriculture

1. Though Artificial Intelligence offers vast opportunities for application in agriculture, there still exists a lack of familiarity with high tech machine learning solutions in farms across most parts of the world. Exposure of farming to external factors like weather conditions, soil conditions and presence of pests is quite a lot.

2. So what might look like a good solution while planning during the start of harvesting may not be an optimal one because of changes in external parameters.

3. AI systems also need a lot of data to train machines and to make precise predictions. In case of vast agricultural land, though spatial data can be gathered easily, temporal data is hard to get. For example, most of the crop-specific data can be obtained only once in a year when the crops are growing. Since the data infrastructure takes time to mature, it requires a significant amount of time to build a robust machine learning model.

4. This is one reason why AI sees a lot of use in agronomic products such as seeds, fertilizer, pesticides and so on rather than in-field precision solutions.

How AI Transform Agriculture?

1. A pilot project in Andhra Pradesh on the southeast coast of India offers a hint of what is becoming possible. In an area of small, subsistence farms where growers have always relied on a combination of ancient traditions and guesswork to decide when to plant, Microsoft is working with the non-profit International Crop Research Institute for Semi-Arid Tropics (ICRISAT) to enable farmers to take advantage of the power of AI to increase yields. Last year, ICRISAT received a Microsoft AI for Earth grant to support continued development of AI solutions that focus on sustainable agriculture in developing parts of the world.

In the pilot’s first year, 175 groundnut farmers participated. Most farmers in the region planted in early June, as dictated by custom and tradition. Farmers who used the AI Sowing App delayed planting by three weeks. For those who waited, the results were dramatic—on average they harvested 30 percent more per hectare than farmers who planted at the beginning of June. In the second year, the program was expanded to more than 3,000 farmers and covered a much wider range of crops, including maize, rice, and cotton. Average increases ranged from 10 percent to 30 percent, depending on the crop and the location.

2. Reducing our 1.3 billion tons of food waste:

a. According to the UN, increasing production is only part of the answer to the problem we face in feeding the world’s growing population. Almost as important is to reduce the amount of food that is wasted every year. The Food and Agricultural Organization estimates that one-third of all food produced for human consumption—1.3 billion tons—is wasted annually.

b. This is an important focus of a pioneering AI-based operations management system that is improving efficiency, ensuring safety, and lowering costs for a brand-new milk processing and manufacturing facility operated by ACM in Girgarre, a small town in Australia. Designed to handle 200 million liters of milk, the facility uses a state-of-the art information system built on Microsoft Dynamics 365 and Azure Cognitive Services to automate the process of pumping milk from tanker trucks to silos – monitoring quality, and creating a rich data trail so the milk can be tracked from the farm to the store.

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Cucurbit Fruit Fly, *Bactrocera cucurbitae* A Threat to Cucurbitacious Crops

Article ID: 10640

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Abstract

The cucurbit fruit fly also known as melon fruit fly *Bactrocera cucurbitae* (Coquillett) is a devastating pest of different cucurbit vegetables responsible for considerable damage of cucurbits. It can attack about 16 different types of cucurbit crops and can cause up to 70% damage.

It has egg, maggot, pupa and adult stages in its life cycle in which maggot is only damaging stage which feeds inside the fruits whereas adult female only lays eggs. Keeping in view the melon fruit fly can successfully be managed by bagging fruits, field sanitation, pheromone traps, resistant cultivars, using bio control agents, and safe insecticides.

Introduction

Cucurbits are infested by a number of insect pests among them cucurbit fruit fly, *Bactrocera cucurbitae* (Coquillett) is a devastating pest of different cucurbit vegetables responsible for considerable damage of cucurbits (Butani and Jotwani, 1984).

The cucurbit fruit fly can attack about 16 different types of cucurbit crops. Although the rate of attack varies among the crop, infestation reduced both the yield and quality of the cucurbit fruits. Yield losses due to fruit fly infestation vary from 19.19 to 69.96 percent in different fruits and vegetables (Kabir et al., 1991).

Symptom of Damage (Weems and Heppner, 2001)

1. Maggots feed inside the fruits, but at times, also feed on flowers, and stems.
2. Generally, the females prefer to lay the eggs in soft tender fruit tissues by piercing them with the ovipositor.
3. A watery fluid oozes from the puncture, which becomes slightly concave with seepage of fluid, and transforms into a brown resinous deposit. Sometimes pseudo-punctures (punctures without eggs) have also been observed on the fruit skin.
4. This reduces the market value of the produce.
5. In Hawaii, pumpkin and squash are heavily damaged even before fruit set.
6. The eggs are laid into unopened flowers, and the larvae successfully develop in the taproots, stems, and leaf stalks.

Life Cycle

The melon fruit fly remains active throughout the year on one or the other host. During the severe winter months, they hide and huddle together under dried leaves of bushes and trees. During the hot and dry season, the flies take shelter under humid and shady places and feed on honeydew of aphids infesting the fruit trees.

The lower developmental threshold for melon fruit fly was recorded as 8.1° C (Keck, 1951). The eggs were hatch out in 1-1.5 days feed on the pulp and seeds of fruit, drop to the ground. Fully developed maggot of fruit fly is white in color with white grey color patches on body. The apodous maggot is passes through 3 instars. Mean of total maggot period was with a mean 5.18±1.16 days.

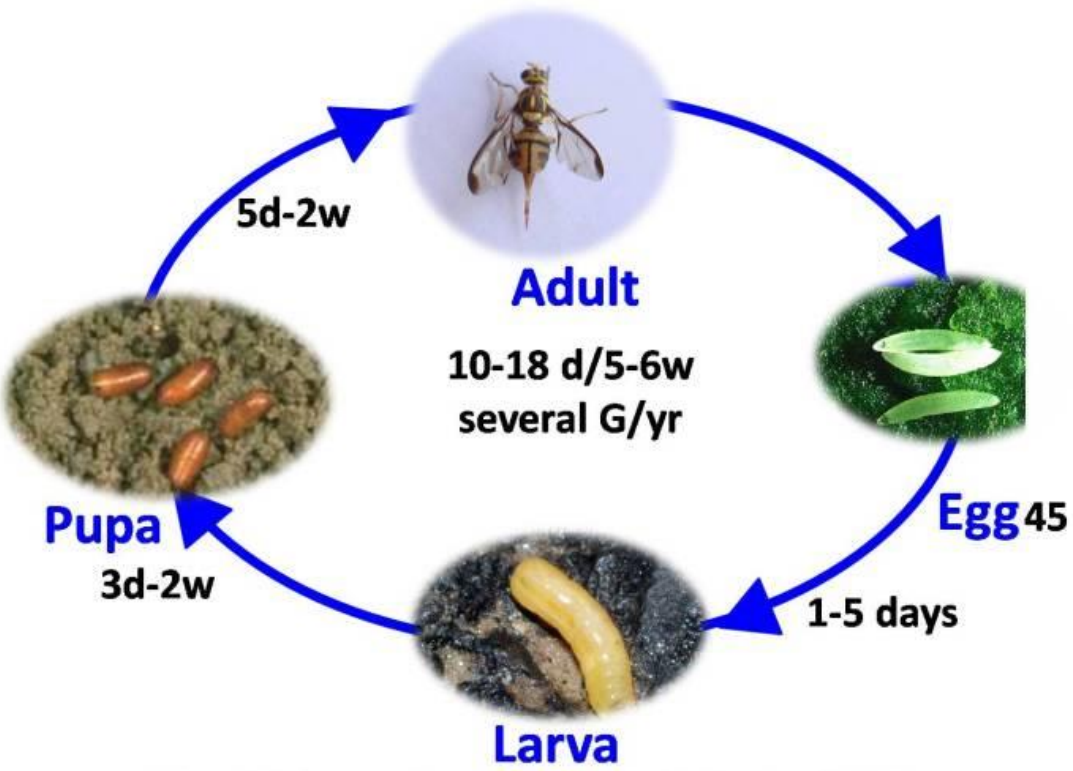

Fig. Life cycle of Cucurbit Fruit fly

Image source- https://jamesfrall.wordpress.com/2011/08/12/life-cycle-of-insects/life-cycle-of-cucurit-fruit-fly/

Management

1. Bagging of fruits on the tree (3 to 4 cm long) with 2 layers of paper bags at 2-to-3-day intervals minimizes fruit fly infestation and increases the net returns by 40 to 58% (Jaiswal et al., 1997).

2. Field sanitation i.e., to break the reproduction cycle and population increase, growers need to remove all unharvested fruits or vegetables from a field by completely burying them deep into the soil. Burying damaged fruits 0.46 m deep in the soil prevents adult fly eclosion and reduces population increase (Klungness et al., 2005).

3. Methyl eugenol and cue-lure traps have been reported to attract B. cucurbitae males from mid-July to mid-November (Ramsamy et al., 1987).

4. Use of bio-control agents against the melon fruit fly. (Srinivasan, 1994) reported Opius fletcheri Silv. to be a dominant parasitoid of B. cucurbitae, but the efficacy of this parasitoid has not been tested under field conditions in India.

5. The application of molasses + malathion (Limithion 50 EC) and water in the ratio of 1: 0.1: 100 provides good control of melon fly (Akhtaruzzaman et al., 2000).

6. Use of resistant cultivars developed in different cucurbits against fruit fly.

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Fly-Ash: 'Polluting Waste' to 'Resource Material'

Article ID: 10641

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Introduction

Power generation in India is rapidly increasing since industrialization and approximately 70% of the power is produced through thermal power plants. In India, most thermal power plants generate power through coal combustion. Coal combustion produces various types of residues such as FA, bottom ash and flue gas desulphurization waste, fluidized bed boiler waste and coal gasification ash (Singh et al., 2010). FA a residue of burning of coal / lignite in thermal power plant has traditionally been considered as a waste product.

In the last decade, annual FA generation from power plants has risen by almost 76 per cent from 123 million tonnes (MT) in 2009-10 to 226 MT in 2019-20. Ash is piling up either in wet form as slurry in ash ponds or in dry form in open fields. In the past decade, approximately 35-40 per cent of the FA generated has remained unutilised every year. Disposal of FA in this quantity is a great problem because, at present, there are no large-scale recycling options. Previous attempts to use FA in the construction sector, like brick making and road foundation, were economically not viable and can potentially only recycle limited fraction of the total amount of cash generated annually. The highest utilization was in cement industry (approx. 49%) whereas, agricultural sector contributed very less (approx. 1%). The common practice to dispose huge quantity of FA is disposal at the dumping site, which requires large area and causes environmental pollution. When FA is dumped it affects the groundwater and surface water quality, vegetation and soil of the surrounded dumping area. It also affects mankind and animals inhabiting in the power plant areas by causing cancer and various respiratory disorders. These consequences have led to the realization that alternative uses for FA beyond incorporation in construction materials is needed. As a result, there is growing interest in looking for newer applications of FA in different study areas. Its usefulness as a sorbent for removal of contaminants and in waste stabilization is extensively researched. Land application of FA to improve soil properties or to reclaim wastelands is another attractive utilization option.

Properties of FA

FA is produced from four types of coal. Each type of coal varies in properties such as its chemical composition, geological origin, ash content and heating value. The different coals are bituminous, sub-bituminous, lignite and anthracite.

FA is a coal combustion residue which shows a wide variation in their physico-chemical and mineralogical properties depending on the nature of parent coal, conditions of combustion, type of emission control devices, storage and handling methods (Jala and Goyal, 2006). Generally, FA is grey in colour, abrasive, mostly alkaline and refractory in nature (Ahmaruzzaman, 2010).

FA possess minute glass like particles with size ranging from 0.01 to 100 mm size (Bhanarkar, 2008). Some glass like particles is hollow which are known as cenospheres, while other glass particles are known as plerospheres. The texture of FA is silty loam with low to medium bulk density (1.00 – 1.18 g cm^{-3}). The maximum water holding capacity of FA ranges from 40 - 60% with porosity in the range of 50- 60% and its specific gravity ranges from 1.6 to 2.6 g cm^{-3} (Nyambura et al., 2011). Because of some important physical characteristics like particle size, water holding capacity, porosity, bulk density and surface area, FA can be used significantly as an adsorbent (Ahmaruzzaman,2010).

The distinctive character of FA is that it is alkaline in nature (Ahmaruzzaman, 2010). But it depends on the amount of sulphur present in coal. Generally, the pH varies from 4.5 – 12 (Jambhulkar & Juwarkar, 2009) with alkaline FA produced with low Sulphur containing coal (Gupta and Sinha, 2008), while acidic FA produced from high Sulphur containing coal. In India, low Sulphur content coal is available therefore, FA is alkaline. Electrical conductivity of FA is dependent on the number of dissolved salts. Generally, FA having alkaline pH contains more electrical conductivity than acidic pH FA (Yeledhalli et al., 2007). Organic carbon content of FA depends on carbon content in coal. Sub-bituminous FAs have lower content of carbon than bituminous FAs. FA has cation exchange capacity in the range of 8.5 Cmol kg^{-1}.

The mineralogical properties of FA depend on the quality of the coal. In general, Indian coal produces relatively high amount of ash (10–30%) in comparison to other countries. FA contains approximately 99% of Fe, Ca, Si, Al and about 3.5% of K, P, S, Na and rest are trace elements such as B, Cd, Mn, Cr, Ar, Va and Se. It usually contains hydroxides, oxides and sulfates of Ca and Fe (Lokeshappa and Dikshit, 2011). The most significant constituents of the FA are SO_3, Fe_2O_3, Al_2O_3, CaO, MgO, K_2O, Na_2O, TiO_2 and SiO_2.

Causes of FA Toxicity

FA contains various complex organic molecules such as Polychlorinated Biphenyls (PCB), Polyaromatic hydrocarbons (PAH), polychlorinated dibenzofurans (PCDFs) polychlorinated dibenzo-p-dioxins (PCDDs), monomethyl and dimethyl sulphate. It also contains heavy metals such as Zn, Pb, Cd, Ni As, Cr and Cu etc. which are capable enough to cause toxicity hazard in the surrounding environment.

Factors Responsible for Restriction to Plant Growth in FA Amended Soil

The diverse physical, chemical and mineralogical properties of FA restrict plant growth in the disposal sites. Physical limitations include limitation of root growth because of compaction of FA particles. The chemical factors responsible for this limitation include high soluble salt concentration and pH. Phytotoxic levels of trace elements, especially Boron and nutrient deficiencies such as Nitrogen also restricts the plant growth. Microbial limitations are lack of microbial activity, low nutrient status and lack of inoculums of symbiotic microorganism such as *Rhizobium* and *Mycorrhizae* (Haynes, 2009).

Effect of FA Amendment on Soil Properties and Carbon Sequestration Potential

Unfavourable physical properties of soil, such as high bulk density, poor infiltration, and soil structure, which can inhibit drainage and plant establishment can be improved by FA amendment. FA amendment to soil can improve poor physical properties of soil such as WHC, texture, bulk density. Soil having coarse texture can be mixed with FA to increase the sand and silt sized fraction thereby helping in infiltration, soil water storage and aggregation. Use of alkaline FA can be done to neutralize soil acidity and to raise pH of acidic soil. It neutralizes soil acidity since it contains hydroxides and carbonate salts. Lime in FA readily reacts with acidic components in soil and releases nutrients such as S, B and Mo in the form and amount beneficial to crop plants. FA addition results in increased microbial population however, higher doses result in deposition of toxic elements such as Arsenic and Boron in soil which has adverse effects on soil microorganisms and enzyme activity. As FA has alkaline pH it can be used instead of lime in agriculture which results in reduction of net CO_2 emission and thus decrease the global warming effect.

Effect of FA Amendment on Plant Growth

FA, which is presently in abundant supply, can be used to increase the concentration of certain desirable elements in plants, but at the same time, their concentration beyond the certain range could be harmful to plant growth. FA alone is a poor source of important macronutrients such as nitrogen and phosphorus because all of the nitrogen present in coal is volatilized during the combustion. Although sufficient phosphorus is present in FA, most of it is relatively unavailable. The harsh conditions of FA can be improved by amending it with the suitable materials (FYM, biogas slurry, bio-innoculants, vermi-compost etc.,) to support the plant growth. The use of FA amendment in agriculture assists in tackling the FA disposal problem and saves large amount of land required for land filling. Generally, FA amendment in soil increases plant growth and nutrient uptake.

Risk Associated with FA Amendment

The prime concern of FA utilization in agriculture as a soil amendment is the potential leaching of heavy metals, especially when it is applied in a high rate which may result in contamination of surface and ground water. Health risk associated by the application of FA in agricultural soil is dependent on the mobility of their constituent elements which may be toxic in nature.

Conclusion

Fly ash, a multi nutrient solid resource of thermal power plant although toxic to a certain extent can be effectively utilized in agriculture sector for improving the properties of problem soil, improve the trace element concentration and nutrient availability of degraded and nutrient deprived soil and will lead to a cost-effective way of reducing the use of organic manures and other sources as nutrient source.

The major goal is to utilize FA in degraded soils in such a way so as to achieve enhanced fertility without affecting soil quality and minimizing the accumulation of toxic metals in plants below critical levels for human health. There are several potential beneficial effects of FA application in soil: Beneficial effects includes improvement in soil texture; reduction of soil bulk density; improvement in soil water holding capacity; improvement of soil aeration; percolation and water retention in the treated zone (due to dominance of silt-size particles in FA); reduction in crust formation optimization of pH value; increment in soil buffering capacity;; supplementation of micro-nutrients like Fe, Zn, Cu, Mo, B etc. and macro-nutrients like K, P, Ca, etc.; reduction in consumption of soil ameliorants (fertilizers, lime) and reduction in greenhouse gas emission potential.

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Tillage Implements for Groundnut Crop

Article ID: 10642

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Introduction

Groundnut is the one of the important legume crops of tropical and semiarid tropical countries. It contains 48-50% oil and 26-28% protein, and is a rich source of dietary fibre, minerals, and vitamins. Groundnut crop requires better tilth for increased crop production. Therefore, proper tillage is very important for improved crop production.

Sub Soiler

This plough can be used to reduce the effects of compaction and to help break up the plough pan and hardpan Compacted soil hard-pans restrict crop growth by limiting root access to nutrient and moisture in the subsoil. Soil can become deeply compacted in areas tracked by heavy agricultural machineries for primary as well as secondary tillage operation. Compacted layers are typically developed at 15-30 cm below the surface where conventional cultivators can't reach. Sub soiling (vertical tillage) aids in entry of rain water received in that field and lateral movement of excess water as runoff is restricted. The entry of rain water in deep layers through vertical cuts will moistly soil below surface and serve as reservoir without getting evaporated. Moisture below surface layers help crop to sustain even in long periods of dry spell.

Subsoiler

Mould Board Plough

The primary function of the plough bottom is to cut the furrow slice, shatter the soil and invert the furrow slice to cover trash. It is useful in preparing field up to 45 cm depth. The implement can efficiently be used in stone free, non-stick soils. To avoid back furrow and dead furrows in the field, two-way reversible Mould board ploughs are available which can be operated with hydraulic shift lever.

	
Mould board plough	**Disc Plough**

Disc Plough

It is a plough which cuts, turns and in some cases breaks furrow slices by means of separately mounted large steel discs. In stony stumpy soils, where MB plough cannot work satisfactorily, Disc plough can be used successfully. This plough has got rolling plough bottom; hence it is useful for any type of soils and plough enters into the soil due to self-weight of the implement. The rolling discs orientation like disc angle and tilt angle can be changed for getting better soil tilt.

Secondary Tillage Implements

After primary tillage fields are not suitable for sowing. Lighter and finer operations need to be performed to achieve a desired granular soil structure, rapid infiltration, good retention of moisture, adequate air exchange capacity within the soil and to minimize resistance to root penetration.

Rotavator

It is an active implement which gets the power from PTO shaft of the tractor and rotates horizontally. Rotavator is widely considered to be the most important tool as it provides fine degree of pulverization. Rotovator consists of shield in the rear to adjust clod size of the soil in the operation and it also helpful in making field level and clod free.

Rotavator

Power Harrow

It is an active tool and gets the power from the tractor PTO to rotate the vertically mounted tynes in the housing. Since the tynes are located vertically the bottom portion of the field will not become hard. Power harrows finely break up the soil, refining and evenly distributing it over the entire working width to create a perfect seed bed. The advantages of using Power harrows are, they avoid the formation of tillage pan and facilitate drainage.

Power Harrow

Spike Tooth Harrow

Spike Tooth Harrow cuts through clods, manure, and grasses to break up material into finer pieces so that it can be spread evenly across the ground. It is used to smoothen and level the soil directly after ploughing.

Guntaka

It is a type of blade harrow. It cuts the soil to a shallow depth for smoothening and pulverizing the soil as well as to cut the weeds and to mix materials with. It is mainly used to prepare the seed bed mostly in clay soils.

Summary

Tillage of the soil has been used to prepare a seedbed, kill weeds, incorporate nutrients, and manage crop residues. The goal of the tillage system has been to provide a proper environment for seed germination and root growth for crop and increase crop production.

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Seed Priming Techniques

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Introduction

Seed is the reproductive unit responsible for ensuring successful establishment for most agricultural especially vegetable crops like onion, lettuce, French bean etc., which have less seed longevity in normal storage conditions. One of the most important factors is use of quality seed for better germination as well as yield. The quality seed comprised those properties, which determine the potential for rapid uniform emergence and development of normal seedlings under a wide range of environmental conditions.

Seed Deterioration

It can be defined as the loss of quality, viability and vigour either due to ageing or effect of adverse agro-climatic factors. Several climatic factors contribute to seed deterioration and these conditions make very difficult to maintain seed viability during storage. Hence, rate of deterioration is directly proportional to seed moisture content, storage duration or temperature of storage.

The seed quality can be improved by quality enhancement technique. One of the quality enhancement techniques is seed priming.

Seed Priming

It is controlled hydration of seeds to a level that allow pre-germinative metabolic activity to continue, but interrupt the emergence of the radicle. It is one of the best methods which show rapid and uniform germination, synchrony in growth, development and increased yield. Seed quality enhancement is possible through various seed priming techniques including hydro priming, halo priming, osmo priming, thermo priming, solid matric priming and bio priming. It is a pre-sowing strategy for influencing seedling development by modulating pre-germination metabolic activity prior to emergence of the radicle and generally enhances rapid, uniform emergence and plant performance to achieve high vigour and better yields. The principle of priming is based on the fact that it is possible to hydrate seed some ways as a moisture level sufficient to initiate the early events of germination but not sufficient to permit radicle protrusion.

Seed priming is commonly used to reduce the time between seed sowing, seedling emergence and also to overcome the constraints of low-quality seed, improper seed bed preparation, untimely sowing, poor sowing techniques, inadequate seed bed preparation, inadequate soil moisture and adverse soil conditions, low seed zone water potential and soil crusting due to rain.

Since, it is found to be a useful technology there is a need to standardize this technology in every crop species particularly in vegetables crops. Seed priming is a simple, low-cost and powerful technique for improving emergence of seedling, vigour and yields of several horticultural and field crops.

Farmers are forced to use aged seed of low germination percentage due to unavailability of fresh seeds, and so to overcome this problem seed priming is the best option.

Different Methods of Seed Priming are

1. Hydro priming: The seeds were primed on blotter paper wetted with distilled water for 24 hours under ambient conditions at room temperature and were then removed from blotter paper, gently blotted to remove surface moisture. They were then allowed to shade dry at room temperature until the seed reaches to the original seed moisture content.

2. Halo priming: Cleaned seeds were primed with salt solution (Nacl, KNO3,CaCl2, CaSo4). The salt solution was prepared by mixing in 100 ml of distilled water. The seed lots were then primed on blotter paper wetted with the salt solution for 12 hrs at room temperature. After the priming duration the seeds are thoroughly rinsed for a minute or two with distilled water. The primed seeds were shade dried at room temperature until the seed reaches to the original seed moisture content.

3. Osmo priming: Osmo priming was done by using sugar solution (Poly ethylene glycol (PEG), Sorbital, mannitol). The solution was prepared by mixing in 100 ml of distilled water. Cleaned seeds were soaked in solution for 24 hrs at room temperature along with aeration. The primed seeds are removed and thoroughly washed for a minute or two with distilled water and allowed for air drying at room temperature to reach to the original seed moisture content.

4. Sand matric priming: Seeds were placed in perforated plastic covers and then placed in a tray filled with sand of 80 percent water holding capacity (gravimetric method) to ensure uniform contact of seed with substrata as well as for easy separation of seeds from sand. The seeds were primed in sand and retrieved after 24 hrs, then shade dried to original seed moisture content

5. GA_3 priming: On blotter paper wetted with 100 ppm gibberellic acid solution for 6hrs seeds were primed at room temperature. The solution was prepared by mixing 100 mg of GA3 in 1 litre of distilled water. The primed seeds are removed and then rinsed with distilled water. They were then allowed to shade dry at room temperature until the seed reaches to the original seed moisture content.

Benefits of Seed Priming

1. Faster speed of emergence
2. It enables seed to germinate and emerge even under different environmental conditions, for example in cold and wet or under hot conditions.
3. Improves uniformity to optimise harvesting efficiency.
4. Increase's vigour for strong and fast plant development.
5. Increase's yield potential.

Conclusion

Seed priming techniques are showing best results to improve germination, reduce seedling emergence time, improvement of crop establishment and yield. It helps in germination related problems even under unfavourable conditions. Many of the priming techniques are being utilized in many crops. It can enhance germination percentage and seedling emergence which ensure proper establishment under a wide range of environmental conditions.

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Growing Orchid - A New Agri Enterprises Under Chhattisgarh Condition

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Orchids are considered as the most beautiful flowering plants for the exquisite beauty of the flowers, variety of fragrance, brilliance in colour, unusual shapes, variation in form and attractive growth habits. There are about 24,000 species and 32,000 hybrids of orchid.

Growth Habits of Orchid

1. Monopodials: this type of orchid single stem is the main characters of monopodials that produces a series of leaves leaves grow alternately on either side of the stem e.g., vanda, Arachnis.

2. Sympodial" they are characters by presence of rhizomes or modified growth of stem ceases usually at end of one season growth and lateral shoot are produced in following season e.g., Dendrobium, cattleye.

Growing Environment in Chhattisgarh

75% shade net house with 70- 80% humidity, day temperature of 21 - 29° C and night temperature of 18 to 21°C is ideal for growing this tropical orchid. In high rainfall zones, the shade net house should be provided with a rain shelter.

Introduction of Chhattisgarh in Orchid

Although Chhattisgarh has the back ground of traditional floricultural activities, the state is yet to make any dent in the development of orchid trade. Flower trade in Chhattisgarh takes place in an unorganized sector. Flowers are traded in the domestic market mainly through commission agents. The same is being done in case of orchids but for their medicinal importance. Orchid dealers mainly depend on collection of plant parts from the forest to meet a large part of their demand. The major concern is the threat to the rare wild indigenous orchids owing to their indiscriminate exploitation and collection from forest for trade and habitat even before their being noticed and documented by proper authority which could initiate plans to conserve the priceless species.

Suitable Areas and Orchid Species for Chhattisgarh

Area in Chhattisgarh: Baster, Jagadalapur, Bilashpur, Kanker, Baster, Raipur, and Durg.
Orchid in Chhattisgarh: Dendrobium, cymbidium &Vanda's.

Present-Scenario

Though orchids rank among top International market and have added significantly to the growth of economies of some states like Kerala, Andhra Pradesh and the north-east, in Chhattisgarh orchids are yet to gan the attraction, attention and popularity they deserve in spite of their commercial value as cut flower. As of now, they are only being used by local tribal for a variety of folk medicines and cures and are associated with their tradition from the past using orchids like Panda, Dendrobium etc. in their cultural festival and religion. Orchid based floriculture is yet to make its presence felt in the State. The domestic demand of cut flower orchids is presently being met largely by importing flowers from states like West Ben gal. Maharashtra and Karnataka. Ten traded flowers in the several things could be used for growing media orchids.

Some of their names are given below- Tree bark, Sphagnum moss, Tree fern, Coconut chunks, Coconut fibre, Lava rock, Charcoal, Peat moss, Rockwool, Brick pieces and Leaf mould etc.

Care of Orchid

1. Indirect sunlight is ideal for Orchid.
2. Seedlings requires less sunlight than adult plant.
3. Very poor light tends to produce weak plants and retards flowering.
4. Optimum requirement varies between species to species.
5. Under controlled conditions the Orchids can be grown in Orchid house.
6. Running North to South and made from materials like split bamboo, glass, shade nets etc.

Central trunk filed with water or by using artificial fogging nozzles helps in increasing humidity. All types of Orchids cannot be grown under one roof. Tropical Orchid enjoy humid, warm atmosphere. Temperate Orchid should be growing in cool houses Proper ventilation is must to provide fresh air. Orchids dislikes sudden change in temperature., the best suitable range is 18^{o}C to 30^{o}C However Orchids likes *Vanda, Aranda, Arachnis, Renanthera, Kegawara, Mokara* can be grown in open sun in trenches filled with brick pieces and charcoal.

Enterprise of Chhattisgarh Condition

Orchid based farming system a technological option to double farm income in the poly houses orchids are generally grown at 0.9-1.2 m height, on an artificial structure (i.e., table, benches) to avoid soil based disease and to avail proper aeration and air circulation. Thus, a large portion nutrient solution added to the orchid pots are generally leached out of the pot down. A lot of area of the playhouse remains unutilized. That unutilized area and leached out nutrient solution and water can be utilized efficiently.

Vertical Farming of Orchids

You can go for vertical farming of commercial orchids. That will let you utilize your valuable place more efficiently for more production as well as more income. Here we are giving some pictorial examples of vertical farming in ICAR-NRCO.

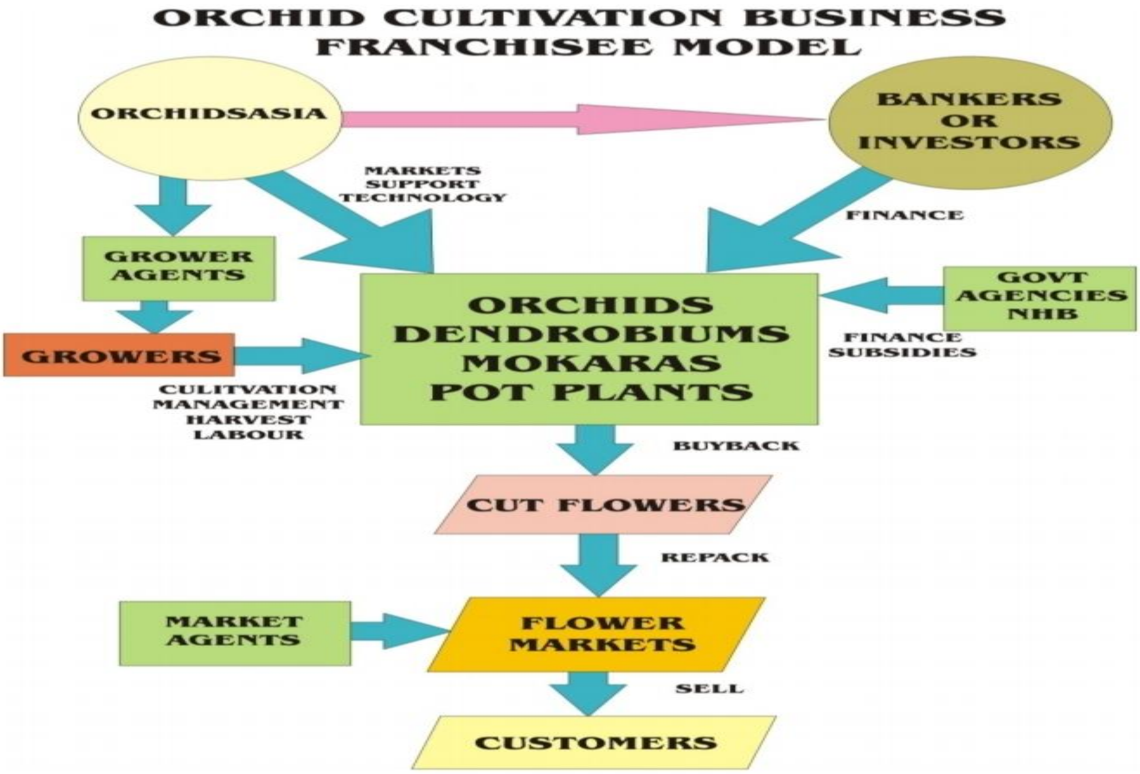
Preparations from cymbidium dried leaves: Waste to Wealth You can use waste dry leave of Cymbidium after flowering; dead leaves should be collected and dried, it can be utilized for making the baskets, those buckets can be utilized for keeping of different commodities in the houses and for decorative purposes. We are going to give some pictorial examples below.

Grading and Packaging of Dendrobium Orchid

Grading: Export quality orchids are graded to maintain the quality. They are graded on the basis of length, colour, flower size, number of flowers on the spike, arrangement of the flowers etc. Dendrobiums are graded in four standard grades, like- XL, L, M and S. XL graded Dendrobium spikes will be of at least 50 cm length along with >10 flowers per spike. L graded dendrobium spikes will be of 45-50 cm length along with 8-10 flowers per spike. M graded Dendrobium spikes will be of 40-45 cm length along with 6-8 flowers per spike, S graded Dendrobium spikes will be of 30-40 cm length along with 4-5 flowers per spike.

Packaging:

1. Put base of each spike in a tube containing water or preservative solution or wrap the base with wet cotton swab. To use cotton swab, dip the cotton swab in water or preservative solution and wrap it at the base of the flower spike then cover it with a polythene sheet tied by a rubber band.
2. Put flower spikes of Dendrobium along with preservatives in polythene sleeves of standard thickness.
3. You should keep a bunch of around five spikes of same grade and variety in a box. Provide cushioning material in the back side of the sleeve to avoid damage during transportation
5. Tie the base of the spike with the base of the cartoon with an adhesive tape to prevent the movement of the flower spikes inside the box during transportation.
6. Size of the cartoon varies according to the size of the spike; the cartoon used for packaging will be large enough to comfortably place the flower spike in it. The cartoon should be provided with sufficient no of holes or vent for proper aeration.

Orchid's Preparations

Orchid is one of the main ingredients for various products like:
1. Edible products: Spice e.g., Vanillin, Herbal tea, Vegetable, Pickles, Ice cream.
2. Ornamental products: Orchid scaping, Cut flowers, Dried flower craft.
3. Medicinal products: Skin care products, Hair cosmetics, Nutraceuticals, Herbal drugs.
4. Fragrant products: Perfumery, Essential oils.
5. Other uses: Floral ornaments, Pot pourri, Designer candles etc.

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Development Issues of Indian Economy

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Development Issues of Indian Economy

India receiving sustained growth rate but, it is still a low-income developing economy. Even today, nearly 27 percent of India's population lives below the poverty line. In India, many human and natural resources are under-utilized. In this article, we find out the economic issues in India.

The Economic Issues in India

India is a developing country and one of the fastest growing economies in the world, there are some unique economic issues in India which are given below.

1. Low per capita income.
2. Huge dependence of population on agriculture.
3. Heavy population pressure.
4. The existence of chronic unemployment and under-employment.
5. Slow improvement in Rate of Capital Formation.
6. Inequality in wealth distribution
7. Poor Quality of Human Capital.
8. Low level of technology.
9. Lack of access to basic amenities.
10. Under-utilization of natural resources.
11. Lack of infrastructure.
12. Demographic characteristics.

Low Per Capita Income

Usually, developing economies have a low per-capita income. Further, apart from the low per-capita income, India also having a problem of unequal distribution of income which leads to the problem of poverty. Poverty is a critical one and a big obstacle in the economic progress of the country. Therefore, low per-capita income is one of the primary economic issues in India. Even today, nearly 25 percent of India's population lives below the poverty line.

Huge Dependence of Population on Agriculture

The Indian agriculture sector has managed to live up to the demands of the fast-increasing population of the country. About 64 per cent population of India lives in rural areas which are directly or indirectly depends on agriculture. In India, large amount of marginal and small farmer having 0-1 ha and 1-2 ha land respectively, In India, about 80 per cent farmers having marginal and small. These farmers face the problem of seasonal unemployment.

Heavy Population Pressure

Today, India is the second most-populated country in the world, the first being China. We have a high-level of birth rates and a falling level of death rates. In order to maintain a growing population, the administration needs to take care of the basic requirements of food, clothing, shelter, medicine, schooling, etc. Hence, there is an increased economic burden on the Indian Economy.

The Existence of Chronic Unemployment and Under-Employment

The huge unemployed working population is another aspect which contributes to the economic issues in India. There is an abundance of labour in our country which makes it difficult to provide gainful employment to the entire population. Also, the deficiency of capital has led to the inadequate growth of the secondary and tertiary occupations.

This has further contributed to chronic unemployment and under-employment in India. With nearly half of the working population engaged in agriculture, the marginal product of an agricultural labourer has become negligible. The problem of the increasing number of educated-unemployed has added to the woes of the country too.

Slow Improvement in Rate of Capital Formation

India always had a deficiency of capital. However, in recent years, India has experienced a slow but steady improvement in capital formation. The only way to improve the standard of living is to increase the rate of gross capital formation.

Inequality in Wealth Distribution

Unequal distribution of wealth is certainly one of the major economic issues in India. According to Oxfam's 'An economy for the 99 percent' report, 2017, the gap between the rich and the poor in the world is huge. In the world, eight men own the same wealth as the 3.6 billion people who form the poorest half of humanity.

In India, merely 1 percent of the population has 58 percent of the total Indian wealth. Also, 57 billionaires have the same amount of wealth as the bottom 70 percent of India.

Poor Quality of Human Capital

In the broader sense of the term, capital formation includes the use of any resource that enhances the capacity of production. Therefore, the knowledge and training of the population is a form of capital. Hence, the expenditure on education, skill-training, research, and improvement in health are a part of human capital.

Low Level of Technology

Any new technology requires capital and trained and skilled personnel. Therefore, the deficiency of human capital and the absence of skilled labour are major hurdles in spreading technology in the economy. Another aspect that adds to the economic issues in India is that poor farmers cannot even buy essential things like improved seeds, fertilizers, and machines like tractors, investors, etc.

Further, most enterprises in India are micro or small. Hence, they cannot afford modern and more productive technologies. New technologies are being developed every day. However, they are expensive and people with a considerable amount of skill to apply them in production.

Demographic Characteristics

According to the 2011 Census, India had a population density of 382 per square kilometres as against the world population density of 41 per square kilometres.

Further, 29.5 percent was in the age group of 0-14 years, 62.5 percent in the working age group of 15-59 years, and around 8 percent in the age group of 60 years and above. This proves that the dependency burden of our population is very high.

Under-Utilization of Natural Resources

India is rich in natural resources like land, water, minerals, and power resources. However, due to problems like inaccessible regions, primitive technologies, and a shortage of capital, these resources are largely under-utilized. This leads to the economic issues in India.

Lack of Infrastructure

In India, lack of infrastructural facilities is a one of the serious problems. These problems included transportation, communication, electricity generation, and distribution, banking and credit facilities, health and educational institutions, etc. Therefore, the potential of different regions of the country remains under-utilized.

Amla - Value Added Medicinal Products

Article ID: 10646

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Aonla (*Phyllanthus emblica* Linn) commonly known as Indian gooseberry is arguably the most important medicinal plant in the Indian traditional system of medicine, the Ayurveda. various parts of the plant are used to treat a range of diseases, but the most important is the fruit. The fruit is used either alone or in combination with other plants to treat many ailments such as common cold and fever; as a diuretic, laxative, liver tonic, refrigerant, stomachic, restorative, alterative, antipyretic, anti-inflammatory, hair tonic; to prevent peptic ulcer and dyspepsia, and as a digestive.

Amla Marmalade

A freshly-grown large gooseberry is perforated thoroughly with bamboo sticks or German silvers or bites made of bile, then after 24 hours of soaking in the lime water, clean the gooseberries. Take down the flame with water on the fire and remove it from the water and dry it in the shade for some time. Make a two-wire sugar syrup of half weight sugar from the gooseberry and put it in the gooseberry and keep it for 8 - 10 days, then take it out and then make a four-wire sauce of the same size as the gooseberry and put it in the above amla and for a while. Like rasgullas on the fire, cook it in the Chasani and cool it down and fill it in the glass or food grade plastic cartons with the Chasani.

Quantity: Eat two - two gooseberries in the morning and evening.

Uses: Useful in bile sedative, burning sensation, headache, dizziness, ophthalmia, constipation, haemorrhage, hemorrhage, skin blemish, spasm and cardiovascular disorders. Cook 2 grams of fresh gooseberry juice on low heat. When 1 kg is left, remove it from the fire.

Then take 200 grams of pipal, 200 grams of dry grapes, 30 grams of liquorice, 30 grams of bamboo and 30 grams of sautha. After extracting the seeds of dry grapes and making the fine powder of the remaining medicines, mix them all and make 650 grams sugar syrup and mix this powder in it. Then mix 250 grams of honey and keep it safe.

Quantity: Watch with 10 grams cow urine or buttermilk.

Properties and Uses: It is used in Jaundice and Kamala diseases. This causes red blood particles to grow. Apart from this, blood bile, bile disorder, acid bile, increased heartbeat, etc. are beneficial in diseases.

Chavyanpras Constituent Matter

7 kg of fresh gooseberry and vine bark, Arani, Arlu, Khmer, Patla, Mudr Parni, Maash Parni, Sal Parni, Pashmiparni, Gokhru, Chhoti Kateli, Bada Kateli, Kakdasingi, Bhuianla, Munka, Jeevandhi, Pohkamool, Agar, Giloy, Bade Hare, Bala, Barahikand, Vidari Kand, Kachur, Nagarmotha, Punarnwa, Satavari, Small Cardamom, Lotus, White Sandalwood, Root of Adusai, Kakoli, Asagandha, Kakansha (50 grams each of Sakut Chur O)

Method: Put 7 kg of ripe gooseberry in a pot, and cook it. When the fourth water remains, take it off the stove and keep the gooseberry aside and filter the water and keep it safe. Now take out the gooseberry kernel and rub it with a thick cloth so that the skin and fibers of the gooseberry are separated. Then put 400 grams of cow's ghee in the donkey from the cloth and roast it in a low flame till the fraction of water burns. When the water is burnt, the ghee starts appearing again in the pot. When cooked well, put it down. 3 in the decoction saved above Make sugar syrup by adding 5 kg sugar or sugar candy. Then add roasted gooseberries to it and after adding Vansha Lochan 200 grams, Peepal 100 grams, Dal Chini, Tej Pat, Nag Kesar, small cardamom each and every 10 grams, mix them in a clotted sieve and mix 300 grams of Amla in it. Add honey and keep it safe.

Dose: Take 10 to 20 grams in the morning and evening with cow's milk.

Properties and Uses: Children, elderly, incest, women with sexual intercourse, swelling, heart disease, and weak voice benefit greatly from its consumption. Cough, cough, breath, thirst, vata blood, chest congestion, gout and gall disease, Venus defect and urinary defect are destroyed by its use. It is an intelligence and memory enhancer and pleasure in sex. It provides radiance and happiness, and increases immunity by which man becomes old age.

Sour Gooseberry

Take 1 kg fresh green gooseberry and separate the kernels. After that cut it into small pieces. Now mix 100 grams of water in these pieces and grind them in a grinder and extract the juice. Thereafter 1. Mix 5 kg of sugar and cook for half an hour on low heat. When lightly cold, add 2 grams of potassium metabolic sulphate and fill it in glass bottles and seal it.

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Farm Machinery for Small & Marginal Famers in Cotton Crop

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Introduction

Agricultural mechanization plays a key role in improving agricultural production in developing counties, and should be considered as an essential input to agriculture (Rasouli et al., 2009). The average farm size in India is small (1.16 ha) and small and marginal land holdings (less than 2.0 ha) account for 85% of land holdings. Mechanizing small and non-contiguous group of small farms is against 'economies of scale' for individual ownership of farm machinery (Mehta et al., 2014). For increasing production and productivity, small and marginal farmers who account for major chunk of land holding needs to be mechanized with suitable machinery/implements which are affordable and having less maintenance cost.

Mini Tractor

A mini-Tractor is capable of performing all agriculture operations that a bigger tractor can, but only at a lesser cost. The overall dimensions of the tractors like – wheel base, wheel track, height, weight, turning radius, are suitable for most of the crops like cotton, lentil / pulses, castor, grapes, groundnut. Due to compact size, the small tractor has a short turning ability, which allows the tractor to easily navigate around obstacles without damage to the standing crop.

Machinery Suitable to Match Mini Tractor

Cultivator: The main function of the cultivator is weed control. Cultivators are usually raised and lowered by a three-point hitch. Cultivators are available in rigid tyne and spring loaded.

Rotavator: Rotavator is used for pulverizing the soil, soil condition, weed control, seedbed preparation. The depth of tilling is 100-120 mm.

Rotavator

Reversible plough: The basic functions of this plough is inverting and breaking the soil. It tills the soil which has deep roots, unwanted plants, shrubs and weeds. It can be easily rotated using lever.

Ridger: Ridger is operated in tilled soil, the share point penetrates in the soil and displaces it to both sides and a furrow is created. The soil mass between furrows forms a ridge. The depth is controlled by tractor hydraulic system.

Cotton seed drill: This seed drill is used for sowing cotton seeds. Row to row distance can be maintained. It saves seeds, working time and labour cost. It is easy for mounting with three-point linkage.

Spraying: Small tractor mounted sprayer is useful for spraying pesticides on plants. Spray pump is driven by the PTO shaft of the tractor. Mixing of chemical and water is ensured during the spraying.

Conclusion

The production and productivity in Indian agriculture cannot be enhanced by primitive and traditional practices of farming. The small farms can be mechanized by use of improved machinery and tools which fit in with their land size holding and economy.

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Application of Centrality Measures to Identify Actor's Roles in a Social Network

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Summary

With technological advancement, there has been a constant and growing demand of network studies across a variety of disciplines. Social networks have been applied to study various social and structural phenomenon such as social relationships, communication patterns, individual's roles, group cohesiveness and organizational linkages, and so on. One of the measures widely used in social network analysis is network centrality, which identifies the network roles of actors in a network. The present article provides an explanation on social networks and its application in identifying roles of actors using network centralities. Leaders, key communicators, bridges, gatekeepers, isolates, connectors, influencers are roles often identified using social network analysis based on network centralities.

Introduction

Over the past decade, there has been an explosion of interest in network research studies and theories yielding explanations of social phenomenon in a wide variety of disciplines. Social networks define networks in terms of relationship between actors which may be individuals, groups or organizations. While, social network analysis is an approach and a set of techniques which mainly focus on patterns of relationship between actors and examines the availability and exchange of resources between these actors (Scott, 1991; Wasserman and Faust. 1994; Wellman and Berkowitz, 1988). The resources exchanged may include tangibles such as goods, services, or money, or intangibles such as information, social support, or influence. This approach has been driven largely by the computing technologies which allow one to analyse large data sets making it possible to uncover the network properties. For social network analysis, a number of analysis software is available, which includes both paid and unpaid software. Lopez et. al.,(2009) provided a list of freely available software packages used for social network analysis for academic use. These were, AGNA, UCINET, Bianche, Cytoscape, FATCAT, Igraph, Iknow, KliqFinder, JUNG, Multinet, NetDraw, NEGOPY, Netvis, ORA, Pajek, PermNet, PGRAPH, Network Insight, StoCNET, STRUCTURE and VISIONE.

Though social network analysis covers a wide range of parameters for study, network centrality occupies a significant place as it measures how central or well-connected an actor is in a network. As explained by Borgatti et.al., (2018), network centrality theoretically signals importance or power and increased access to information. It is a property of actor's position in a network. Sociologically, centrality is interpreted in a wide variety of ways, many of which refer to central nodes as prominent, or influentials, or leaders, or gate keepers, or as having great autonomy, control, visibility, involvement, prestige, power or so on. In empirical studies, centrality is often used as an independent variable to predict positive outcomes for nodes, such as the acquisition of wealth or status, or life satisfaction, and so on (Borgatti et.al., 2018). Actors who play prominent and significant roles hold central positions in the network and often scored high in any of the centrality measures (degree centrality, betweenness centrality and closeness centrality, etc.).Lee and Cotte (2009) have examined the role of centrality in social networks. They suggested that individuals high in centrality can leverage their network position to potentially become an influential member in their social group. Also, occupying structurally advantageous positions within a social network is extremely valuable to individuals, because it can provide benefits such as the ability to influence others and to efficiently diffuse information. Levin and Cross (2004) has noted that the more central a member's position in the network the more the member will be willing to contribute knowledge.

Individuals who maintain contact with many others within the network will be in a better position to influence those others. The more ties a person has within a group the more influence he or she can weave in decision making or leadership.

Network Centrality Measures for Identifying Actor's Roles in a Network

Network centrality can occur in three ways: through the existence of many ties (degree), through the short distance from one actor to another (closeness), or by an actor being a component of many paths between other actors (betweenness) Freeman (1979).

Degree Centrality

Degree centrality represents the ability to communicate directly with others. It can be interpreted as the opportunity to influence or be influenced directly. The degree of an actor is defined as the number of direct connections it has with others. This metric aims to detect the most important actor in the network and signifies network activity or popularity. Actor with high degree centrality acts as a hub in the network having a lot of connections coming in and out. High degree centrality refers to actors who access and spread information faster than others. Conversely, the person whose index is low can be judged as someone who plays a marginal role in the network. From the early works of Freeman (1979), in networks with un-directed ties, degree centrality is simply a count of the number of ties for every actor. In directed networks, degree centrality is distinguished into in degree centrality which counts received (incoming) ties and Out degree centrality which counts sent (outgoing) ties.

Out degree is the expansiveness of the actor (or node) in the network. It is the sum of all connections from the actor to others. It is important because it tells us how many connections an actor has. Actors with high Out degree are interested in bringing awareness and exchanging knowledge. These are the focal actors with maximum connections to others and thereby, can be targeted for motivating the network and for rapid diffusion of information through the network. In degree is on the other hand, is interpreted as prestige or popularity of the node/actor. It computes the number of ties to a given actor. Actors who have a high in degree are considered as leaders with more prestige or support. As a result, they gain greater access to information, greater capacity to influence others and are able to communicate their opinions to others more efficiently. Based on degree centrality, they are considered as leaders, influencers, key communicators, etc. and as having more autonomy, control, visibility, involvement, accessibility and power than others.

Betweenness Centrality

Borgatti et. al., (2018) has explained that node can have fewer connections than another node, but its position could be more relevant with respect to the network flows. Betweenness centrality as defined by Hanneman and Riddle (2005) is a measure of the structural position of an actor in a network to show whether that actor is in a favoured position to control information flow. Intuitively, this measures the degree to which information or relationships have to flow through a particular actor and their relative importance as an intermediary in the network. Actors with high betweenness take the role of a bridge, gatekeepers or connectors. In this way, they direct information flow in the network and consequently can spread as well as distort or withhold information easily. The vertices with highest betweenness also resulted in the largest increase in typical distance between others when they are removed.

Closeness Centrality

Closeness centrality is expressed as a measure of how long it will take for the information to spread from a given node to others in the network (Borgatti et. al., 2018). This metric is based on the notion of the geodesic distance (i.e., shortest path) among the nodes of the graph and measures the independence of a node as stated by Hanneman and Riddle (2005). It measures how many ties are required for a particular actor to access every other actor in the network. From the pioneering works of Freeman (1979), with directed data, in closeness and

Out closeness centrality are calculated separately. In closeness for the reversed closeness is called integration and the out-closeness is called radiality. Actors with high in closeness and Out closeness centrality takes into account the ability of actors to extend influence throughout the network, and measures how close or proximate that extended sphere of influence is. In other words, these actors are able to disseminate information in the network in the quickest possible time due to their close proximity with rest of the members. Further, this captures the assumption that actors with high closeness centrality signal that they are closer to each other and takes minimum time until the arrival of information flowing through the network.

Conclusion

Social network analysis is an appropriate and scientific instrument with its application in understanding human relationships and various social phenomena. The application of network theories dates back to 1930's with the grounded work of psychosociologist J. L. Moreno and others. With the advent of data management programs and data analysis software, studies based on networking have become more practical and feasible. Network centrality is one among many network metrics which has its relevancy and application in network studies. Among them, degree centrality, betweenness centrality and closeness centrality holds significant importance in identifying roles such as of influencers, key communicators, leaders, gatekeepers, connectors, bridges and isolates and so on. Network analysis has been adopted in different field of studies over the years, which further proves its efficiency and effectiveness in theoretical and practical applications. Still due to decade old negligence, misconceptions and lack of in-depth understanding, network studies demand encouragement and

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Pros and Cons of New Agriculture Policy 2020

Article ID: 10649

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Abstract

At the end of September 2020, the Farmer's Produce Trade and Commerce (Promotion and Facilitation) Bill, 2020, and the Farmers (Empowerment and Protection) Price Assurance and Farm Services Bill, 2020 were accepted and noticed as legislation. The key provisions of the planned legislation are proposed to assist small and marginal farmers, who have no means of also negotiating for a better price for their construct or investing in technology in order to increase farm efficiency. The Agri market bill seeks to allow farmers to sell their produce to whoever they desire outside 'mandis'. Even at their ranch gates, everyone may acquire their produce. Although 'commission agents' of the 'mandis' and states could lose 'commissions' and 'mandi fees' respectively (the main reasons for the protests), by completion and cost-cutting on bring, farmers will get better prices by this law.

Introduction

The pandemic lockdown across the nation has brought trade and industry activity to a near halt. Among this situation, the government is expectant that agriculture sector could be a silver lining for the Indian financial system. According to the NITI Aayog, the agriculture sector is estimated to cultivate at a rate of 3 per cent for the year 2020-21. The Indian agricultural sector is also on the verge of a considerable transition. The government, throughout the new agricultural policy, allows farmers to trade their produce to whomever and wherever they desire. Farmers would have to attach new innovations to match the changing dynamics and continue updating with market information.

The motivated farm liberalisation schedule of the government in the form of three bills, which were currently enacted in the legislation, could be a new technique of engaging food producers and their buyers. These three bills would work to diminish inefficiencies through fruitful investments and allocate free trade between farmers and buyers. This new rule would also grant a necessary forum for buyers to benefit the correct remuneration to sell their goods. In September 2020, three agri reform bills The Farmers 'Produce Trade and Commerce (Promotion and Facilitation), the Farmers' (Empowerment and Protection) Price Assurance and Farm Services Agreement and the Essential Commodities (Amendment) Act were introduced by the government as a step to raise farmers' incomes in the coming years.

Objectives of Agricultural Policy of India

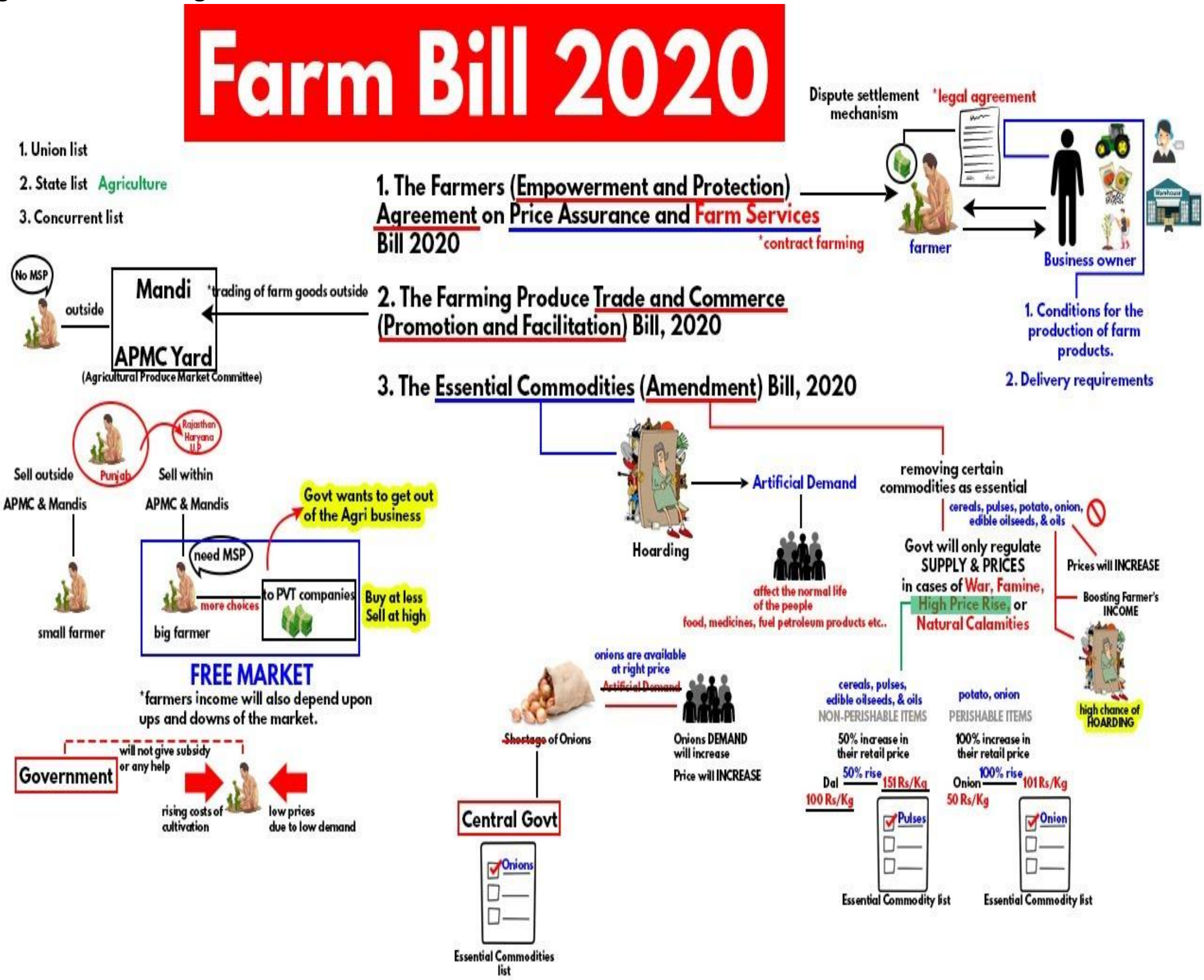
1. Raising the Productivity of Inputs.
2. Raising Value-Added per Hectare.
3. Protecting the Interest of Poor Farmers.
4. Modernizing Agricultural Sector.
5. Checking Environmental Degradation.
6. Agricultural Research and Training.
7. Removing Bureaucratic Obstacles.

The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Bill, 2020

At present, the Indian farmer's visage difficulties because of different restrictions, including limitations to retail their products only to the state government's registered licensees and prevention on selling produce outside the notified APMC market yards. Along with this, due to the occurrence of various APMC laws, by the state governments, there are hindrances in the free stream of agricultural work between states.

The new bill seeks to erect an environment wherein farmers and traders can like the liberty of choice regarding trade and purchasing of fabricate; this will assist remunerative prices through spirited, alternative trading channels to support efficient, open and barrier-free interstate and intrastate trade.

This bill is a momentous step towards unlocking the countries greatly regulated agricultural markets. It will open more farmers' options, reduce farmers' marketing costs, and permit them to get improved prices. It will also tolerate farmers from regions with excess outputs to accept better prices and lower prices for customers from regions with shortages.



The Farmers (Empowerment and Protection) Agreement of Price Assurance and Farm Services Bill, 2020

With an aspire to transform the farming sector, the new bill seeks to provide a national agricultural agreement system that protects and empowers farmers to interrelate regularly and transparently with agribusiness companies, processors, wholesalers, exporters or major retailers in the field of agricultural services and sell prospect agricultural produce at mutually agreed remunerative value structures.

This rule would shift the risk of market impulsiveness from the farmer to the support and allow the farmer to access fresh technologies and better inputs. It will reduce the marketing costs and amplify farmers' retribution.

Farmers can contribute in direct marketing so that the intermediaries are eliminated, resulting in maximum price realisation. Through this bill, farmers have been given passable protection, and with apparent timelines for redress, a resourceful quarrel resolution process has been established.

The Essential Commodities (Amendment) Bill, 2020

Although India has become a surplus in mainly agri commodities, the capitalist spirit has dampened because farmers have been incapable to get better prices due to the lack of investments in cold storage, warehouses, cultivating and export services. When there are plentiful harvests, especially of consumable commodities, farmers suffer huge losses.

The new bill aims to exclude items from the list of crucial commodities such as cereals, pulses, oilseeds, edible oils, onions, and potatoes. This will assuage concerns of undue regulatory involvement of private investors in their business operations. The ability to grow, keep, transport, distribute and supply will attach the economies of scale and draw straight private sector/ foreign investment into the farming division.

The law would help hasten investments in cold storage and food supply chain modernisation. It will benefit farmers and customers alike, while at the same time bring in price constancy. It would create a favourable business atmosphere and avoid wastage of agri products due to the lack of storage amenities.

Pros and Cons of Agri Reform Bills

1. The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Bill, 2020:

a. Permits the trade of produce outside the Agricultural Produce Market Committee (APMC) mandis.
b. No cess or levy outside the mandis will be charged to farmers.
c. Permit interstate trade of agricultural produce.

The state's income from the respective mandis would be lost. While the bill proposes to eliminate the middleman, farmers transversely various states suppose that the scheme would pilot to the end of Minimum Support Price (MSP) regime.

2. The Farmers (Empowerment & Protection) Agreement of Price Assurance and Farm Services Bill, 2020: This policy encourages 'contract farming' wherein farmers enter into direct contracts with buyers who want to purchase farm produce by removing intermediaries appointed by the state APMC.

a. Given that companies might be more interested in dealing with groups of farmers and not with individual farmers, the probability of conflicts will increase.
b. Dealing with an agent is much better from a business point of view.

3. The Essential Commodities (Amendment) Bill, 2020:

a. It deregulates manufacturing, storing, and selling of a range of food products, including cereals, pulses, edible oils, and onions, except in rare situations.
b. It can bring in new investments from FDI and large companies in infrastructure provisions, e.g., cold storage.

i. If prices on the perishables increase by 100% or non-perishables by 50%, the Act can be invoked.
ii. This legalises hoarding effectively, which can be devastating for prices of vital commodities such as vegetables and pulses.

Conclusion

The three new reforms would allow farmers to escape the difficulty of restrictive trading practices and cartel operations, placing their welfare at the heart of the development agenda. The clear aim of these reforms is to certify freedom of choice for farmers in the agribusiness marketplace. Similar to what industrial delicensing did in 1991, these reforms will also establish to be a game-changer in the Indian agriculture. There is now an expectation that the incomes of farmers will be on a route of higher growth. The method the bills are passed shaped distrust in farmers on government side-lining the positive sides of the bills such as the opportunity to modernise the Indian farming sector. It is the responsibility of the government to take the opinions of farmers and also of the states before passing such bills. Moreover, the main thing to do to ensure the betterment of farmers is reinforcement the government market spaces APMCs and to eradicate the loopholes in them.

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Defence Mechanism in Plants to Counter Pathogen Attack

Article ID: 10650

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Abstract

Natural environmental conditions provide a nutrient rich culture media to diverse range of pathogens including virus, viroid, bacteria, mycoplasma and fungi. In general, plants defend themselves against pathogens by combination of two arsenals:

1. Structural characteristics that act as physical barriers and inhibit the pathogen from entering and spreading throughout the plant system.
2. Biochemical reactions occurring in plant cells to inhibit or kill the pathogen.

In response to microbial attack, plants activate a complex series of responses that lead to the local and systemic induction of a broad spectrum of antimicrobial defences.

Introduction

Plants have developed multiple layers of sophisticated surveillance mechanisms that identify possibly precarious pathogens and rapidly answer before those organisms have a chance to cause serious damage. Some of them are listed below.

Structural Defences

All plant tissues contain pre-formed structural barriers that help limit pathogen attachment, invasion and infection. Some examples are given below:

1. Cell wall: apart from cellulose, other depositions in cell wall like pectin (cementing substance), lignin, cutin, suberin, waxes along with outer protective tissues of the plant body, including bark helps in limiting pathogen attack to plant cell.

2. Idioblasts ("crazy cells") help protect plants against herbivory because they contain toxic chemicals or sharp crystals that tear the mouthparts of insects and mammals as they feed. There are many classes of idioblasts including pigmented cells, sclereids, crystalliferous cells, and silica cells.

3. Pigmented cells often contain bitter-tasting tannins that make plant parts undesirable as a food source.

4. Sclereids are irregularly-shaped cells with thick secondary walls that are difficult to chew for example- the rough texture of pear fruit (Pyrus spp.) is caused by thousands of sclereid stone cells that can abrasively wear down the teeth of feeding animals.

Chemical Defences

Plant chemicals can be divided into two major categories: primary metabolites and secondary metabolites. Primary metabolites are substances produced by all plant cells that are directly involved in growth, development, or reproduction. Examples include sugars, proteins, amino acids, and nucleic acids. Secondary metabolites are not directly involved in growth or reproduction but they are often involved with plant defence. These compounds usually belong to one of three large chemical classes: terpenoids, phenolics, and alkaloids.

Terpenoids

1. Monoterpenoid: Pyrethrins are esters produced by chrysanthemum plants that act as insect neurotoxins.

2. Diterpenoids include gossypol, a terpenoid produced by cotton *(Gossypium hirsutum)* that has strong antifungal and antibacterial properties.

3. Triterpenoids such as cardiac glycosides, digitoxin, digoxin and Saponins.

Phenolics

Are another large class of secondary metabolites produced by plants to defend themselves against pathogens? Flavonoids are one of the largest classes of phenolics.

1. Anthocyanins are colourful water-soluble flavonoids pigments produced by plants to protect foliage from the damaging effects of ultraviolet radiation. Anthocyanins are responsible for the showy colours of many plants and are present in high concentrations in flowers, fruits, and the leaves of deciduous plants in fall.

2. Phytoalexins are is flavonoids with antibiotic and antifungal properties that are produced in response to pathogen attack. Examples include medicarpin produced by alfalfa (Medicago sativa), rishitin produced by both tomatoes and potatoes (the Solanaceae family), camalexin, produced by Arabidopsis thaliana.

3. Tannins are water-soluble flavonoid polymers produced by plants and stored in vacuoles. Tannins are toxic to insects because they bind to salivary proteins and digestive enzymes including trypsin and chymotrypsin resulting in protein inactivation. Insect herbivores that ingest high amounts of tannins fail to gain weight and may eventually die. The sharp taste of red wine is caused by grape tannins binding to salivary proteins in the mouth which results in protein coagulation.

4. Lignin is a highly branched heterogeneous polymer found principally in the secondary cell walls of plants, although primary walls can also become lignified. It consists of hundreds or thousands of phenolic monomers and is a primary component of wood. Because it is insoluble, rigid, and virtually indigestible, lignin provides an excellent physical barrier against pathogen attack.

Nitrogen Compounds

1. Alkaloids are a large class of bitter-tasting nitrogenous compounds that are found in many vascular plants and include caffeine, cocaine, morphine, and nicotine.

2. Cyanogenic glycosides are a particularly toxic class of nitrogenous compounds that break down to produce hydrogen cyanide (HCN), a lethal chemical that halts cellular respiration in aerobic organisms.

3. Glucosinolates, also known as mustard oil glycosides, are sulphur-containing compounds synthesized by members of the mustard family (Brassicaceae) and produce cyanide gas when broken down by enzymes called thioglucosidases.

Proteins

1. Defensins are small cysteine-rich proteins that display broad anti-microbial activity and were first isolated from the endosperm of barley *(Hordeum vulgare)* and wheat *(Triticum aestivum).* They are widely distributed and may be present in most plants.

2. Digestive enzyme inhibitors are proteins that block the normal digestion and absorption of nutrients by vertebrate and invertebrate herbivores.

3. Protease inhibitors are typically produced in response to herbivore attack and inhibit digestive enzymes including trypsin and chymotrypsin.

Hydrolytic Enzymes

Hydrolytic enzymes are produced by some plants in response to pathogens and often accumulate in extracellular spaces where they degrade the cell walls of pathogenic fungi i.e.
1. Chitinases are enzymes that catalyse the degradation of chitin, a polymer with a backbone similar to cellulose that is present in the cell walls of true fungi.

2. Gluconates are enzymes that catalyse the degradation of glycosidic linkages in glucans, a class of polymers similar to cellulose that is present in the cell walls of many oomycetes (water moulds).

3. Lysozymes are hydrolytic enzymes that are capable of degrading bacterial cell walls.

Plant Defence Response

1. Basal Resistance: also called innate immunity, is the first line of pre-formed and inducible defenses that protect plants against entire groups of pathogens.

2. The Hypersensitive Response is characterized by deliberate plant cell suicide at the site of infection. Although drastic compared to basal resistance, the HR may limit pathogen access to water and nutrients by sacrificing a few cells in order to save the rest of the plant. The HR is typically more pathogen-specific than basal resistance and is often triggered when gene products in the plant cell recognize the presence of specific disease-causing effector molecules introduced into the host by the pathogen. Bacteria, fungi, viruses, and microscopic worms called nematodes are capable of inducing the HR in plants.

3. Systemic Acquired Resistance (SAR) represents a heightened state of readiness in which plant resources are mobilized in case of further attack. Researchers have learned to artificially trigger SAR by spraying plants with chemicals called plant activators. These substances are gaining favor in the agricultural community because they are much less toxic to humans and wildlife than fungicides or antibiotics, and their protective effects can last much longer. SA induced expression of several pathogenesis-related (PR) genes at the site of attempted invasion provides SAR.

4. RNA Silencing: Many viruses produce double-stranded RNA or DNA during replication in a host cell. Plants can recognize these foreign molecules and respond by digesting the genetic strands into useless fragments and halting the infection. Plants that are infected with viruses will often exhibit chlorosis and mottling, but disease symptoms may eventually disappear if RNA silencing is successful, a process called recovery. In addition, the plant may retain a template of the digested genetic strand that can be used to quickly respond to future attack by similar viruses, a process analogous to the memory of vertebrate immune systems.

Conclusion

The mechanisms discussed in this article represent a broad overview of plant defence responses. However, there are other aspects of plant defence including symbiotic relationships, the importance of beneficial microbes on plant health, and the impact of environmental conditions on plant disease.

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Role of Aquaporins (AQPs) in Water Absorption in Goat

Article ID: 10651

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Drinking water is an important requirement for livestock. Water is required for numerous essential physiological functions. The lack of sufficient water availability can be a critically limiting factor in animals' physiology and productivity. Both quality and quantity of water have an impact on the livestock production.

India occupies first position in terms of goat population and milk production. Since ancient times goat milk has traditionally been known for its medicinal properties and has recently gained importance in human health due to its proximity to human milk for easy digestibility and health promoting traits. Goat living in water scared area represents a climax in the capacity of domestic ruminants to adjust to such areas. This ability is multifactorial: low body mass, and low metabolic requirements of goats can be regarded as an important asset to them for it minimize their maintenance and water requirements, in areas where water sources are widely distributed and food sources are limited by their quantity and quality.

These goat breeds also have unique characters in terms of economic water use, disease resistance, heat tolerance and fecundity. The normal body water content of goat varies with age, amount of fat in the body and environmental temperature. Water makes up 80% of the blood, regulates body temperature and is vital for functions such as digestion, waste removal and absorption of nutrients.

The movement of water across cell membranes is fundamental to life. Aquaporins (AQPs) are a class of membrane water channels whose primary function is to facilitate the passive transport of water across the plasma membrane of the cell in response to osmotic gradients that are created by the active transport of solutes. The water transporter family of proteins (aquaporin - AQP) has been strongly implicated as critical in regulating cell volume in a range of organisms, since they are responsible for significant water flux across cell membranes. AQPs are widely expressed in the body, particularly in cell types that are involved in fluid transport, such as epithelial cells in several organs. Aquaporins play a main role in water movement in most of the cell membranes, especially for excretion in urinary tract.

Based on their Permeability, Mammalian AQPs are Divided into Three Groups

1. Water-selective permeable aquaporins (AQP0, AQP1, AQP2, AQP4, AQP5, AQP6, and AQP8)
2. GLPs permeable to water, glycerol, urea, and other solutes (AQP3, AQP7, AQP9, and AQP10)
3. Subcellular aquaporins (AQP11 and AQP12), which have low homology with the other AQPs.

Aquaporin-1 constitutes approximately 1% of total cortical protein and has an important function in the kidney. AQP1 is abundantly expressed in the proximal tubule descending thin limb of Henle and localized to the apical and basolateral plasma membranes of proximal tubule. Aquaporin 2 (AQP2) is a small, integral tetrameric plasma membrane protein that is expressed in mammalian kidneys. The specific constitution of this protein and its selective permeability to water means that AQP2 plays an important role in hypertonic urine production. The role of AQP3 is osmotically driven water absorption across the collecting duct epithelium.

The role of aquaporins in different breeds of animals is not well understood till date. Sufficient studies are available on aquaporins in aquatic animals, rat & mice. The studies which have explored the immunohistochemistry, expression and localization of different aquaporins are very limited in large animals particularly in ruminants like bovines (cattle & buffalo), sheep and goat. So, research should be carried out in the ruminant species to understand the role of aquaporins during water stress condition.

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ICT-Mediated Knowledge Services for Farmers in Agriculture

Article ID: 10652

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Introduction

What exactly are ICTs? Is any device, tool, or application that permits the exchange or collection of data through interaction or transmission. Umbrella term that includes anything ranging from radio to satellite imagery to mobile phones or electronic money transfers and they really are useful and cost-effective for poor farmers with restricted access to capital, electricity, and infrastructure.

In the past, television and radio were the main electronic broadcast technologies used to reach rural communities; however, in the past two decades, Internet- and mobile-based channels have emerged. ICTs now include computer-based applications and such communication tools as social media, digital information repositories (online or offline), and digital photography and video, as well as mobile phones (Agri app, IFFCO kisan app, Farm Bee and Kisan yojana) (Balaji, Meera, and Dixit 2007). The application of ICT in agriculture is increasingly important.

E-Agriculture is an emerging field focusing on the enhancement of agriculture and rural development through improved information and communication processes (Mahant et al. 2012). ICT has become indispensable to explore various ways to keep our farmers update about modern technologies and relevant information. The development and timely dissemination of better personalized technologies specific to different agro-climatic conditions, size of land holding, soil type, type of crops and related pest/disease is the real issue to brazen out ahead for agriculture scientists/expert. The timely availability of right information and its proper utilization is indispensable for agriculture (Singh et al. 2017). According to UNESCO "ICT is a scientific technology, engineering discipline and management technique used in handling information, its application and association with social, economic and cultural matter". ICT help agriculturists to improve their livelihoods through increased agriculture productivity and income by reducing risks.

What is ICT?

1. The word 'ICT' stands for "information and communication technology".
2. ICT refers to technologies that provide access to information through telecommunications.
3. ICTs focus on communication technologies.

ICT Tools Application in Agriculture

1. Agmarknet:

a. Launched, in March 2000, linking important agriculture produce markets, the State Agriculture Marketing Boards and Directorates.
b. It provides information on agriculture products, their price, arrivals, availability, trends, analysis and laws etc.
c. Marketing channel---PPP initiative Public- Partner-Participation concept
d. http://agmarknet.nic.in.

2. E-sagu:

a. E-sagu is a tool for IT-based personalized agro-advisory system.
b. "Sagu" in a Telegu language means cultivation.
c. Initiative of IIIT Hyderabad.

E-sagu An Agro Advisory System

i. Provide timely and query less advice.

ii. Improve agriculture productivity by agriculture expert advice to the farmers.

iii. Generate advise based on crop situation –basis of text and photographs.

iv. Capacitates rural livelihoods and generates rural employment.

v. Advice is provided on a regular basis.

3. Kisan Call Center:

a. The Department of Agriculture & Cooperation, Ministry of Agriculture, GOI, launched KISSAN CALL CENTER on January 21, 2004 across the country to deliver extension services to the farming community.

b. KCC provided answers to farmers on queries related to agriculture, horticulture, plant pathology, soil science and animal husbandry etc.

c. These cell centers are working in 14 different locations covering all the states.

d. Toll free number: 1800 180 1551

e. Service period: 6 am – 10 pm during working days except on Sunday and gazette holidays.

f. Replies to the farmers' queries are given in 22 local languages.

4. Agriwatch (IASL):

a. The project by Indian Agribusiness System Ltd. (IASL) 2001 provide valuable analyses to the trade participants to enhance their decision taking abilities in trade and extend e-commerce in agriculture products.

b. Agriwatch brings to you daily online reports from various agriculture markets in India.

c. http://www.agriwatch.com.

5. Hariyali Kisan Bazaar:

a. "hariyali kisan bazaar" is a rural business centre.

b. Set up as a complete Agri-solution provider in a July 2002 by DSCL to provide rural consumers with choice, trust, dignity and building long term relationship.

c. Hariyali kisan bazaar aims at providing end-to-end ground level support to the Indian farmers for improving their productivity and profitability.

6. e-Choupal:

a. Launched in June 2000

b. e-Choupal is a Hindi word which means "village meeting place".

c. e-Choupal is an initiative of ITC Ltd (Indian Tobacco Company Limited), to link directly with rural farmers via the internet for agriculture and aquaculture produce like soybeans, wheat and coffee.

d. e-Choupal is a virtual market place where farmers can transact directly with a processor and can realize better price for their product.

e. Marketing channel Public-Partner-Participation concept.

7. TARAhaat:

a. "TARAhaat" meaning a village bazaar

b. Is a for profit social enterprise which delivers education, information, services and other opportunities to rural areas, through internet.

c. TARAhaat mostly utilized India existing telecom infrastructure, such as telephone lines.

d. The most interesting aspect of TARAhaat is strong focus on developing products and information content relevant to rural consumers.

8. Tata kisan kendra (TKK):

a. TKK is an initiative by Tata Chemicals Limited (part of the tata group) with the following objectives:-

b. To provide the farmers with a package of inputs and services for optimum utilization of balanced primary nutrients; plant protection chemicals; water; seeds; post-harvest services.

c. TKK are designed to be one stop centers for all agriculture problems.

d. The develop a partnership with farmers.

9. eNAM:

a. Electronic National Agriculture Market (eNAM) is a pan-India electronic trading portal which networks the existing APMC mandis to create a unified national market for agriculture commodities.
b. eNAM portal provided a single window service for all APMC related information and service to its stakeholder i.e., farmers, traders, buyers, processers and exporters.
c. Tatal 585 markets to be covered under eNAM by March 2018.

Conclusion

Information and knowledge are essential components for facilitating rural development and bringing social and economic change. It also helps in empowering the rural farmers and agriculture providing better access to natural resources, improved technologies, production strategies, markets, banking, financial services, new varieties and weather forecasting etc.

1. ICT help in growing demand for new approaches
2. ICT is an important contributor to growth every economic, social and cultural
3. Improve the quality of life, Farm management, better marketing pricing and enhanced incomes in rural areas.

Greenhouse Technology for Plant Propagation and Production

Article ID: 10654

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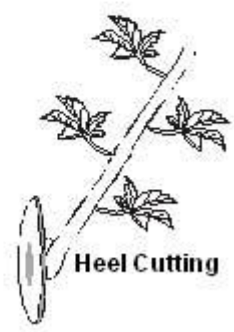
Introduction

Plant propagation is the process of creating new plants from a variety of sources: seeds, cuttings, bulbs and other plant parts. Plant propagation can also refer to the artificial or natural dispersal of plants. Plants can be propagated by two methods, namely – sexual and asexual.

1. Sexual Propagation: Seed formation takes place only after pollination. After fertilization, seeds are formed. Seeds when sown give rise to new plants.

2. Asexual Propagation: This process is also called as vegetative propagation. Stem cuttings, root cuttings, leaf cuttings, root division, layering, grafting and budding are all vegetative methods of propagation.

a. Stem Cuttings: Herbaceous stem cuttings of plants like Dahlia, Mint, Portulaca etc. easily root. They do not need any special treatment. In herbaceous plants tender, growing and leafy sections make better plants. Semi-hard cuttings like Schefflera, Aralia, Philodendrons and Hibiscus can be easily rooted. Hardwood cuttings of Bougainvillea, Ixora etc. can be rooted with good amount of success if root promoting hormones are used. These hormones – normally available in powder form – are applied on the lower end of the cutting.

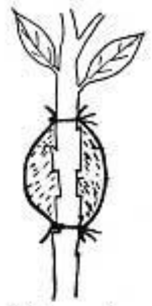


b. Root Cuttings: Some plants like Breadfruit, Curry patta, White Poinsettia and some Jasmines and Ixora can be propagated with root cuttings. Roots of such plants if cut at the plant end and the cut tip of the root if exposed to air will start growing in to a new plant.

c. Leaf Cuttings: Entire leaves removed from many succulents and kept in moist sandy medium will sprout plantlets. Echeveria, Kalanchoe, and Sedum are such plants. Herbaceous plants like African violets, Begonia Rex, Peperomia also can be propagated through leaf cutting. Sansevieria, Gasteria and Drimiopsis also can be propagated through entire leaf or by planting leaf sections.

d. Root Division: Bamboo, Asparagus and Gerbera plants grow in clumps. This clump can be divided into sections, with each section having some roots. The sections are then planted as separate plants.

e. Air Layering: Plants which cannot be propagated with any of the above-mentioned methods may respond to layering. Layering actually is a type of stem cutting only. But the difference between the two is that in normal stem cutting the stems are cut away from the mother plant and then they are forced to root. In layering, first the roots are formed on a stem of a mother plant and only after that the stem is cut off and is planted as a new plant. Plants grown from layering will fruit earlier than the ones grown from seeds. Mature or semi-mature branches are selected for layering, depending upon the species.



Air Layering

f. Stooling: Stooling is a type of air layering only. In this method the branch from which the ring of bark has been removed, is bent down and the portion of the stem from where the bark was removed is inserted in the ground. A stone is kept on the soil to prevent the branch from springing out of soil. After the roots are formed, the branch is cut off from the plant end. The newly rooted branch then is replanted.

g. Grafting: Mango, Sapota and Golden Champa are available mostly as grafted plants. These days even Cashew, Jackfruit and Jamun plants are being successfully being grafted. Decorative plants such as hybrid red Mussaenda and cactus plants too are available as grafts. “Stock” is a rooted plant upon which a branch of a desired variety of the plant is grafted. The branch, which is being grafted, is called as “scion”. Grafting is done on a stock plant, which has a very strong root system. Sapota plant is always grafted on a sampling of Rayan (also called as Khirni) tree. Following are some important methods of grafting like Wedge grafting, Side grafting, Veneer grafting, Approach grafting (inarching) and Butt grafting (used for grafting cacti plants).

h. Budding: Budding, actually, is a type of grafting only. However, in budding, the scion is in a section of shield-shaped skin along with an eye (lateral axillary bud, not a flower bud). On the stock a “T” shaped cut is given. The skin is opened and the bud is inserted inside the skin. After this, the cut is covered by winding a strip of polythene sheet, keeping only the bud exposed. The growing tip of the stock then is severed. Growth of the grafted bud starts within 15 days. Rose, Bougainvillea, limes and other citrus plants, Hibiscus, Ber can be budded.

Plant Tissue Culture

Plant tissue culture is a collection of techniques used to maintain or grow plant cells, tissues or organs under sterile conditions on a nutrient culture medium of known composition. Plant tissue culture is widely used to produce clones of a plant in a method known as micro-propagation.

Different techniques in plant tissue culture may offer certain advantages over traditional methods of propagation, including:

1. The production of exact number of plants that produce particularly good flowers, fruits, or have other desirable traits.
2. To quickly produce mature plants.
3. The production of multiples of plants in the absence of seeds or necessary pollinators to produce seeds.
4. The regeneration of whole plants from plant cells that have been genetically modified.
5. The production of plants in sterile containers that allows them to be moved with greatly reduced chances of transmitting diseases, pests, and pathogens.
6. The production of plants from seeds that otherwise have very low chances of germinating and growing, i.e.: orchids and Nepenthes.
7. To clean particular plants of viral and other infections and to quickly multiply these plants as 'cleaned stock' for horticulture and agriculture.

Plant tissue culture relies on the fact that many plant cells have the ability to regenerate a whole plant (tot-potency). Single cells, plant cells without cell walls (protoplasts), pieces of leaves, stems or roots can often be used to generate a new plant on culture media given the required nutrients and plant hormones.

Applications

Plant tissue culture is used widely in the plant sciences, forestry and in horticulture.

Applications Include

1. The commercial production of plants used as potting, landscape, and florist subjects, which uses mere-stem and shoot culture to produce large numbers of identical individuals.
2. To conserve rare or endangered plant species.
3. A plant breeder may use tissue culture to screen cells rather than plants for advantageous characters, e.g. herbicide resistance/tolerance.
4. Large-scale growth of plant cells in liquid culture in bioreactors for production of valuable compounds, like plant-derived secondary metabolites and recombinant proteins used as biopharmaceuticals.
5. To cross distantly related species by protoplast fusion and regeneration of the novel hybrid.
6. To rapidly study the molecular basis for physiological, biochemical, and reproductive mechanisms in plants, for example in vitro selection for stress tolerant plants, and in vitro flowering studies.[8]
7. To cross-pollinate distantly related species and then tissue culture the resulting embryo which would otherwise normally die (Embryo Rescue)?
8. For chromosome doubling and induction of polyploidy, for example doubled haploids, tetraploids, and other forms of polyploids. This is usually achieved by application of antimitotic agents such as colchicine or oryzalin.
9. As a tissue for transformation, followed by either short-term testing of genetic constructs or regeneration of transgenic plants.
10. Certain techniques such as meristem tip culture can be used to produce clean plant material from viruses' stock, such as potatoes and many species of soft fruit.
11. Production of identical sterile hybrid species can be obtained.

Plant Genetic Resource of Vegetables

Article ID: 10655

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Introduction

Genetic Resource is reservoirs of variation which provides value material for breeding. Importance of genetic resources realised since Vavilov discovered the geographical centres of diversity. Up to 1960 not much emphasis has been given for collection and preservation of genetic resources in vegetable crops. During 1970 Breeders have become very conscious of vegetable genetic resource, since inception of IBPGR (1974, renamed as IPGRI) has given highest priority for plant genetic resource. In the same contest NBPGR started to conserve the plant genetic resource including vegetable crops in India. Activities of these agencies includes exploration, collection, evaluation, utilisation, conservation and documentation.

Components of Plant Genetic Resource in Vegetable

Various components include Land races, absolute species, improved varieties, modern varieties, advance breeding lines, wild species, wild and weedy relatives and mutants. Among these, land races are heterogeneous able to survive under varied environmental conditions. But due to development and adaption of improved varieties which are generally uniform and homogenous and therefore it led to the replacement of innumerable local varieties and land races.

Vegetables having rich genetic diversity in India include brinjal, okra, cucubits, Taro *(Colocasia esculenta)* and yams. Collection, Characterisation, Evaluation, conservation and utilization of genetic resource is an important and gigantic task especially in country like India because of wide diversity in these crops with respect to mode of reproduction (seeds v/s vegetative. Seed storage behaviours, growth habits (annual v/s perennial), seed storage behaviour (orthodox v/s recalcitrant), growth habit (annual v/s perennial) etc. But still it was possible to conserve about 11000 and more vegetable germplasms (about 1.22,000 total horticulture germplasms) through National research centres.

Now all the national research centres and institutes on horticulture are grouped under National Active Germplasm Sites (NAGS).

Various Activities of Germplasm in India on Vegetables

1. Indigenous germplasms collection: The collection of vegetable germplasm resource receives less importance than field crops in India and as well as in the world. Out of total germplasm collections held in various gene banks in the world only 15 % belongs to horticulture crops and out of these, vegetables accounting to 7.5% (constitute more than 60% of total horticulture germplasm). Furthermore, only small portion of the farmers varieties or land races and wild relatives are included in these collections.

Some important explored areas are:

Cucumis sps	Across all agro climatic zones of India
Cucurbita species	North eastern hill region
Luffa species	Indo Gangatic plains

2. Introductions: about 29,550 vegetables have introduced from other countries and many vegetables are direct introduction i.e., released for commercial cultivation without any alteration in their genotypes:

Copenhagen market & Golden acre cabbage	Cabbage
Erfut -Alfa	Cauliflower

Snowfall	Green Sprouting broccoli
Early grano	Onion
Sioux	Tomato
Poinsette	Cucumber
Sugar baby	Watermelon

But many of these introductions have been utilised as parents in the hybridisation programmes for developing new varieties.

Some of Vegetable Varieties Still Need to be Introduced

Asparagus	Young shoots
Broccoli	Curds
Summer squash	fruit
Parsley	Leaf and tender stem
Lettuce	Leaves , stem

Trait Specific Introduction Required

Garlic	Large bulb / clove
Onion	better storage and processing quality
Tomato	Cherry type, carotene rich, high lycopine content, better canning and processing quality, tolerance to heat, Resistance to Tobacco mosaic virus , Bacterial wilt, fusarium wilt, and Root knot Nematode
Chilli	Multivirus resistant type, Field resistance to Bacterial spot, paprika(mild hot and red chilli)
Okra	Darkgreen fruit, with short and rounded beaks, Yellow vein Mosaic virus resistance (YMV)
Cabbage	Extra early , heat tolerant, resistance to black rot
Sweet potato	High protein, high beta carotene content

Characterisation of Vegetables

To avoid the duplication the promising germplasm, have to be characterised for its utilization in crops improvement programmes.

National Bureau of plant genetic resource has Characterised some important vegetables such as Brinjal (1188 accession), Okra (5322) Brassica (555) Tomato (2980). Minimal description list of 42 vegetables for uniform recording of observations has been published by NBPGR. In vegetables such as okra, brinjal, tomato and cowpea extensive work on characterisation has been done especially for reaction to stress, nutritional importance and processing attributes. Where as in chilli and pea great collection has been done but still characterisation has to be carried out. Similarly, Cole crops and cucurbits needs more attention for evaluation during various stages of collection.

Assay of Quality Traits in Vegetables Crops

Especially characteristics like colour, Nutritional constituents, pungency, flavour requires sophisticated analytical instrumentation but the practical problem is that there are no definite criteria for edible maturity in different vegetables since it has not been formulated which led to errors in sampling. Development of various constituents affecting quality was highly influenced by environmental conditions and vigour of the plant eg. Carotene content in tomato fruits depending on temperature and maturity.

Conservation of Vegetable

Depends on various criteria to conserve the vegetables:

1. In situ conservation - on farm

2. Ex-situ conservation - off farm, controlled condition, 3-5 % moisture content at 20º.

Through various methods the vegetable germplasm conserved in India:

	Seed gene bank	Invitro gene bank	Cryo preservation
Vegetables	15671	554	389

Utilization

In horticulture crop except vegetables very limited number of genetic resources have been utilized for crop improvement which is cause of concern therefore situation can be improved with the association of plant breeders. The emerging area are Processing, Product development, Value addition, Stable performance in biotic and abiotic stress, broadening the genetic base shall be prioritised in the utilisation programme. The wild species are usually good in all above aspects. e.g. Tomato.

Lycopersicon hirsutum ,	Resistance to Fungal disease
Lycopersicon pimpinellifolia	Resistance to Fungal disease
Licopersicon chilense	Resistance to viral infection
Licopersicon peruvianum	Resistance to viral infection
Licopersicon chamielewskii	For better fruit quality
Licopersicon cheesmanii	Resistant to adverse environments

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Aerobic Rice Cultivation and its Effect on Growth, Water Productivity and Yield

Article ID: 10656

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Introduction

Rice consumes 34 to 43 percent of the total fresh water and occupies one-third of the world's total cultivated area of cereals. With increasing scarcity of water and labour, the sustainability of food production and ecosystem services are threatened. The estimated world demand for rice in 2025 will be 140 MT. This projected demand can only be met by maintaining steady increase in production over years, but per capita availability of fresh water is declining continuously and could reach alarming levels in most Asian countries by the year 2025. Rice is a unique plant that grows well both under aerobic and anaerobic conditions. When it is grown under aerated conditions, it is called aerobic rice as against the anaerobic rice which is grown under un-aerated flooded conditions. Aerobic rice is characterized by the presence of air in the soil medium and its limited water requirement as compared to the irrigated rice.

A new development in water saving technology is the concept of "aerobic rice". Aerobic rice is a new way of cultivating rice that requires less water than lowland rice. It entails the growing of rice in aerobic soil, with the use of external inputs such as supplementary irrigation and fertilizers and aiming at high yields. Aerobic way of growing rice saves water by eliminating continuous seepage and percolation, reducing evaporation and eliminating wet land preparation. The target environments for aerobic rice includes irrigated lowland rice areas where, rainfall is insufficient to sustain lowland rice production (estimated to require about 1200-1500 mm) but sufficient for aerobic rice (about 800 mm). It is also popular in pump irrigated areas where water has become so expensive that lowland rice production was abandoned. In aerobic rice systems, fields remain unsaturated throughout the season. Irrigation is by surface method (e.g., flush irrigation, furrow irrigation) or by sprinklers and aims at keeping the soil "wet" but not flooded or saturated.

Earlier aerobic rice varieties were developed with the aim to replace the low yielding rice varieties of upland ecosystem. In the last decade, aerobic rice has not become popular among farmers due to high weed infestation and high cost to control weeds under aerobic situation as compared to puddled transplanted rice. With the availability of appropriate weed control measures, mechanization reducing labour requirements from 11 to 66% compared to puddle transplanted rice and improved agronomic management practices; aerobic rice cultivation system is being successfully implemented in rainfed shallow lowland ecosystem. In recent years, aerobic system of cultivation has gained momentum in irrigated lowlands where rainfall is not sufficient and pumping water from deep well is expensive, delta regions with delayed water supplies and upland system with supplemental irrigation. Aerobic rice needs 30– 51% less total water for land preparation depending upon the soil types providing 32–88% higher crop productivity, 50% saving on labour and can have 50% reduced GHG emission compared to puddle transplanted rice.

Origin and History

International Rice Research Institute (IRRI) developed the aerobic rice technology to address the water crisis in tropical agriculture. In aerobic rice systems, where in the crop is established in non-puddled, non-flooded fields and rice is grown like an upland crop (unsaturated condition) with adequate inputs and supplementary irrigation when rainfall is insufficient. The new concept of aerobic rice may be an alternate strategy, which combines the characteristics of rice varieties adopted in upland with less water requirement and irrigated varieties with high response to inputs. In China, the water use for aerobic rice production was 55–56% lower than the flooded rice with 1.6–1.9 times higher water productivity. It indicates that aerobic rice may be a viable option where the shortage of water does not allow the growing of lowland rice.

Effect of Aerobic Rice on Changes in Soil Properties

Peng et al. (2006) reported decline in soil organic matter as a possible reason for a decline in yield under aerobic cultivation, because total soil N at physiological maturity in the micro plots was not significantly lower in aerobic than in continuously flooded soil in both 2002 and 2003. Since soil extractable NO3+ and NH4+ did not constitute more than 0.2% of total N at physiological maturity, almost all N was in organic form. Assuming that C, N ratios were not different between flooded and aerobic soils lead them to conclude that soil organic matter content did not differ between the two water regimes after both seasons. They predicted a decline in soil organic matter under aerobic system as compared with permanent flooding or the rotational flooded rice-aerobic rice.

Effect of Aerobic Rice on Nutrient Concentration and Uptake

Belder et al. (2005) reported relatively low uptake of nitrogen under aerobic conditions as compared to flooded conditions which was reflected by the relatively low fertilizer-N recovery under aerobic conditions. About 47% N must have left the system as gaseous-N losses promoted by rapid nitrification–denitrification processes. A higher recovery of N in aerobic rice (more than the 22%) was desirable to increase N application efficiency, thereby reducing fertilizer costs to farmers, and reduce gaseous-N losses to the environment such as N2O, which is a potent greenhouse gas. Belder et al. (2005) suggested combining water treatments with N treatments to optimize yield and resource-use efficiency. Fertilizer N application as basal just before transplanting showed the lowest N recovery. High N recoveries up to 0.6–0.7 kg kg^{-1} N in arable cereal crops show that higher N recoveries in aerobic rice might be possible when N dose and timing better match the N requirement of the crop. For upland rice production, Yoshida (1975) mentioned inadequate water supply as the primary constraint to yield, followed by N when water is sufficient. But also restricted uptake of nutrients other than N may be a limitation for rice in aerobic soils. In flooded soils, the majority of plant nutrients are usually more available, with exceptions for S, Zn, Cu, and P, availability of Fe and Mn is often particularly high in anaerobic soils because of low redox potential. In aerobic soils, however, Fe and Mn may become limiting, especially when the soil pH is high. Moreover, nutrient uptake and supply to plants may be reduced because of lower delivery rates to roots through mass flow and diffusion as both of these processes are influenced by the reduced soil water content.

Effect of Aerobic Rice on Physiological Changes Under Water Stress

Drought is undoubtedly one of the most important environmental stresses limiting the productivity of crop plants around the world. Rice is considered a drought sensitive crop species, however, within this species, there are considerable varietal differences in sensitivity to this environmental stress. In aerobic rice crop may face water stress. Drought stress decreases the rate of photosynthesis. Severe drought stress also inhibits the photosynthesis of plants by causing changes in chlorophyll content, by affecting chlorophyll components and by damaging the photosynthetic apparatus. Plants can partly protect themselves against mild drought stress by accumulating osmolytes. Proline is one of the most common compatible osmolytes in drought stressed plants. Proline accumulation can also be observed with other stresses such as high temperature and under starvation. Proline metabolism in plants, however, has mainly been studied in response to osmotic stress. Proline does not interfere with normal biochemical reactions but allows the plants to survive under stress. The accumulation of proline in plant tissues is also a clear marker for environmental stress, particularly in plants under drought stress. The aerobic rice production system has been reported to be less sustainable than irrigated rice systems operated under predominantly flooded soil conditions, especially when aerobic rice is grown in sequence for several years. In a long-term aerobic rice experiment at IRRI, yields of aerobic rice gradually declined over time as compared to a continuously flooded control. For continuously grown upland rice in the Philippines, yield reductions of 30–60% as well as yield failures and rapid yield loss in repeated cropping of aerobic rice were reported.

Effect of Aerobic Rice on Water Saving and Water Productivity

Water requirement of low land rice varies from 1,650 to 3000mm. Aerobic rice production system eliminates continuous seepage and percolation losses, greatly reduces evaporation as no standing water is present at any time during the cropping season, and effectively uses the rainfall and thus helps in enhancing water productivity, concomitant loss of soil sediments, silt and fertility from the soil. A comparison of water requirement of lowland flooded rice and aerobic rice system clearly shows that aerobic rice system can save about 45 per cent of water. Water saving in the aerobic rice system compared with the conventionally irrigated lowland rice results mainly from no water losses during land preparation, less percolation and seepage due to the elimination of the pressure ahead of the ponded water layer normally maintained in an irrigated field, and less evaporation losses.

Effect of Aerobic Rice on Yield and Yield Attributes

The yield difference between aerobic and flooded rice ranged from 8 to 69% depending on the number of seasons that aerobic rice has been continuously grown. The yield gap between aerobic and flooded rice widened as the number of cropping seasons increased. In general, the difference in yield between aerobic and flooded rice was greater in dry season than in wet season, which was associated with difference in the soil water status of aerobic rice between dry season and wet season. The soil was wetter in wet season because of more frequent rains than in dry season. The yield difference between aerobic and flooded rice was attributed more to biomass production than to harvest index. Among yield components, sink size (spikelets m-2) contributed more to the yield gap between aerobic and flooded rice than grain filling percentage and 1000-grain weight. In general, flooded rice produced more panicles with more spikelets per panicle than aerobic rice. Like grain yield, the difference in yield attributes between the first season aerobic rice and flooded rice was small. Rapid yield decline was reported under continuous upland rice cropping and under monocropping of aerobic rice in the Philippines. Studies on bottlenecks in yield formation under aerobic condition analysed using Handao varieties in North China have shown, sink size as the major limitation of aerobic rice yield, because in aerobic rice spikelet number m^{-2} was too low compared with the lowland rice. So, future research, should focus on effects of water regimes on tiller dynamics to increase yield.

Weed Problems in Aerobic Rice

In traditional irrigated lowland rice systems, rice has a two- to three-week head start over weeds, which favours rice in competition against weeds that have not emerged yet at transplanting, and the water layer after transplanting effectively suppresses the emergence and growth of most weed flora, including upland and semi-aquatic weeds. Among rice ecosystems, therefore, the greatest weed pressure and competition occurs in upland and aerobic rice, and the least in transplanted irrigated and rainfed lowland rice. Mahajan et al. (2011) found almost double weed density and biomass in aerobic rice field than those of conventional transplanted rice at 35 and 75 days after sowing /transplanting. In conventional transplanted system, weeds are suppressed by standing water and by transplanted rice seedlings, which have a head start over germinating weed seedlings. On the other hand, aerobic soil dry-tillage and alternate wetting and drying conditions are conducive for germination and growth of weeds causing grain yield loss of 50 to 91%. Thus, it appears that weed is the major constraint to aerobic rice production and therefore, success of this technology mostly depends on effective weed management.

Conclusion

Over the years, lowland rice has proven to be a remarkably sustainable system for rice production mostly because of its luxurious water availability. But currently, water crisis threatens the sustainability of lowland rice production and necessitates the adoption of water saving irrigation technologies. Aerobic rice is a new concept to decrease water requirements in rice production and is highly suitable for irrigated lowland rice with insufficient rainfall and favourable uplands with access to Experiments on aerobic rice have shown that water requirement in aerobic rice were more than 50 per cent lower (only 470-650 mm) and water productivities were 64-88 per cent higher than the lowland rice. The concept of aerobic rice holds promise for farmers in water short irrigated rice environments where water availability at the farm level is too low or where water is too expensive to grow flooded lowland rice. In India, aerobic rice systems are still very much in the research and development phase and varieties developed for another environment are evaluated under aerobic system. However, more varieties need to be evaluated and their nitrogen requirement should be assessed.

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Pokkali Paddy Farming

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Abstract

The chapter discusses a farming practice on unique Paddy variety, Pokkali in the state of Kerala. Pokkali Paddy is a saline tolerant traditional variety which is cultivated organically as it is entirely different from other paddy varieties, the overall cultivation methods with its characteristic features, problems and effects were discussed in this chapter along with its cultivation importance to provide an overall understanding about the present Pokkali Paddy farming. The schemes, developments and supports offered to the crop cultivation on Pokkali are also important factor which are discussed.

Introduction

About 3000 years ago, from the Western Ghats, a wild Paddy grass seeds reached the parts of coastal area through flooding. The seeds started growing in the saline tracts of that coastal area in the regions of central Kerala of India. The Paddy variety is then started for cultivation on the same region under saline water. Presently there is about 6274 hectares of cultivation land. The name of the Pokkali Paddy came due to its height, which means "one who flares up". As due to the several problems and limitations, the cultivation area is getting reduced year by year. Even though the paddy variety has noted for its higher nutritional value with a peculiar taste, the interest on cultivation among the farmers is declining. Government has taken steps to increase the productivity by extending the cultivation area.

Fig.1 A Pokkali Farm

Pokkali Farm

Pokkali farm is an ecosystem which is a unique kind with Paddy farming in yearly once followed by prawn cultivation with the available saline water. The colour of soil is pale or dark bluish black and the texture is found to be clayey (Sudhan C et al 2016). There is puddling operation as in the normal paddy cultivation. Some fields have mounds which are acting as seed bed, and in some fields, it is broadcasted without mounds. The dikes are formed around the boundaries and sluice gates are present to control the water flow. The field size is varying and mostly smaller kind. The left-over stalks of paddy cultivation will be utilized as organic feed for the prawns.

The prawn wastes enrich the soil for next paddy cultivation. Once the prawn cultivation is over, the field will be dried by eliminating the water; to remove the harmful gases formed which will escapes through the cracks formed on the soil surface due to drying process.

Fig.1 Sluice gate for controlling water flow in Pokkali Farm

Pokkali Paddy

The Paddy grows upto the height of 6 feet in case of indigenous variety, but the hybrid varieties may have less height such as 4.5 feet. It is rich in proteins and an attractive smell. The season is from June – July to October – November for the Pokkali Paddy (120 days) and December to April for Shrimp cultivation. Pokkali Paddy is cultivated in the season of monsoon which favours the less salinity by the replacement of salt water with rain water. The seeds are pre-processed by soaking and bagging followed by sowing. The sowing method is mainly broadcasting when the field is dry and prepared with mounds. After that rainfall arrives and the sown seeds are germinated, simultaneously the water level will be increased by operating the sluice gates. The Pokkali paddy cultivation is excluded from artificial fertilizers, pesticides and weedicide applications. At the age of 35 days, the height will be 40 to 45 cm. When the crop is matured, the upper part of the crop, about 1 foot with panicles are the harvested. Even the water level will be varying from 1 foot to 5 feet at the time of harvest. The left-over stalks below the one foot will be decayed on the stagnated water and utilized in shrimp cultivation. The cut portion will be dried for 2 days and then threshed.

Mechanization

The diking operation is nowadays done by the bulldozers in some parts. Still soil preparation and mound making are manual operations which involves more drudgery and laborious. Sowing and mechanical weeding (if any) is also done manually. For harvesting there are special types of harvesters invented, but still there are problems on the mechanization of harvesting the Pokkali Paddy. Threshers are available in some parts. But mostly the farmers are doing the harvesting and threshing by manual operation, as the mechanization is not perfectly reached and working.

Importance

Apart from the tradition preservation and protecting an organic rice variety, there are several other importance lies on the Pokkali paddy farming. The prawn cultivation is advised to complete by April 15, so as to leave the field dry. This makes the harmful gases to go out and also reduces the salinity level. When the Pokkali Cultivation is carried out, it helps in maintaining the ecological balance for shrimp farming and salinity management. If the Pokkali paddy is not cultivated and shrimp farming is alone carried out, it leads to the soil infertility, high salinity levels and saline water intrusion into groundwater. Hence the government makes steps to sustain the Pokkali paddy cultivation.

Constraints and Effects

The mechanization requirement on diking and harvesting is major problem which is catalyzed by the labour shortage issues. Conversion of Pokkali farms into fish farms which offers more income is a constraint which reduced the interest of farmers on Pokkali Paddy cultivation. Nearby industrialization, construction of road and railways are also decreasing the cultivable area. Endangered bird species, Moorhen, is spoiling the crops, which reduces the yield mainly. Also, the invasion of other animals and reptiles are reducing yield. There is no proper income for the input on Pokkali farming. Apart from these, as like the major crops, involvement of youth in agriculture is also makes a gap in sustainability. The major population of Pokkali Paddy farmers falls above 40 – 50 years of age. Such a category will be falling under the category of 'laggards' in the extension term.

As due to the above constraints, the cultivation area gets reduced from 25000 hectares to 6274 ha as of present. Some farmers can't' able to harvest the paddy, lefts the crop completely and starts the shrimp cultivation. As the shrimp cultivation is providing nominal income than paddy, the famers are more interested on shrimps. Some of the government subsidy is provided for Pokkali Paddy cultivation, which is availed by the farmers by simple sowing and there won't be any harvest and productivity due to the loss in cropping. Mechanization of harvest can solve such problem, which is not perfect right now. The adverse field conditions, crop instability on cutting force, presence of sludge on harvested portions, stability maintenance of the machine, higher investments, large size and weight, skills on design and operation are the major constraints faced on the mechanization of harvesting the Pokkali paddy.

Schemes and Supports

Government is providing subsidies to the Pokkali Paddy farming individuals. The seeds are also provided by the government agricultural department sometimes. The State Agricultural University released several varieties of hybrid Pokkali Paddy from the Rice Research Station, Vytilla. The Kelappaji College of Agricultural Engineering and Technology of Kerala Agricultural University has developed a KAU Pokkali Paddy Harvester, also still researches are in progress for mechanizing the Pokkali Paddy perfectly. Government is also taking necessary steps to mechanize the cultivation. NGO's and reformers such as Palliyakkal bank are also doing works to uplift the cultivation of Pokkali Paddy. Even though such supports and plans exists, it has to be improved and ensured to reach the complete Pokkali paddy farmers.

Conclusion

As considering the importance of Pokkali Paddy cultivation on ecology, tradition, unique food quality, the mechanization strategies have to be developed and adopted by the farmers on diking, harvesting operations etc. Bird scaring and repelling technologies can be adopted to protect the crops from birds without killing or harming them. Also, the nominal market price of the produce has to be ensured for making enough profits to the farmers. Demand for the product is increasing in case of organic categories, hence, overall, the Pokkali cultivation area and productivity has to be increased.

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Production Technology Under Protected Cultivation for Important Flowers

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Rose

Normally one-year-old budded plants having at least 3 canes on rockstocks like *Rosa indica* var. odorata or *R. canina* or *R. manetti* are most ideal for greenhouse cultivation.

Planting: Optimal planting time is October-December. The planting density should be between 7-13 plants/m2 (50-60 thousand bushes/ha area). Planting should be done preferably in 2-row system.

Temperature requirement: The greenhouse temperature is generally maintained from 200C or 210C on cloudy days and 240C –280C on sunny days. However, the temperature range of 15-270C is optimum.

Fertiliser dose: Liquid fertilizers containing 200 ppm nitrogen and 150 ppm potassium plus iron and magnesium as needed, can be applied with good results in a wide range of soil conditions. Binding of unproductive shoots leads to a greater number of basal sprouts.

Harvesting and yield: Red and pink cultivars are harvested when first 2 petals are beginning to unfold and calyx is reflexed below the horizontal lane.

Yellow cultivars are harvested slightly earlier and white cultivars slightly later than red and pink types.

After cutting the stem ends are dipped in 200-500 ppm citric acid or aluminium sulphate and placed in cold storage at 10C till grading. Stem ends are recut, bunched in 20’s and placed in preservative solution with sucrose up to 2%.

Flower yield of 250-350 stems/m2 is considered to be ideal.

Flower yield can be increased by spraying BAP 50-100 ppm before flowering flush. Burning of saw-dust during winter months in the morning hours (7-10 AM) increases flower yield and quality significantly.

Carnation: Perpetual carnations *(Dianthus caryophyllyus).*

Temperature requirement: temperature is maintained at 20-25 ^{0}C.

Planting: Plant density of 20-30 plants/m2 is optimal (1.5 –2.0 lakh/ha).Can be planted round the year under greenhouse environment.

Fertilizer dose: A nutritional dose of 40 g N, 20 g P_2O_5 and 10g K_2O is ideal. Liquid feeding of carnation plants with nutrient levels of 190 ppm N and 156 ppm K, and 1 ppm B with each irrigation water results in high grade carnation. Overhead sprinkling is quite effective and economical than soil surface irrigation. At bud appearance stage, over-head sprinklers should be replaced with soil surface system.

Practices followed: Pinching, disbudding and deshooting are important practices followed in the standard carnations. Pinching should generally be done by leaving 5-6 nodes on the plant. In case of standard type, terminal buds are retained and all auxiliary buds are removed and vice-versa in spray type. Plants need support [2-3 layers of nylon mesh (10x10 cm size)] when 45 cm in height. After pinching, spraying BAP (100 ppm) increases production.

Harvesting and yield: Standard carnations are harvested at paint brush stage and sprays when 2-3 upper flowers in the inflorescence are open and remainders showing colour. The flowers after harvest should be pulsed with

10% sugar + 4 mM STS for 10-12 hr and at 2-4 0C. The flowers are kept in sugar 2% + 0.5 mM STS for prolonging vase-life.

Yearly production of 300-400 flower/m2 is ideal and economical.

Lilies

Lilies, especially Asiatic and Oriental types are most fascinating, in international floriculture trade.

Forcing: Forcing lily flower for normal durations, the bulbs require cold treatment at 2-4^{0}C for 6 weeks in case of Asiatic hybrids and 8 weeks for the Oriental ones. It is possible to use "frozen-in" bulbs which are kept at 10C after pre-cooling treatment for off-season flowering. A night temperature of 16 ^{0}C with a day temperature below 21 ^{0}C inside the greenhouse is recommended for forcing.

Planting: The best time of planting hybrid lilies under north Indian climate is from mid-September to mid-December. Planting density depends on cultivar, bulb size and time of the year, with a range of 25-60 bulbs/m^2.

Light requirement: Light is very important factor for lily culture. High light intensity in summer reduces the stem length and therefore 50% shade nets are recommended to cover the crop. Low light intensity in winter leads to flower abortion and abscission. Supplementary lighting during winter increases yield, stem sturdiness and quality of flowers.

Plants require liquid feeding or use of controlled released fertilizers. Supporting plants with nylon mesh is advisable.

Harvesting and yield: Asiatic hybrids take 8-10 weeks, while Orientals 14-16 weeks from planting to harvesting, but `frozen –in' (Eskimo) takes less time the blooms are cut when the lower most flower bud is fully coloured but not open. Cut lilies could efficiently be started both dry (sealed in plastic bags) or wet (1/10 portion in 25 ppm silver nitrate) at 10C cold storage temperature up to 4-6 weeks provided they are pulsed with 0.2 mM STS + 10% sucrose for 24 hr.

Chrysanthemum

Chrysanthemum is a very popular flower crop of commercial importance. Chrysanthemums are grown in 2 ways for cut flowers, depending upon market demand.

Disbudded inflorescence: All flower buds except terminal ones are removed to allow one inflorescence/stem to develop. If the bloom is an incurved or reflexed type and in between 10 and 15 cm in diameter, is usually referred as standard.

Spray inflorescence: The entire cyme is allowed to bloom but very often the central inflorescence (oldest) is removed at the time colour begins to show in the ray flowers. These groups are usually known as pompon or spray chrysanthemums.

Light and temperature requirement: Chrysanthemum is primarily a typical short-day plant and normally cannot form flower buds when day length exceeds 14 1/2 hr. Light and temperature are important environmental factors influencing growth and development. Chrysanthemums are broadly classified into 3 groups on the basis of their response to temperature. Thermozero varieties flower at any temperature ranging 10-27^{0}C but most consistently at a constant 16^{0}C night temperature. Thermopositive varieties require higher temperature (27^{0}C) for bud initiation and lower temperature inhibit completely. Thermonegative varieties flower at any temperature between 10 and 27^{0}C, but flowering is delayed at higher temperature.

Planting: July-August is ideal time of planting chrysanthemum in north India. However, if controlled photroperiod facilities are available planting can be done round the year.

Planting density varieties from 32 to 56 plants/m2.

Practices: Pinching and disbudding are most important cultural practices for the production of quality blooms. Growth regulator spraying of B-9 (Alar) or Cycocel 2-3 blooms of good quality.

Harvesting: Standard types are generally harvested when outer ray florets cease to elongate, while decorative when petals in the centre of topmost flower are fully developed. Single and anemones are harvested when flower is fully developed.

Gerbera

Planting: Planting medium should be adequately porous and well-drained. The optimum planting, density recommended for large flowering cultivars is 8-10 plants/m^2. Two –row or 4-row planting systems are generally used. Planting can be done round-the-year but preferably during September-October. The plants should be left undisturbed for 2 years for flower production (no separation of clumps). Treating plants with GA3 (100 ppm) results in early flowering having long stems.

Temperature requirement: The temperature during day time should be 16-20^{0}C and 12^{0}C during nights.

Harvesting and yield: The harvesting stage is critical as the flowers should not be cut before the outer row of flowers show pollen, or the flowers will wilt and close at night. Optimum storage temperature (wet) for gerbera is 4^{0}C. The flowers could be stored efficiently up to 4 weeks. Most modern cultivars of gerbera yield 250-300 good quality flowers/m^2/year.

Causes of Flower Bud Abortion

Article ID: 10659

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Many of the crops we grow in greenhouses are for their flowers. In fact, most floriculture crops are not marketable to consumers unless they are in flower, or very close to it. If flowers do not develop normally, or abort prematurely, the crop may be less marketable or in some cases, not saleable.

There are many potential causes to flower bud abortion, including insects and mites that feed on flower buds and shoot tips, or pathogens that attack a root system, making a plant less able to support the water and fertility demands of the developing flowers. Below is a list of some environmental and cultural factors that can contribute to, or cause, flower bud abortion. Insufficient light. Flowers require a relatively large supply of energy to develop normally. The energy can come from stored carbohydrates, such as from bulbs and tubers, and light that drives photosynthesis.

When the amount of light is not sufficient to support the energy demands of the flowers, they can abort. Usually, low-light induced flower bud abortion only occurs under a low daily light integral (for example, less than 6 mol·m–2·d–1) and thus, only occurs during the winter. However, if crops are initially grown under a high DLI and have a large number of flower buds, and then are transferred to a low DLI, the lower DLI may not provide enough energy for all of the flowers to continue to develop.

Unsuitable Photoperiod

Many floriculture crops have a photoperiodic flowering response, which means that short or long days (long or short nights) accelerate or are required for flowering. For most photoperiodic crops, once flowers have initiated, they continue to develop if other growing conditions are favorable. However, some crops with an obligate photoperiodic flowering response (for example, plants that require long days for flowering) require continual favorable photoperiods for flowers to continue to develop. I have observed this in some long day cultivars of petunia and pansy, as well as in the short-day butterfly weed (asclepias) and surely, it occurs in a handful of other crops too.

High temperature. Excessively warm temperatures can initiate stress responses in plants, which are processes meant to ensure survival. In addition, because plants develop progressively faster with temperature, the energy demand to support developing shoots (including flowers) also increases with temperature. Therefore, high temperatures, especially combined with low light, can cause flower bud abortion. What constitutes a high temperature varies widely among crops, and can be as low as 75° F for some cold-tolerant crops to 95° F or higher for cold-sensitive crops.

Nutrient (especially calcium and boron) deficiency. Calcium is a macronutrient and boron are a micronutrient that are both components of cell walls and developing flowers. When deficient in one or both of these elements, flower buds can abort. In some instances, a calcium or boron deficiency can occur even when present in sufficient amounts in the substrate.

Plant uptake of nutrients occurs with water uptake. If conditions exist such that there is little uptake of water (for example, high humidity and no air movement), plant tissues may be nutrient deficient, leading to bud abortion. Examples of calcium and/or boron deficiency causing flower bud abortion include lily, angelonia, argyranthemum, bracteantha, calibrachoa, nemesia and petunia.

Ethylene. Ethylene is a gaseous hormone that plants generate when stressed, which can abort flowers and flower buds at very low concentrations. Ethylene is also an unwanted contaminant generated by incomplete combustion of natural gas and propane, and can enter a greenhouse if heaters are inadequately ventilated. Ethylene abortion of flowers is usually only a problem when heaters operate, but there can be other sources of ethylene, such as decomposing organic material and ripening fruit. Drought stress. Flower buds require an adequate amount of water to support rapid cell expansion.

Usually, a mild to moderate water stress will not jeopardize flowers, but a severe water stress can lead to flower bud abortion. Water stress is sometimes used as a height control technique, but as plants approach marketability, ensure water is not withheld to the point of wilting.

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Yield Maximization Through Plant Ideotype

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Introduction

A major challenge of the 21st century is to achieve food supply security under a changing climate and roughly a doubling in food demand by 2050 compared to present, the majority of which needs to be met by the cereal's wheat, rice, maize, and barley. Future harvests are expected to be especially threatened through increased frequency and severity of extreme events, such as heat waves and drought that pose particular challenges to plant breeders and crop scientists. Process-based crop models developed for simulating interactions between genotype, environment, and management are widely applied to assess impacts of environmental change on crop yield potentials, phenology, water use, etc. During the last decades, crop simulation has become important for supporting plant breeding, in particular in designing ideotype, i.e., 'model plants', for different crops, for yield improvement and cultivation environments. The plant type concept in crop improvement started to receive major attention with the discovery of dwarfing genes in wheat and rice. The discovery and the analysis that followed showed that yield increases in many crops with the advent of scientific plant breeding are associated with better partitioning efficiency of the total dry matter produced, which on its own may have registered little increase. The two physiological parameters of crop yields - dry matter production and harvest index are now explicitly recognized as targets for future studies as major food grains of the world begin to reach a saturation point in their yields. The present paper describes the evolution of the plant type concept and discusses its wider implications. The concept is particularly relevant for modernization of traditional agriculture where genetic diversity for plant types could help to develop improved crop varieties responsive to applications of fertilizers, irrigation and other farm inputs. The plant type genes could help to accelerate the process of crop improvement in many of the developing countries.

The concept of the 'ideotype' – "a form denoting an idea" was conceived by Donald (1968) as an aid to crop breeding programmes, specifically based on physiological factors conferring close to optimum yield in wheat *(Triticum aestivum)* in the first instance. The 'ideotype' is in effect the ideal model phenotype, which can be expected to perform in a predictable way within a defined environment, so providing the strategy and goal for genetic selection. Food security has become a major challenge given the projected need to increase world food supply by about 70% by 2050 (FAO 2009). Considering the limitations on expanding crop-growing areas in developed countries such as the United Kingdom, a significant increase in crop productivity will be required to achieve this target.

Types of Ideotype

1. Isolation ideotype.
2. Competition ideotype.
3. Crop ideotype.

Isolation Ideotype

It is the model plant type that perform best when the plants are space-planted.

Competition Ideotype

This ideotype perform well in genetically heterogeneous population. In case of cereals, this ideotype is tall, leafy, free tillering plant that is able to shade its less aggressive neighbours. In case of annual seed crops, such an ideotype will include the following features: Annual habit, tallness, leafy canopy, tillering or branching, seed size, speed of germination and root characters.

Crop Ideotype

This ideotype perform best at commercial crop densities because it is a poor competitor. In case of cereals, a crop ideotype is erect, sparsely-tillered plant, with small erect leaves.

Other Ideotypes

Market ideotype: Includes traits like seed colour, seed size, cooking and baking quality, etc.
Climatic ideotype: Includes traits important in climatic adaptation such as heat and cold resistance, maturity duration, drought resistance etc.
Edaphic ideotype: Includes salinity tolerance, mineral toxicity/ deficiency tolerance etc.
Stress ideotype: Shows resistance to both biotic and abiotic stress.

Ideotype Breeding

Ideotype breeding can be defined as a method of crop improvement which is used to enhance genetic yield potential through genetic manipulation of individual plant character.

Main Features of Ideotype Breeding

1. Emphasis is given on individual morphological and physiological trait which enhances the yield. The value of each character is specified before initiating the breeding work.
2. Character which exhibit positive association with yield are included in the model.
3. Ideotype breeding makes use of genetically controlled physiological variation in increasing crop yields, besides various agronomic traits.
4. It is a slow method of cultivar development, because incorporation of various desirable characters from different sources into a single genotype takes long time.
5. Selection is focused on individual plant character which enhance the yield.
6. The phenotypes of new variety to be developed is specified in terms of morphological and physiological traits in advance.
7. It requires the knowledge from the disciplines of genetics, breeding, agronomy, physiology, pathology, entomology etc.

Future Prospects of Ideotype Breeding

In India, the future research on crop ideotype should be directed towards following aspects. India has achieved self-sufficient in the production of food grains through modification of plant characters and development of high yielding varieties and hybrids. To further, the yield potential of food grains crops, ideotype have to be evolved for straight varieties and hybrids. There is ample scope of developing hybrid ideotype crops like maize, sorghum, pearl millet and rice. China has developed hybrid rice for commercial which covers more than 18 million hectares (Barwale, 1993).

Crop ideotype have been developed in cereals and millets. There is ample scope for developing ideal plants or models plants in pulses, oilseeds, cotton and several other field crops. In these crops, again ideotype have to be evolved both for irrigated as well as rain fed cultivation. In cotton, ideotype have to be developed according to agro climatic conditions. In addition to traditional breeding approach, especially tissue culture and protoplast technology have to be utilized in future for designing new plant types. Biotechnology may also help in ideotype development.

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Ophiocordyceps sinensis: Himalayan Gold

Article ID: 10661

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Introduction

The *Ophiocordyceps sinensis* (Berk.) fungus infects the larvae of ghost moths Thitarodes (Hepialus) spp. (Lepidoptera) in the Qinghai-Tibetan Plateau (altitude 3,600-5,000 m) and the fruiting body grows from the mummified cadaver. "Chinese cordyceps" is used to refer to this fungus-insect complex, which has been a valued rare resource for medicinal treatments and health food in Asian countries since the 15th century (Zhang et al., 2012). Chinese cordyceps is one of the best-known traditional Chinese medicines with substantial benefits to human health and enormous economic value. It is popularly referred to as "Dong Chong Xia Cao" (summer-plant, winter-worm) in Chinese, or "Hia Tsao Tong Tchong" and "Hea Tsaon Tsong Chung" in early English translations. It is known as "yarsa gumba" in North Sikkim and Keera Jhar (insect herb) by the local Nepalese. Chinese cordyceps is an entity of the Chinese caterpillar fungus.

The use of Chinese cordyceps as a medicine and tonic has been appreciated for hundreds of years in China. Over 20 bioactive ingredients have been reported, including cordyceps acid, adenosine, ergosterol, polysaccharides, etc. It was officially documented for medicinal uses in the Qing dynasty to replenish the kidney and soothe the lung and was officially classified as a drug in each edition of the Chinese Pharmacopeia. It is also known as Himalayan Viagra. The folk healers of Sikkim use it to cure 21 ailments, including cancer, asthma, TB, diabetics, cough and cold, erectile dysfunction in males, and hepatitis. Recent studies have shown its multiple pharmacological effects, including its anti-inflammatory, anti-tumor, immunomodulating, and antioxidative activities. The natural yield of Chinese cordyceps is very limited, so its price has continuously increased in recent years. Due to over-exploitation and habitat degradation, the yield of O. sinensis is declining (Li et al. 2018).

Worldwide Distribution of *Ophiocordyceps sinensis*

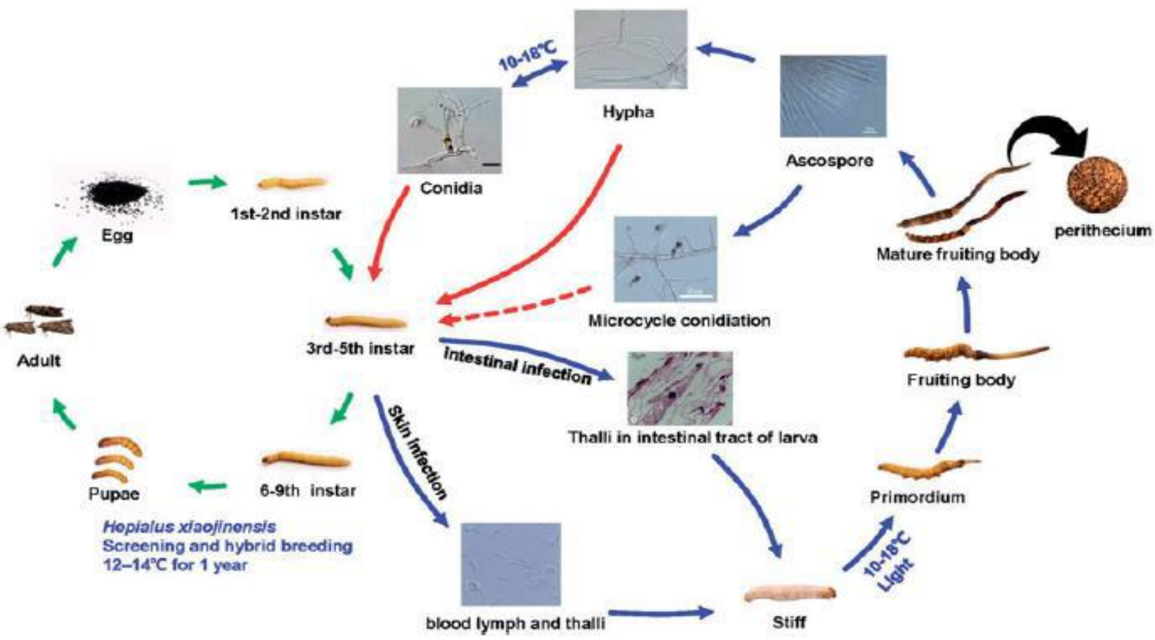

Figure 1. Life and infection cycles of Ophiocordyceps sinensis (Li et al., 2018)

The life cycle of *O. sinensis* includes two stages: anamorphic and teleomorphic. During the asexual stage, the hyphae or conidia of *Hirsutella sinensis* infect their host larva, which lives in topsoil's and belongs to the genus Thitarodes. Fungal infection may induce a larva to sluggishly crawl upwards at a position near the ground. The fungus multiplies in the body cavity of the host larva, and it may ultimately fill the haemocoel with its threadlike hyphae.

The host larva gradually becomes hard and turns into a caterpillar-shaped sclerotium. After overwintering, the fungal fruiting body, by using the dead host larva as a substrate, ruptures the larval cuticle, generally at the head in late spring. The stroma continually grows upwards, breaks through soils, and finally forms a stalked fruiting body with the ability to produce multiseptate ascospores.

Under suitable conditions, the ascospores can be released and spread by wind or water to infect another larva. Clearly, *O. sinensis* colonizes the living larva of the host insects and then switches to necrotrophy when the larvae are eventually dead, indicating that *O. sinensis* is not an obligate biotroph but a facultative saprophyte (Li *et al*., 2016).

Artificial Cultivation

Artificial cultivation of *O. sinensis* should be urgently established to meet the market demand and to protect the fragile ecological environment of this valued medicinal resource. Artificial cultivation of the Chinese cordyceps contains three important milestones: Mass production of the host insects, cultivation of *O. sinensis* fungus and formation of fruiting body from the infected cadaver.

Through decades of effort, artificial cultivation of the host insect *Thitarodes* (*Hepialus*) spp. for *O. sinensis* infection from low- altitude laboratory with mimicking environmental conditions was established (Tao *et al*., 2016). *Ophiocordyceps sinensis* is a psychrophilic and slow-growing fungus and its host insects need 1-2 yr to complete a developmental cycle in the low-altitude laboratory (Cao *et al*., 2015).

Meanwhile, various fungus strains were isolated from different locations and stable fruiting body production of *O. sinensis* by artificial media without living insects was successfully realized. Although the ghost moth larvae were infected by the hyphae and conidia of *O. sinensis* and fruiting bodies with mature ascospores grew from the cadavers also in the low-altitude area outside the Tibetan plateau, low infection and mummification rate post-infection is still an unresolved problem and obstacle for commercial production.

Fungal Isolate

Isolate of *O. sinensis* can isolate from the fruiting bodies of wild *O. sinensis*. The isolate can culture on PPDA medium (liquid PPDA medium: 200 g potato extract, 20 g glucose, 10 g peptone, 1.5 g KH2PO4, 0.5 g MgSO4, 20 mg vitamin B1 and 1,000 ml distilled water; solid PPDA medium should add 15% agar in liquid PPDA medium) at 13°C (Liu *et al*., 2019).

Insect Rearing

The pupae of *O. sinensis* host insects from 3,500 to 4,000 m altitude mountains and housed in plastic containers (L = 50 cm; W = 40 cm; H = 30 cm) with moist moss *Rhizomnium* spp. at 9–17°C and 50–80% relative humidity. When the adults emerged, they are housed in equal proportions of males and females in small mosquito cages for mating (L = 104 cm; W = 50 cm; H = 50 cm). The laid eggs from the mated females have to transferred to a culture room and maintain at 9–13°C to obtain the larvae for fungal infection.

Fungal Infection of Insect Larvae and Stroma Cultivation

The harvested blastospores have to dilute with sterile PBS buffer solution. An aliquot of 4 µl blastospores suspensions has to inject into each 6^{th} instar larva by the microinjection system. The injected larvae have to rear at 4°C for 1 wk and then transfer to a culture room at 13°C until the larvae became stiff and coat with growing mycelia. The mummified larvae then planted head upwards into soil at 55–60% relative humidity to induce the formation of stroma at 4°C.

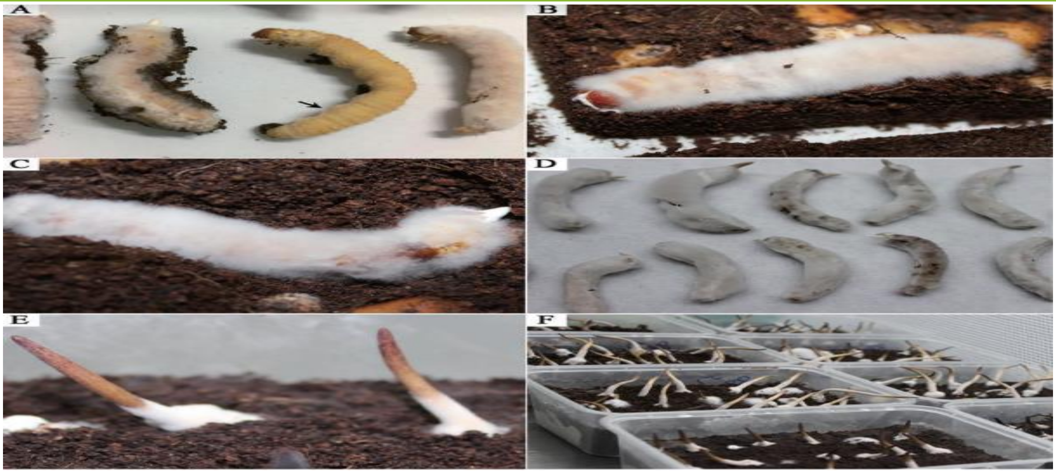

Figure 2. Stromatal induction from the mummified T. xiaojinensis larvae after O. sinensis infection in the laboratory (Liu et al., 2019)

We are fortunate that we live in an age of such rapidly expanding biotechnological progress, for now we have ways at our disposal to produce *Cordyceps* in large enough volume and at a low enough cost that research becomes possible to nearly anyone interested in looking at this unique organism. As time passes, we may find that this once rare fungal species may hold the key to controlling some of our more difficult-to-manage diseases. It is clear from literature that we know only a little of the wonders of these strange *Cordyceps* creatures. *Cordyceps* still has many secrets in store for us. More research is needed on these and other species of medicinal mushrooms.

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Zebra-like Stripe Painting on Cow: A Method to Control the Disease-Causing Biting Flies Menace

Article ID: 10662

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Introduction

Zebras are several species of African equids united by their distinctive black-and-white striped coats. Their stripes come in different patterns, unique to each individual. They are generally social animals that live in small harems to large herds. Unlike their closest relatives, horses and donkeys, zebras have never been truly domesticated. Wallace suggested that zebras evolved striped coats as camouflage against carnivores in tall grass. Darwin criticized this hypothesis as an explanation, as zebras do not occur. Many functional hypotheses on the striped pattern of zebras were generated in scientific researches, such as camouflage, confusion of predators, signalling to conspecifics, thermoregulation, and avoidance of biting flies (Caro, 2016). Several experiments now show that zebra stripes protect against biting flies, which is one of these theories. The phylogenetic distribution of body stripes is correlated with tabanid fly distributions at the species and subspecies level, according to Caro *et al.* (2019) Furthermore, Egri *et al*. (2012) demonstrated that tabanids resist landing on black-and-white surfaces such as trays, boards, balls, and buckets in an experiment. Moreover, Caro *et al*. (2019) demonstrated that tabanids flies are far less likely to land on striped cloth coats than on black or white coats when placed on horses. In contrast, the other hypotheses such as camouflage, confusion of predators, social interaction, and heat management have not been supported by researchers (Caro, 2016).

Biting flies are the most damaging arthropod pests of cattle worldwide and the economic impact of biting flies on the United States cattle production was estimated at $2,211 million per year (Taylor *et al*., 2012). Because of the economic loss associated with this pest, cattle owners have primarily used insecticidal control measures (Oyarzun *et al*., 2005). However, insects often evolve resistance to a new pesticide within about a decade after its introduction (Palumbi *et al*., 2001). In fact, biting flies reduce grazing, feeding, and bedding down time of cattle and increase fly-repelling behaviours (e.g., head throwing, foot stamping, skin twitching, and tail flicking) and this can reduce weight gains in feedlot beef cattle and milk yield in dairy cows (Mullens *et al*., 2006). So that cows painted with black-and-white stripes on their body could avoid biting fly attacks and decrease their fly-repelling behaviours. This may be an alternative environmentally friendly practical method of controlling biting flies without the use of pesticides in animal production.

Why do Black-And-White Stripes Deter Biting Flies from Landing on Surfaces?

Modulation brightness or polarised light have been proposed as explanations for this phenomenon (Egri et al., 2012). Even though stripes did not deter tabanids at a distance (Caro et al., 2019) discovered that tabanids reached their target faster and failed to decelerate in the terminal stages of their flights before contacting zebra surfaces. A similar explanation is confusion of insect motion detection systems that control their approach and landing [50]. Future research that improves our understanding of this process, however, will be needed to back up these hypotheses.

Materials and Methods

To make the black and white stripes, use commercial waterborne white lacquers. Striping with waterborne lacquers (NIPPONPAINT Co., Ltd's Color Spray BASIC) fades quickly (in a few days). The paint the stripes can draw by freehand in width of approximately 4–5 cm. Painting stripes on cows required approximately 5 minutes/individual.

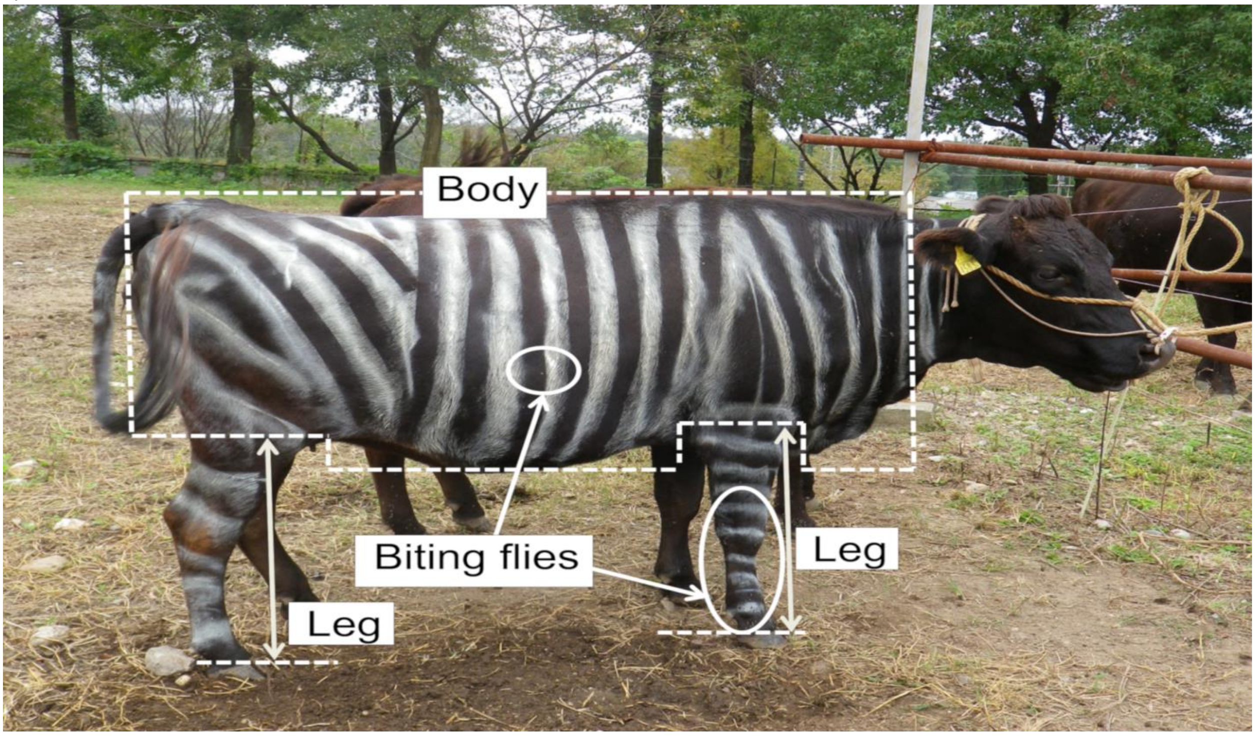

Figure 1. Cows painted with zebra-like striping can avoid biting fly attack (Kojima et al., 2019)

Kojima et al., (2019) observed the effects of black-and-white stripe painting on biting fly attacks on Japanese Black cows with an all-black body colour. The total numbers of biting flies on legs, body, and the sum of legs and body for black and white cows were almost half those on black cows.

He also found that black-and-white painted cows had the lowest fly loads, which may have resulted in more skin twitches compared to that of non- painted cows. Hence, painting black-and-white stripes on the surfaces of domestic animals such as cattle provides an alternative method to the use of pesticides for defence against biting flies and is also a method for controlling pests that is beneficial to the environment and human health.

Painting is a cheap, easy, and animal welfare friendly method to mark animals. However, painting is usually considered a short-term marker, which can persist from a few weeks to several months. Therefore, in the future, the development of more effective techniques to ensure the persistence of black-and-white stripes on livestock during the biting fly season (3 to 4 months) may be necessary in order to apply this method to animal production sites.

Conclusion

Biting flies are serious livestock pests that cause economic losses in animal production. The painting zebra-like stripes on domesticated cows will avoid biting fly attacks and reduce the incidence of biting flies landing on individuals by 50 per cent.

The paintings zebra like stripes can be used as an alternative to the use of conventional pesticides for mitigating biting fly attacks on livestock that improves animal welfare and human health, in addition to helping resolve the problem of pesticide resistance in the environment.

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Virgin Coconut Oil Characteristics Feature and Important

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Introduction

Coconut an important plantation crop belongs to family arecaceae. It is cultivated in more than 93 countries in the world with an area of 12 million hectares. Ten million people in India depend on coconut for their livelihood either directly or indirectly. Copra, oil, coir fiber and tender nuts are the major traditional products of coconut. Coconut farming gradually becoming non-profitable enterprises due to frequent fluctuation of prices, higher input costs, labours etc. To make coconut cultivation profitable attempts were made for maximizing the returns per unit area through value addition. In recent years, value added products like virgin coconut oil, desiccated coconut, vinegar, beverages, Neera, Jaggery, and milk-based coco sap sweet, handicrafts, shell powder, shell charcoal and activated carbon can also be prepared which are having high domestic and international demand. Virgin Coconut Oil (VCO), a rich source of medium chain fatty acid (e.g., Lauric acid) is also being used as food ingredient in functional foods due to its beneficial effects on human health and nutrition and is off great demand. In West Bengal coconut is grown in an area of 30820 ha with a plant population of 54.55 lakh. If 1% of the total plants of the state are used for VCO production then on an average 2182 litres of VCO can be produced from 54550 palms in a year with an economic return of Rs10, 91,000. From 1 ha area of plantations on an average 9897 number of nuts can be produced where from 396 Liters of VCO can be produced with a return of Rs197940/ha/year(@Rs500/liter). As a result, production of Virgin Coconut Oil will not only benefit the coconut farmers by uplifting the economic status but also will directly reflect on the GDP.

What is Virgin Coconut Oil (VCO)?

1. Virgin coconut oil (VCO) is defined as the oil resulting from the fresh and mature kernel of the coconut through mechanical and natural means, either with the use of heat or not provided that it does not lead to alteration or transformation of the oil (APCC, 2003).

2. It is (VCO), a rich source of medium chain fatty acids (like Lauric acid, capric acid, caprylic acid, and caproic acid) is being used as food ingredient in functional foods due to its beneficial effects on human health and nutrition. It is called “Virgin” because the oil obtained is pure, raw and pristine.

Chemical Properties of Virgin Coconut Oil

VCO, which is extracted directly from coconut milk by a wet process under controlled temperature conditions, VCO has a rich content of medium chain fatty acids (MCFAs), predominantly lauric acid; others include caproic acid, caprylic acid. As reported by(Mansor et al.,2012) the concentrations of SFA and total unsaturated fatty acids ranged from 28% to 31% and 6.73% to 8.13%, respectively. In the 1920s and 1930s it was discovered that coconut oil differed from other fats and oils in that it was found to be composed predominantly medium chain triglycerides. The composition of Fatty acids in VCO as determined by Gas Liquid Chromatography include. VCO is colorless, free of rancidity and has a specific fresh natural coconut aroma and the specifications which should meet by the Virgin Coconut Oil. Saturated acid mainly content lauric acid 45%-52%, myristic acid content 16% - 21%, plamitic acid 7%-10%, caprylic acid 5%-10, and unsaturated fatty acid content oleic acid 5%-8, linoleic acid 1%-3%.

Characteristics Feature

1. Virgin coconut oil is abundant in vitamins, minerals, and anti-oxidants, thus making it the mother of all oils.

2. Extracted from fresh coconut kernel without any chemical processes, it is the purest form of coconut oil, water white in color.
3. Virgin coconut oil is a major source of lauric acid and vitamin E.
4. The virgin coconut oil is free from trans fatty acid, high in medium chain fats or medium chain triglycerides is known as lauric acid.
5. VOC is widely consumed as MCT oil for weight loss treatment, etc.
6. Supplement your body with antioxidants. Antioxidants is your body's natural defense against free radicals.
7. High quality of this oil makes it an ideal massage oil babies and also for skin and hair applications.

Medicinal Important

Anti-Inflammatory Properties of VCO Inflammation is a protective response of the immune system against pathogens, but can also result to damaging consequences if not regulated. The complex immune processes and mediators involved in the inflammatory response can induce and aggravate many diseases.

Antioxidant and Anticancer Benefits

A group of compounds that include tocopherols and tocotrienols. Coconuts have been shown to have modest tocopherol and tocotrienol concentrations of 0.07, 0.79, 0.18, and 1.04 mg/100 g. Regarding potential anticancer properties, developed tocopherol-rich nano emulsions which were shown to possess anticancer activity.

Virgin Coconut Oil May Lower Cholesterol Levels

VCO has a rich content of MCFAs consisting of caproic acid, caprylic acid, capric acid, and lauric acid. It contains high amount (65%) of medium chain triglycerides (MCTs). These MCTs are directly absorbed from the intestinal tract and sent directly to the liver and doesn't participate in the biosynthesis and transport of cholesterol (Enig,M.G.et al., 1999) and, thereby provides a quick source of energy. As a result, VCO was found to be effective against cholesterol levels. VCO was found to reduce the total cholesterol, triglyceride, phospholipid, and LDL, and increase the HDL in the serum and tissues.

Bone Loss Prevention

In one study, it was shown that VCO effectively improved bone structure and prevented bone loss in osteoporosis rats and this effect can be attributed to the polyphenols present in VCO (Mohamed, N et al.,2012). Further, VCO showed a significant improvement in the bone antioxidant status by preventing lipid peroxidation.

Antimicrobial Property

VCO has a long history of use as an antibacterial agent. A history of safe topical use of VCO against infections. VCO contains high quantities of MCFA like lauric acid, caproic acid, and caprylic acid; studies have shown that these MCFA are responsible for its antibacterial, antifungal, antiviral, and properties (HipSeng,Y.et al.,2010).

Important of Food and Cosmetic Industries

VCO has a wide array of uses, which can be classified as either edible or inedible categories.

Edible Applications:

a. VCO serves as an important source of energy in diet.

b. VCO is used as cooking and frying oil due to its exceptional resistance to rancidity development, and it enhances the flavor of food. (Bawalan, D.D., et.al.,2006)

c. Due to its nature of unchanging palatability, VCO is used as a substitute forbuttermilk in filled milk, filled cheese and ice cream.

Inedible Applications:

a. It is used as a skin and hair conditioner.

b. Aromatherapy and massage oils.(Songkro, S.et al., 2010).
c. Oil base for a variety of cosmetic and skin care products.

Health Benefits of VCO

VCO is the only naturally available low-calorie fat:

1. VCO boosts the immune system and protects humans from atherosclerosis and cardiovascular disease. (Fife, B. et al., 2004).
2. Digestion of VCO takes place easily without the need for bile.
3. VCO stimulates metabolism and prevents obesity.
4. It also inhibits cancer causing agents.
5. It increases the absorption of vitamins, minerals and amino acids.
6. VCO has the potential to prevent exercise and chronic cold restraint stress-induced damage and restores the antioxidant balance.
7. The presence of polyphenols and medium-chain fatty acids in VCO imparts antistress activity.
8. Wound-healing rate was increased in skin of rats treated with VCO.
9. VCO was also used as an 'ethnomedicine' to treat gastrointestinal problems and minor cuts, injuries and swelling. (lans et al.,2007).
10. Effective and safe as mineral oil when used as a moisturizer for mild to moderatexerosis.
11. Dried-and fermented-processed VCO has hepatoprotective property.
12. Has anti-oxidant activities and does not adversely affect serum lipid levels. (Dosumu, O.Oet al., 2012).
13. VCO displayed inhibition of Candida sp. responsible for fungal infection.
14. The fatty acid present in VCO acts as a potential immunostimulant, which increases immunity through the increase of lymphocyte and Th-CD4 in chickens vaccinated against Avian influenza virus.

Important by Product During Processing of Virgin Coconut Oil

VCO meal is the by-product of the vco process based on coconut milk. The residue represents approximately 25-50% of the weight of freshly grated meat on a wet basis, depending on the coconut milk extraction process used. The vco meal usually retains about 35-40% of the original oil content of the fresh coconut meat and is very rich in dietary fiber (about 32%).

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Weed Utilization: As a Bio-Resource

Article ID: 10665

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Introduction

Among the conservative estimate of 2,50,000 flowering plants in the world, more than 8000 species are weeds. They are widespread unwanted plants which pose significant threat to ecosystem worldwide. According to Convention on Biological Diversity (1992) "biological invasion of alien species is the second worst peril after habitat destruction".

They cause immense menace both ecologically and economically as they interfere with agricultural productivity, forests, natural ecosystems and human health. In agriculture, these plants compete with crop plants for available resources, lower quality of agricultural produce, pastures and increases cost of production.

In India, weeds are estimated to cause 30% loss in potential crop production worth about US $90 billion per year in reduced crop yields. At least 50 species of them have been shown to interfere with crops through allopathic secondary compounds.

They generally have a negative connotation like effects on crop production and human health but many have beneficial properties that have usually being overlooked. Their chemical constituents and essential oils show extensive range of pharmacological activities suggesting their role as chemotherapeutic agents.

They have inherent tolerance to various adverse environments notably their endurance to climate change and other stresses including heavy metals. Therefore, besides being used as bio-resource they can also be used as management tool.

Weeds as Pharmaceuticals

Global demand for herbal medicines is growing day by day and more than 80% of developing world rely on traditional medicines manufactured predominantly from plants being cheaper and without any side effects. Some weed plants are rich source of many natural products most of which have been extensively used for traditional human health care systems viz. Ayurveda, Unani and Siddha.

They have biologically active compounds that have been shown by generations to be effective against specific disorders. In India, about 2000 drugs are of plant origin and 120 weed species provide the raw materials to the pharmaceutical industries. Rural communities use weeds as medicine as they are less vulnerable to disease and insect attack. Weeds are relatively high in bioactive secondary compounds and are thus, likely to hold promise for drug discovery. Several weed plants contain alkaloid, terpenoid and cardiac glycoside compounds which are used as weed pharmaceuticals.

The biggest challenge in the production of medicines from weed plants is to obtain the quality, efficacy, safety and reproducibility. So, there is need of a tool to standardize the weed product from different bathes.

Utilization of Aromatic Weeds for Essential Oils

Some species of weed plants produce essential oils which are complex mixture of terpenes (mono-, sesqui- and sometimes even diterpenes) and their oxygenated derivatives. These essential oils can be used in flavor, fragrance, cosmetic and pharmaceutical industries. Along with essential oils and aromachemicals, certain aromatic weeds also produce secondary metabolites of aromatic and medicinal significance. Hence, utilization of aromatic weeds for essential oils can be a sustainable approach to the problem being created by weeds to the environment, agricultural economics and natural ecosystem. The main limitation of essential oils obtained from weed plants is of their internal use due to toxicity issues.

Weeds as Metal Hyper Accumulators

Compared with crops, weed species have inherent tolerance to various adverse environment conditions notably their endurance to drought and other stresses including heavy metals. Moreover, weed species are of quickly growing nature, produce huge biomass, thrive well in disturbed habitats and need no special environmental requirements for growth.

They also have an inherent capacity to uptake metals at levels 50–500 times greater than average plants. Further, they show resistance to herbivores so restrict the contaminants from being introduced to the food chain. These plants have intrinsic capacity to accumulate metals into their shoots and roots, have the ability to form phytochelates and stable compound with ions.

This behaviour of accumulation along with formation of chelate and stable compounds can be utilized as a tool for phytoremediation activity in metal contaminated sites. However, the main barrier for commercial implication of phytoremediation is the safe disposal of huge quantity of metal laden biomass. Therefore, further treatment of this biomass is necessary.

Weeds as Low-Cost Adsorbent

Various organic and inorganic contaminants discharged from industrial, residential and commercial sources degrade the surrounding ecosystems. Weed plants has attracted significant attention as bio sorbent due to their extremely rapid proliferation, massive growth, renewability, high biosorption capacity and low cost.

They exhibit an amazing ability to absorb and concentrate many toxic metals from the contaminated environments. Further, they have various functional groups that can bind heavy metal ions like hydroxyl, amino, carboxyl, phosphate, sulfonate and ether. The main technical challenge to use untreated weed biomass as sorbent is release of its soluble organic compounds.

Weed Species as Biofuels and Bioenergy

Due to greater awareness of climate change, global energy sector is trending toward incorporation of increasing amounts of renewable energy of which bioenergy is a growing component. Weed plants can be used as a potential renewable energy source as it is not possible to fully eradicate them in the fields and their large-scale utilisation can represent one of the best strategies for their management.

They are non-conventional crops on wastelands with minimum inputs and potential traits for biofuels like high productivity, low input requirement and wide habitat range. So, in response to the economic and environmental incentives for low-input biofuel crops and the desire to prevent future invasions, we can use weed plants as leading candidates for biofuel production.

Use of Weed Biochar in Soil Amendment, Carbon Sequestration and Biosorption

Preparation of biochar from weed biomass and its employment in soil amendment, biosorption and carbon management is a sustainable weed management strategy. Besides storing carbon in soils, it also improves its quality. Further, pyrolytic conversion of weed biomass to biochar destroys allelochemicals present in weed plants which otherwise may disturb the growth and establishment of crops.

Its use for soil improvement is promising due to large surface area, presence of numerous micropores which provide microhabitat for beneficial soil microorganisms, high organic carbon content, high moisture and enhanced nutrient adsorption. Significant increases in seed germination, plant growth, crop yields along with increased microbial population and microbial activity in soils amended with biochar.

Organic and Inorganic pollutants exert toxic effect to ecosystem if they move through soils and leach into groundwater. However, weed biochar can act as an efficient sorbent. It can potentially be used as green environmental sorbent to reduce the bioavailability and leachability of heavy metals and organic pollutants in soils and water, Addition of biochar to soil enhances its cation exchange capacity (CEC) and reduces nitrogen losses.

Thus, improved nitrogen use efficiency reduces greenhouse gas emission. Weed biochar is highly heterogeneous material with diverse range of properties which govern its biogeochemical interactions inside soil environment in conjunction with agronomic and environmental impacts.

Hence, the major concern that needs to be address before using weed biochar in soil amendment, biosorption and carbon management is to study its long-term effects on ecosystems and human health.

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Impact of Covid-19 on Demand of Organic and Sustainable Food

Article ID: 10666

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Introduction

As Covid-19 continues to spread, consumer purchasing patterns and more importantly priorities are changing. Some farmers are seeing an uptick in demand for certain products, while others have to dump their agricultural outputs due to a glut of demand.

Currently, consumers are taking a closer look at their health and with no vaccine in sight, if there is one area where the corona virus pandemic is causing massive rethinking is what to eat, where we get our food from. There is a growing awareness regarding the health benefits of a natural, balanced diet which is boosting the demand of organic, sustainable foods as ammunition against Covid-19.

As people are searching for healthy food to feed their families, organic fruits, vegetables, pluses, cereals etc are providing to be the food of choice for home, organic foods are composed of the natural and organic ingredients that are cultivated as per standards of organic farming.

The World Organic Agriculture report of 2020 notes that organic agriculture is practiced in 186 countries and 71.5 million hectares of agricultural land are managed organically by approximately 2.8 million famers. India has highest number of organic producers in 2018.

The size of the Indian organic food market remains relatively small, at around $250 billion global organic food market. the cultivation of organic agriculture is growing around the world, rising to 50.9 million hectares in 2015 from around 11 million hectares in 1999.

Some Indian states like Sikkim have taken the lead in converting their produce to organic cultivation and while still unorganized estimates suggest that Indian organic agriculture is growing at 25% a year. The corona virus pandemic has led to surging demand for organic and sustainable foods.

What is Driving Interest in Organic Food?

1. Covid-19 is raising consumer awareness of relationship between nutrition and health. This has resulted in a surge in interest in products that benefit from 'health halo' including functional foods, fruits and vegetables.

2. Whenever there is a food scare or health scare, consumers look at disease prevention and improving nutrition. Organic food gets a sale boost as they perceived to be healthier and safer than conventional foods.

3. Organic foods avoid synthetic pesticides and agro-chemicals and are therefore considered to have less harmful chemicals than conventional foods. Organic foods have more nutrients than conventional foods.

4. In the current corona virus crisis, consumers are looking to boost their personal immunity. They are spending more on organic foods, plant-based foods, nutritional supplements, etc. The price premium is not so important when consumers are looking to improve their overall health and look at disease prevention.

Demand Boost Leads to Supply Challenge

1. The challenge is to maintain supply when demand increases. In particular Covid-19, international supply networks for organic products under pressure. As raw materials used by European and North American organic food companies are produced in Asia, Latin America and Africa.

2. The organic food industry is prone to supply-demand swings. Since, there is a conservation period for organic farming practices, so, it is not easy to increase supply of organic products. It is therefore common to see demand

surges which lead to supply shortages. When supply eventually increases, demand can sometimes taper off. This has been a major issue for organic products which have experienced under supply, overproduction and then under supply.

Challenges of Post Covid-19

1. Food safety is more important in food supply chain.
2. To provide quality and nutritious food to enhance immunity with minimum price.
3. Nutritional labelling of package food for restaurant and other business.
4. Preventive controls and food supplier verification.
5. Social distancing in human and animal food and feed sector as a part of the essential critical infrastructure workforce.
6. Sanitization factors.

Opportunities and Strategies for Re-Orienting Agriculture in Post Covid-19

1. Strengthening of local food chain: Local supply chain development requires collaborative support from across the sector including government, local authorities, NGOs, farmers, growers and consumers.
2. Family farming: The current pandemic has exposed the fragility of food systems, but highlighted the importance of organizing small and medium farmers, family farmers- to collectively face the challenges of feeding the world.
3. Quality food consumption and healthy diet for better immunity: Eating healthy and nutritional food affect our body's ability prevent, fight and recover from infections.
4. Adoption of GMP/GAP: Adoption of Good Manufacturing Practices or Good Agricultural practices can help to improve quality, packing, handling as possible to minimize risks of microbial food safety hazards.
5. Organic food: Organic food often have more beneficial nutrients, such as antioxidants than their conventionally grown foods.
6. Re-orientation of concept of health, care, economy
7. Training for safety of farmers, food workers and food production systems
8. Tech-driven solution: This pandemic has triggered an unprecedented demand for digital health technology solutions and revealed successful solutions such as for population screening, tracking the infection, prioritizing the use and allocation of resources and designing targeted responses.

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Senescence: Death Regulation Mechanism in Plants

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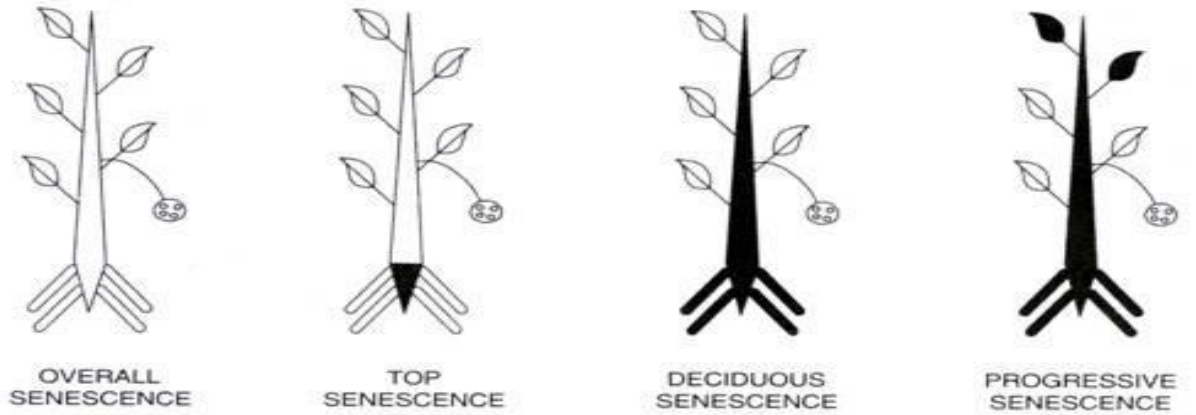
Introduction

Like human beings, plants a1so grow old and undergo aging and then they die. Aging is the sum total of changes in the total plant or its organs. During aging, the plants undergo chemical and structural changes. Aging leads to senescence and later phase of development that u1timately terminates to death.

Plant senescence is the process of aging in plants. Plants have both stress-induced and age-related developmental aging. Chlorophyll degradation during leaf senescence reveals the carotenoids and is the cause of autumn leaf color in deciduous trees. Leaf senescence has the important function of recycling nutrients, mostly nitrogen, to growing and storage organs of the plant. Unlike animals, plants continually form new organs and older organs undergo a highly regulated senescence program to maximize nutrient export.



The deteriorative process which naturally terminates the functional life of an organ, organism or other life unit is collectively called senescence. Senescence is a phase of the aging process. The major characteristic of senescence is that the metabolic processes are catabolic and eventually become irreversible and terminate to death. Senescence is not confined only to whole plant. It may be limited to a particular plant organ such as leaf and flowers or cells or cell, organelles. Senescence is closely associated with the phenomenon of aging. Aging leads to senescence. Wheat plant dies after the development of fruit. This is the senescence of an entire plant. Leaf fall in a coconut tree is an example of senescence. Types of senescence Leopold (1961) has proposed types of senescence patterns in plants which are as follows.

1. Overall Senescence: This type of senescence occurs in annuals where whole plant is affected. It is also called whole plant senescence. The entire plant dies after the development of fruit and seeds. E.g., Paddy, wheat, soybean etc.

2. Top Senescence: In top senescence, the parts remaining above the ground or (shoot system) may die, but the root system and underground system remain viable. It is also called shoot senescence. E.g., Dock, perennial herbs.

3. Deciduous Senescence: In deciduous woody plants, all the leaves die but the bulk of the stem and root system remains viable. It is called deciduous senescence or simultaneous or synchronous senescence. E.g., Leaf fall in deciduous trees.

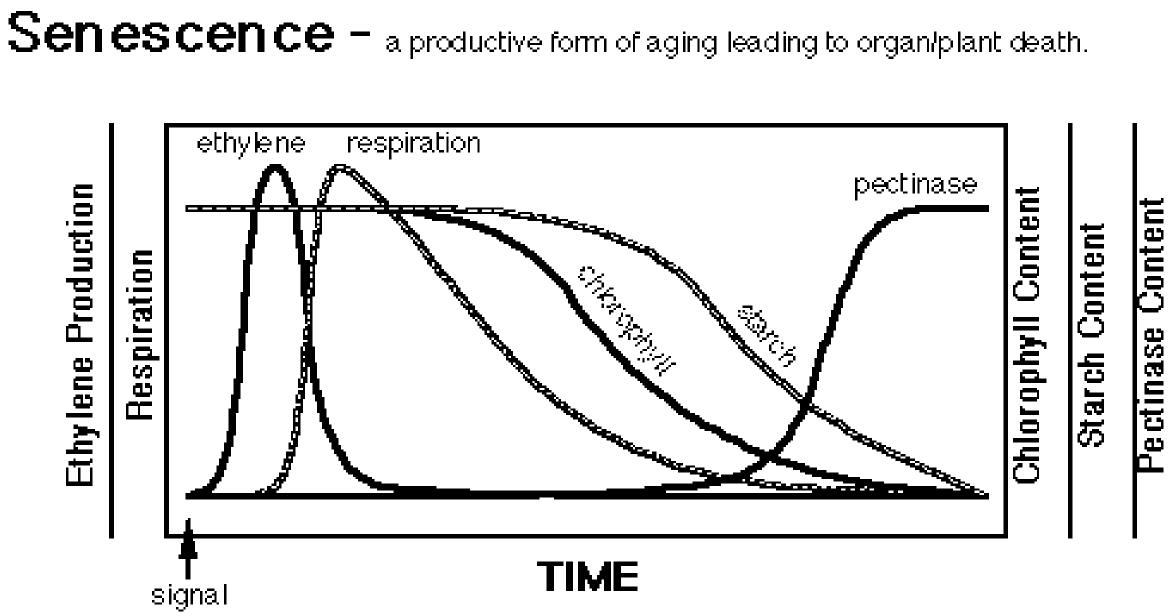
4. Progressive Senescence: It is a gradual death of old leaves from the base to the top of the plants. It may occur at any time. It is also called sequential senescence. E.g., Leaf fall in a coconut tree.

Causes of Senescence

1. Leaf senescence is accompanied by early loss in chlorophyll, RNA and enzymes.
2. Cellular constituents are decreased due to slower synthesis or faster break down.
3. Competition between vegetative and reproductive organs for nutrients.
4. A senescence factor (a hormone) is produced in soybean fruits that move to leaves where it causes senescence.
5. Short-day and long-night conditions induce flowering and leaf senescence.
6. Degradation of food reserves and loss of integrity in food storage cells of seeds.
7. Senescence is also hormonally controlled.

Physiology of Senescence

The following physiological changes occur during senescence:
1. Photosynthesis stops.
2. Chlorophyll degradation: The colour of leaf changes from green to yellow.
3. Anthocyanin pigments accumulation in the leaves causing reddening in leaves.
4. The vacuoles function as lysosomes and digest the cellular materials.
5. The starch content decreased.
6. RNA and proteins are decreased.
7. DNA molecules are degraded by the enzyme DNase.
8. Growth promoting hormones such as cytokinin decrease.
9. The deteriorative hormones such as ethylene and abscisic acid (ABA) content are increased.

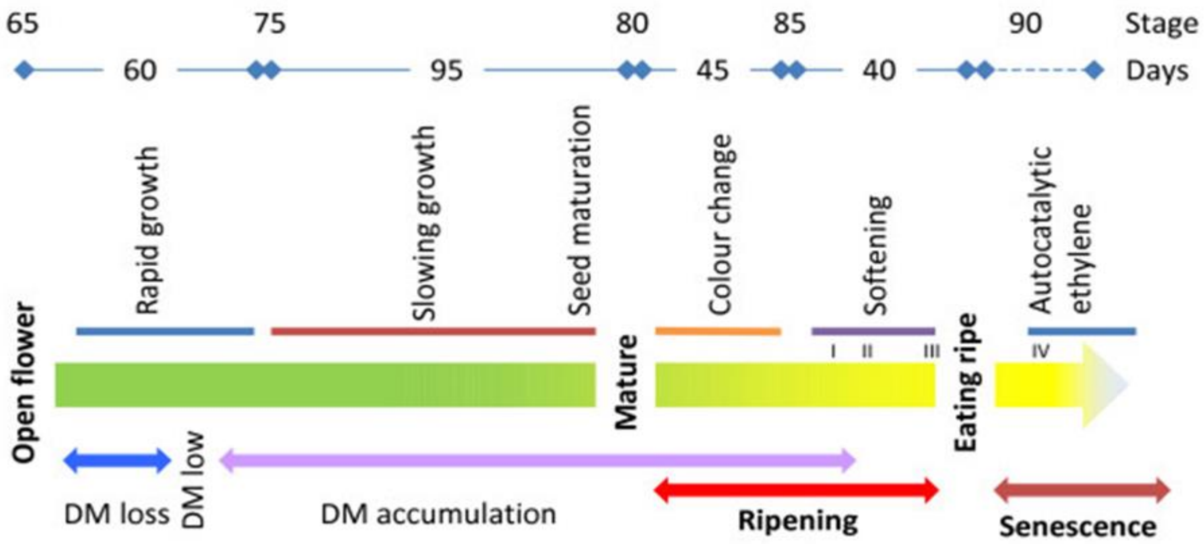


Senescence Promoters

Senescence is promoted by hormones such as abscisic acid and ethylene. The senescence accelerating ability of abscisic acid is well documented. The function of ABA as a promoter of flower tissue senescence including initiation of colour fading or bluing has been established.

The ABA content of aging leaves increases markedly as senescence is initiated. Ethylene plays a very important role in the senescence of certain plant parts, particularly fruit and petals and in the abscission process. It is an inducer in the senescence of flower tissue. Senescence Retardants: The primary plant hormones involved here are auxin, gibberellin and cytokinin.

Significance of Senescence



1. The whole plant senescence occurs in monocarpic plants coinciding the seed setting and seed dispersal.
2. Due to the formation of abscission layer, the older leaves tend to fall down so that the nutrients will be diverted to the next young leaf.
3. The senescence process helps the mobilization of nutrients and of the vegetative parts of the plant into the fruits.
4. Plants escape the influence of seasonal adversity by undergoing senescence of its organs. Leaf fall in deciduous trees reduces the rate of transpiration to survive under adverse conditions.

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Value Addition of Indian Aloe

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Aloe vera is common name of Indian aloe and belonged to the family Liliaceae. *Aloe vera* (L.) Burm**.** economic part is succulent leaves. It grows mainly in dry regions of Asia, Africa, America and Europe. In India, it is found in Maharashtra, Andhra Pradesh, Madhya Pradesh, Utter Pradesh, Gujarat, Rajasthan and Tamil Nadu (Richard LW., 2005). Cosmetics and some medicinal products are made from the mucilaginous tissue at the centre of the *Aloe Vera* leaf and are called *Aloe Vera* gel. This gel is a clear, tasteless, thin, jelly like material. The other part of the plant is a group of specialized cells known as the pericyclic tubules. They occur just beneath the outer green rind of the leaf. These cells produce exudates that consist of bitter yellow latex with powerful laxative-like action (Richard LW., 2005). Aloe vera show laxative effect due to presence of anthraquinone. It has also been reported to have moisturizing and anti-aging effect along with anti-septic and anti-diabetic effects (Eshun K. 2004). Aloe vera contains polysaccharides which increase the insulin level and show hypo glycaemic properties (Eshun K. 2004).

Harvesting of Aloe Leaf

Crop is ready to harvest after 18 months of sowing. The plants can be harvested every 6 to 8 weeks by removing 3 to 4 leaves per plant. To avoid bio-degradation the Aloe vera leaf is harvested and pulled carefully from the mother plant so as not to break the rind. The plant can be removed manually. Crop is ready to harvest after 18 months of sowing. Economic yield is obtained up to 5 years, after that it needs replanting. In India, the average yield for organically grown aloe is about 12 tonnes/ha (Husain 1993, Farooqui and Khan 1993).

Post-Harvest Management

Immediately after harvesting the Aloe leaves should be processed within a couple of hours so as to prevent oxidation (Rajeswari R. et al. 2012). The Aloe leaf consists of three layers.

1. The outer thick green rind.
2. Viscous, jelly-like mucilage layer into which the vascular bundles, attached to the inner surface of the rind.
3. The fillet consisting of hexagonal structures containing the fillet fluid. The pericyclic cells located at the top of the vascular bundles contains the "Yellow Sap" or "Latex". This sap is rich in aloin and similar anthraquinones having laxative properties.

Aloe leaves are processed either by the traditional hand filleting method or by whole leaf method.

Traditional Hand Filleting Method

This method was used to avoid possible contamination of the fillets with the yellow sap. In this method, the lower one inch of the leaf base (the white part attached to the large rosette stem of the plant), the tapering point (2-4) of the leaf top, and the spines located along the leaf margins are removed by a sharp knife. The knife, is then introduced into the mucilage layer below the green rind avoiding the vascular bundles and the top rind is removed. The bottom rind is similarly removed, and the rind parts, to which a significant amount of mucilage remains attached, are discarded. Another portion of the mucilage layer accumulated on the top of the filleting table is of critical concern because of the highest concentration of potentially beneficial aloe constituents in this layer. The materials of the mucilage layer, subsequent to their synthesis, are distributed to the storage cells (cellulose reinforced hexagons) of the fillet which is extracted in this process. The hand-filleting method is very labour intensive and therefore machines have been designed and employed which attempt to simulate the Hand-Filleting technique.

Whole Leaf Method

In the whole leaf method, the base and tip are removed as previously delineated and then the leaf is cut into sections and ground into particulate slurry. The material is then treated with chemicals which break down the hexagonal structure of the fillet releasing the constituents. These constituents are filtered by means of a series of course and screening filters, or passage through a juice press to get rid of the rind particles. The expressed juice is passed through various filtering columns which remove the undesirable laxative agents. This process, performed properly, can produce a constituent rich juice, virtually free of the laxative anthraquinones.

Value Additions

In addition to pharmaceutical importance, Aloe Vera is widely used in food beverage and cosmetic industry. In the food industry, Aloe is being used as an ingredient for functional foods, mainly as food supplements the development of health drinks, desserts and beverages. In the recent past, the plant has emerged as an important commercial item.

Major value-added products from Aloe are:

a. Aloe gel: is the pulp of the leaf. It is the new wonder an ageing agent. Gel is widely used in various medical, cosmetic and nutraceutical applications. Aloe Vera gel is used as an ingredient in commercially available yogurt, beverages and some desserts.

b. Aloe juice: is obtained by homogenizing and diluting the gel. The Aloe products are widely adopted as main ingredients in cosmetic and hair care products. Large numbers of Aloe containing beauty products, creams, lotions, soaps, shampoos, oils, facial cleaners, moisturizers, etc. are available worldwide. International Aloe Science Council (IASC), a non-profit organization certifies Aloe Vera products by measuring total solids, calcium, magnesium, malic acid and polysaccharide content.

Fig1: Preparation of aloe gel

Fig2: Preparation of aloe juice

Conclusion

The leaf of Aloe vera plant contains biological active compounds, which needs careful harvesting and handling. There seems to be ever-decreasing doubt that aloe gel has genuine therapeutic properties, certainly for healing of skin lesions and perhaps for many other conditions. It is also clear that the subject is by no means closed and much needs to be discovered, both as to the active ingredients and their biological effects.

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Flower Production of Marigold in Western Uttar Pradesh

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The Marigold (*Tagetes spp.*) is a native of Central and South America especially Mexico, and belongs to family Asteraceae is one of the most commonly grown loose flower and use extensively on religious and social functions in different forms.

African Marigold flowers has attractive range of colours for a considerably prolonged period and the flowers can be kept remarkably well when cut. In India marigold is one of the most commonly grown flowers and used extensively on religious and social functions in different forms. Because of their ease in cultivation, wide adaptability to varying soil and climatic conditions, long duration of flowering and attractively coloured flowers of excellent keeping quality, the marigolds have become one of the most popular flowers in our country.

Marigold is one of the oldest cultivated ornamental plants, being very popular in tropical and sub-tropical region of the country as a garden plant for beautification. Marigold are grown as landscape plants due to its variable height and various colours of flowers. It is highly suitable as a bedding plant, in herbaceous border and is also ideal for newly planted shrubbery to provide colour and fill spaces.

French Marigold is ideal for rockeries, edging, hanging baskets and window boxes the use of plant growth substances has been found to be of great significance in the commercial cultivation of many ornamental crops.

Species and Varieties

There are about 33 species of the genus Tagetes. Important spp. Are:

1. African Marigold *(Tagetes erecta)*. 2n=2x=24 (diploid).
2. French Marigold *(Tagetes patula)*. 2n=2x=48 (tetraploid).
3. Single signet Marigold *(Tagetes tenuifolia)*. 2n=2x=24 (diploid).
4. Sweet scented marigold *(Tagetes lucida)*. 2n=2x=22 (nulisomic).

Tagetes erecta and *Tagetes patula* are commercially grown in india.

Marigold *(Tagetes erecta)*

African Marigolds are generally tall in nature (up to 90 cm) with large sized double globular flowers of lemon, golden yellow, yellow, primrose, orange or bright yellow colours. The important varieties are. Pusa Narangi Gainda, Pusa Basanti Gainda, Cracker Jack, Climax, Golden Age, Golden Jubilee, River Side, Chrysanthemum Charm, Crown of Gold, Alaska, Apricot etc.

French Marigold *(Tagetes patula)*

French Marigolds are generally dwarf in nature, (30-40 cm) early- flowering and compact with dainty single or double blooms, the colour of flowers is: yellow, golden yellow, orange, rusty red or deep scarlet. The plant are hardy and bushy type and leaves are dark in colour. The important varieties are: Red Borcade, Rusty Red, Butter Scotch, Valencia, Bolero, Burpees Gold, Nugget, Disco Red, Lemon Drop etc.

Climate and Soil

The marigolds are hardy and can be successfully grown in different types of soils and climate. Mild climate during growing period (14.5° - 28.6°C) greatly improves flowering while higher temperature (26.2° - 36.4°C) adversely affects flower production. Depending on environmental condition, Marigold can be successfully cultivated on a wide variety of soil. The French marigold grows best in light soil while the African marigold requires a rich, well-manured and moist soil. However, the soil is deep fertile friable having good water holding capacity well drained and near to neutral in reaction viz. pH 7.0-7.5 is most desirable. They can grow in almost all seasons except in very cold weather, as they are susceptible to frost.

Planting

There are two common methods of propagation of marigold:
1. By seeds.
2. By cuttings.

Seed rate: 1-1.5 kg of seed for African marigold and 1-1.5 kg of seed for French marigold for 1 hectare. Seeds can be sown in lines or by broadcast method. Seeds need to be covered with light soil or sand or strained leaf mould.

Nursery beds: 3 x 1m size mixed with 10 kg of well rotten farmyard manure per sq. meter. Nursery bed should be kept moist by watering accordingly.

Sowing Time

Marigold can be grown three times in a year rainy, winter and summer seasons. The season of sowing and transplanting of seedlings for obtaining flower at different seasons of the year are given below.

Season	Time of Nursery sowing	Time of Transplanting
Rainy	Mid of June	Mid of July
Winter	Mid of September	Mid of October
Summer	First week of January	First week of February

Spacing

Proper spacing between plants is required for better development of plant and higher flower yield. The following spacing is recommended for marigold.
1. African marigold: 40 X 40 cm.
2. French marigold: 20 X 20 cm.

Manures and Fertilizers

200:100:100 NPK kg/ha should be applied to get highest flower yield.
100:100:100 NPK kg /ha at the time of land preparation and remaining 100 kg N/ha should be applied one month after seedlings are transplanted.

Intercultural Operations

In marigold control of weeds is an important operation. If the weeds are not removed in time, a great loss would occur in terms of growth and productivity of marigold particularly during rainy season. Hoeing and weeding should be done 3 to 4 times during the crop period to make the soil loose and weed free. Chemical weed control is also recommended.

Irrigation

Marigold takes about 55-60 days to complete vegetative growth and to enter into reproductive phase. At vegetative and flowering period sufficient amount of moisture in soil is essential. The frequency and quantity of water mainly depends upon soil and climatic condition. Though plants tolerate dry weather up to 10 days without irrigation but growth and flower production is affected adversely. From April to June, frequent irrigation at the interval of 4-5 days is required.

Pinching

The shoot is pinch to make the plants bushy and compact. Pinching the plants 40 days after transplanting enabled the plants to yield more flowers. If the terminal portion of shoot is removed early, emergence of side branches starts earlier and a greater number of flowers of good quality and uniform size are produced.

Diseases and Insect Pests

In general, the marigolds are hardy and almost free from diseases and insects. However, occasionally the following diseases and insect pests having observed.

Diseases

1. Damping off *(Rhizoctonia solani):* Brown necrotic spots, girdling the radical which later on extend to plumule and cause pre-emergence mortality. Post-emergence symptom appears as water-soaked brown necrotic ring, leading to collapse of seedlings.

Control:

a. Proper drainage should be provided in the nursery beds.

b. Spray of blitox (0.4%) should be followed.

2. Leaf spots and Blight *(Alternaria, Cercospora and Septoria)*: Minute brown circular spots on lower leaves and enlarge at later stage of infection leading to premature defoliation and ultimate death of the plant.

Control: Spraying of Dithane M-45 fungicide @ 0.2% at fortnightly intervals starting from the first appearance of disease symptoms.

Insect-Pests

Red Spider Mite (*Tetranychus* sp.): Mites appear on the plants near flowering giving dusty appearance.

Control: Spraying Rogor E.C. or Nuvacron 40 E.C. @ 1 ml/lit. of water.

Hairy Caterpillar *(Diacrizai obliqua)*: Polyphagus insect and caterpillar eats away foliage.

Control: Sprays of Nuvon 50 E.C. or Thiodan 35 E.C. @ 1 ml/l of water.

Harvesting

Marigold flowers are plucked when they have attained full size. Plucking of flowers should be done in cool hours of the day. The field should be irrigated before plucking so that flowers keep well for a longer period after harvest. Plucked flowers are collected in polythene bags or bamboo baskets for carrying to markets.

Packaging

For the local market marigold flowers are taken into gunny bags whereas from distant market bamboo baskets are used.

Transportation

Different means of transportation viz. Rickshaws, Buses, Trains are used to carry the flowers to market depending upon the distance.

Yield

Flower yield of rainy season= 180 - 200 q/ ha.
Flower yield of winter season= 150 - 170 q/ha.
Flower yield of summer season= 100 - 120 q/ha.

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Paddy Cum Fish Cultivation: A Duo Farming Culture System

Article ID: 10670

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Summary

Paddy cum fish farming culture system is the system where paddy is the main crop and fish is the secondary source of income which leads towards more sustainable agriculture with more profits, less cost of production and more nutrition to the farmer. This system is mainly practiced in north-eastern parts and coastal areas of our country. In this article, we are going to learn about the system and its objectives, type of paddy and fish varieties to be used, procedure followed in the farming and advantages of this system.

Introduction

Fish cultivation is as primitive as rice cultivation itself. Rice and fish combination is a type of duo farming culture system in which rice is the main crop and fishes are taken up for additional income. This system is mainly practiced in many rice-growing belts like Indonesia, Thailand, Philippines, China, India, Bangladesh, and Malaysia. In India, this system is an older farming practice adopted mainly in the coastal areas of the country.

Rice and fish are a staple food in India while India is an agro-based country. As an economic activity, the fishery sector stands second in the world behind the agricultural sector. So, the future development of the country is closely linked to the agriculture and fishery sector. Fish as a key component plays an important role in terms of nutrition, employment, foreign exchange, good supply, and most importantly socio-economic stability in rural areas.

Rice cum fish duo culture farming system involves the simultaneous production of rice and fish in irrigated areas where the fish is an additional product from the same piece of land at the same time. In this system, there exists a mutualism where both the entities are benefited from an increase in production. It is one of the simplest environments friendly farming systems with an increase in the production of rice, fish, and productivity per area.

The Main Objective of this Practice is

1. To assess the relative profitability of rice cum fish cultivation in comparison to rice cultivation alone.
2. To determine the effects of rice cum fish culture on yields, nutrition, total costs, returns and labour employment in comparison to rice monoculture.
3. To identify the problems in practicing integrated rice cum fish farming.
4. To determine the effect of different fish combinations on fish yield.

Rice Varieties Used for Rice Cum Fish Culture System

1. The most promising deepwater rice varieties chosen for different states are IB-1, IB-2, AR-1, PLA-2 (Andhra Pradesh), 353-146 (Assam), AR 61-25B, BR-14, PTB-16 (Kerala), Jaladhi-1, Jaladhi-2, Jisurya (Punjab), TNR-1 (Tamilnadu), Thoddabai (Manipur).

2. Manoharsali rice variety seeds are used in rice fields where the rice cum fish system is adopted.

The Procedure Followed in Rice Cum Fish Farming

Site selection: The site selected for the cultivation should be a low-lying area with free flow of water and availability of water at needs.

Soil quality: The soils should be rich in organic matter and have high water holding capacity with medium-textured soils like silt clay or silt clay loam.

Bund preparation: The plots should be prepared in February by raising the embankment all the plots and bamboo screen mating should be done at the base of the bund area for support. The bunds should be strong enough to prevent leakage and to retain the water to the desired depth. The bunds should be heightened than normal to prevent the escape of cultivated fingerlings/ fishes during the floods.

Field levelling: After the bund construction, the base of the field should be levelled with the help of spades or locally made wooden plates. Manual weeding should be done in February followed by the construction of irrigated channels for easy passage, storage, and draining of water. 2-3 channels should be constructed at the middle of the paddy field for water management which divides the field horizontally and perpendicularly which bisect at a point. It is important to have 1 or 2 inlets and more outlets in every field which serves as entry and exit of water. The bottom side dykes are meant for draining out the water for harvesting paddy and fishes whereas middle dykes are used to maintain water at desirable depth. Once the dressing is done, the field is ready for the transplantation of rice seedlings. However, the fish seed is stocked 10-15 days after transplantation of rice seedlings from its nursery bed.

Pond construction: Rice fields should be carefully rehabilitated to grow rice and aquaculture. Building soil valleys around rice fields are very important for water conservation and the reception of fish and shrimp during aquaculture. The height of the embankment will be kept between 50 and 100 cm depending on the structure of the building and the height of the waves in the area. Perimeter routers are required in the inner periphery. For one paddy field, the width and depth of the canal may be 2 m and 1 m, respectively. Land removed from excavated canals can be used to build or strengthen the dykes. In addition to the perimeter channel, two cross-section tanks 1 meter wide should also be built on both sides. The bottom of the trench must be above the perimeter channel so that during the desalination process all the water can easily flow into the canal. The area covered by canals and pits will make up 12% of the total land area.

Flooding: Fields should be flooded after transplanting and a water level of a minimum of 5 cm is maintained to allow filtration. Until the rice matures the water Level is maintained at 30-50 cm deep.

Weeding: Weeding should be done manually twice or thrice a week on both sides of the plot. The chemical method should be avoided to prevent the pollution and mortality of fish due to harmful chemicals.

Fertilization: is mainly composed of varieties of animal extracts like poultry droppings, cow dung @ 10kg/50m biweekly, pig excreta, wastes like rice husks, ashes from household brunt, decomposed straw, weeds, rice stalks, etc by broadcasting the fertilizer evenly on the field.

Source of fish: The progressive farmers produce adequate fish seeds in the small ponds for 1-2 months and sell them to farmers to leave the seed directly into the paddy fields.

Stocking of fish seeds and fingerlings: Before releasing the fish seed**,** the transplantation of paddy should be done from rice seedbeds to main fields in April and are left for two weeks for the strengthening of paddy roots. The fish seeds are released @ 2500 nos/ha of paddy field.

The fish fingerlings should initially have a mean weight of 20 to 35 grams respectively and are stocked at 200 fish/ 50m of paddy field after flooding.

Feeding of fingerlings: Feeding of the fish should be done immediately after stocking at the established feeding spots. The fish should be fed once a day. Desired composition and quantity should be given to the seedlings at the proper scheduled period.

Growth rate: The growth rate of the fishes is monitored by randomly arching the fish using a hand net. The weights and measurements were taken and the fish is released back into the trenches. The feeding rates were adjusted accordingly.

Harvesting: Special baskets called cane/bamboo made of simple bamboo are used for harvesting the fishes. First, the water is drained through the outlet pipe allowing the water and fishes to accumulate in the mid-channel of the paddy field. Then the fish is caught and stocked in plastic buckets in live condition. Paddy is harvested in the last part of September and October.

Yield: The production of fish is 200-300 kgs/ha for a culture period of 3-4 months and 400-500 kgs/ha for 5-6 months of the culture period.

Advantages of the System

1. Improves the soil health and soil fertility.
2. Increase in production per unit area.
3. Recycling of nutrients.
4. Provides balanced nutritious food for the farmers.
5. Decreased use of chemicals and pollution-free environment.
6. A decrease in production cost and farm input requirements.
7. Employment generation and efficient use of family labour.

Conclusion

This system helps the farmers to have high productivity per unit area at lost cost of production, generates employment, increase nutrient intake which brings food security for them. Proper planning, policies, positive attitude of the farmers and extension workers, training facilities to farmers and timely supply of seedlings at appropriate times will encourage the farmers to practice this system in a broad spectrum.

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Storage Study of Maize Under Different Bag Storage Modes

Article ID: 10671

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Abstract

Qualitative loss of maize grain (12.2%, w.b.) in different storage bags was made. The storage behaviour of freshly harvested and chemically treated (Alminium Phospide) maize grain was studied at ambient condition (30± 5 °C) in four different modes, i.e., in hermetic bags (super bags), polyethylene bags, plastic bags and jute bags. Weekly changes in physical properties such as grain moisture content, water activity & colour index and degradability in terms of degree of insect infestation, germination percentage and production of aflatoxin were recorded for 8 months. It was observed that the variation in grain moisture content (0.245, w.b), water activity (0.132) and colour index (0.232) was least in the super grain bag while the variations were maximum in case of jute bags (0.855, 0.166 and 0.426 respectively) . The germination percentage was maximum for maize stored in super bags (92%) and least for jute bags (44%) after 8 months storage period. No visible damage due to pest infestation was observed maize samples stored in super bags. The aflatoxin level under of the stored maize in hermetic bags was least and under the acceptable limit i.e. 20ppb throughout the storage period. However, the aflatoxin levels in other storage bags were around 100-150 ppb rendering it unfit for human consumption.

Keywords: Hermetic, Storage, Germination, Degradability, Aflatoxin.

Introduction

A hermetic storage bags is a safe, cost-effective storage method that controls insect infestations in addition to preserving the quality of grains, while allowing for pesticide-free, short-term and long-term qualitative and quantitative seed preservation, without refrigeration, maintaining seed vigoro and pest control. Hermetic bags need to be validated for its effectiveness in hermetic storage of food grains under Bihar condition. The present study was undertaken in response to requests by farmers, traders and private seed companies to determine the effectiveness of hermetic bags for storage of maize grain. Hence, a comparative study on storage behaviour of Maize in different storage bags was made to assess the qualitative and quantitative loss and to validate the advantages of hermetic super grain bags over the conventional storage bags used in the region.

Materials and Methods

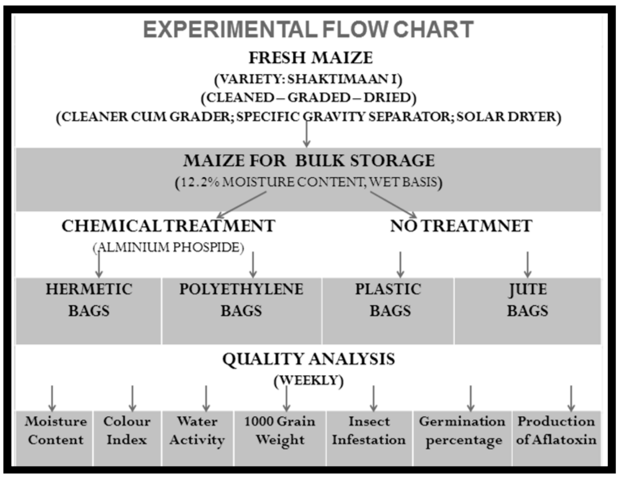

Table 1. Experimental flowchart

Fresh and healthy maize seeds were cleaned and graded. The experiment consisted of seven treatments using four different types of bags – Hermetic grain bags, Polythene bags, Jute bags and Plastic bags by using one chemical fumigant (Aluminium Phosphide) and no treatment. All the treatments were kept under ambient conditions. The temperature and relative humidity were recorded on a daily basis while the other dependent parameters were recorded on weekly basis.

T1	Hermetic bag + Jute bag
T2	Polyethylene bag + jute bag
T3	Jute bag
T4	Plastic bag
T5	Hermetic bag + Jute bag + Chemical treatment
T6	Polyethylene bag + Jute bag + Chemical treatment
T7	Jute bag + Chemical treatment
T8	Plastic bag + Chemical treatment

Fig 1 Treatments (stored grains)

Results and Discussion

The moisture content of Maize increased with storage period. The increase in moisture content resulted in the increase in water activity, colour index and 1000 grain weight of Maize. Higher the moisture content, more will be the values of water activity, colour index and 1000 grain weight of Maize.

The germination percentage of all the treatments except the hermetic bags decreased substantially to around 20 ± 5 %. The germination percent in case of hermetic bags were around 80 ± 2%. Visible damage of around 22 ± 4 % was seen in all treatments except TI and T5. No damage due to insect infestation was observed in case of hermetic bags.

The Aflatoxin level in hermetic bags was around 15 ± 3 ppb throughout the storage period. The Aflatoxin levels in other storage bags were around 100-150 ppb.

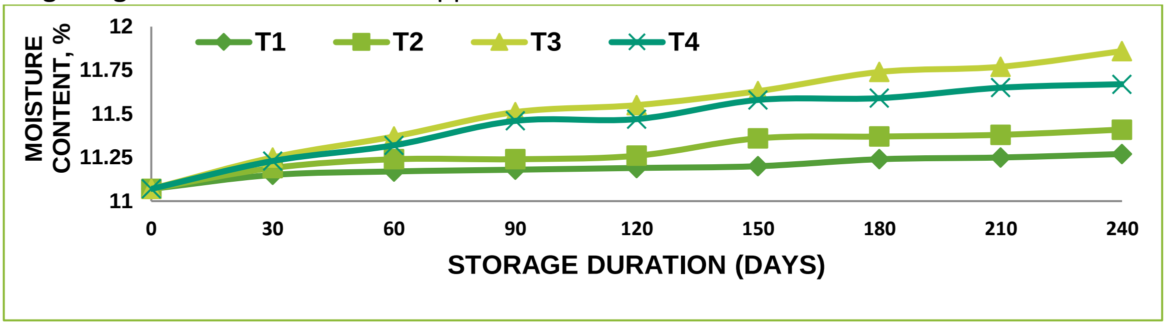

Fig 2.Variation in moisture content during storage of maize

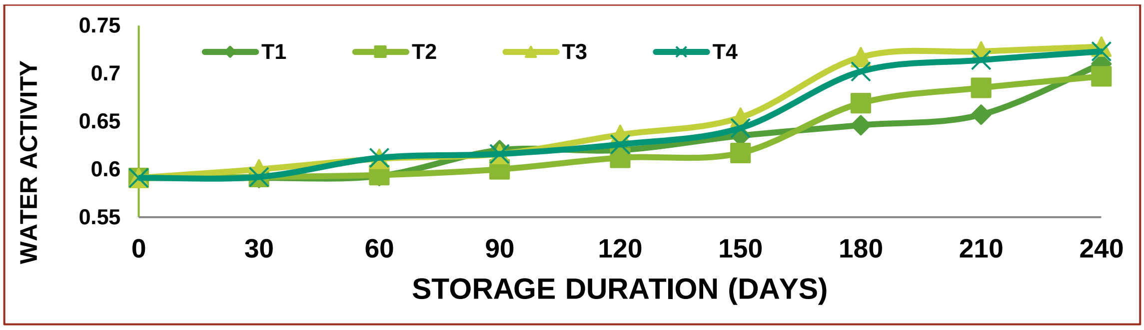

Fig 3.Variation in water activity during storage of maize

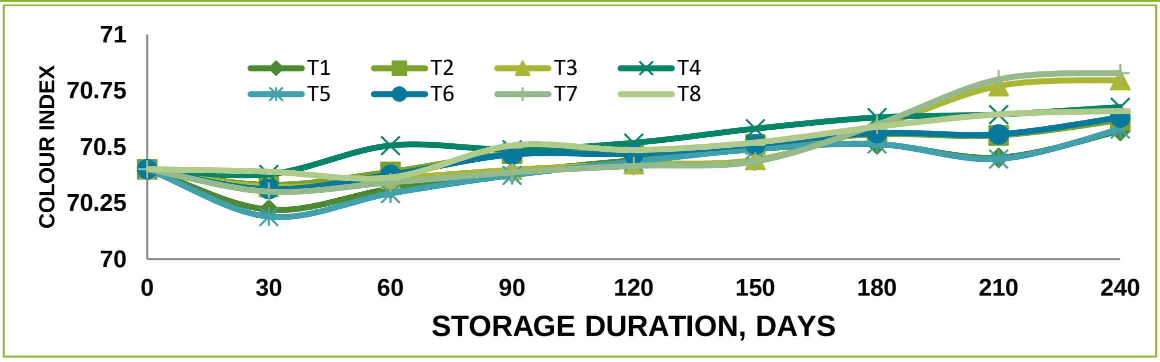

Fig 4.Variation in colour index during storage of maize

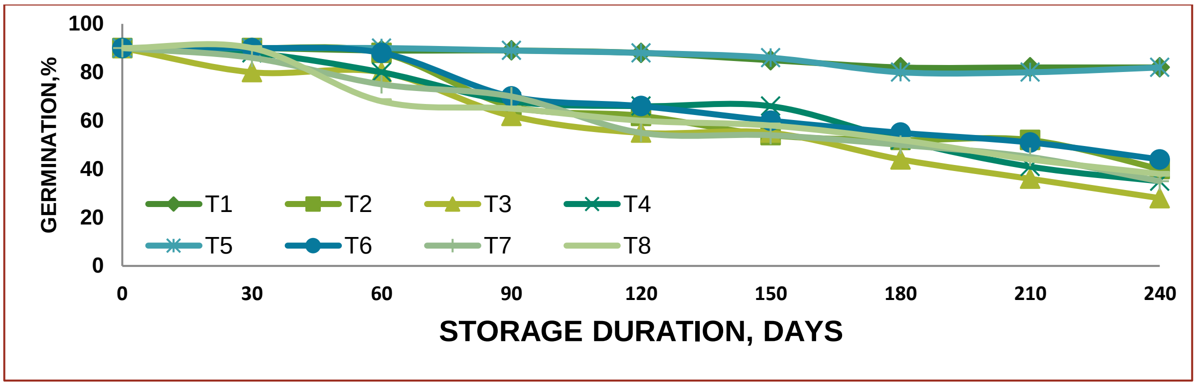

Fig 5.Variation in germination percent during storage of maize

Conclusion

Maize could be stored under ambient conditions up to eight months in hermetic storage bag with minimum qualitative and quantitative loss. There is no requirement of any chemical treatment of grains stored in hermetic super bags as the micro environment developed is sufficient enough to restrict the growth of pests, insects and micro-organism. The hermetic bags can be a key post-harvest technology for reducing PHL at storage in the fight against hunger and ensuring food security.

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Medicinal Use and Cultivation of New Emerging Fruit Pepino (*Solanum Muricatum* Ait.) in Human Diet

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Introduction

The pepino (*Solanum muricatum* Aiton), which is also referred to as pepino dulce in Spanish language, has been described as a succulent, juicy, and sweet fruit that is used mainly in desserts, although some cultivars have been used in salads due to their higher acidity content and grassy flavor notes (Rodriguez-Burruezo et al.,2011). In the pepino was proposed as a physiological model of the texture or firmness changes that occur during maturation and ripening (Heyes et al., 1994).

The pepino fruit is a diploid (2n = 24) subtropical species and is also known as melon pear, melon shrub, or sweet cucumber. Native species from South America, more specifically from the Andes area of Peru and Chile, is widely distributed from Colombia to Bolivia (Daunay et al., 1995). The pepino fruit served as an important crop in Pre-Columbian Andean cultures, and it is a member of the Solanaceae family. Pepino is one of the few that is domesticated and cultivated for food purposes (Daunay et al., 1995).

Interestingly, most pepino research has been conducted in New Zealand, Spain, and Israel through their respective breeding programs (Rodriguez-Burruezo et al., 2011). Unfortunately, pepino studies in the area of origin are scarce, and some reasons may lie in the fact that pepino is classified as a secondary fruit (Lizana and Levano, 1977), exotic or non-traditional crop, it has a low cultivated surface leading to reduced product availability in markets, and an insignificant economic importance relative to other major crops.

Composition and Uses

It's also prized for its medicinal applications. Aqueous extract of its fruit could attenuate the progression of diabetes due to its anti-inflammatory, antiglycative and antioxidant effects (Hsu et al., 2011). A medium serving (~100 g) of its fruit provides 80 calories of energy and 5 g of dietary fibres similar to oatmeal, which helps to lower cholesterol and it's easy to digest.

The fibre also helps with constipation and it tends to sooth away gastric ulcers too. The fruit is rich in minerals and vitamin C but low in starch, sugars and free from oxalates. The minerals contained in Pepino fruits are Fe, Zn, Cu, Mn, Ca & P. It has been observed that level of glucose and fructose decreases during ripening, whereas, sucrose concentration increases as the ripening progresses. A discernible reduction has also been noticed in contents of protein and fat as the fruit turns from raw to mature (Huyskens-Keil et al. 1999). Pepino is known as a source of beta-carotene, 27 mg per 100 grams of fruit flesh. The crop is also considered as a sucrose accumulator during final ripening stage. Fruits picked when immature are flavourless and non-aromatic.

The fruit is juicy (more than 40% juice) with very mild flavour. Fruit acidity is low (0.04-0.10%) and citric acid is predominant. Vitamin C content varies among cultivars from 30 to 70 mg/100 g fresh weight. Pepino fruits contain about 9.5% soluble solids, 4.06 g/100 g sugars, 0.06 g/100 g acids, and 34.25 mg/100 g vitamin C (De Arriola et al., 1976). Redgwell and Turner (1986) reported that ripe pepino fruits of 'El Camino' contained 6.8–8.2% dry matter, 0.1% protein, 4.9-6.4 g/100 g sugars, 48-68 mg/100 g vitamin C, 119-153 mg/100 g organic acids, and 52-70 mg/100 g amino acids. Uses of the pepino fruit include juices, preserves, ice-cream, and jam. Fruits at the "green" and "turning stage" before ripening may have a cucumber-like scent and can be used in green salads or as a vegetable in stews, and it can be consumed as a refreshing dessert fruit or as an ingredient of fruit salads (Gonzalez et al., 2000).

Composition of 'Pepino' (100g Fresh Fruit)

Water (g)	92
Carbohydrates (g)	5.6
Proteins (g)	0.4
Fat (g)	0.1
Calories	25
Fiber (g)	0.5
Potassium (mg)	111
Calcium (mg)	21
Ferum (mg)	1
Vitamin C (mg)	26
Misc. (g)	1.24

Levy et al., (2006)

Diversity

William Aiton described the (*Solanum muricatum*) but pepino as *S. furcatum* was also called by Bertero based on Dunal. Taxonomically, pepino is placed within *Solanum* subgenus Potatoe section Basarthrum (Correll, 1962; Anderson and Bernardello, 1991 and Anderson *et al.* 1996).

This section, characterized by the basal pedicel articulation (i.e., flowers fall off with pedicels attached, leaving only scars on the inflorescence axis), includes 11 species, the cultivated pepino and 10 wild species distributed through Central and South America.

The wild species are characterized by green fruits, 1 to 5 cm in length and typically ovate or round. Species from Solanum section Basarthrum are distributed among four series: series Muricata, of which pepino (*Solanum muricatum*) is the only member; series Caripensia, which includes eight species (*Solanum basendopogon* Bitter, *Solanum caripense* Humb. & Bonpl. ex Dunal, *Solanum cochoae* G. J. Anderson & Bernardello; *Solanum filiforme* Ruiz Lopez & Pavon; *Solanum fraxinifolium* Dunal in DC; *Solanum heiseri* G. J. Anderson; *Solanum tabanoense* Correll and *Solanum trachycarpum* Bitter & Sodiro); series Suaveolentia, whose only member is *Solanum suaveolens* Kunth and Bouche; and series Canensa, also with a single species, *Solanum canense* Rydb There is no clearly defined wild ancestral form of the pepino (Heiser and Anderson, 1999). However, at least one Andean wild relative of *S. muricatum* is known to be edible, the cimbalo, *S. caripense* Dunal, which has edible fruits with an acid-sweet taste (Nuez *et al.,* 1999).

The two other wild relatives *S. basendopogon* Bitter and *S. tabanoense* Correll, both of Peru, may also be picked from the wild and consumed. Wild species from Solanum section Basarthrum represent invaluable genetic resources for pepino breeding. In particular, fertile hybrids with several species of section Caripensia are easily obtained and the introgression of genes into the pepino for high sugar content has been carried out via the backcross method.

Furthermore, because interspecific somatic hybrids between tomato and pepino have been obtained (Sakamoto and Taguchi, 1991), the genetic resources of the pepino also represent genetic resources that can be useful to improve tomatoes. and may make a significant contribution to antioxidant intake in the diet (Chun *et al.,* 2005). Important cultivars viz. Valentia, Turia, El Camino, Kawi, Suma, Vista are available in other countries.

Botany

The pepino fruit has been described as a berry that develops on a cymose inflorescence (Gould et al., 1990). The fruit presents a simple sigmoid growth curve, and its maximum fruit size is reached 60 day after anthesis.

Origin and Distribution

The pepino fruit subtropical species and is also known as melon pear, melon shrub, or sweet cucumber. Native species from South America, more specifically from the Andes area of Peru and Chile, is widely distributed from Colombia to Bolivia (Daunay et al., 1995), pepino is one of the few that is domesticated and cultivated for food purposes (Daunay et al., 1995). Though the crop originated in South America, it has domesticated in other parts of the world like Netherland, New Zealand and Spain (Blanca et al., 2007).

Soil

The crop can be grown in different types of soil, preferably low in fertility as higher fertility may hamper reproductive growth. It performs better in soil pH 6.0–7.5 with well-drained soil. Pepino has also wider soil adaptability even under salinity conditions of 8 dS m-1. A vast area in India having salt-affected soils including the coastal area where the scope for cultivation may be explored (Kumar et al., 2017).

Climate

The crop has wider adaptability across temperate, tropics and subtropical conditions but the fruit set is very much influenced by temperature, the optimum range being reported between 12-25°C. The crop is often considered as non-climacteric fruit but some cultivars also behave as climacteric. The crop generally prefers warmth climatic conditions however if cut back even at a suboptimal temperature (<-3°C), it can survive (Prohens et al. 1996). The analysis of the weather parameters during its growth and development periods (2014-15 and 2015-16) were recorded at the established agro-meteorological observatory. Monthly average minimum and maximum temperatures varied between 6.2-25.8 °C and 17.2–39.8 °C, respectively. The monthly average relative humidity ranged between 25.1-89.7 %. Most importantly higher pan evaporation up to 11.4 mm per day during summer months was recorded while in winter months as low as 2.3 mm per day was observed. Uneven distribution of rainfall was noticed. A sum of 732.2 and 553.2 mm of rainfall was recorded during 2014–15 and 2015–16 respectively. This rainfall is lower than the average of around 800–1000 mm. Unseasonal rainfall of 87.2 mm was also recorded during Jan.–Feb. months of the 2015–16 seasons. A bright sunshine 2.8–9.8 hour and wind velocity of 1.1–4.3 km.h-1 was observed. Profuse growth and higher productivity of Pepino under such variations in weather parameters under subtropical climatic conditions. Kumar et al., (2017).

Propagation

The Pepino can be grown from seeds but is usually propagated vegetatively to maintain the original quality from semi-hardwood cuttings. In the subtropical conditions, the mother plants need attention during rainfall i.e., covering of the mother plants with ventilated plastic rain shelter from July–September. The cuttings should be made during the month of October for maximum survival in the subtropics. Cuttings are easy to root and treatment with growth regulator is not mandatory Nemati and Tehranifar (2007). Plant can be grown from seed. Often cutting are used Stem cutting 9-14 cm long with about 4 leaves are suitable. Rooting hormone, bottom heat and mist help propagation. A spacing of 1x1 m spacing is appropriate.

Manuare and Fertilizer

Rana and Verma (2011) obtained good quality fruits, an application of well rotten compost manures @ of 10 t/ha and 60 kg N, 40 kg P and 40 kg K is suggested.

Irrigation

Young plants require sufficient moisture in the soil. Water stress at the time of flowering may cause flower dropping and arrest subsequent plant growth also. Therefore, at least 2- 3 irrigations at weekly interval during summer are essential for healthy plants.

Pollination and Fruit Set

Pepino is normally self-pollinated, but insect pollination can boost up the fruit set. Flowering continues throughout the year but fruit set during winter would not attain the proper size. Apart from low temperature affecting fruit set, high temperature leads to shrivelling of flower buds and loss of pollen viability. Pepino takes 150-160 days between anthesis to fruit ripening in spring-summer season. However, more time can be taken if cool weather is prolonged. Fruits are harvested when its colour changes from pale green to yellowish green with purple stripes on their surface. Fruit weigh 150-700 g and one plant produces 10-15 fruits. The fruits mature irregularly, hence many pickings are required. Fruits should be plucked with pedicel for market supply. Fruits can be stored for 15-20 days under ambient conditions Rana and Verma (2011).

Harvesting

Fruit harvest started from March onwards and continued until the month of May. The variations in different parameters viz., fruits weight (150–350 g), yield (4–5 kg per plant), moisture content (93.6%), Vitamin C (37.17 mg per 100 g), Acidity (0.13–0.14 %) and TSS (4.9–5.5 %) was recorded (Kumar 2016).

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High Density and Meadow Orchard Planting System in Horticulture

Article ID: 10673

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Introduction

It is well known that the diversity in soil and climatic conditions in India permits growing of a large variety of tropical, sub-tropical and temperate fruits in different regions, due to which India is regarded as a horticultural paradise. In recent year, the concept of fruit production is undergoing a change where emphasis is being given to higher production per unit area. High density planting or meadow orchard system is the fastest way of reducing the gestation period and increasing the productivity of the orchards. The choice of the system of planting in the orchard depends on topography, crop, variety, plant density, production technology to be followed.

Concept of High-Density Planting and Meadow Orcharding in Fruit Crops

1. Accommodation of the maximum possible number of the plants per unit area to get the maximum possible profit per unit of the tree volume without impairing the soil fertility status is called the high-density planting.

2. High density orchards were first planted in Europe at the end of the 19th century and since then these are a decline in traditional orchards with low densities.

3. The underlying principle of a HDP is to make the best use of vertical and horizontal space per unit time and to harness maximum possible return per unit of inputs.

4. In other words, it is the planting of a greater number of plants than optimum through manipulation of tree size. Meadow Orchard System is a new concept of planting which has been developed in guava for the first time in India at CISH, Lucknow.

5. The Meadow Orchard is a modern method of fruit cultivation using small or dwarf tree with modified canopy.

6. Better light distribution within tree canopy increases the number of well illuminated leaves.

7. Fertilizer dose, spacing, growth regulation by the training and pruning, use of the mechanical devices etc. may also be tried either singly or coupled with other crop management practices for a successful adaptation of these concepts.

8. It also promotes rate of photosynthesis that leads to high yield per unit area.

9. Basically, the availability of a dwarf plant is the first and foremost prerequisite for establishing any high density or meadow orchard.

Different Types of Planting

1. Low density planting:

a. Non intensive system, age old planting system, trees planted at wide spacing, accommodating about 100-250 plants/ha.
b. Dwarfing rootstock not used.
c. Trees acquire commercial production potential after 10-15 years of planting.
d. Output from orchard during early 10-15 years is less.
e. Less input and care intensive, holds popularity among growers.

2. Medium density planting:

a. Highly minimized distance covering 250-500 plants/ha.
b. Proper pruning undertaken to manage tree in desirable shape.
c. More care intensive, labour requirement is more, obtained yield is also more.
d. Lead in output reliable growers to produce amenable fruit crops like pomegranate, citrus, guava, papaya, banana, etc.

3. High density planting:

a. Very condensing planting with 500-10,000 plants/ha depending on fruit crop.
b. Medium high density:– 500-1500 plants/ha
c. Optimum high density:– 1,500-10,000 plants/ha
d. Ultra-high density:– 10,000-1,00,000 plants/ha
e. Relies heavily on rigorous training and pruning.
f. Maintenance of pruning is very heavy.
g. Dwarfing rootstock and chemicals also used in this system.
h. Yield as well as expenses per unit area is high.

4. Meadow orcharding:

a. Meadow-grassland, also known as Ultra-high-density planting.
b. 10,000-1, 00,000 plants/ha in order to maintain tree form, sever top pruning is practiced similar to mowing of grassland.
c. Plants intended to produce yield after 2 years age.
d. Heavy use of growth regulators as well as pruning.

Table 1: Spacing at different planting system in fruit crops:

Sr. No.	Crop	Normal spacing (m)	HDP spacing (m)	Meadow spacing(m)
1.	Mango	7.5 X 7.5 - 12.5 X 12.5	3 X 2.5 – 5 X 5	2.5 X 2.5 - 3 X 1
2.	Banana	2 X 2 - 2 X 3	1.5 X 1.5 - 1.8 X 1.8	1.2 X1.2 - 3 X 0.5
3.	Citrus	6 X 6 – 8 X 8	3 -6 X 3 -4.5	-
4.	Papaya	2 X 2 – 3 X 3	1.8 X 1.8	1.2X1.2 - 1X1
5.	Gauva	6 X 6 – 8 X 8	3 X 3 – 3 X 1.5	2X2 - 2X1
6.	Sapota	10 X 10	5 X 5	-
7.	Aonla	10 X 10	5 X 5	-
8.	Apple	10 X 10	3 X 0.75	3 X 0.37 - 0.60

Components of HDP and Meadow

1. Dwarf scion varieties.
2. Dwarf rootstock varieties.
3. Training and pruning.
4. Suitable crop management practices.
5. Use of bio-regulators.
6. Planting Density.
7. Planting Geometry.
8. Mechanization.

Training and Pruning

1. Training and pruning are effective tools in HDP and meadow orcharding by virtue of their impact on shape and size control of the tree.
2. The training begins when the tree is first planted and continues throughout its productive life.
3. Proper tree forms, branch angle and limb spacing in itself aids in growth control.

4. First training is done after one growing season.
5. Each plant is allowed to maintain single stem (main stem) with upward growth upto 60- 80 cm and then four scaffold branches are allowed in four directions to make the tree frame.
6. Thereafter, 2 shoots arising from each primary branch at a distance of 60-75cm from main stem is allowed to form secondary and likewise the tertiary branches.
7. After start of bearing in plants, shoots arising from secondary and tertiary branches are given 15-20 cm deep pruning soon after fruit harvest.
8. Spray of 1% urea combined with 0.2% Blitox-50 or any other copper fungicide should be done soon after pruning.

Use of Bio-Regulators

1. Prolonging dormancy.
2. Reducing vegetative growth.
3. Flowering.
4. Reducing fruit drop.

Adoption of Suitable Crop Management Practices

1. Mulching.
2. Fertigation.
3. Organic farming.
4. INM.
5. IPM.

Planting Density

1. Even though a small canopy with a high number of well-illuminated leaves is efficient in photosynthesis but it is very poor in light interception, which leads to low potential yield per hectare.
2. Light interception could be improved by increasing tree density.
3. An optimum tree density is the level of density which is required to facilitate optimum light distribution and interception leading to high photosynthesis. As a result, yield per hectare is maximized.
4. An optimum light interception is a factor of plant form, planting density, tree arrangement and leaf response to light for photosynthesis.
5. Optimum light interception can be defined as a level of light intercepted by an orchard system above or below which, the economic yield will be reduced.

Planting Geometry

1. Planting system is a combination of tree arrangement and plant form.
2. Tree arrangement in HDP system must have sufficient alleyways for movement of farm machinery.
3. The way trees are arranged also determines the light distribution pattern and light interception level.
4. Single hedge row and double hedge row system and square system having enough alley space is being practiced in developed countries for HDP.

Mechanization

1. Another component in high density fruit planting is the system automation which contributes to high production efficiency.
2. One of the important farm operations that can be automated is irrigation and fertigation vis-à-vis indiscriminate mechanical pruning.
3. In fact, irrigation and fertigation have been identified as one of the key factors for the success of high-density orchards.

4. Plant should not be kept under stress after pruning therefore, assured irrigation coupled with fertigation is essential after pruning and during fruit development in high density orchards.

Conclusion

1. HDP and meadow orcharding gives higher yield as well as returns/unit area due to increasing the no. of trees/unit area. It is possible by regular pruning and use of bioregulators for maintaining the size and shape of the tree.
2. Mango planted at spacing of 5m x 5m (Kesar and Alphonso) and 3m x 1m (Keitt) gives higher yield under HDP and meadow, respectively.
3. Guava planted at spacing 2.5m x 2.5m and 3m x 6m under HDP and 2m x 1m under meadow gives higher production as well as more income in Allahabad Safeda and L-49.
4. Citrus gives higher production when planted at 6m x 3m spacing under HDP.
5. For HDP in banana is planted at 1.0 x 1.2m spacing gives better yield in cv. Rajapuri.

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Quorum Sensing in Plant Pathogenic Bacteria

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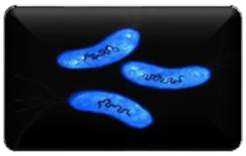
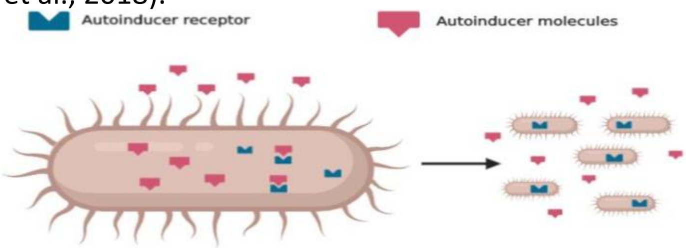
Autoinducer was first described in the marine symbiotic bacterium *Vibrio fischeri* (Nealson et al., 1970). The 'autoinducer' concerned was subsequently purified and the structure determined as a N-(3-oxohexanoyl) homoserine lactone (3-oxo-C6-HSL) (Eberhard et al., 1991). Until 1992, N-acylhomoserine lactone (AHL) was exclusively associated with *V. fischeri*. Bainton et al. (1992) reported that some Gram-ve bacteria were also produced the same autoinducers. This work was rapidly followed by numerous scientists and subsequently resulted in the introduction of the term 'quorum sensing' (QS) (Fuqua et al., 1994).

Quorum Sensing

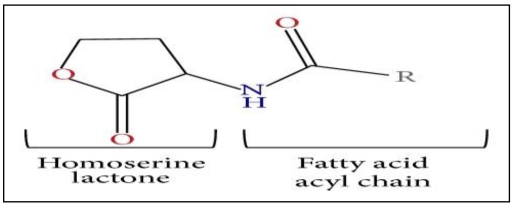
Cell-to-cell communication activity in bacteria termed as "Quorum Sensing" – just to coordinate group behaviors in a cell density dependent manner via signal mediated activation (Hirakawa and Tomita, 2013). QS refers to a process where bacteria accumulate, detect and respond to small diffusible communication signals by gene expression (Sibanda et al., 2018).

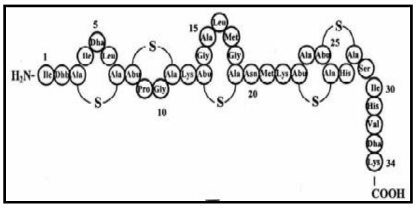


Auto-Inducers and its Type

Bacteria communicate through the production of small diffusible signal molecules known as "Auto-inducers". Three main classes of autoinducers:

1. Acyl-homoserine lactone (AHL) used by Gram-ve bacteria.
2. Oligopeptides used by Gram+ve bacteria.
3. Autoinducer-2 interspecies communication among Gram+ve and Gram-ve bacteria (Antunes et al., 2010).





Mechanism of QS

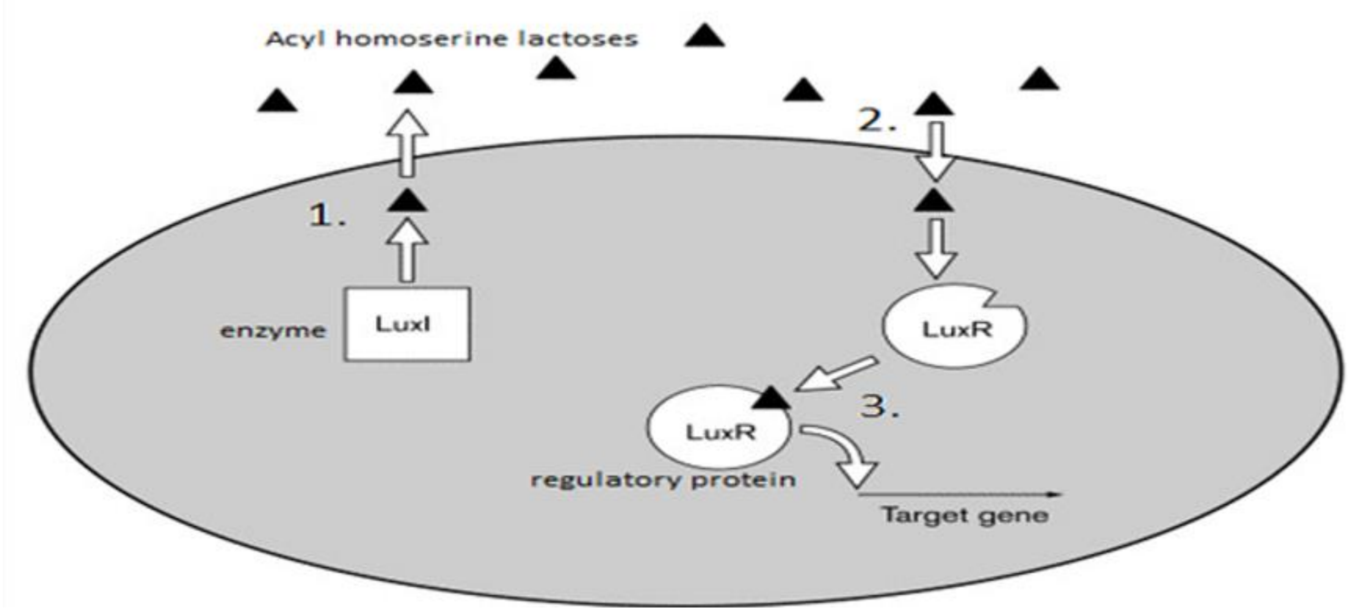
Bacteria showing QS requires two main things i.e., autoinducers and receptors. These signaling molecules binds to the receptors either on the bacterial surface or in the cytoplasm when these autoinducers reach a critical threshold level. The autoinducer/receptor complex then bind to DNA promoters and activate the transcription of QS controlled genes in the bacterium (Waters and Bassler, 2005).

QS in Plant-Pathogenic Bacteria

Many plant-pathogenic bacteria are dependent on QS to evoke disease, as some virulence-related traits are induced only when the bacterial population reaches a specific density threshold level. The potato soft rot pathogen *Pectobacterium* spp. cause disease through the prolific production of a wide variety of plant cell wall degrading enzymes (PCWDEs) which are regulated by the QS regulatory system (Helman and Chernin, 2015).

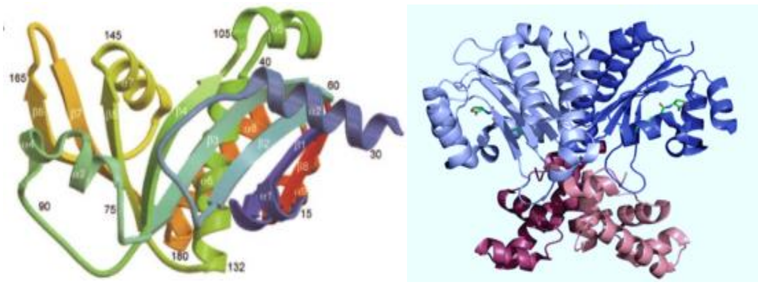
QS in Gram-ve Bacteria

AHLs (N-Acyl-Homoserine Lactones) are biosynthesized by members of LuxI-family of AHL synthase, using S-adenosylmethionine (SAM) and acetylated acyl carrier protein (acyl-ACP) or from acyl-CoA as a substrate. Once a critical concentration threshold is achieved, AHLs interacts with the cognate LuxR-family transcription factors and regulates the QS dependent gene expression (Eberhard *et al.*, 1991). The LasR and LasI proteins of *Pseudomonas aeruginosa*, which regulate a number of virulence factors including elastase. The ExpR and ExpI proteins of *Erwinia carotovora*, which control exoenzyme production and antibiotic synthesis, *etc.* (Fuqua and winans, 1996).



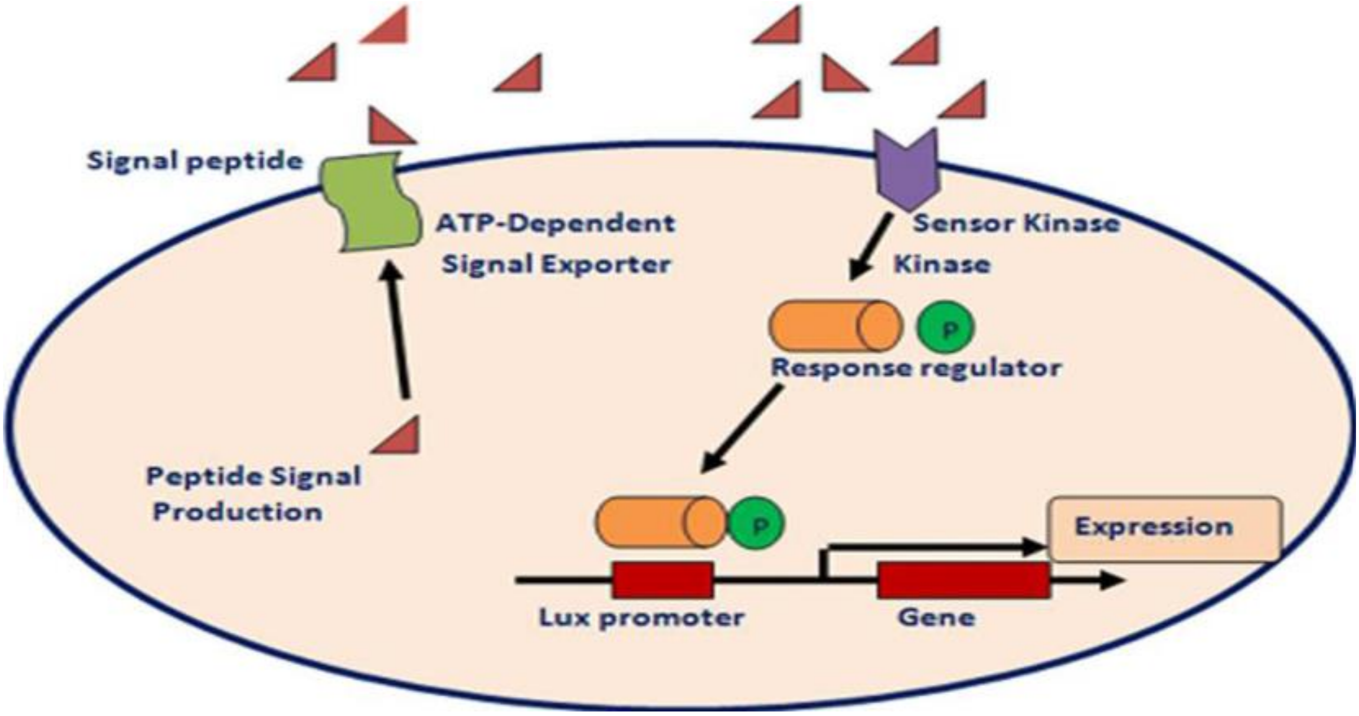
I Protein & R Protein

I-proteins are responsible for AHL synthesis. Multiple classes of AHL-synthase have been identified. The most common is LuxI-type that utilize cellular metabolites SAM and specific cellular acetylated-ACPs to form the AHL. Two classes of transcriptional regulators known as R proteins exist. One requires an AHL signal to bind to DNA whereas the second only binds DNA in the absence of AHL signal. The only known example of the latter class is EsaR in the potato bacterial wilt pathogen *Pantoea stewartii* (Loh et al., 2002).



QS in Gram+ve Bacteria

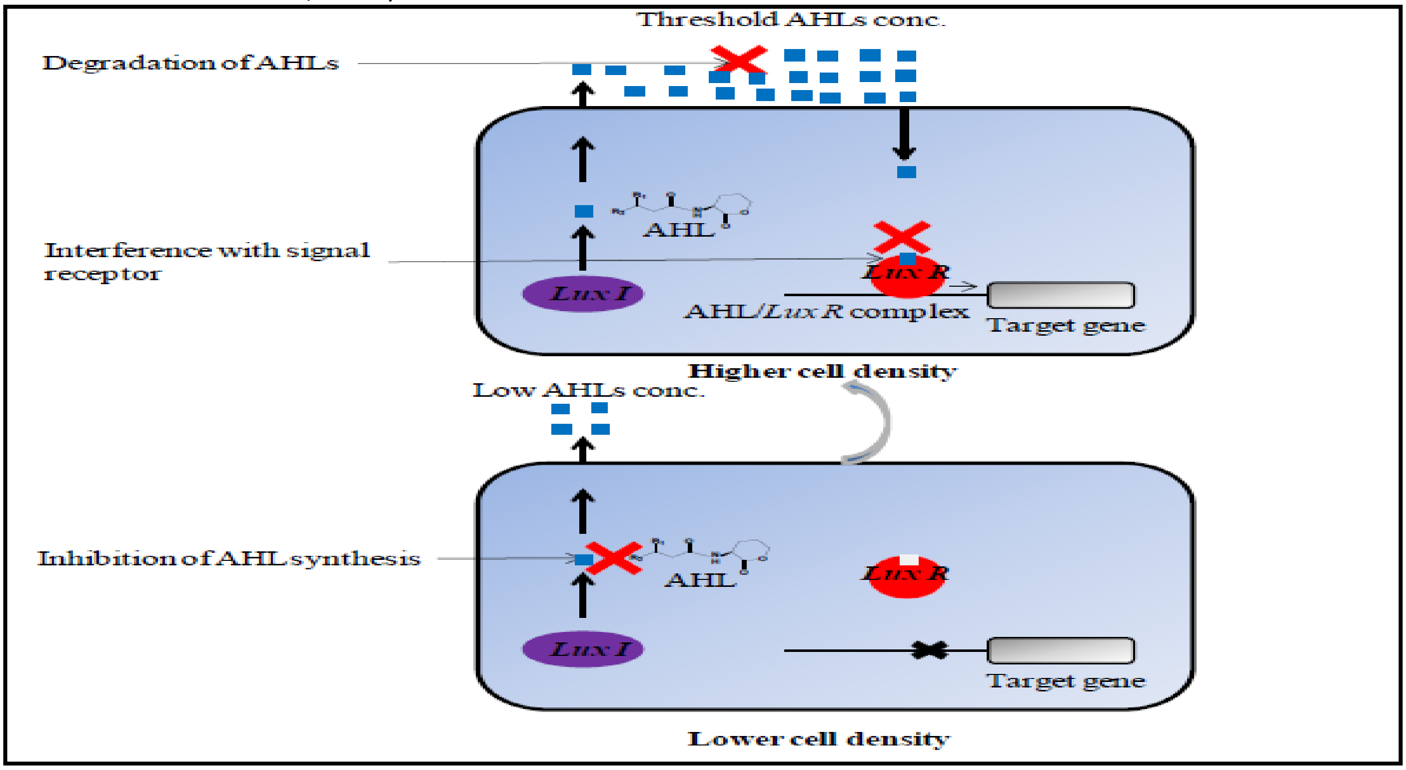
The peptide used as autoinducer in Gram+ve QS is secreted through an ATP Binding Cassette transporter (ABC). These peptide signals are detected by a membrane bound sensor kinase, which switches its kinase/phosphatase activity in response to interaction with peptide, which alters the phosphorylation state of the cognate response regulator and ultimately results in activation or repression of QS target genes and alters the transcription of target genes involved in QS (LaSarre and Federle, 2013).



Quorum Quenching and its Mechanism

It is the process of preventing QS by disrupting the signalling molecules. It can be achieved by:

1. Reducing the activity of AHL cognate receptor protein or AHL synthase.
2. Inhibiting the production of QS signal molecules.
3. Degradation of the AHL.
4. Mimicking the signal molecules primarily by using synthetic compounds as analogues of signal molecules (Gutierrez-Pacheco et al., 2019).



Quoram Quenching Enzymes and AHL Mimics

Three main enzymatic mechanisms have been clearly described *i.e.* 1) Lactone hydrolysis by AHL lactonase 2) Amide bond hydrolysis by AHL acylase 3) Modification of the acyl chain by AHL oxidase and reductase (Uroz *et al.,* 2009). There is now good evidence that higher plants, including pea, rice, tomato, soybean and *Medicago truncatula* secrete various compounds that act like (mimic) bacterial QS signals (Von Bodman *et al.*, 2003).

Case Study

Lopes *et al.* (2015) extracted AHL produced by *P. syringae* pv. *tabaci* causes wildfire disease in tobacco and incubated with the aliquots of growth cultures of endophytic isolates for 18hr. It decreases AHL in the supernatant which evaluated using *Chromobacterium violaceum* CV026 biosensor inoculated in plates and inhibition zones was determined after a 24hr of incubation. The result showed that *Microbacterium testaceum* and *Rhodococcus erythropolis* (endophytic bacteria) were more effective to cleave AHL molecules.

Conclusion

Bacteria use a cell-to-cell communication activity termed "Quorum Sensing" (QS) which coordinate group behaviours in a cell density dependent manner. QS influences the expression profile of diverse genes via specific chemical compounds called "autoinducers". N-acylhomoserine lactones (AHLs) in Gram-ve bacteria, oligopeptides in Gram+ve bacteria and autoinducers-2 as an interspecies autoinducer among Gram-ve and Gram+ve bacteria. Quorum quenching is the process of preventing QS by disrupting the signaling molecules.

Future Thrust

1. Need to increase understanding on diverse mechanism of QS by biotechnological approaches.
2. QS based approaches need to be developed as practical application in plant disease management under Integrated disease management.
3. Need to emphasize targeted characterization of specific gene in bacteria and/or strain by transcriptomes and thus regulation of gene expression.
4. Need to investigate the impact of QS interfering agents on beneficial activities of non-target bacteria in the host microbiome.

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Indigenous Traditional Knowledge: A Smart Technique for the Farmers Coping with Diverse Agriculture

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Introduction

Indigenous Traditional Knowledge: The word indigenous refers to the notion of a placed based human ethnic culture that has not migrated from its homeland and is not a settler or colonial population. Traditional Knowledge, indigenous knowledge and local knowledge general refers to knowledge systems embedded in the cultural traditions of regional, indigenous or local communities.

What is the Purpose of Traditional Knowledge?

1. For rural and indigenous knowledge and local knowledge informs decision making about fundamental aspect of day-to-day life.
2. This knowledge is integral to a cultural complex that also encompasses language, systems of classification, resource use practices, social interactions, ritual and spirituality.

Indigenous Knowledge

Local or indigenous knowledge refers to the cumulative and complex bodies of knowledge, know how, practices and representations that are maintained and developed by local communities who have long histories of interaction with the natural environment" (UNESCO, 2012).

Importance of ITK

1. In the emerging global knowledge economy a country's ability to build and mobilize knowledge capital, is equally essential for sustainable development as the availability of physical and financial capital (world bank.1991).
2. The bases component of any country's knowledge system is its indigenous knowledge.
3. It encompasses the skills, experiences and insights of people, applied to maintain or improve their livelihood.
4. Significant contributions to global knowledge have originated from indigenous people for instance in medicine and veterinary medicine with their intimate understanding of their environments.
5. Indigenous knowledge is also the social capital of the poor, their main asset to invest in the struggle for survival.
6. Accordingly, indigenous knowledge is of great relevance for the development process in the following sectors: Agriculture. Animal husbandry and ethnic veterinary medicine. Use and management of natural resources. Primary health care (PHC), preventive medicine and psychosocial care. Saving and lending. Community development and Poverty alleviation.

Sources of ITK

1. Farmers, community members, especially elders are the best source of ITK.
2. Folklore, songs, poetry and theatre can reveal a great deal about people's values, history and practices. These are often not written down and need to be recorded.
3. Community records- although ITK is mostly transmitted by word of mouth. Some indigenous forms or record keeping may exist. These include writings, paintings and carvings and many other forms.

4. People working with communities such as extensionists can be valuable sources of ITK. Other resource persons are local School headmaster, credit cooperative society officials, village milk co-operative members, men and women labourers and village panchayat sarpanch.
5. Secondary sources include published and unpublished documents, databases, videos, photos, museums and exhibits.

Indigenous Knowledge System-Sustainability

1. Indigenous knowledge plays an important role in sustainability through farming system approach (FSA).
2. In FSA, researchers and farmers meet together on a common platform to diagnose the problems that farmers are facing and to develop suitable technologies and scientific knowledge.
3. The knowledge that researchers are bringing is referred to as scientific knowledge, while the technical knowledge of farmers is collected under the term indigenous technical knowledge (ITK).
4. ITK includes information, practices and technologies, beliefs, tools, experimentation, human resources and materials.
5. As farmers participation is key for the success of FSA, their input in the form of ITK is essential for sustainable agricultural development.

Integration of ITKs with Scientific Knowledge

Farmers comparative vis-a-vis scientists it often includes:

a. The experience and discipline from actual farming system and its physical, social and economic development.
b. Continuous observation of changing processes of natural resources.
c. Freedom to make progressive change, managing and adapting sequences, unrestricted by rapid experimental design.
d. Development and adaptation of technology for diverse local condition.
e. The understanding, development and management of technology with many elements and linkages.
f. A long time horizon (unless insecure and desperate).

Scientist's comparative competence vis-a-vis farmers usually includes:

a. Processes where reductionism and precise measurement work well.
b. Breeding and biotechnology.
c. Minute and microscopic phenomena
d. Developing package technology for uniform and widespread conditions.
e. Access to knowledge and genetic from other ITKs may provide solutions for low external input but intensive agricultural production.

A systematic documentation of available ITK facilitates a process in which researchers and farmers learn from each other. In this way, researchers may be facilitated to build on to existing ITK (Chambers, 1991:82).
1. Integration of ITK, with scientific knowledge system is vital for sustainable agriculture.
2. The efficacy and efficiency of locally available treatments can also be improved significantly through modern science.
3. Scientific procedures can identify the active ingredients and could come up with appropriate recommendations in terms of effective application rates.

Roles of Indigenous Knowledge in Development

The very basic fact that sustainable development relies upon participatory approach makes IK an important ingredient for development.

Indigenous knowledge is relevant on three levels for the development process:
1. Local community in which the bearers of such knowledge live and produce.

2. Development agents (CBOs, NGOs, government, donor, local leaders and private sector initiatives) need to recognize it, value it appreciates it in their interaction with the local communities. Before incorporating it in their approaches, they need to understand it-and critically validate it against the use fullness for their intended objectives.
3. Indigenous knowledge form part of the global knowledge. Indigenous knowledge can be preserved, transferred or adopted and adapted elsewhere.

Techniques for Documentation of Indigenous Technical Knowledge

Documentation is the conversion of traditional knowledge information provided by communities into written documents, drawings or audio recordings.

The main aim of documentation is to ensure information is not lost and to protect communities by presenting information is prior art.

Reasons for Documentation of ITK in Agriculture Sector

1. To understand scientific rationale
2. To accelerate technological change.
3. To enable better understanding technology development and development of newer concept.
4. To increase awareness among the younger generation and develop appreciation of traditional systems.
5. To revive and restore pride among the farmers and other practitioners themselves.

Conclusion

1. The knowledge is typical and belongs to peoples from specific places with common cultural and social ties.
2. Indigenous knowledge reflects how such forms of knowledge address local problems and solutions that are context specific.
3. Knowledge centres should be established to collect, promote, protect and preserve traditional knowledge

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Air-Based Protein: Sustainable Protein Source

Article ID: 10676

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Abstract

The ever-increasing growing population led to drastic global food demand in manifold and emphasizes the need of establishing food security. Actually, the concept of food security is not only to fulfil the hungry stomachs but also to provide the people with nutrition security. The present scenario strives the farmers to increase the actual yield of about 70 percent with limited land resources. If the condition progresses further, the food production become much critical and complex which necessitates to explore the sustainable technologies with minimal utilization of the natural sources. The air-based protein technology become one of the best solutions for the innovation of sustainable protein source. The technology is based on utilizing the metabolic pathways of microorganisms for successful transformation of the air constituents by combining with hydrogen and oxygen through electrolysis of water to produce large protein biomass.

Keywords: Air-Based Protein, Food Security, Protein Deficiency, Microbes.

Introduction

The protein sources of plant, animal and insect origin are well explored and established with good scientific data base. However, these conventional sources require huge land area for farming to meet the protein requirement and demand of ever-increasing world population. The condition drives to adopt new approach with focus on efficient sustainable protein source with minimum land resource utility aiming at conservation and maintenance of ecosystem. The research area of air-based protein from the microbes existing in air is the new quest challenging the scientists to streamline the modalities for standardized formulations and to introduce as alternative source to minimize protein gap. Recently, many start-ups are working on the concept of Air-based protein such as Air Protein, Solar foods, NoVo nutrients etc and few of them are at product launching phase. Air-based protein technology offers better solutions associated with numerous existing problems in the processing of conventional protein production system.

Motivational Factors

1. Exponential Population Growth: The world population is growing exponentially as projected to reach 9.9 billion by 2050 accounts to more than 25 percent from the current 2020 population of 7.8 billion. Farmers need to increase food production by 70 percent with only 5 percent cultivable land increase to meet the expected growing population by 2050.

2. Food Security: Ever increasing population, climatic changes, and limited natural resources eventually targeting the people to achieve food security. Global food demand almost tripled over the last 50 years. Sustainable food security sufficiency also involves nutrition security including energy, proteins and micronutrients as well as safety.

3. Protein Deficiency: The major international nutrition and health agencies such as United Nations (UN), Food and Agriculture Organization (FAO) and World Health Organization (WHO) enlighten the countries on protein malnutrition as the major worldwide nutritional problem. Indian diets are predominantly cereal-based and 60 percent of protein derived from cereals has poor digestibility and quality. The condition demands for the innovation of good quality protein of high biological value to mitigate the protein malnutrition.

4. High Protein Content: Air based protein technology uses probiotic production process to convert the elements into a nutrient-rich protein with the same amino acid profile as an animal protein and packed with crucial B vitamins, which are often deficient in a vegan diet. Air based protein contains nine essential amino acids and high protein content ranging from 50 to 83 percent of the dry biomass.

5. Sustainable Protein Source: Current global trends in food consumption are unsustainable emphasises the major thrive for less harmful technologies to the environment during production. Air based technology serves as an ideal protein production technology that can transform the elements of the air we breathe into protein as sustainable and climate resilient food production form.

6. Conservation of Ecosystem: The changing scenarios such as conversion of natural forest resources into cultivable land, altered dietary habits towards increasing consumption of animal protein foods, farming and animal husbandry practices to enhance the yield drastically disrupt the global ecosystem. The revolutionary approach in protein production with less impact on environment is beneficial for the conservation of ecosystem.

Processing Principle

The basic principle underlying the novel Air-based protein is bacterial fermentation for producing protein from the elements present in air such as carbon dioxide, oxygen and nitrogen using microorganisms and a renewable energy source to convert into proteinacious powder base.

Processing Steps

Microbes collection from air

⇓

Screening for best microbes at Lab

⇓

Incubation in flask for multiplication

⇓

Cultivation in bioreactor (Batch/Continuous)

⇓

Capture of CO_2 from atmospheric air/Direct Air Capture

⇓

Production of hydrogen & oxygen through water electrolysis

⇓

Fermentation

⇓

Post-processing of microbial mass

⇓

Air- Based Protein

Unique Features of Air-Based Technology

1. Air-Based protein technology is basically produced from microorganisms existing in the air by utilizing air constituents.

2. The main principal hydrogen trophic metabolic pathways involves carbon dioxide reduction, sulphate reduction, acetogenesis and other hydrogen oxidizing bacteria which can efficiently transform into protein-rich biomass.
3. The production technology is closed system and independent of seasonal, climatic and environmental changes.
4. Consumption of industrial wastes for carbon dioxide protects environment by eliminating greenhouse emissions and in fact the technology is free from herbicides, pesticides, hormones and antibiotics.
5. The land needed for the sake of cultivation of plant-based protein through farming and animal-based proteins through animal rearing shelters is minimized to the greater extent.
6. The food applications include meat alternatives, producing protein enriched pastas, cereals, beverages, sports products and as food additives in various products.

Challenges and Suggestions for Current and Future Research

1. New technology in the field of food industrial sector, lacks awareness and lacuna of scientific knowledge in the establishment of air-based protein production laboratories require lots of efforts.
2. Skilled professionals and labour are required to screen suitable microbes as well as processing air-based protein.
3. Electrolysis of water, an essential processing step in the production of hydrogen and oxygen while converting to protein is an energy intensive process.
4. Extensive and vigorous research is the crucial factor to familiarize the technology for which capital, operational and marketing investments may be much higher initially.
5. Specific Food Safety Protocols and labelling call attention to determine the safety of air-based protein as it is not tuned well in the human food supply chain.
6. Air based protein can be introduced into the public distribution system and supplementary feeding programs to mitigate protein malnutrition.

Conclusion

Air-based technology is the upcoming sustainable protein source obtained from the microorganisms existing in the air. The research is yet at budding stage which need to be propagated in terms of processing and marketing to establish into the mainstream of the human diets as a source of protein. Air-based protein found to be the better solution to meet the demands of food and nutritional security with minimal land utility and lesser impact on environment.

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Organic Agriculture and their Management

Article ID: 10677

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Introduction

Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It is a system that begins to consider potential environmental and social impacts by eliminating the use of synthetic inputs, such as synthetic fertilizers and pesticides, veterinary drugs, genetically modified seeds and breeds, preservatives, additives and irradiation. These are replaced with site-specific management practices that maintain and increase long-term soil fertility and to prevent insect-pests and diseases. Organic agriculture systems and products are not always certified and are referred to as "non-certified organic agriculture or products". This excludes agriculture systems that do not use synthetic inputs by default (e.g., systems that lack soil building practices and degrade land). It can be identified for organic agriculture in many ways:

1. Consumer or market-driven organic agriculture: Products are clearly identified through certification and labelling. Consumers take a conscious decision on how their food is produced, processed, handled and marketed. The consumer therefore has a strong influence over organic production.

2. Farmer-driven organic agriculture: Some farmers believe that conventional agriculture is unsustainable and have developed alternative modes of production to improve their family health, farm economies and/or self-reliance.

Certified Organic Products

Certified organic products are those which have been produced, stored, processed, handled and marketed in accordance with precise technical specifications (standards) and certified as "organic" by a certification body. The essential elements constituting an "organic" product have been met from the farm to the market. It is important to note that an organic label applies to the production process, ensuring that the product has been produced and processed in an ecologically sound manner. The organic label is therefore a production process claim as opposed to a product quality claim.

National Mandatory Standards

The Codex Alimentarius and IFOAM guidelines are minimum standards for organic agriculture, intended to guide governments and private certification bodies in standard setting. As such, they can be considered as standards for standards. APEDA, which is the nodal agency in India, is also adopting both these standards which are legally binding for any organic certification agency.

Organic Food More Expensive than Conventional Food

Certified organic products are generally more expensive than their conventional counterparts (for which prices have been declining) for a number of reasons:

1. Organic food supply is limited as compared to demand.

2. Production costs for organic foods are typically higher because of greater labour inputs per unit of output and because greater diversity of enterprises means economies of scale cannot be achieved.

3. Post-harvest handling of relatively small quantities of organic foods results in higher costs because of the mandatory segregation of organic and conventional produce, especially for processing and transportation.

4. Marketing and the distribution chain for organic products is relatively inefficient and costs are higher because of relatively small volumes.

5. As demand for organic food and products is increasing, technological innovations and economies of scale should reduce costs of production, processing, distribution and marketing for organic produce.

6. Prices of organic foods include not only the cost of the food production itself, but also a range of other factors that are not captured in the price of conventional food, such as:

7. Environmental enhancement and protection (and avoidance of future expenses to mitigate pollution). For example, higher prices of organic cash crops compensate for low financial returns of rotational periods which are necessary to build soil fertility.

8. Higher standards for animal welfare.

9. Avoidance of health risks to farmers due to inappropriate handling of pesticides (and avoidance of future medical expenses).

10. Rural development by generating additional farm employment and assuring a fair and sufficient income to producers.

Non-Certified Organic Food

They are non-sustainable systems which do not use synthetic inputs but which degrade soils due to lack of soil building practices. In developed countries, non-certified organic food is often sold directly to consumers through local community support programmes such as box schemes, farmers markets and at the farm gate.

Benefits for Environment

Organic agriculture considers the medium- and long-term effect of agricultural interventions on the agro-ecosystem. Many changes observed in the environment are long term, occurring slowly over time. It aims to produce food while establishing an ecological balance to prevent soil fertility or pest problems. Organic agriculture takes a proactive approach as opposed to treating problems after they emerge.

Soil

Soil building practices such as crop rotations, inter-cropping, symbiotic associations, cover crops, organic fertilizers and minimum tillage are central to organic practices. These encourage soil fauna and flora, improving soil formation and structure and creating more stable systems.

Water

In many agriculture areas, pollution of groundwater with synthetic fertilizers and pesticides is a major problem. As the use of these is prohibited in organic agriculture, they are replaced by organic fertilizers. (e.g., compost, animal manure, green manure).

Biodiversity of Organic Agriculture

Organic farmers are both customers and users of biodiversity at all different levels.

1. At the gene level, traditional and adapted seeds and breeds are preferred for their greater resistance to diseases and their resilience to climatic stress.

2. At the species level, diverse combinations of plants and animals optimize nutrient and energy cycling for agricultural production.

3. At the ecosystem level, the maintenance of natural areas within and around organic fields and absence of chemical inputs create suitable habitats for wildlife. The lack of pesticide use, attract new or re-colonizing species to the organic area (both permanent and migratory), including wild flora and fauna (e.g., birds) and organisms beneficial to the organic system such as pollinators and pest predators.

Genetically Modified Organisms

The use of GMOs within organic systems is not permitted during any stage of organic food production, processing or handling. As the potential impact of GMOs to both the environment and health is not entirely understood, organic agriculture is taking the precautionary approach and choosing to encourage natural biodiversity.

Ecological and Agro-Ecosystem

The impact of organic agriculture on natural resources favours interactions within the agro-ecosystem that is vital for both agricultural production and nature conservation. Ecological services derived include soil forming and conditioning, soil stabilization, waste recycling, carbon sequestration, nutrients cycling, predation, pollination and habitats. By opting for organic products, the consumer through his/her purchasing power promotes a less polluting agricultural system. The hidden costs of agriculture to the environment in terms of natural resource degradation are reduced.

Food Security

Global food production is more than enough to feed the global population, the problem is getting it to the people who need it. In market-marginalized areas, organic farmers can increase food production by managing local resources without having to rely on external inputs or food distribution systems over which they have little control and/or access. The market returns from organic agriculture can potentially contribute to local food security by increasing family incomes. At the global level, however, and with the present state of knowledge and technology, organic farmers cannot produce enough food for everybody.

Organic Agriculture and Food Security

No global evaluation on the contribution of organic agriculture to food security exists, essentially due to the small place it occupies within the agriculture sector as a whole. Projections are also difficult to make due to lack of data, lack of a common model for data collection and analysis, as well as rapid changes in agricultural technology and development policies.

Conclusion

Food security is not only a question of the ability to produce food, but also of the ability to access food Persisting world hunger has demonstrated that agriculture alone (be it conventional or not) cannot alone solve food insecurity. Still, many questions are asked with regards to the ability of organic agriculture to provide food and many speculations are made, without any comprehensive data basis.

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Seed Production Technology of Radish

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Radish *(Raphanus sativus)* belongs to the family Brassicacea. Chromosome No = 2n =18. Origin- Europe, Western Asia, Radish is grown for its tender tuberous roots which are eaten raw as salad or as cooked vegetable. The commonly eaten portion of radish is the napiform taproot. It has a unique pungent flavour. It is also used in Parathas which are taken with curd for breakfast in north India. It has a cooling effect, prevents constipation and increases appetite and is more nutritious when cooked with leaves. Young leaves are also cooked as vegetable. It is recommended for patients suffering from piles, liver troubles, jaundice etc. It is an important point that every person should know the nutritional values of radish. Remember that radish is rich in carbohydrates, dietary fibres, fat, protein, thiamine, riboflavin, pantothenic acid, vitamin C, Mg, Ca, P, Zn & K. Among these, thiamine is known as vitamin B_1. Vitamin B & Vitamin C are water soluble vitamins. Also note that riboflavin is known as vitamin B_2 & pantothenic acid as vitamin B_5 respectively. Another interesting fact is that vitamin C is known as ascorbic acid. So, remember that radish is mainly used in salads & several dishes.

Behaviour of Radish to Produce Seed

1. Radish is a long day crop and produce seeds with the advent of spring.
2. The tropical zed Asiatic cultivars mainly developed in India are high temperature tolerant and behave like annual and set seeds freely in the plains after wither months with the advent of long day condition in the spring.
3. The Chinese and Japanese radishes are not true biennial but require low temperature for bolting and seed set. Seeds of this type are produced in low hill situation.
4. Radish bears hermaphrodite flowers but varying levels of cross-fertilization takes place even up to 80 per cent in different open-pollinated varieties due to manifestation of self-incompatibility of different intensities.

Radish is a highly cross-pollinated and entomophilies in nature. The development of seed production in radish (both European and Asiatic types) can be made by the following methods:

a. Emasculation and hand pollination.
b. Free insect pollination.
c. Using self-incompatible lines.
d. Using male sterile lines.

Seed Production Mechanisms

Climate and Soil: Radish is predominantly a cool season crop and grows best in mild and cool climate, the tropicalized Asiatic types can’t tolerate high temperature than the temperate types. For seed production, a less humid climate is desirable. Long spells of hot dry periods are not suitable for seed production. Temperatures of 32 o c or above can cause the stigma to dry and the pollen may fail to germinate. Radish can be grown in slightly acidic soil also with soil pH ranging between 5.5 and 6.8. In the hills, the seed fields are so selected that the same kind of crop was not grown within the previous two years.

Varieties

Asiatic Cultivars: Pusa Reshmi, Pusa Chetki, Pusa Desi, Kashi Sweta, Arka Nishant, Bombay Red, Punjab Safed, Punjab Ageti, Kalynapur No-1, Chinese pink, Kashi Swta, Kashi Hans.

European cultivars: Scarlet Long, Wood Long Frame, French breakfast, Rapid Red White Tipped, White Icicle, Scarlet Globe, Pusa Himani, Pusa Mridula.

Field Preparation: One ploughing with a soil turning plough and two ploughings with cultivation followed by planking. It will bring the soil to good tilth. The soil should not contain any undecompesed organic matter, because they may result in forking or misshapen roots.

Seed Rate

1. 10-12 kg seed /ha.
2. For F1 (CMS based): 600 g female and 200 g male.
3. For F1 (SIC based): 500 g male, 500 g female.

Seed Treatment

Seed treatment should be done before sowing with any mercurial fungicide @ 2 g/kg of seed.

Soil

Soil building practices such as crop rotations, inter-cropping, symbiotic associations, cover crops, organic fertilizers and minimum tillage are central to organic practices. These encourage soil fauna and flora, improving soil formation and structure and creating more stable systems.

Sowing Season

1. Asiatic types = Early to third week of October - in plains
2. European types = Second fortnight of September to middle of October and first fortnightly of March - hills.
3. September – October Generally followed (for seed production).

Sowing Method

Generally sowing of radish in major growing areas is carried out by hand on the ridges.

Isolation

Radish is cross-pollinated by insects, chiefly honey bees. Seed yield in radish is greatly influenced by the number of honeybees visiting the flowers.

Foundation seed - 1600 metres.
Certified seed - 1000 metres.

Spacing for Seed Production

1. Asiatic type = 60 x 30 cm and 90 x 20 cm.
2. European type = 45 x 30 cm.

Fertilizer Application

Apply FYM at 25 t/ha and 150 kg N, 80 kg P and 80 kg K/ha as basal dressing and 25 kg N/ha. Use full doses of P, K and half of N as based dose. The remaining half N should be applied in two split doses–one at 20 days after the seed germination and again at root development stage.

Inter-Cultural Operation

1. Thin out: The extra plants after 15 days of sowing to maintain optimum plant population and intercultural practices.
2. Weeding: The crop should be kept free from weeds. Regular hand weeding is necessary to check the growth of weeds. Pre-sowing application of Tok E-25 (Nitrofen 25%) @ 2.0-2.5 kg a.i./ha controls weeds effectively in the field.

3. Earthing up: After 30-35 days of sowing is necessary to get quality r5oots.
4. Staking: Sometimes staking is done to provide support to the seed stalks.

Irrigation

It is given as per the requirement of the crop. The irrigation requirement of radish is One or two irrigations may be given after flowering which results in better seed yield. It is advised to give irrigation in.
1. Kharif season - at an interval of 10-15 days.
2. Rabi season - at an interval of 8-10 days.
3. Summer season - at an of weekly interval.

Seed Production Methodology

Root to seed (Transplanting): This method gives high quality seed as compare to the in-situ method because the transplanting method gives an opportunity to select the desired roots.

Selection of Roots:

a. Uniform true-to-type desired roots are selected.
b. These roots are slant cut leaving ca. 10 cm from the top.
c. The leaves are also cut leaving ca. 8 cm attached with the roots.
d. Now the stecklings are ready for transplanting. These stecklings are treated with Bavistin powder at the cut end before transplanting.

Seed-to-seed (in-situ): This method usually commercial marked seed of both Asiatic and European varieties are grown by this simpler method. The annual radish crop is sown during October in the plain and the temperate radish is sown in mid-September to mid-October in the hill condition in a well-prepared land. The crop is allowed to growing and produce seeds at their original position rouging should be done to raise seed-to-seed crop.

Rouging

At the vegetative stage rouge out the volunteer and off type plants from the field. The times of flowering initiation rogue out the fertile plants (from male sterile) and other types from the female rows.

Production Technology for Better Yield

1. Sowing north-south direction gives better yield than east-west direction.
2. Application of 5 kg sulphur and 250 g boron per acre where the soils are deficient in these 2 nutrients increases seed yield of radish.
3. Having a seed production program under a favourable environment where the self-incompatibility reaction is not adversely affected can reduce the production of seeds.
4. For effective hybrid seed production-utilizing self-incompatible lines frequent cross-pollination is essential.
5. Synchronization in male and female parents is of immense importance, so adjust the planting dates for proper synchronization to get maximum yield.

Plant Protection Measures

1. Major Insects: Aphids, Mustard sawfly.
2. Disease: Damping off, White rust, Alternaria blight.
3. Control Measures: To control the disease the seed should be treated before sowing with Thira or Captan @ 2 gm/kg seed and on the occurrence of disease spray Dithane M-45 or Blitox @ 0.2% at 15 days interval.

Harvesting

1. Harvest the crop when 75% pods/siliques have turned yellowish.
2. The drier the pods, the more easily will they break open during the threshing process.

3. If there is no problem of shattering in radish, because the pods do not dehisce.
4. Since there is no natural dehiscence, the pods are allowed to mature and ripe fully before they are harvested.
5. The crop is cut by sickle and brought to threshing floor for threshing.

Threshing Methods

There is more often considerable difficulty in threshing the seed from the pod. Frequently, the pod will not break and let the seed escape. It is, therefore, important to thoroughly dry the pod and seed before commencing the threshing. Threshing should be done either by using the stick or by tractor or thresher/bullock.

Seed Yield

Asiatic Type - 500 to 1000 kg/ha.
European Type - 500 to 600 kg/ha.

COVID-19 and National Lockdown- Impact on Agriculture

Article ID: 10680

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Introduction

India has taken early action to limit the spread of COVID-19, ordering a 21-day nationwide lockdown for its population of 1.3 billion people starting March 25. The novel coronavirus has spread widely in India relatively recently compared to other countries, and the number of reported infections is low so far, with 5,274 cases and 149 deaths as of April 8. However, as COVID-19 cases are increasing fast, there is great concern about the disease's potential spread and impact. India has to be ready for a possible surge. Testing should be expanded significantly. The government views the pattern of the spread of COVID-19 as similar to the 2009 H1N1 influenza pandemic, meaning the spread is unlikely to be uniform. After the 21-day period expires, it is planning to maintain the full lockdown in "hotspot" areas and relax it in other places. These measures may help in limiting the health crisis, but as in other countries the complete shutdown of all economic activities except essential services will create an economic crisis and misery for the poor, with massive job losses and rising food insecurity. The economic shock will likely be much more severe for India, for two reasons. First, pre- COVID-19, the economy was already slowing down, compounding existing problems of unemployment, low incomes, rural distress, malnutrition, and widespread inequality. Second, India's large informal sector is particularly vulnerable. Out of the national total 465 million workers, around 91% (422 million) were informal workers in 2017-18. Lacking regular salaries or incomes, these agriculture, migrant, and other informal workers would be hardest-hit during the lockdown period. Here, I focus on the likely impacts on agriculture, supply chains, food and nutrition security and livelihoods.

Agriculture & Supply Chain

COVID-19 is disrupting some activities in agriculture and supply chains. Preliminary reports show that the non-availability of migrant labor is interrupting some harvesting activities, particularly in northwest India where wheat and pulses are being harvested. There are disruptions in supply chains because of transportation problems and other issues. Prices have declined for wheat, vegetables, and other crops, yet consumers are often paying more. Media reports show that the closure of hotels, restaurants, sweet shops, and tea shops during the lockdown is already depressing milk sales. Meanwhile, poultry farmers have been badly hit due to misinformation, particularly on social media, that chicken are the carriers of COVID-19.

Here are some measures are required to keep the agricultural sector and supply chains working smoothly:

1. The government has correctly issued lockdown guidelines that exempt farm operations and supply chains. But implementation problems leading to labor shortages and falling prices should be rectified.
2. Keeping supply chains functioning well is crucial to food security. It should be noted that 2 to 3 million deaths in the Bengal famine of 1943 were due to food supply disruptions—not a lack of food availability.
3. Farm populations must be protected from the coronavirus to the extent possible by testing and practicing social distancing.
4. Farmers must have continued access to markets. This can be a mix of private markets and government procurement.
5. Small poultry and dairy farmers need more targeted help, as their pandemic-related input supply and market-access problems are urgent.
6. Farmers and agricultural workers should be included in the government's assistance package and any social protection programs addressing the crisis.

7. As lockdown measures have increased, demand has risen for home delivery of groceries and E-commerce. This trend should be encouraged and promoted.
8. The government should promote trade by avoiding export bans and import restrictions.

The lockdown has choked off almost all economic activity. In urban areas, leading to the widespread loss of jobs and incomes for informal workers and the poor. Estimates by the Centre for Monitoring Indian Economy show that unemployment shot up from 8.4% in mid-March to 23% in the first week of April. In urban areas, unemployment soared to 30.9% as of April 5. The shutdown will cause untold misery for informal workers and the poor, who lead precarious lives facing hunger and malnutrition.

The best way to address this urgent need is to use social safety nets extensively to stabilize their lives with food and cash.

The Indian government has quickly responded to the crisis and announced a $22 billion relief package, which includes food and cash transfers. Several state governments have announced their own support packages. The central government's relief package, called Pradhan Mantri Garib Kalyan Yojana (Prime Minister's plan for well-being of the poor), is aimed at providing safety nets for those hit the hardest by the COVID-19 lockdown. However, it is inadequate compared to the enormous scale of the problem. Nobel Prize economists Esther Duflo and Abhijit Banerji say that the government should have been much bolder with the package's social transfer schemes. The $22 billion in spending is only 0.85% of India's GDP. This is much lower than the packages passed by the United States, European and some Asian countries. India should think bigger, and be spending at least 4% to 5% of GDP. The central and state governments must spend more, even if there is one-time hike in the fiscal deficit.

Below are some additional measures needed in addition to the government package:
1. Food and nutrition security: Government warehouses are overflowing with 71 million tons of rice and wheat. In order to avoid exclusion errors, it is better to offer universal coverage of distribution in the next few months. Nutrition programs like Integrated Child Development Services (ICDS), mid-day meals, and Anganwadis (rural child care centres) should continue to work as essential services and provide rations and meals to recipients at home. Eggs can be added to improve nutrition for children and women. Several state governments have started innovative programs to help informal workers and the poor. For example, the Kerala government is providing meals with diversified diets at the doorsteps of households.

2. Cash transfers: Unemployed informal workers need cash income support. The government has provided Rs. 500 ($6.60) per month to the bank accounts of 200 million women via the Jan Dhan financial inclusion program. But this too is insufficient. We need to have a minimum of Rs.3000 ($40) per month in cash transfers for the next three months

3. Migrant workers: There are about 40-50 million seasonal migrant workers in India. In recent days, global media have broadcast images of hundreds of thousands of migrant workers from several states trudging for miles and miles on highways; some walked more than 1000 kilometers to return to their home villages. They should be given both cash transfers and nutritious food.

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Use of Minerals Isotopes in Nutritional Studies

Article ID: 10681

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Introduction

Isotopes are atoms of the same element that have different numbers of neutrons in their nuclei. Isotopes may be stable or unstable. The unstable ones emit radiation, and the stable ones do not. When isotopes were introduced into the human body, they can be detected by radiation or other means.

Applications of isotope techniques in nutritional sciences are progressing very rapidly in key areas of nutrition and health: assessment of nutritional status, nutrient requirements, and micronutrient malnutrition; detection of infections; analysis of foods; and air pollution measurements.

The isotopes, used in conjunction with sophisticated equipment, give medical professionals a powerful "window" into the body, allowing them to diagnose diseases, study biological processes and investigate the movement and metabolism of drugs in living people.

Mainly the isotopic techniques are used in measurements of breast-milk intake, energy expenditure, micro/macronutrient status/bioavailability and body composition. The stable isotope techniques, although still costly, can be used effectively by food industry for developing nutrient-fortified food products. This stable isotope technique can be used by governmental and international institutions for designing food fortification programs and public health authorities for establishing reliable dietary recommendations for intake of inorganic nutrients.

Due to a greater sensibility of the scientific community towards the use of radioactive substances in healthy volunteer as well as to the availability of new and improved analytical techniques such as Inductively Coupled Plasma Mass Spectrometry, Accelerator Mass Spectrometry, Charged Particle Activation Analysis and Thermal Ionization Mass Spectrometry.

Metabolic Fate of Isotopes in Human Body

Stable isotopes are valuable tools for studies of mineral metabolism in humans. A number of approaches can be used to determine absorption. The most common method used is to administer isotopes orally followed by complete stool collections.

It is assumed that the isotopes administered and not recovered in the stools were absorbed. Isotopes may be administered in a single bolus, added to a single meal or multiple meals, or incorporated into a food intrinsically. It is critical when using this approach to ensure complete stool collections. If collections are not complete, absorption will be overestimated.

When using fecal monitoring to determine absorption, some of the tracer that was fed is absorbed and excreted into the gastrointestinal tract, resulting in absorption being underestimated. The degree of the underestimation varies depending on the mineral studied, and is greatest when the primary route of excretion is via the bile into the gastrointestinal tract.

Correction for the excretion can be made by administering another isotope of the same mineral intravenously and determining the fraction excreted into the stools. Iron absorption can be determined in human by administering an isotope orally and measuring its incorporation into erythrocytes approximately 2 wk after administration (Fomon et al., 1988).

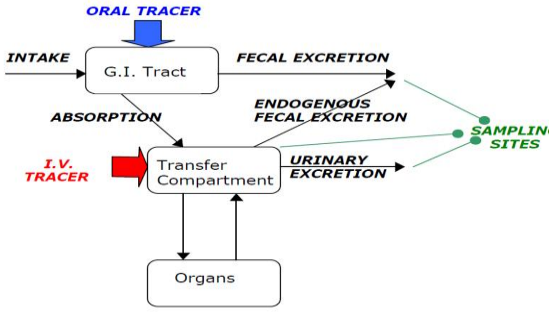

Fig 1: Simplified scheme of the distribution of an element in the organism, as can be studied using the double stable tracer techniques.

Many naturally occurring elements exist as a mixture of two or more stable non-radioactive isotopic forms. There are heavy stable isotopes (^{54}Fe, ^{56}Fe, ^{57}Fe, ^{58}Fe, ^{64}Zn, ^{66}Zn, ^{68}Zn, ^{70}Zn) and light stable isotopes (^{1}H, ^{2}H,^{13}C, ^{12}C, ^{15}N, ^{14}N, ^{16}O, ^{17}O, ^{18}O). The stable isotopes can be administered either orally or intravenously. Stable isotope tracers have several limitations. Stable isotopes cannot be localized in vivo. Sample preparation can be laborious and costly and instruments are more expensive than those used for radioisotopes.

Uses of Isotopes in Nutrition Research

1. Estimation of total energy expenditure: Estimation of total energy expenditure is used to determine the caloric expenditure of people in their normal environment and also can be applied under field conditions. After administration of a simple dose of doubly labelled water, $^{2}H_2{}^{18}O$, both isotopes equilibrate with total body water and are eliminated differentially in body fluids over a period of days. Deuterium (^{2}H) leaves the body as water and ^{18}O leaves it as water and CO_2. Thus, the difference the rate of loss of the two isotopes (^{18}O and ^{2}H) is used to calculate CO2 production of the subject, which in turn is used to calculate energy expenditure.

2. Estimation of Body Composition: A trace dose of water labelled with ^{2}H or ^{18}O is administered and allowed to equilibrate for 4-6 hours. Isotope enrichment in urine or saliva samples is measured to calculate body water volume. Total body water is used to quantify fat-free mass. Body composition is calculated from measured body water and the hydration coefficient of fat-free mass. The amount of adipose tissue is calculated as the difference between total body weight and fat-free mass.

3. Breast Milk Intake: The mother is given a dose of ^{2}H- or ^{18}O-labeled water, which mixes with the body water pool and is transferred to the baby via the breast milk. By collecting samples of the mother's saliva or milk and the baby's saliva or urine, the breast milk intake of the baby can be calculated.

4. Minerals/ Trace Element Bioavailability: The uptake and metabolism of labelled micronutrients can be traced *in-vivo*. In fact, stable isotopes techniques provide the most reliable way of measuring the uptake and bioavailability of trace elements in humans. This technique can be used to determine the effectiveness of fortification and supplementation programs in several developing countries and could be useful to assess the success of new programs in any countries.

5. Analysis of Foods: Neutron Activation Analysis (NAA) is very effective technique due to its exceptional sensitivity for several trace elements. Inductively Coupled Plasma Mass Spectrometry (ICP-MS) also offers multi-element determinations.

6. Osteoporosis: Low energy x-rays are passed through the bones to measure the mineral calcium) content of the bones using DEXA (Dual Energy X-ray Absorptiometry). The precision of DEXA is very high and the data can be standardized for age, weight, height and ethnic status.

7. Detection of Infection: The ^{13}C-urea breath test is used to detect *Helicobacter pylori* infection in humans. Breath is collected for a base value before a ^{13}C-labeled urea is administered. The enzyme urease of *H. pylori* breaks down the urea into ammonium and labelled bicarbonate. The latter compound will be metabolized by the person into carbon dioxide and expired. After 20-30 minutes a second breath sample is collected and measured for the label.

Major Consideration in Stable Isotope Studies of Minerals Nutrition

In determining the dose of an isotope to be administered, isotopic abundances must be considered, as well as the fractions of the dose expected in the samples to be collected, the total quantity of the element in those samples, the length of time detectable enrichment is required, and the precision of the ratio measurements. All these factors must be considered to design and conduct a successful, cost-effective experiment. However, with the introduction of user-friendly software to aid data analysis and computer modelling, advances have been made in the determination of mineral status by measuring exchangeable pools and compartmental modelling.

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Sehund: Poison or Medicine

Article ID: 10682

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***Euphorbia neriifolia* Linn. (Sehund)**

Introduction

Sehund (*Euphorbia neriifolia* Linn.) belonged to family *Euphorbiaceae*, is popularly known by the name of Ilachevikalli in Siddha, Sehundah in Ayurveda, Zaqqum in Urdu, Snuhi in Sanskrit, Dotathur in Rajasthan, Danda Thohar in Punjab, Siju in Oriya, Ilakkalli in Malayalam, Thor in Gujrati, Dog's Tongue in English, and Shij in Bengal (Pracheta et al., 2011). The Euphorbias are named on a Greek surgeon "Euphorbus". He used the latex of Euphorbia as a potion for the treatment of the Romanised king of the North African Kingdom (Upadhyaya and Sathish, 2017).

Case Study

The roots and leaves of this plant are used as poison for fish. Due to the milky latex part, the Sehund is regarded as the toxic plant. The latex of Euphorbia plant is a highly irritant to the eye and skin. A few cases of Keratouveitis and deliberate ingestion of milky latex have been reported.

A 51-year-old man experienced the accidental entering of sap into his left eye when he was trimming the overgrown plantation of *E. neriifolia* in his garden. Initially, he felt some irritation and immediately washed his eye with water. But after 4 hours, he presented blurring vision and inflammation in his eye. His visual acuity decreased to 20/60. Clinical finding varied from secondary elevated intraocular pressure, anterior uveitis, epithelial defects, mild to severe corneal edema, and kerato-conjunctivitis. All the signs and symptoms had cured within the time-period of 10-15 days under medical supervision. It is advised to wear eye protection whenever you deal with Sehund (Upadhyaya and Sathish, 2017).

One rare case of latex ingestion has been reported in Kannada, Karnataka where a 20-year-old girl drank 100 ml of latex plus water mixture because of a quarrel with her mother. On hospitalization, she experienced burning pain in her stomach and vomited twice. No symptom of diarrhea has been reported. On examination, everything such as haemoglobin, differential count, blood urea, total leucocyte count, urine test, and vital parameters were normal except mild discomfort in the abdomen. She was managed with parental ondansetron, antacid, parenteral ranitidine, I.V. fluids and discharged after 2 days. No symptom of systemic toxicity was experienced, this was due to the latex dilution with water.

Properties of Sehund

Sehund is associated with properties such as Laghu (light), Katu (pungent), Snigdha (oily), and Ushnaveerya (hot). It is a branched shrub with fleshy leaves, milky latex, stipular thorns, cylindrical stem, and reticulated bark which is distributed throughout the Deccan Peninsula of India. In Ayurveda, roots, leaves and whole part of the plant are used in the cure of fever, ulcers, anaemia, bleeding piles, cough and cold, inflammation, pain, leucoderma, tumor, bronchitis, and abdominal troubles. The latex is utilized in earache, to remove warts and as an aphrodisiac, rubefacient, and expectorant (Janmeda et al., 2011).

Phytochemicals and their Biological Activity

Phytochemical analysis revealed the isolation of triterpenes such as glut-5-en-3b-ol, glut-5(10)-en-1-one, b-amyrin, taraxerol, nerifoliene, euphorbol, euphol, cycloartenol, nerifolione from leaf, whole plant, root, bark, and latex. Diterpenes such as ingenol triacetate, 12-deoxy-4b-phorbol-13- dodecanoate-20-acetate, antiquorin, and anthocyanin like tulipanin and delphin were isolated from root and bark with variable biological activity. The pharmacological study determined the efficacy of the leaf as immunomodulator, wound healer, and in-vitro antioxidant, latex extract as an anti-inflammatory, antiarthritic, and cytotoxic (Bigoniya and Rana, 2008).

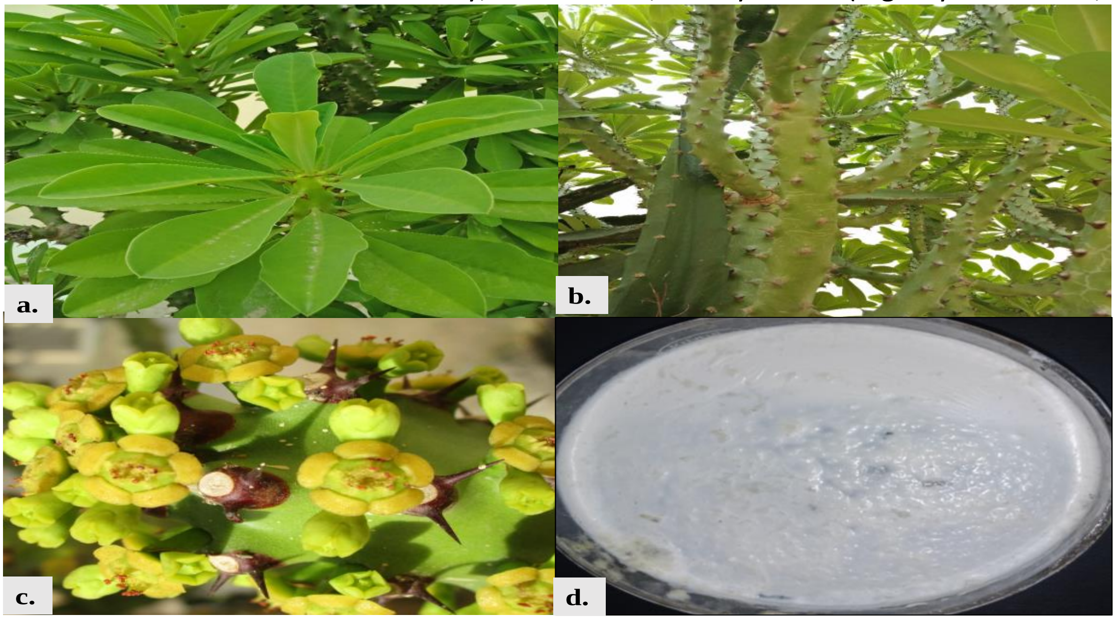

Fig 1: Medicinal parts of Sehund: a. Leaf, b. Stem, c. Flower, d. Latex

Therapeutic Value of Sehund

For a long, Sehund has been used as a medicinal plant for the treatment of various diseases. The villagers of Chhattisgarh prefer to use Sehund externally as well as internally but under the prescription of the traditional healer as the overdose of this can result in loose motion and vomiting.

The warm leaves of Sehund provide relief in piles swelling and itching pain. The ash of Sehund wood and Kali Mirch is prescribed with sugar to patients who suffer from chronic respiratory illness. Children administered the extract of Sehund leaf with honey and common salt to relieve their respiratory trouble (Pracheta et al., 2011).

For deep cracks, the milk of Sehund is used in castor oil with salt by the natives of Chhattisgarh. The Sehund milk has wound healing properties and is commonly applied to a burn area like an aloe vera gel. Boiled milk of Sehund in neem oil is applied to the affected area for the treatment of rheumatism. The prepared formulation of bare-root in boiled rice water is mixed with Kali Mirch and applied externally on snake bites and scorpion sting.

Sehund is not only utilized for remedial purposes, but also used in the form of field fencing by the farmers to restrict the entry of animals to crop fields as this plant is full of spikes. Sehund has an allelopathic effect on the growth of weeds in crop fields. It is also reported to have pesticidal and insecticidal properties that's why farmers prefer to grow this plant as a guard crop surrounding the Kalmegh and Marigold plantation. Herbal application of Sehund in the form of the allelopathic herb, live fance, natural pesticide, and natural medicine emphasized the higher potential of this plant (Thorat and Bolli, 2017).

From the above cases, we came to know that the accidental exposure and ingestion of poisonous latex can be cured easily under the take care of medical experts. Sehund is the important constituent of "Kshaarasootra", which is utilized in Indian medicine for the cure of anal-fistula. "Kshaarasootra" is prepared by applying the fresh latex of sehund on the surgical thread, turmeric powder of Curcuma longa, and alkaline powder of Achyranthes aspera. Indian Council of Medical Research (ICMR) has carried out a trial on 265 patients to test the efficacy of "Kshaarasootra" in the treatment of fistula-in-ano. The results indicated that the outcome of Kshaarasootra was better with recurrence in 4 patients as compared to surgery with recurrence in 11 patients but the healing time is more in Kshaarasootra than in surgery. In chronic fistula-in-ano, "Kshaarasootra" offered a safe, ambulatory, and effective treatment. This determines the fact that the Sehund is poisonous yet medicinal (Upadhyaya and Sathish, 2017).

Conclusion

According to a literature survey, mainly the therapeutic activities of Sehund are reported from the leaf or from the fraction of ethanol. Ethanol fractions comprises of triterpenoidal saponin, alkaloids, tannins, flavonoids, and reducing sugar. Method for triterpenoidal saponins isolation from the latex of sehund has been established. Similarly, for other remaining compounds, the isolation methods are needed to be developed. The extracts and isolates of Sehund can be investigated further for their therapeutic application with the help of modern methods. Molecular mechanisms should also be determined for therapeutic applications. Therefore, the research on Sehund must be undertaken in order to find out ways for its safe and gainful utilization, while inhibiting its deleterious effects.

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Role of Traditional Folk Media in Rural Development

Article ID: 10683

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Summary
The traditional media are the most important means and can be used to reach the rural people in the process of change and development. These media have a remarkable impact on rural society because of their acceptable idioms, functional significance and entertainment component. Folk media can overcome the difficulty of language, speech, words and other barriers of communication like, interest, understanding, interpretation, attitude and perception. The power of folk media in behavioural change of rural community results largely from the media's originality, the audience's belief and trust in the sources of the messages. Therefore, we need to keep our traditional media alive by continuously and cautiously safeguarding and preserving from the adverse effects of globalization.

Introduction
Traditional media means the mediums through which the cultural traits passed from generation to generation. In every society there are various forms of communication among the rural people. Some channels of communication are deeply rooted in the culture and preserved traditionally from generation to generation. Traditional Folk Media is a term used to denote "People's Performances" and describes folk dance, rural drama and musical variety of the village people. This term speaks of those performing arts which are cultural symbols of people. These media have innumerable influences on all sections of people. It has a remarkable impact on the rural society because of their acceptable idioms, functional significance and entertainment component. They serve various social needs of community. They are direct, face to face and linked with emotions and values of people. They are cheap and do not require external resources. Their special nature is derived from the fact that they have no grammars or literature, yet they are nurtured through oral and functional source. Folk media can overcome the difficulty of languages, speech, words and other barriers of communication, like interest, understanding, interpretation, attitude, perception and mood.

Forms of Traditional Folk Media
1. Oral tradition: Oral tradition refers to those forms of traditional utterances which are verbal, i.e., spoken, sung and voiced. Examples: songs, tales, poetry, ballads, rhymes, proverbs and elaborate epics.

2. Material culture: Material culture includes these visible aspects of folk behaviour. Examples: skills, clothes, farming, fishing and various other types of tools and machinery.

3. Social folk customs: Social folk customs emphasize activities that involve the group or the community. Examples: festivals, fairs, ritual and ceremonial gatherings, market occasions.

4. Performing arts: Performing arts are those aspects of folk culture which are most colourful and vibrant and which enable other people to identify a particular culture. Examples: traditional music, dance and drama.

Types of Traditional Folk Media
According to Parmar (1975), some of the traditional folk forms of entertainment situations and institutions are:
1. Traditional folk theatres of rural dramatic forms including tribal dance-dramas.
2. Puppetry.
3. Oral-cum-musical forms, folk musical styles, ballads, Harikatha, storytelling etc.

4. Fairs and festivals including social, ritual and ceremonial gathering.
5. Traditional youth clubs like ghotul of tribal of Bastar or the Dhumkuria of the Oraon of Jharkhand.
6. Folk dances.
7. Ritual symbols and Traditional designs.
8. Sound signals and speech surrogates.

Why Traditional Media?

In India, modern mass media alone does not constitute the sum total of communication channels. The use of these media is limited largely to the urban population and upper segment of society. Millions of people in rural areas have no regular access to such mass media because of poverty and illiteracy. Also, these channels have limited coverage, are more rigid, and local people are often sceptical about externally controlled channels and information. To them, the mass media proved to be glamorous, impersonal and unbelievable in comparison with the familiar performance of traditional artist whom the villagers could not only see and hear but even touch emotionally.

Advantages of Traditional Folk Media

Advantages of the traditional folk media over the radio and television are many, particularly in the rural and tribal areas of the country. They are as follows:

1. Traditional folk media are most intimate with the masses in all the regions of the country. Their primary appeal is to the emotions rather than intellect.
2. They command an immense variety of forms and themes to suit the communication requirements of the masses.
3. They are local and live, and able to establish direct rapport with the audiences as they antecede the mass media.
4. They are easily available to their customers.
5. They are flexible to accommodate new themes.
6. They are enjoyed and approved by all the age groups.
7. They are low- cost media as compared to the sophisticated mass media.
8. They are people oriented. They involve people both as resource (talents) and audience. People have control over it.
9. They are credible and culturally compatible. As people believe them and can understand them easily, they are acceptable in rural society.
10. They are capable of raising public consciousness. As indigenous channels are popular and linked with the emotions and aspirations of people, they have great appeal to the masses. Messages of development can be effectively communicated in local idioms, proverbs and symbols.

Role of Folk Media

Folk media play very important role on the rural citizens of our country. The rural people are mostly, illiterate, simple and ignorant as well, and this is why 'Folk Media have come to be very suitable to all of them. As the messages delivered by the folk media are easy and understandable quickly as well, so, the villagers can enjoy its presented program as a whole. Folk media carry diverse messages of education, political, social, healthcare and agricultural innovation. The predominant emphasis of rural people, has been mostly utilized by the folk media, through their presentation of varied programmes, that contribute to the development of rural sector significantly.

Traditional media has greatest appeal to the masses and have qualities of touching the deepest emotions of the illiterate millions. Among this puppetry is believed to be the oldest form of popular theatre in India. It is important for communicating technology to the farmers in the village life, its problems and solutions. Folk theatre form like Tamasha, Nautani, Keertana or Harikatha attract the rural audiences most, so people can be educated through the mediums to bring about desirable changes in their behaviour. Street play is not like theatre but it attracts a large number of people. The villagers have a great fascination for their folk dances and folk songs. Melas or country fairs are synonymous with joy and gaiety and in the rural areas where life follows a hard routine; nothing is more welcome to the people than the prospect of a festival and mela. Story telling has been one of the best and most commonly used method of instruction in informal education, religious propagation, rural development etc. Riddle is also and educational device through which elders sued to communicate knowledge. Proverbs which predominate in oral civilization represent the essence of rural wisdom and knowledge. Bioscope is also a popular folk medium sued for entertainment and for propagation of information on education, agriculture etc.

Conclusion

There is big gap between the modern scientific knowledge and the knowledge possessed by the common masses. This gap is to be bridged by communicating effectively the developmental information to the rural masses. The messages communicated through the traditional media gain access to the mind through audio and video effects. The use of the eyes and the mind produces a sense of richness in meaning on the individuals. This mental reaction is both intellectual and emotional. They create a high degree of interest and make learning more permanent.

Zero Budget Natural Farming in Tamil Nadu

Article ID: 10684

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Introduction

Zero-Budget Natural Farming (ZBNF) is a holistic alternative to the current concept of high-cost chemical inputs-based agriculture. It is very efficient in addressing the worries of environment change1. Alternative low-input farming practices have emerged in India and across the world likely to reduce input costs and higher yields for farmers, chemical-free food for consumers and improved soil fertility. Zero Budget Natural Farming (ZBNF) is one such low-input, climate-resilient agriculture that inspires farmers to use low-cost and locally-sourced and available inputs, eliminating the use of artificial/ chemical fertilizers and industrial pesticides. Organic / natural farming is native to India. The farmers of ancient India were known to have evolved naturally-friendly farming systems and practices such as mixed farming, mixed cropping and crop rotation3. Organic farming is in a growing stage in India. About 2.78 million hectares of farmland was under organic agriculture as of March 2020, according to the Union Ministry of Agriculture and Farmers' Welfare. This is two per cent of the 140.1 million ha net sown area in the nation.

Abstract: Micro Organisms, Leaf Roller, Stream Borer, Fruit Borer, Pod Borer.

Importance of Desi Cow in ZBNF

1. One gram of Desi cow dung includes 300 to 500 crores of advantageous efficient microbes.
2. Microorganisms decompose the dried biomass on the soil and compose accessible the nutrients to the foliage land.
3. All Indian cow breeds are appropriate for ZBNF.

Four Pillars of Zero Budget Natural Farming

1. Bijamrita (Seed Treatment): It is a mixture of water, cow dung, cow urine, lime and forest soil, which is used to treat seeds, seedlings or any planting substance which protects from soil and seed bear pathogens.

2. Jiwamrita (No Fertilizers No Pesticides):

a. It is a mixture of water, cow dung, cow urine, jaggery (unrefined brown sugar), flour of any pulse when applied over soil promotes biological activity and adds soil microbes.

b. It acts as a catalytic representative to promote biological activity, thereby breaks the nutrients obtainable in the soil by growing soil microbes.

c. When we relate Jiwamrita to the dirt, we pin nearly 500 crores micro-organism to the soil.

d. These micro-organisms adapt the non-available form of nutrients - nitrogen, phosphate, potash, iron, sulphur, calcium, etc - into accessible forms.

e. Two hundred liters per acre per month is sufficient as a culture to renovate the soil.

f. Once you apply Jiwamrita to the soil, the earthworms begin their work and they can bring the nutrients from 15 feet deeper in the soil to the upper surface and make them available to the roots

g. These earthworms, microorganisms and other insects need a positive micro-climate, i.e. 25 to 32 °C temperature.

h. When we mulch the soil, this micro-climate or humus is shaped automatically.

3. Mulching (Soil, Straw & Live):

a. It is necessary to create the microclimate under which micro-organisms can well develop, that is 25 to 32 °C temperature, 65 to 72 % moisture.

b. It creates darkness and warmth in the soil.

c. It conserves humidity of the soil, cools it and protects its micro-organisms.

d. Mulching promotes humus formation, suppresses weeds and maintain the water requirement of crops.

4. Weaphasa (Soil Moisture):

a. If there is no Waaphasa (soil aeration) in the soil, the plants will die.

b. For this, water is sprayed on degradable materials that are certified to remain on the farmland.

c. This form humus that helps retain the moisture and nutrients in the soil.

d. Farmers need to draw only 10 percent of the required water from the soil for cultivation using this process.

Multi-Cropping

1. Multicropping is a good way to reduce the risks for the farmer who is able to enjoy the continuity of yield all through the year.
2. In case of a crop failure, he can also rely on the other crops.
3. It has expanded farmers' income sources.

Uniqueness of ZBNF

1. An advance towards sustainability.
2. Expense-free crop growing.
3. Farming up to 30 acres with one citizen cow.
4. Farming with less electricity and water utilization.
5. Producing worth, poison-free food.
6. Agriculture without outside input.
7. Techniques of multi-crop agriculture for higher net profits.
8. Reducing outdoor labour necessity.
9. Farming in the refrain with nature.
10. Saving the farmers from suiciding themselves.

Scope for ZBNF

1. 70 % of land area are under dry land agriculture with insignificant resource depressed farmers.
2. The average pesticide usage of country is 0.6 kg/ha < China (13kg/ha) <Korea (16.56 kg/ha). So ZBNF can be effortlessly employed.
3. 80 % conventional yield can be achieved with ZBNF.
4. The Farmer gets a premium price of 22-35% over conventional produce.
5. Due to diversified cropping farmers get year around income and insurance against crop failures.
6. The income obtained from the farm is high with low input.

Pest Management in ZBNF

1. Agniastra, Bramhastra and Neemastra are three processes under ZBNF which are to control the pests like leaf roller, stream borer, fruit borer, pod borer, sucking pests and mealy bug etc.
2. All these processes use locally available inputs like cow dung, cow urine, green chilies, neem pulp, neem leaves which are always available in farmers' farm free of cost.

ZBNF for Combating Climate Change

1. ZBNF for warfare Climate change.
2. ZBNF is positioned as an explanation for the debt crisis among Indian farmers.

3. Most recent available figures by the government of India show that about 52% of the agricultural households in the country are in debt (NSSO, 2014).
4. The Government of Andhra Pradesh has decided to change farming to Zero Budget Natural Farming (ZBNF) by the year 2024.
5. AP Government has decided to approach 60 lakh (6 million) farming households to adopt “Climate Resilient Zero Budget Natural Farming (CRBZBNF)” as a farming practice that believes in natural growth of crops without supplying any other external inputs.

Challenges of ZBNF

1. There is no special market to retail.
2. Takes long alteration period.
3. It is practiced in less parts of India.
4. It is a highly restricted farming.
5. It is practiced in trifling area.
6. The farming type is still under dispute and not much scientific research is done still under appraisal.

Conclusion

ZBNF has been emerged as a farming model for small and marginal farmers to overcome the agriculture distress and satisfying the livelihood and maintenance the health of family on top precedence. It reduces farmers’ costs through eliminating outside inputs and utilising in situ wealth to revitalize the soil, concurrently upward income, restoring ecosystem/ soil health and climate resilience through diverse, multi-layered cropping systems. Now Indian government has also proposed in the budget 2019-20 for ZBNF. These types of cultivation models should be adopted and simulated in other state of India.

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Role of Women in Agriculture Development

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Introduction

Women play a significant and crucial role in agricultural development and 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 laborers 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.

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 broader economic and social development goals.

Participation of Women in Agricultural Activities

These are the following fields were women participation in agricultural activities:

1. Soil testing: Soil testing is a scientific tool to assess the inherent fertility status of soil. The success of soil testing programme depends upon proper collection of samples, proper trained women in this aspect play vital role for the sustainability of growth in agriculture.

2. Crop cultivation: Women are involved in all the agricultural operation right from planting to harvesting. Nearly 40 percent women involved in crop cultivation in India.

3. Fisheries: Nearly 43 percent of women are engaged in fisheries and its allied activities, such as catching and marketing.

4. Dairy production: Cattle management, care taking especially during pregnancy, storage of feed and selling of Milk are the work mainly done by women.

5. Sericulture: Sericulture is another field where women play important role. Women carry out almost 60-65 % of the activities in sericulture industry.

6. Crop management: Nearly 35% women are playing active role in all operation from preparation to cultivation, sowing, harvesting and post harvesting and weed picking operation.

7. Production and planting of plantation crops: - Women play crucial role in this aspect; they are involved weeding, mulching, plot watering in coconut. Plucking, picking and storing in tea, coffee and flowers, tapping rubber, plantation, picking and cleaning cardamom and herbs. In addition, they are involved in ornamental plants, fruits and vegetable processing industry and marketing of horticultural produces.

8. Apiculture: Women play vital role in rearing of honey bee. They actively involved all the operation of apiary managements.

9. Live Stock management: Nearly 25 percent women are actively participation in Live Stock production and their management. Besides these women are also engaged in Goatry, Poultry, Piggries. Mostly women are engaged in cattle management activities such as:

a. Cleaning of animal and sheds
b. Watering of cattle.
c. Milking the animals.
d. Fodder collection.
e. Preparing dung cakes.
f. Collection farm yard manure.

Except grazing, all other livestock management activities are predominantly performed by women. Men, however, share the responsibility of taking care of sick animals. It is evident that the women are playing a dominant role in the livestock production and management activities.

10. Use of organic Wastage: Farm women graduates can teach the farm/ rural women on the mannurial value of their farm wastes, composting, sugarcane trash, weeds and other crop residues and integrated of this enrich farm waste, with chemical fertilizers thereby reducing fertilizer cost. These natural resources management is very useful to the farmers and in these fields', women are important input to manage it.

Conclusion

Thus, on the basis of above discussion we can say that women carry out bulk of the work in agricultural production. Women play major role in almost all activities i.e.- Planting, weeding, fertilizing, harvesting and post harvesting. In the present scenario of liberalization and privatization, its leads to economic empowerment of women once it's achieved. It would lead to overall development of women and the nation at large.

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Different Types of Vegetable Gardens

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Introduction

Mainly two types of vegetable gardens have present:

1. Non-commercial vegetable garden: Kitchen garden.

2. Commercial vegetable gardens:

a. Market garden.
b. Truck garden.
c. Vegetable garden for processing.
d. Vegetable garden for seed production.
e. Forcing vegetable garden.
f. Floating vegetable garden.

Non-Commercial Vegetable Garden

Kitchen garden: Kitchen garden is source for continuous supply of fresh vegetables for family use. A number of vegetables are grown in available land for getting different types of vegetables. In kitchen garden can produce fresh vegetables year around and also each and every family member will participate in garden works. Area of garden, lay out, crops selected etc. depend on availability of the land and nature. In rural area, land will not be a limiting factor and scientifically laid out garden can be established but in urban areas, land is a limiting factor and very often crops are raised in limited available area or in terraces of buildings.

Advantages of a kitchen garden:

1. It provides an opportunity for recreation and exercise to family members.
2. Improves the knowledge of family members about vegetable cultivation.
3. It is best means to convert free time into yields.
4. It improves the standard of living by providing nutritious fresh vegetables
5. Reduce the expenditure on purchase of vegetables from market.
6. Provides the pesticides free vegetables through organic farming.
7. It creates a healthy green environment surroundings to the home.
8. The family can get the sudden requirement of fresh vegetables.

Commercial Vegetable Gardens

1. Market garden: Market gardens are mainly established within 15-20 km of city to supply fresh vegetables to nearby local market. This gardens mainly depends on demands of local market by different cropping patterns. Generally high value crops and early varieties, which do not stand long distance transport are grown on an extensive manner in market garden. The agro-techniques and time of sowing are selected to catch the early market or too late market to get a better price. The market gardening is done nearby the cities or towns and the farmers himself transport the produce to the wholesale market (Mandi) of the city for selling.

2. Truck garden: Truck gardens are mainly established within 50-60 km of city to supply vegetables to nearby city. The word 'Truck' is derived from the French word 'troquer' meaning 'to barter' and it should not be conceived as 'Truck' means 'Truck Vehicle'. Production of only one or two vegetables relatively on a larger area in a huge amount too far from cities is called as Truck garden, Under Truck garden the most extensive area is taken but cultivation is less intensive in comparison to market gardening. Vegetable cultivation mainly done by machines. The growers generally sell the produce to a middleman at their field as it is and middleman harvest the produce, transport to the distance market and sale. The growers get a return as huge amounts are incurred on transport and commission to a middleman. The vegetables which can sustain long distance market with least damage are preferred for truck gardening.

3. Vegetable garden for processing: This type of vegetables cultivation mostly available in foreign countries, when a particular variety of vegetables suitable for processing is cultivated to ensure a continuous supply of quality raw materials to the processing industries then such cultivation is called vegetable garden for processing. Cultivation practices and supply of vegetables to processing industry are mostly based on some agreement between factory owners and farmers. Vegetables like tomato, peas, potato, sprouting broccoli, spinach, lima bean, gherkin and onion are utilized by processing industries for canning, dehydration, freezing, pickling and for making other processed products in developed countries. Kufri Chipsona-1 and Kufri Chipsona-2 varieties of potato used for making of chips and Punjab Chhuhara, Roma and S-152 varieties of tomato used for processing.

4. Vegetable garden for seed production: The growing of vegetables exclusively for seed purpose is called vegetable cultivation for seed production. Major share of requirement is met with home saved seeds of farmers. Vegetables for seed production are mainly depends on good fertile soil, climate and disease-free conditions. Each crop / variety is grown in specified isolation distance meeting all the field and crop standards. Timely inspection and rouging are also done to maintain seed purity. Special handling techniques of seed crop curing, threshing, cleaning, package and storage are requiring thorough knowledge. Since pests and diseases affect seed field more than that of vegetable field, timely crop protection measures are to be taken, especially for control of seed borne diseases.

5. Forcing vegetable garden: The production of vegetables out of its normal season and environmental conditions comes under vegetable forcing garden. This type of vegetable gardening is more popular in western and developed countries. The vegetables are cultivated under protected conditions with high-tech knowledge, resulting in the very high cost of production. Vegetable forcing is done for higher income consumers having more paying capacity normally residing in metropolitan cities. It is highly specialized growing of vegetables with special growing infrastructures like a poly house, glass house and net house with regulated internal conditions including temperature, humidity and light intensity. Vegetable Forcing ensures more earning by vegetable availability during offseason.

6. Floating vegetable garden: In Dal lakes of Kashmir, vegetables are cultivated in floating bases made up of roots of Typha grass growing wild in the lakes. The base is first prepared by weaving of roots of Typha grass. Then fertile soil rich in humus are placed on the grass base and seeds are sown. All the intercultural operations including watering are done with the help of boats. The floating garden can be dragged to different places for specific purposes. Most of the summer vegetables supplied to Srinagar are from these floating gardens.

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Zinc Biofortification through Agronomic Means

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Introduction

Zinc is an essential nutrient for normal growth and development of plants, for animals and human as well. Zinc is a major constituent of carbonic anhydrase enzyme which is important for biosynthesis of chlorophyll. In general, Zn has key role in the activation of many enzymes, synthesis of protein, and oxidation and metabolism of carbohydrate.

It is also required for the production of tryptophan which is a precursor of auxin. Zinc plays a key role in maintaining the integrity of biological membranes, protein synthesis, photosynthesis, pollen formation and disease resistance.

It helps the plant in abiotic stress condition and enhances disease and pest resistance. Nowadays Zinc deficiency is a very prominent not only in plants but in human being and animals as well.

Approximately one third of total population of poor world is suffering from poor zinc nutrition because they rely on cereals for their daily caloric intake. Its deficiency is a global concern and can be found in every part of the world. In India almost 49% of the soil is deficient in Zn.

Zinc as Zn+2 ions adsorb on the soil colloids and become unavailable to the crop plant; this makes it an immobile nutrient in soil so, managing zinc fertilization is an important aspect. To alleviate the global malnutrition, adopting biofortification process of zinc will be a precise step.

Zn Biofortification Process

Biofortification is the process of enhancing the micronutrient content of a food crop through selective breeding, genetic modification, or by adopting suitable agronomic management practices. Although biofortification can be done by genetic engineering approaches, it is purely a research oriented and time-consuming process but agronomic process of biofortification can be more convenient for farmers.

Agronomic biofortification of Zn includes:

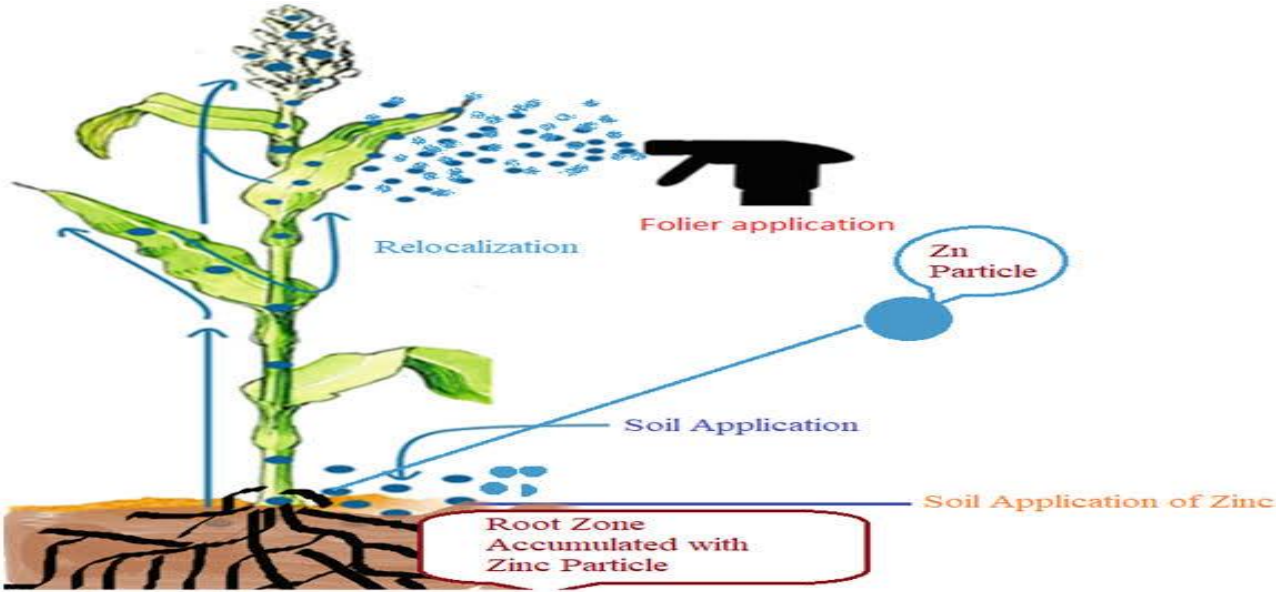
1. Soil application of Zn fertilizers.
2. Foliar application of Zn fertilizer.
3. Seed priming with Zn.
4. Use of Zn solubilizing microorganisms.
5. Application of organic matter.

Soil Application of Zn Fertilizer

Increasing concentration of Zn in grains is the only possible way to overcome the Zn deficiency. Among the different zinc fertilizers, e.g., zinc sulphate ($ZnSo_4$) has the potential to increase growth and yield of crops that also increases Zn concentration in grains.

Foliar Application of Zn

Foliar fertilization is a promising technique for applying micronutrients especially on environments where soil application is not suitable either due to fixation or other factors limiting the nutrient availability to plants (fig 1). Foliar application can fulfil the micronutrient requirements of crops and improves crop growth, grain weight and yield.



(Fig 1: Soil and foliar application of zinc fertilizer)

Seed Priming

Micronutrient delivery as seed treatment (priming or coating) is a cost-effective option. For priming, seeds are soaked in aerated water or nutrient solution for specific periods and then dried back to their initial weight. Nutri-priming is a type of seed priming in which seeds are soaked in aerated solutions of nutrient (Rehman et al.2015). However, as Zn is needed in very small quantities, priming in solution with higher concentration may cause seed damage and poor germination. Therefore, Zn source and the concentration of nutrient solution should be optimized before field testing.

Organic Matter Application

Soil organic matter increases availability of zinc in rhizosphere and reduces fixation, which results in its more uptake by plant roots. Organic matter produces polysaccharide which increases zinc bioavailability.

Interaction with Other Nutrient

It is seen than zinc management without application of nitrogen is a waste because the use efficiency of zinc depends on nitrogen fertilization. Also, the interaction of zinc with phosphorus is antagonistic, so fertilization.

Zinc Solubilizing Bacteria (ZSB)

(Fig 2: Mechanism of zinc solubilization by Zn solubilizing microorganism.)

One of the new concepts and novel approaches for biofortification of crops is the use of microbial strains. These microorganisms have the ability to improve the quality of crops through enhanced uptake of micronutrients due to their growth-promoting traits, viz., nutrient solubilization, siderophores production, and exopolysaccharides production, in addition to some other growth promoting attributes (fig 2).

Mechanism of Zinc Solubilizing Bacteria

1. Chelation: Bioavailability of Zinc in root zone could be increased by Zn-chelating compounds. These compounds are released either by plant roots or microflora into the rhizosphere which tends to form chelated-Zn compound that are more available to the plant than normal sources. Bacterial metabolites form complexes with Zn^{2+} and reduce their reaction with the soil.

2. Organic Acids Production: Organic acids like cinnamic acid, ferulic acid, caffeic acid, chlorogenic acid, syringic acid, and gallic acid solubilizes zinc and makes it available to the plant.

3. Changes in Root Architecture: Zinc is immobile in soil, so it needs extensive root growth to reach the soil Zn concentration. Bio fertilizers influences root growth which ultimately helps is uptake of zinc.

Conclusion

Zinc is not only an essential nutrient for plants but animals also. To increase the concentration of zinc in grain proposes a way to fight malnutrition of underdeveloped countries. Agronomic biofortification helps to achieve that goal. There is a need for future research on agronomic biofortification of zinc as it can be adapted to the farmers' fields. Whereas genetic biofortification is very complex, long term and research-based approach. So, improving the agronomic interventions is viable approach.

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Mycorrhiza: A Potential Tool for Nutrient Uptake and Stress Management

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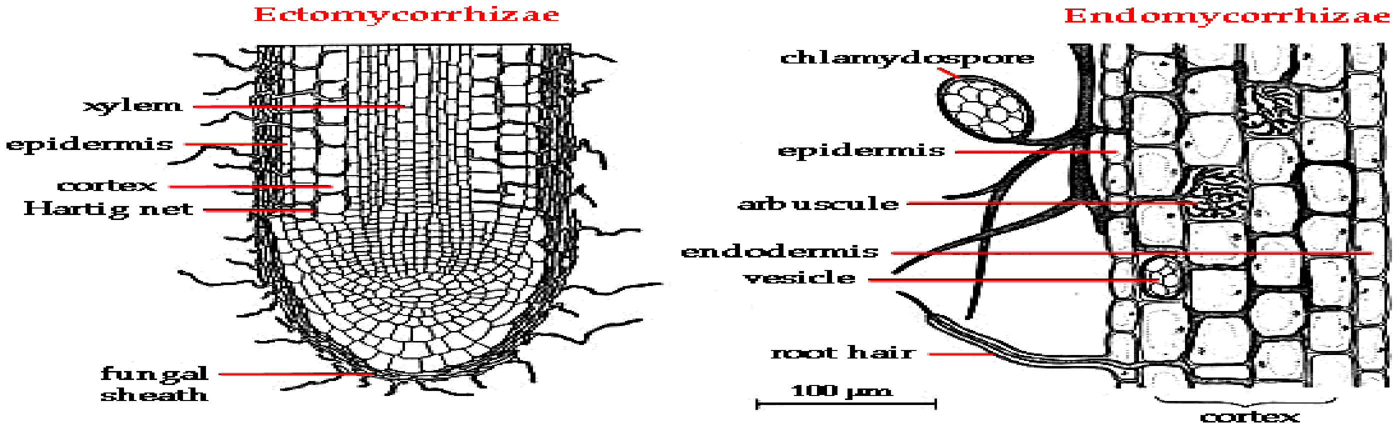
Introduction

Mycorrhiza is a symbiotic association between the root of higher plants and the fungus that colonizes the root of the plant. The term "mycorrhizae" means "fungus root", "Myco" is a fungus, and "rhiza" is a root. Mycorrhizae are highly evolved, mutualistic associations between soil fungi and plant roots, and provide a critical linkage between the plant root and soil. There are mainly two types of mycorrhizae: Ectomycorrhiza and Endomycorrhiza. While, ectomycorrhiza does not penetrate the root cell wall but forms a sheath around the root, and nutrient structures are known as a "Hartig net", endo mycorrhizae penetrate the root cortex and form nutrient exchange structures within the root cells (arbuscules, vesicles). Moreover, the prior forms symbiotic relationships with about only 10% of plant families, the latter forms symbiotic relationships with about 85% of plant families that are commonly associated with agricultural, horticultural, and tropical trees.

Arbuscular Mycorrhiza, Arbutoid Mycorrhiza, Ericoid Mycorrhiza, Orchidaceous Mycorrhiza are some common endo mycorrhizae. Among them, Arbuscular Mycorrhiza is most significant in fruit crops. Fungi forming endomycorrhiza belong to the genus *Endogone, Glomus, Sclerocystis, Acaulospora, Gigaspora, Enterophophora, Scutellispora.*



Arbuscular Mycorrhizal Fungi (AMF)

AMF is the organisms that penetrate the roots of plants to form a mutualistic symbiotic relationship. They help in the absorption of the mineral nutrients, preferably phosphorus, nitrogen, and water from the soil via the extensive hyphal network and transferred to the plant. In turn, they obtain organic carbon compounds. They are known to improve plant nutrient uptake, protect plants from pathogens and buffer against adverse environmental conditions, especially drought. AMF can promote a rapid increase in plant growth and contribute to the better establishment of seedlings when transplanted to the field while in the nursery, inoculation of these fungi can improve plant growth, reducing the time for seedling production and protecting the plants against soil-borne pathogens.

Contributing to increasing the nutrient uptake and plant vigour, the AMF can act as biological control agents by direct or indirect mechanisms. The exploitation of the symbiotic feature of AM fungi is one of the efficient approaches to improve crop tolerance to the unfavoured environment. AM fungi are probably the most ubiquitous soil microbe that can colonize 80% of terrestrial plant species consisted of many fruit crops. Many beneficial effects from mycorrhizal colonization including increased seedling survival, enhanced growth, fruit yield and quality, uniformity of fruit crops, and earlier and increased flowering as well as induced resistance to abiotic and biotic stresses. However, products containing AMF are rarely used in commercial horticulture due to several factors such as difficulties in producing AMF inoculum in large quantities, their variable beneficial effects, and uncertainties in the benefits with added AMF in the presence of resident AMF populations. Substrates such as coir are usually devoid of beneficial microbes such as AMF; thus, introducing them into substrate production is more likely to generate benefits.

Nutrient Uptake

Arbuscular mycorrhizal fungi (AMF), as a biofertilizer, supports plant nutrition by absorbing and translocating mineral nutrients beyond the depletion zones of the plant rhizosphere. One of the most dramatic effects of mycorrhizal infection on the host plant is the increase in phosphorus (P) and Zn uptake, mainly due to the capacity of mycorrhizal fungi to absorb nutrients from the soil and transfer it to the host roots. Also, mycorrhizal infection results in an increased uptake of other macro-and micronutrients and water. When a nutrient is deficient in the soil solution, the root parameters such as surface area, length, and nutrient exchange capacity control the uptake. Phosphorus (P) is one of the critical minerals for plant growth and makes up about 0.2% of the dry weight, but it is one of the most difficult nutrients for plants to acquire and the major advantage of the AM symbiosis for plants in acquiring P is that AM fungi provide a very effective pathway by which P is scavenged from large volumes of soil and rapidly delivered to the cortical cells within the root, bypassing direct uptake.

Mechanism of Nutrient Uptake

Despite its coenocytic nature, the mycelium that is formed within the root, the intraradical mycelium (IRM) differs morphologically and functionally from the extraradical mycelium (ERM), the mycelium that grows into the soil. The ERM absorbs nutrients from the soil and transfers these nutrients to the host root. The IRM on the other hand releases nutrients into the interfacial apoplast and exchanges them against carbon from the host. The fungus uses these carbon resources to maintain and enlarge the ERM, for cell metabolism (e.g., active uptake processes, nitrogen assimilation), and for the development of spores, which can initiate the colonization of the next generation of host plants.

Generally, there are three mechanisms responsible for enhanced P uptake in mycorrhizal plants:
1. The hyphal network of AM fungi extends the plant root system
2. AMF releases organic acids that solubilize phosphate from insoluble AlP, Fe-P, and Ca-P complexes
3. AMF produces phosphatase and exudates them to the rhizosphere accelerating the mineralization of organic P to inorganic phosphate.

The external hyphae of AM fungi extend well beyond the depletion zone, accessing supplies of nutrients at a distance and in narrow soil pores. As the hyphae develop around the root, distributed beyond the root area, nutrient uptake is high and the nutrient depletion zone is extended. When nutrients are removed from the soil solution more rapidly, a nutrient depletion zone develops and that nutrient can be replaced by diffusion.

Mycorrhiza in Combating Biotic Stresses

Microorganisms play an antagonistic role against various pathogens, derived from the resident microbial community or of foreign origin. Arbuscular Mycorrhizal Fungi (AMF) forms one such group of organisms that can act as bio protectors of plants. The mycorrhizal symbiosis involves several mechanisms in the control of plant diseases:
1. Creating a mechanical barrier for the pathogen penetration and subsequent spread.

2. Thickening of cell wall through lignification's and production of other polysaccharides which in turn hinder the entry of root pathogen.
3. Stimulating the host roots to produce and accumulate sufficient concentrations of metabolites (terpenes, phenols, etc.), imparting resistance to the host tissue against pathogen invasion.
4. Increasing the concentration of orthodihydroxy phenols in roots, deterring the activity of pathogens.
5. Producing antifungal and antibacterial antibiotics and toxins that act against pathogenic organisms.
6. Competing with the pathogens for the uptake of essential nutrients in the rhizosphere and the root surface.
7. Stimulating the microbial activity and competitions in the root zone (rhizosphere, rhizoplane) and thus preventing the pathogen to get access to the roots.
8. Roots colonized by VAM/AM fungi may also harbour more actinomycetes antagonistic to root pathogens.
9. Compensating the nutrient absorption system from damage to roots by pathogens.
10. Changing the amount and type of plant root exudates.

Mycorrhiza in Combating Abiotic Stresses

Mycorrhizal symbiosis helps in the amelioration of different types of plant stresses such as metal, salt, drought, and other biotic stress. All these stresses produce reactive oxygen species (ROS) that cause oxidative stress in plants. ROS negatively affects the cellular activities that cause oxidation of proteins, peroxidation of lipids, and inhibiting the enzyme activity that results in total cellular damage. AM fungi enhance the antioxidant defence level in a host and produce isoprenoid to protect the plant from several stresses.

In case of drought stress, the external hyphae of AM fungi extend well beyond the depletion zone, accessing supplies of water at a distance and in narrow soil pores. As the hyphae develop around the root, distributed beyond the root area, the water uptake is high and the water depletion zone is extended.

In salt stress conditions, mycorrhizal roots have a higher hydraulic conductivity at low water potential and increase stomatal conductance, which increases the demand for transpiration. In presence of mycorrhizal symbiosis, the plant increases its ability to resist salt stress by the accumulation of solutes and improving osmotic adjustment and increases antioxidant production by increasing P uptake and by modification in morphology and physiology of the host plant.

Heavy metal (HM) toxicity adversely affects plant growth, development, and production. HM causes chlorosis, necrosis, senescence, turgor loss, and finally plant death. Similar to other stresses, it also produces ROS and methylglyoxal which is involved in the peroxidation of lipids, oxidation of proteins, inactivation of enzymes, and DNA damage. Endomycorrhizal fungi trap HM in their binding sites and immobilize and accumulate in their mycelia. Additionally, glomalin protein produced by AM fungi provides a binding site for HM.

Conclusion and Future Prospects

Many soils have low fertility and productivity around the world. To achieve optimum plant growth and good fruit yield, chemical fertilizers are being intensively used. Since, excess use of chemical fertilizers negatively impacts viable soil microorganisms, especially, mycorrhizal fungi; mycorrhizae-dependent horticultural trees are negatively affected. Many horticultural fruit species (citrus, cherry, plum, peach, apple, pear, nectarine, apricot, grape, kiwifruit, pomegranate, fig, olive, pistachio, wild black cherry, and pecan) are strongly mycorrhizal dependent. Roots of these plant species are naturally inoculated with arbuscular mycorrhizal fungi.

Mycorrhizal fungi can promote early plantlet root growth before transplanting to marginally poor soils and under environmental stress conditions. Mycorrhiza facilitates the host plant to cope with different stressed environments as heavy metals, toxic chemicals, and water pollution that make the horticulture lands polluted ultimately, decrease the crop production and increase health risk. In modern agricultural practices, these irreversible changes are managed with many biological tools such as beneficial microbes. However, at present time, decreasing plant diversity and continuous agricultural practices adversely affect mycorrhizal diversification. Therefore, there is an acute need for more insight into the genetics, interaction biology, and tolerance as well as remediation mechanisms among fruit crops and beneficial microbes to maximize fruit productivity.

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Biosurfactants as a Biological Tool to Increase Agricultural Productivity

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Abstract

Agricultural productivity to fulfil growing demands of human population is a matter of great concern. Biosurfactants can help to solve this problem. These are surface-active molecules which are produced by the wide range of microbes including bacteria, fungi, and yeast. They have several advantages over the chemical surfactants such as higher biodegradability, lower toxicity, better environmental compatibility, high selectivity, higher foaming, and specific activity under extreme conditions such as temperature, pH, and salinity. Biosurfactants synthesized by environmental isolates has promising role in the agricultural industry. Many rhizosphere and plant associated microbes produce biosurfactant; these biomolecules play vital role in motility, signalling, and biofilm formation, indicating that biosurfactant governs plant–microbe interaction. In agriculture, they can be used for plant pathogen elimination and for increasing the bioavailability of nutrient for beneficial plant associated microbes. They can be widely applied for improving the agricultural soil quality by soil remediation. Thus, biosurfactants from environmental isolates have potential role in plant growth promotion and other related agricultural applications.

Keywords: Bioavailability, Biosurfactants, Rhizosphere.

Introduction

Surfactants have several functional properties, well known, and exploited in many commercial sectors. There are numerous areas of agriculture which also requires surfactants. Biosurfactants are low molecular weight surface-active compounds widely produced by bacteria, yeast and fungi. These amphiphilic biomolecules reduce the surface tension at the air or water interfaces and the interfacial tension at oil or water interfaces (Satpute et al., 2010). They belong to various classes of compounds including glycolipids, glycolipoproteins, glycopeptides, lipopeptides, lipoproteins, fatty acids, phospholipids, neutral lipids, lipopolysaccharides and glycoglycero lipids. The properties and applications of biosurfactants include detergency, emulsification, foaming, dispersion, wetting, penetrating, thickening, microbial growth enhancement, antimicrobial agents (Govindammal and Parthasarathi, 2013), metal sequestering, and enhanced oil recovery. These important properties may allow biosurfactants to replace some of the most versatile chemical surfactants that are currently in use.

Properties of Biosurfactants

The properties of biosurfactants when compared to their chemically synthesized counterparts and broad substrate availability made them suitable for commercial applications. Microbial surfactants are identified with their surface movement, resilience to pH, temperature and ionic quality, biodegradability, low poisonous quality, emulsifying and demulsifying capacity and antimicrobial action.

The major highlights of properties are:
1. Surface and interface activity.
2. Temperature and pH tolerance.
3. Biodegradability and Low toxicity.
4. Emulsion framing, emulsion breaking and anti-adhesive agents.

Table 1: Microbial source and type of biosurfactants (Roy, 2017):

Biosurfactant	Microbial source
Rhamnolipids	*Pseudomonas aeruginosa, Pseudomonas chlororaphis, Serratia rubidea*
Sophorolipids	*Candida bombicola, Candida batistae, Trichosporon ashii*
Saphorose lipid	*Torulopsis bombicola*
Trehalose lipids	*Rhodococcus erythropolis, Arthrobacter* sp., *Nocardia erythropolis, Corneybacterium* sp., *Mycobacterium sp*
Ornithine lipids	*Pseudomonas* sp, *Thiobacillus thiooxidans, Agrobacterium* sp
Viscosin	*Pseudomonas fluoresens, Leuconostoc mesenteroids*
Carbohydrate lipid	*Pseudomonas fluoresens, Debaryomyces polmorphus*

Agriculture Related Applications of Biosurfactants

The dual hydrophobic or hydrophilic nature of biosurfactant has more advantages the chemically produced surfactants. These biosurfactants can be widely exploited in areas related to agriculture for enhancement of biodegradation of pollutants to improve the quality of agriculture soil, for indirect plant growth promotion as these biosurfactants have antimicrobial activity and to increase the plant microbe interaction beneficial for plant. Role of biosurfactants and biosurfactant producing microbes in agriculture are shown in Fig. 1.

Fig. 1: Multifunctional prospective of biosurfactants in agriculture

Improvement of Soil Quality

The productivity of agriculture land is affected by presence of organic and inorganic pollutants that impart abiotic stress on the cultivated crop plant. To increase the quality of such soil contaminated by hydrocarbon and heavy metals, process of bioremediation is required. As biosurfactants are known to enhance bioavailability and carry out biodegradation of hydrophobic compounds, different technologies such as soil washing technology and clean up combined technology employ biosurfactants for effective removal of hydrocarbon and metal, respectively (Kang et al., 2010). Biosurfactants can also enhance the degradation of certain chemical insecticides which are accumulated in the agricultural soil (Singh et al., 2009). Rhamnolipids are found to be useful in removal of poly aromatic hydrocarbon and pentachlorophenol from soil. Thus, biosurfactants can be applied in agriculture soil to enhance soil quality. However, high cost for production of biosurfactants yet restricts the application of these green surfactants for bioremediation of soil contaminate by crude oil and/or petroleum (Moldes et al., 2011).

Use of agro-industrial waste for production of green surfactants which can further be used for biodegradation of hydrocarbons from soil needs imperative examination. Further, biosurfactants such as rhamnolipid and surfactin are known to remove heavy metals such as Ni, Cd, Mg, Mn, Ca, Ba, Li, Cu, and Zn (ions) from soil with a new method of foaming surfactant technology. Thus, rather than use of harmful synthetic surfactants overproducer of biosurfactants can be the most useful for bioremediation.

Elimination of Plant Pathogen

Several biosurfactants from microbes have antimicrobial activity against plant pathogens and therefore they are considered to a promising biocontrol molecule for achieving sustainable agriculture. Biosurfactants produced by *Rhizobacteria* are known to have antagonist properties (Nihorimbere et al. 2011). An agricultural application of chemical surfactants and biosurfactants also facilitates biocontrol mechanism of plant growth promoting microbes such as parasitism, antibiosis, competition, induced systemic resistance, and hypo virulence. In addition, these surfactants are used in combination with fungus (*Myrothecium verrucaria*) to eradicate weed species which affect the land productivity and also the spread of such weed species have adverse effect on biodiversity. *Pseudomonas sp*. are reported as biocontrol agents against *Verticillium microsclerotia*; a causative agent of verticillium wilt mainly in potatoes. Strains of *Pseudomonas sp*. terminate the growth of pathogenic fungi *Rhizoctonia solani* and *Phythium ultimum* by production of dual functioning compounds tensin, viscosin and viscosinamid. The dual function includes biosurfactants and antifungal activity *Colletotrichum gloeosporioides*, is a causative agent for anthracnose on papaya leaves is reported to be controlled by biosurfactant producing *Bacillus subtilis* isolated from soil (Kim et al., 2010). The above examples prove that the green surfactants are well documented for plant growth promotion by their potential effect on pathogens. Hence, these biosurfactants and/or biosurfactant producing microbes are potential substitutes.

Asset for Beneficial Plant Microbe Interaction

To provide beneficial effect to the plants by rhizobacteria, it is very important for these microbes to interact with the plant surfaces such as root (Nihorimbere et al., 2011). It is reviewed that quorum sensing molecules such as acyl homoserine lactone (AHL) are required for synthesis of antifungal compounds by the rhizobacteria. Studies also indicate that the concentration of these molecules is high in rhizosphere as compared to that to bulk soil (soil away from plant roots) suggesting the role of AHL and AHL-like molecules in rhizosphere competence (ability of beneficial microorganism to colonize the root surface).

Potential of Biosurfactants in Pesticide Industries

Agriculture important products like pesticides formed with the assistance of biosurfactant can be widely used on agricultural fields. Surfactants are must as adjuvant with fungicides, insecticides, and herbicides. The synthetic surfactant presently used in pesticides industries act as emulsifying, dispersing, spreading and wetting agent and enhance the efficiency of pesticides. In addition, these surfactants are used in insecticides in modern agriculture as these have defensive properties. There is a report on bacteria belonging to *Pseudomonas sp*. and *Burkholderia sp*. from paddy field to degrade surfactants (Nishio et al., 2002). Different types of surfactants such as anionic, cationic, amphoteric, and nonionic are presently being used at several pesticide manufacturing industries. Thus, surfactants are widely used in formulation of pesticides.

Conclusion

Surfactants have several applications in agriculture and agrochemical industries. There is need to work on the production cost of green surfactants and to look for cheap cost for net economic gain from application of biosurfactants in agriculture as well as other sectors. The high prevalence of biosurfactants and biosurfactant producing bacteria in rhizosphere is a positive indication for its potent role in sustainable agriculture. A modern approach such as functional metagenomics is the utmost essential which will even lead to discovery of novel green surfactants. Intense work on green surfactants is a priority to prevent the adverse effects of synthetic surfactants largely employed in many commercial sectors including agrochemical industries. More research is needed in order to produce cost effective biosurfactant for agriculture purpose.

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Technologies for Bio-Hydrogen Production from Biomass

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Introduction

Population growth and changing lifestyle with industrialization and urbanization are the added sinks for soaring energy demand. Present energy security is predominantly drifting around the fossil resources and alternative fuels are being searched (Nigam, 2017). However, the faster depletion of fossil resources and accelerated accumulation of greenhouse gases (GHGs) in the environment that already has exceeded the "dangerously high" threshold of 450 ppm CO_2, stressing the fossil fuel to be an unsustainable source of energy. The conventional fossil-based fuels contributed major share in the global primary energy consumption Singh and Rathore (2017). Global dependence on fossil fuels has led to the release of over 1,100 GtCO2 into the atmosphere since the mid-nineteenth century. Currently, energy related GHG emissions, mainly from fossil fuel combustion for heat supply, electricity generation and transport, account for around 70% of total emissions including carbon dioxide, methane and some traces of nitrous oxide (Rathore et al., 2017).

Need of Bio-Hydrogen

1. Presently, most of the hydrogen is produced from fossil fuels, which accounts about 98 per cent of its total production.
2. Conventional physiochemical methods for H_2 production are based on steam reforming of natural gas (40 per cent); coal gasification (18 per cent); and pyrolysis or gasification of biomass, which produces a mixture of gases (H_2, CH_4, CO_2, CO, and N_2).
3. All these methods require high temperature (>850°C) and, therefore, are energy intensive and expensive.
4. Water can also be used as a renewable resource for hydrogen production and methods are based on photolysis, electrolysis, and thermo-chemical methods.
5. However, electricity costs account for 80 per cent. Although, all these methods have the potential for effective H_2 production but require a source of energy, which is derived from fossil fuels that make these processes economically impractical and unsafe/toxic to the environment (Kapdan and Karg 2006).

Biological Hydrogen Production (BHP) Process

Biological hydrogen production from renewable sources like (biomass, water and organic wastes) are biologically or photo-biologically is called bio-hydrogen. Waste materials used in the hydrogen production are segmented as agricultural waste, municipal waste, industrial waste, and other hazardous wastes. These are further compartmentalized as organic waste materials originating as or from food processing, crop residues, industry, animal manures, agricultural residue, domestic, and community wastes.

Harnessing energy from biomass is an effective alternative due to zero net CO_2 effects than alternative to conventional feed-stocks. Biological production of H_2 as a byproduct of microorganism metabolism is an exciting new area of technology development that offers the potential production of usable hydrogen from a variety of renewable sources. BHP at ambient physiological condition is the most obvious and viable approach over energy intensive conventional chemical or electrochemical processes.

A successful biological conversion of biomass to hydrogen depends strongly on the processing of raw materials to produce feedstock, which can be fermented by the microorganism (Das and Veziroglu 2008).

Biological Hydrogen Production Methods

Biological hydrogen production methods can be classified as below:

1. Direct bio-photolysis.
2. Indirect bio-photolysis.
3. Photo fermentation.
4. Dark fermentation.

Direct Bio-Photolysis

This method is similar to the processes found in plants and algal photosynthesis. In this process solar energy is directly converted to hydrogen via photosynthetic reactions (Eq. (1)).

$$2H2O + \text{'light energy'} \rightarrow 2H2 + O2 \quad (1)$$

Algae split water molecules to hydrogen ion and oxygen via photosynthesis. The generated hydrogen ions are converted into hydrogen gas by hydrogenase enzyme. *Chlamydomonas reinhardtii* is one of the well-known hydrogens producing algae. Hydrogenase activity has also been observed in other green algae like *Scenedesmus obliquus*, *Chlorococcum littorale, Platymonas subcordiformis* and *Chlorella fusca*.

Indirect Bio-Photolysis

In indirect bio-photolysis, problems of sensitivity of the hydrogen evolving process are potentially circumvented by separating temporally and/or spatially oxygen evolution and hydrogen evolution. Thus, indirect *bio-photolysis* processes involve separation of the H_2 and O_2 evolution reactions into separate stages, coupled through CO_2 fixation/evolution. *Cyanobacteria* have the unique characteristics of using CO_2 in the air as a carbon source and solar energy as an energy source (Eq. (2)). The cells take up CO_2 first to produce cellular substances, which are subsequently used for hydrogen production (Eq. (3)). The overall mechanism of hydrogen production in *cyanobacteria* can be represented by the following reactions:

$$12H_2O + 6CO_2 + \text{'light energy'} \rightarrow C_6H_{12}O_6 + 6O_2 \quad (2)$$

$$C_6H_{12}O_6 + 12H_2O + \text{'light energy'} \rightarrow 12H_2 + 6CO_2 \quad (3)$$

Cyanobacteria possess key enzymes *(nitrogenase and hydrogenase)* that carry out metabolic functions in order to achieve hydrogen generation. Because of the higher rates of H2 production by *Anabaena* species and strains, these have been subject to intense study. In indirect bio-photolysis mutant strains of *A. Variabilis* have demonstrated hydrogen production rate of the order of 0.355 mmol/h per litre.

Dark Fermentation

Dark fermentation (DF) mainly defers from photo-fermentation in which, it works without the presence of light. DF employs diverse group of facultative and anaerobic bacteria such as *E. Coli, E. Cloacae and Clostridium sp.* for the efficient conversion of wide range of organic substances. DF technology has the simpler reactor design and less energy requirement when compared to other hydrogen production technology. The most dominant hydrogen producing route for the DF can be achieved with the acetate mediated fermentative pathway with generation of four moles of molecular hydrogen with one moles of hexose as shown in equation below;

$$C_6H_{12}O_6 + 2H_2O \rightarrow 2CH_3COOH + 2CO_2 + 4H_2 \quad (3)$$

$$C_6H_{12}O_6 + 2H_2O \rightarrow 2CH_3CH_2COOH + 2CO_2 + 2H_2 \quad (4)$$

Photo-Fermentation

Photosynthetic bacterial evolve molecular hydrogen catalysed by *nitrogenase* under nitrogen deficient condition using light energy and reduced compounds. The overall reaction of hydrogen production can be given as:

$$CH_3COOH + 2H_2O + \text{'light energy'} \rightarrow 4H_2 + 2CO_2$$

Advantages and Disadvantages of Different Hydrogen Production Processes

1. Direct bio-photolysis:

a. Advantages:

i. Can produce H2 directly from water and sunlight

ii. Solar conversion energy increased by ten folds as compared to trees, crops.

b. Disadvantages:

i. Requires high intensity of light.

ii. O_2 can be dangerous for the system.

iii. Lower photochemical efficiency.

2. Indirect bio-photolysis:

a. Advantages:

i. Cyanobacteria can produce H_2 from water.

ii. Has the ability to fix N_2 from atmosphere.

b. Disadvantages:

i. Uptake hydrogenase enzymes are to be removed to stop degradation of H_2.

ii. About 30% O_2 present in gas mixture.

3. Photo-fermentation:

a. Advantages:

i. A wide spectral light energy can be used by these bacteria.

ii. Can use different organic wastes.

b. Disadvantages:

i. O2 has an inhibitory effect on nitrogenase.

ii. Light conversion efficiency is very low, only 1–5%.

4. Dark fermentation:

a. Advantages:

i. It can produce H_2 all day long without light.

ii. A variety of carbon sources can be used as substrates.

iii. It produces valuable metabolites such as butyric, lactic and acetic acids as by products.

iv. It is anaerobic process, so there is no O_2 limitation problem.

b. Disadvantages:

i. O_2 is a strong inhibitor of hydrogenase.

ii. Relatively lower achievable yields of H_2.

iii. As yields increase H_2 fermentation becomes thermodynamically unfavourable.

iv. Product gas mixture contains CO_2 which has to be separated.

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DOF Transcription Factors in Plants

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Introduction

Many biological processes are strictly regulated through transcriptional control of particular genes in plants. Plants appear to need a large number of transcription factors governing proper and strict transcriptional regulation in response to developmental programs and environmental changes. Indeed, over 5% of the Arabidopsis genome is devoted to encoding more than 1,500 transcription factors, which are classified into approximately 50 classes on the basis of their conserved DNA binding domains. This reveals transcriptional control of the expression of stress-responsive genes is a crucial part of the plant response to a range of abiotic and biotic stresses.

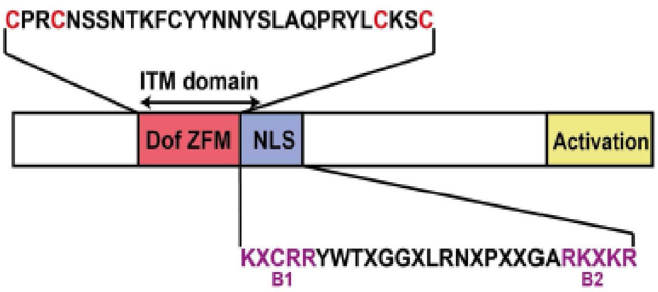
Transcription factors belong to large gene families among which few are unique to plants. Some of the important plant specific transcription factors families are:

1. Ethylene responsive element binding factor (ERF).
2. Basic domain leucine zipper (bZIP).
3. WRKY proteins.
4. MYB.
5. Salicylic acid Inducible DOF.

The DOF domain proteins are another typical example of a family of plant-specific transcription factors. The conserved DNA-binding domain of the DOF domain proteins do not show any apparent homology to animal transcription factors but has the potential for a single zinc finger.

DOF Transcription Factor

DOF (DNA binding with one finger) domain proteins are plant specific transcription factors. It has highly conserved DOF DNA-binding domain usually located close to the N-terminal region of the protein. The regions located outside of DOF domain are divergent amino acid sequences. The regions N- and C-terminal to the DOF domain, unlike the DOF domain itself, are very variable among different DOF proteins. These regions may interact with different regulatory proteins or intercept signals that mediate activation or repression of gene expression. These interactions are likely to contribute to the diverse functions of DOF domain proteins.

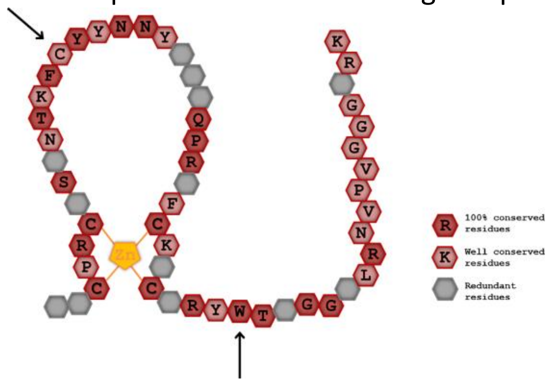


The biological processes involving DOF domain proteins are likely to be very divergent, but it is not surprising due to their variations in the N and C terminal regions. The genomes of higher plants appear to encode a number of DOF genes. For instance, 37 putative genes encoding DOF domain proteins are identified in the *Arabidopsis* genome and a similar number of putative

The DOF protein (*ZmDOF1*) first identified in maize plays a role in light-regulated gene expression, but no *DOF* genes have been isolated from other eukaryotes, such as yeast or humans. In *Arabidopsis*, some of the well characterized *DOF* genes were shown to be involved in many plant biological processes. For example, the *DAG1* genes had the active involvement in seed germination; the *CDF1*, *CDF2*, *CDF3* and *CDF5* genes are associated with photoperiodic regulation of flowering and *HPPBF3*, *COG1* and *OBP3*, participate in the regulation of phytochrome signalling. In rice, *OsDof3* regulates the expression of gibberellins, *OsDof12* and *OsDof23*, regulate flowering time and seed expression, respectively.

DOF Domain

This domain is a region of 52 amino acid residues containing Cys2/Cys2 zinc finger (Cx2Cx21Cx2C). Zinc fingers are not protein structures unique to transcription factors, but they can be found in enzymes as protein–protein interaction domains. It binds specifically to the cis-regulatory element comprising the common core sequence (AT)/AAAG. It is a bi-functional domain responsible for DNA binding and protein-protein interactions.



Association of DOF with Other Transcription Factors

As the zinc fingers of GATA-1, an animal transcription factor, mediate both DNA binding and self-association, the DOF domain is also involved in protein–protein interactions, including interaction with another class of transcription factors (basic domain-leucine zipper proteins, bZIP proteins) and non-histone nuclear proteins called high-mobility group (HMG) proteins. The first protein–protein interaction was found with an *Arabidopsis* DOF domain protein (OBP1), which was identified as a protein interacting with bZIP proteins associated with stress responses. In addition, the binding sites of OBFs and OBP1 were closely located in an *Arabidopsis* GST promoter, and OBP1 enhanced the DNA binding of OBF in the native promoter content in vitro.

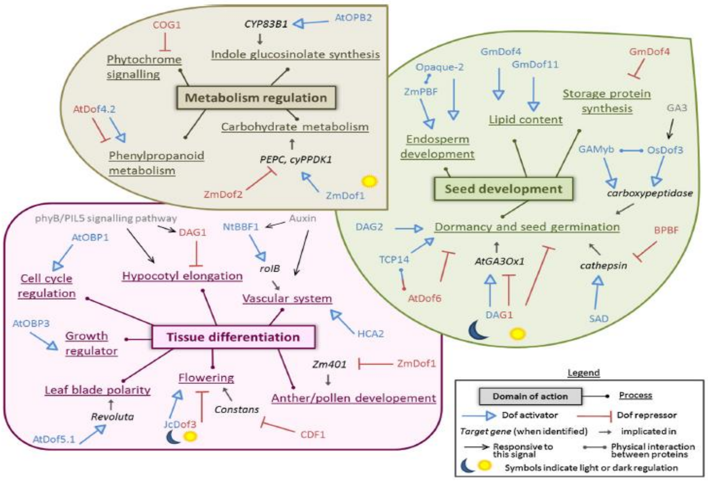
Roles of DOF Transcription factors

Discovery of DOF revealed that it may be involved in expression of photosynthetic gene, genes for seed storage, plant oncogenes and responsive to hormones/plant stresses because of its interaction with variety of plant specific gene promoters.

The role of DOF transcription factors includes:

1. Stress response.
2. Light responses.
3. Phytochrome signalling.
4. Responses to plant hormones.
5. Seed germination.
6. Tissue specific expression in endosperm, leaves/ guard cells.
7. Light regulated and tissue specific gene expression.
8. Tissue differentiation.
9. Regulation of metabolism.

10. DOF role in carbon metabolism.
11. Regulation of glutamine synthase genes by DOF.



Conclusion

DOF transcription factors are involved in regulation of most of the gene expressions in plants. In future several roles of DOF will come into light which may help in transcriptional control of biological regulations. Utilization of single transcription factor which regulates expression of multiple related genes in general, provides advantages in genetic engineering. Plant transcription factor studies might lead us to future challenges for crop improvement.

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Impact of Crop Residue Burning on Soil and Environment

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Introduction

1. In India, Agriculture plays a major role in the overall economy of India. A wide range of crops is cultivated across the vast majority of land in different agro-ecological regions of India which produce a significant quantity of crop residue (non-economical plant parts) that is left in the field after harvest. Around 234 million tonnes/year (i.e., 30%) of gross residue generated in India is available as surplus after being used in competitive alternatives such as cattle feed, animal bedding, cooking fuel, organic manure etc. This crop residue has great economic value. Approximately 500-550 million tonnes (Mt) of crop residue is generated on-farm and off-farm annually from its production of wheat, rice, maize, millets, sugarcane, fibre crops (jute, mesta, cotton) and pulses (Jain et al., 2014).

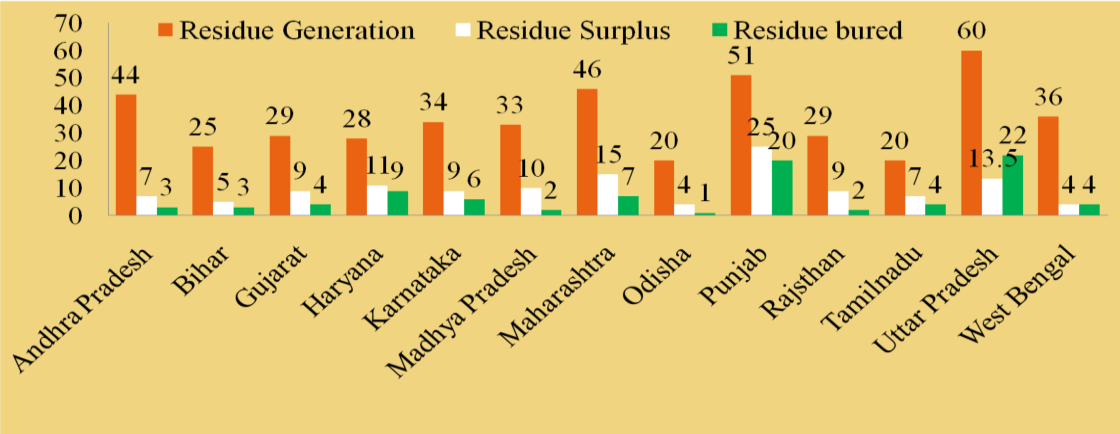
2. Multipurpose uses of crop residue include, but are not limited to, animal feeding, soil mulching, bio-manure, for rural homes and fuel for domestic and industrial use.

Crop Residue Generation in India

1. Crop residues are materials that are leftover plant materials including leaves, stalk and roots after harvesting of the crop. It is estimated that India generates around 500 Mt of crop residue annually with wide regional variability.

2. The use and uneven distribution of crop residue depends upon the growing crops, cropping intensity and productivity of particular region across the nation. Uttar Pradesh is the major state to record the highest crop residue around 60 Mt. Other high crop residue producing regions were Punjab and Maharashtra with 51 Mt and 46 Mt, respectively (Figure-1). Cereals, fibres, oilseeds, pulses and sugarcane are the major crop to contribute in residue generation with production estimates of 352 Mt, 66 Mt, 29 Mt, 13 Mt and 12 Mt, respectively. Among cereal crops, rice, wheat, maize and millets together contributed 70% of crop residue followed by fibre crop (Jain et al., 2014).

Figure-1: Status of Crop Residue Generation, Surplus and Burning in Different States (in million tons):



(Source: Compiled from data provided by Ministry of Statistics and Program Implementation (MOSPI, 2013-14)

What is Crop Residue Burning?

Crop residue burning is intentionally setting fire to the straw stubble that remains after wheat and other grains have been harvested. Crop residue burning practice was widespread until the 1990s when governments increasingly restricted their use.

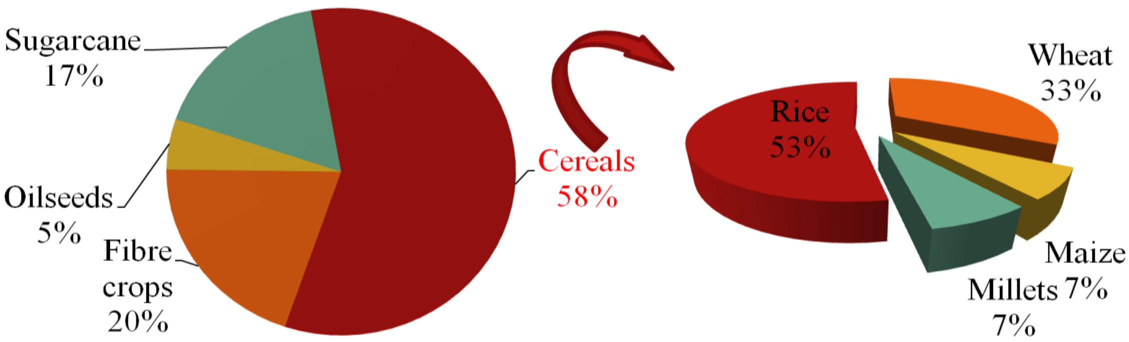


Figure-3: Contribution of different crops in residue burning (Jain et al., 2014)

Utilization or On-Farm Burning of Crop Residues in India

1. In India, crop residue is being utilized differently depending on the type of cultivated crop, the number of crops per year, the respective region and its socio-economic status as well. For example, rice stubble is used for domestic fuel or in boilers for parboiling rice in southern India whereas a large amount is burnt on-farm in northern India. Similarly, sugarcane residues which are used for either feeding to cattle or burnt on-farm for ratoon purpose.

2. In brick and lime kilns groundnut residues are used as burning materials. Some crop residues are also used for domestic fuel purpose like Cotton, pulses, oils seed crops, chillies, coconut shells, rapeseed and mustard stalks, sunflower and jute (Pathak et al., 2010).

Why do Farmers Burn the Straw?

Straw was traditionally used as fodder but due to following reasons farmers burn the straw:

1. Mechanization ------- fewer animals needed.
2. Additional cropping cycles.
3. Straw disturbs land preparation ------ waste.
4. Availability of fertilizers.
5. To supposedly prevent further spread of diseases.

Why Farmers should NOT Burn it?

According to 2¬nd ECHO Asia Agricultural Conference, September 21-25, 2009 - Chiang Mai, Thailand. 1 ton of rice straw contains: 5 to 8 kg nitrogen, 1.2 kg phosphorous, 20 kg potassium, 400 kg carbon.

Environmental Impacts of Crop Residue Burning

Out of the total gasses emitted from crop residue burning in India, almost 66% of it is carbon monoxide. Some researcher claimed that crop residue burning is a major source of black carbon in the environment. It has been seen that during the post-monsoon and winter period's black carbon content are a significant increase in the environment.

Health Impacts of Crop Residue Burning

1. The net effects of emissions of all these gases are catastrophic on the environment and health of human beings.

2. Some health-related problem likes, Irregular heartbeats, Nonfatal heart attacks, Aggravated asthma, decrease lung function, Increase respiratory symptoms.

Impacts of Crop Residue Burning on Agriculture Sector

1. Loss of Nutrients: Generally, crop residues of different crops contain 80% of Nitrogen (N), 25% of Phosphorus (P), 50% of Sulphur (S) as well as 20% of Potassium (K) which being eroded due to burning. If the crop residue is well managed by incorporation or retained in the soil itself, it gets enriched, particularly with organic Carbon and Nitrogen.

2. Impact on soil properties:

a. The heat from burning residues increases soil temperature which leads to the death of beneficial soil organisms.

b. By periodically residue burning leads to complete loss of microbial population and reduces the level of N and C from the top 0-15 cm soil profile, which is important for crop root development.

c. Due to the burning of crop residue, there is a slow and steady reduction in soil health that will lead to reduced productivity that cannot be overcome with increased additions of mineral fertilizers.

3. Wastage of valuable fodder for animals:

a. Many of the crop residues are also a good source of fodder for dairy animals. If this residue is once burnt, it goes to waste.

b. This is becoming a more serious problem when someone passing through a severe shortage of fodder for the animal.

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Karonda: Boom for Neglected Land

Article ID: 10693

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It is known as fruit of dryland which is a widely grown indigenous shrub in India and is able to thrive well in marginal and wasteland where other crops of commercial importance are unsuitable. It is botanically known as *Carissa carandas* belongs to the family Apocynaceae and is commonly known as Karonda in India, Bengal currant or Christ's thorn in South India.

There are more than 25 species in genus Carrissa out of these; five species are indigenous to India. It is hardy, spiny, evergreen and short stature shrub. It produces berry-sized fruits that are commonly used as a condiment or additive to pickles and spices. It is found wild in Bihar, West Bengal and south India. It is grown commonly as a hedge plant.

Regular plantations of Karonda are very common in some parts of Uttar Pradesh. Fruits, sour and astringent in taste, are the richest source of iron containing good amount of vitamin C, sometimes they contain more ascorbic acid than an average orange. Being rich in pectin therefore its fruits have been utilized in processed products such as in the preparation of jam, jelly, squash, syrup and chutney and is in great demand in the international market. It is very useful to cure anaemia and roots and leaf extract have medicinal properties which cure the several diseases.

Climate and Soil

It is very hardy and drought tolerant, it can flourish well throughout the tropical and subtropical climates. High temperature and arid climate are suitable for karonda cultivation. Plants are sensitive for low temperature and front injury. Avoid growing in heavy rainfall and waterlogged conditions.

It can be grown on a wide range of soils including saline and sodic soils. It is most fruitful on deep fertile, well-drained soil but if soil is too wet, there will be excessive growth and lower fruit production. They can be grown in wide ranges of soil pH ranging from 5.0 to 8.0.

Varieties

Earlier there were no well-established varieties of karonda. Cultivated types are named on the basis of fruit colour—green-fruited, whitish fruits with pink blush and dark purple fruited. Maroon (a Narendra Selection) and nos. 13, 16, 12 and 3 have been identified as promising types. Besides, some promising varieties have been released from institutes. Which are listed below.

Pant Manohar

The plant of this variety is medium– sized dense bushes, fruits are dark pink blush on white and yield 27 kg / plant.

Pant Sudarshan

The plant of this variety is medium– sized dense bushes. Fruits are pink blush on white background. On ripening fruits become dark brown. Yield 29 kg / plant.

Pant Suvarna

Plants are upright growing and sparse. Fruitsare colour dark brown blush on green background. yield 22 kg / plant. On ripening, fruit colour changes to dark brown.

Konkanbold

The plants are medium in size and vigorous. Its flowers in the month of Feb.-March and fruit ripe in the month of May-June under Coorg conditions. Fruits are oblong in shape and 12-154g in weight. The colour of fruits is dark purple. This variety is suitable for table purpose.

CHES- K-II-7

The plants are medium size and flower in the month of Feb.-March and fruit ripe in the month of May-June. Fruits are oblong in shape and 12 -13 g in weight. Fruits are sweet with TSS 15^0 Brix.

CHES- K- V-6

The plants are medium size and it flowers in the month of January-February and fruits in May-June. Fruit is also rich in Vitamin –B. This variety is suitable for table purpose.

Propagation

Seed propagation is commonly recommended in karonda. The seeds sown immediately after extraction are advocated because it gives higher germination. Eight to ten months old plant is recommended for transplanting. However, Vegetative methods—air-layering and stem (hard wood) cuttings can also be adopted.

Cultivation

Planting: Field should be thoroughly ploughed and well leveled. Pits of 45cm × 45cm × 45cm and 60cm × 60cm × 60cm size are dug and filled with organic manure and soil, in a 1:2 ratio. The planting distance for fence/hedge should be 1–1.5m, requiring 300–400 plants for planting the boundary of one hectare land. About 500 plants/ha for intercropping while 1,800 plants/ha for regular planting are needed. On set of monsoons is ideal time of planting.

Training/pruning: Initially training of plant is essential to provide the required framework. Unwanted branches should be pruned to provide definite shape and to promote growth of the trunk and crown of the tree. Keep three to four branches 30-45 cm from ground opposite to each other because that form the proper frame of the tree. Open centre system of training is ideal for growth and better production. Requirement of training first two years is essential. Karonda plant grows slowly in arid areas and required comparatively less pruning but in humid and tropical region of the plant grow very vigorously. Heavy pruning is done every year. This help in maintaining reproductive and vegetative balance, tree size and producing regular yield. Further, better growth of plant is achieved by removal of water suckers, crowded and crisscross branches. The hedges are trimmed after harvesting of fruits.

Manuring and fertilization: Karonda plants grown as protective hedge are hardly manured or fertilized. For better growth and development certain doses of manuring and fertilizer is beneficial. Otherwise, its plants slowly get exhausted after taking 2 crops and show symptoms of die back. Therefore, one year old plant should be provided 5 kg of FYM and 100 gm mixture of Nitrogen, Phosphorus and Potash. This growth should be increase in same ratio up to 3 years. The four and more than 3-year-old plants should give 15-20 kg of FYM and 400 g of mixture of NPK. The best time of fertilizer application is June-July after harvesting of fruits. Manures and fertilizers should be applied in a 10-20 cm wide circular trench made at a radial distance of 0.25-0.5 m from the trunk at a depth of 10-15cm followed by irrigation immediately.

Recommended Doses of Fertilizers

Year	Quantity/annum/tree			
	FYM (Kg)	Nitrogen (Kg)	Posphorous (Kg)	Poatash(Kg)
1	5	0.05	0.025	0.025
2	10	0.1	0.05	0.05
3	15	0.15	0.075	0.075

4onwards	20	0.20	0.075	0.125

Irrigation

Being hardy in nature water requirement of karonda is very low. Early stage of plantation irrigation is essential. Young plants should be irrigated at 10-15 days interval in the winter and 6-7 days in summer season. The basin or flood method of irrigation is normally practiced. However, adoption of drip irrigation has been found to be effective in the economic use of water and enhanced growth. The adult's orchards are generally not irrigated. Moisture conservation can do by mulching with dry leaves or residues in the basin.

Inter Crop

It is generally growing in dry soil where water facilities are not available some vegetables are can be growing during rainy season. Cowpea, French bean, okra, brinjal or other suitable crops are grown as intercrops.

Harvesting and Postharvest Management

Bearing in karonda starts after 3rd year. It bears flower during March. The fruits mature from July to September in north India. While in arid conditions, flowering starts late and fruits ripen in post-monsoon period. Karonda requires 2–3 pickings. On an average a plant provides 3–5kg fruits Harvesting is done manually. The harvesting of fruits with stock helps to minimum the oozing of latex by fruits and enhances quality and storage of fruits harvested at maturity, can be stored for a week at room temperature, whereas fruits harvested at ripe stage are highly perishable and can be stored only for 2–3 days.

Diseases and Pests

Diseases	Causal organism	Symptoms	Management
Bacterial leaf spot	*Xanthomonas campestris*	Small, round and water-soaked brown spots for the first time on the lower surface of the leaves. A yellowish green halo may surround the spots which causes necrosis.	Removal of diseased leaves or plant parts, sprays with phytomycin 200 ppm/lit. of water at 10 days interval
Anthracnose	*Colletotrichum gloeosporoides*	Irregular size black, brown, lesions. These spots increase and decreasing the size of the leaves. It also affects fruits and branches.	Copper based fungicide copper oxide, copper trioxide in the initial stage.
Pests			
Leaf eating caterpillars	-	Caterpillars cause much damage, mainly by eating leaves. This affects the growth of the plants. Caterpillars may be controlled by through the use of pesticides, biological control and cultural practices.	Monocrotophos 2ml/l may be used for control of leaf eating caterpillars.
Fruit fly	*Bactroceradorsalis, B. caryeaea*	Moderate infectation of fruit fly infestation was noticed on karonda. Fruit fly infests the ripened fruits. Its infestation is more in southern states. The maggots come out of the affected fruit and pupate in the soil	Preharvest IPM combined with sanitation (Collection and destruction of fallen/infested fruits) + Placing Methyl eugenol trap @ 4-6/acre + In severe infestation spraying of bait spray

Conclusion

From the above article it is concluded that koronda is boom for neglected land because this crop is hardy and can survive any type of edaphic conditions and have potential to grow in high pH, where other crops cannot even stand.

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Technologies in Vegetable Production

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Introduction

In present situation survival of farmers especially small and marginal farmers is challenged by continuously reduced land holdings, decreased subsidies for inputs and increased labour cost. Under these conditions diversification of cropping system with high value crops like vegetables is the best option for farmers to improve their incomes and the economic viability of agriculture. Here some of technologies which can be helpful for promotion of vegetable production in the country.

Nursery Raising

Healthy nursery raising is first most important step in vegetable production which determines the productivity and profitability in vegetable cultivation

A nursery can be simple as a raised bed in an open field or in protected cultivation.

The major vegetables crops which are usually cultivated through transplanting methods are tomato, brinjal, chilli, capsicum, cole crops etc.

Advantages:

a. Intensive care during seedling stage.
b. Reduced cost of cultivation.
c. Opportunity for selection of healthy seedlings.

Drip-Irrigation

It is an effective irrigation system in terms of water conservation, which minimizes the wastage of water by direct delivering to the root zone:

a. It saves water up to 25-70%.
b. Drip irrigation along with fertigation which save water and fertilizers.
c. Saving fertilizers and chemicals (40-60%).
d. Yield increased to 60-100%.
e. Improved produce quality and higher returns.
f. Less pest and disease incidence.

Vegetable Cultivation Under Protected Condition

Production of vegetables under protected condition is the best alternative to use the land and other resources under different climatic conditions.

Optimum plant growth with high yield can be achieved in green houses, polyhouses, net houses, poly-tunnels cold frames etc.

In India total area under protected vegetable production is around10,000 hectares.

Advantages:

a. Year around availability of quality vegetables.
b. Increases the crop yield compare to open field.
c. Quality of produce is also superior.
d. Input use efficiency is high.

Mulching

It is a beneficial practice for vegetable production. It enriches, protects and provides a better growing environment and it helps in maintaining moisture in the soil

Different vegetables like muskmelon, honeydews, watermelon and cole crops which shown significant increases in earliness, total yield and quality.

In vegetable cultivation it is susceptible to several pathogens and problems of pesticide residues, to overcome these problems mulching is a good option in vegetable production.

Advantages:

a. Protects the soil from erosion.
b. Maintains even soil temperature.
c. Prevents weed growth.
d. Keep vegetables clean.
e. Improve soil fertility, insect-pest reduction.
f. Minimize fungal and bacterial diseases.

Kitchen Gardening

Depending on necessity urgency and merits, old practices may have to be promoted as a new technology.

Kitchen gardening is such old practice being promoted as new technology to combat mal-nutrition among poor families.

Adopting of kitchen gardening which reduces the price fluctuations and makes more efficient use of natural resources.

Soilless Cultivation of Vegetables

Hydroponics: The science of growing plants without the use of soil, but by the use of inert medium such as gravel, sand, peat, vermiculate, perlite, cocopeat etc to which is added a nutrient solution containing all the essential elements needed by a plant for its normal growth and development.
First crop raised in hydroponics- Tomato
Most popular for growing – lettuce

Nutrient film technique (NFT)
True hydroponics system
The plants roots are exposed to nutrient solution
Eg: Tomato, cucumber

Aeroponics: The plants are grown in tough containers, the roots are suspended and sprayed with nutrient mist
Eg: Lettuce, spinach, potato (minituber production).

Vegetable Grafting

The raising of grafted plants of vegetables was first started in 1920's in Japan and Korea in watermelon on to gourd rootstock, whereas in 1950 eggplant was grafted on to scarlet egg plant *(Solanum integrifolium).*
Leading grafted vegetable in the world- Watermelon.
Intergeneric grafting popular in cucurbits.
Interspecific grafting popular in brinjal.

Objectives:

a. Eliminate soil borne pests.
b. Eliminate problem of soil salinity and acidity.
c. Increase productivity.
d. Increase the grafted plant to different temperatures.

Post-Harvest Technologies

It is an inter-disciplinary science and technology applied to agriculture produce after harvest for its protection, conservation, processing, packaging, distribution, marketing and utilization to meet the food and nutritional requirements of the people in relation to their needs.

India is the second largest producer of vegetables in the world. But having such a huge production a considerable postharvest loss is around 10-25% of vegetables (Selvakumar 2014). To meet these targets of growing population, requirements of processing industry, increasing production, productivity and export trade, we have to reduce post-harvest losses in our country.

Reasons for Postharvest Losses

1. Moisture loss causing wilting or shrinkage.
2. Loss of photosynthates like carbohyderates, proteins occur.
3. Physical damage through pest and diseases attack.
4. Physiological loss causing decline in quality.
5. Fibre development and Greening (Potato).
6. Microbial causes insects and rodents.

Conclusion

Though these technologies in vegetable production are cost effective, but these helps for improvement of land productivity, employment generation, improving economic condition of farmers and providing nutritional security to the country.

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Rice Yield Affected by Heat Stress

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The world human population will arrive at roughly 9.8 billion individuals in 2050, and from there on will keep on developing towards 11.2 billion in the year 2100(Cervantes-Godoy et al., 2014). Given that there are at present roughly 7.7 billion individuals, the normal development of the current population will be around 30% for 2050, and about 45% for the year 2100. This enormous increase of the human population will cause a developing interest for food in the years to come. The projection has been made that harvest yields should increase with half to address the issues of the human population in 2050. Current yield increase is not at an adequate pace to satisfy future needs. One of the harvests of which quicker yield increase are required is rice (Oryza Sativa). An expansion in rice yield is vital to many, on the grounds that rice represents over 20% of caloric admission for over 33% of the universes' human population. World rice production must increase by 1% yearly to satisfy the developing need for food that will result from population development and financial turn of events. The majority of this increase must originate from more prominent yields on existing cropland to stay away from ecological debasement, decimation of regular biological systems, and loss of biodiversity. Accomplishing more noteworthy yields relies upon increase absolute crop biomass, in light of the fact that there is little increase to additionally build the extent of that biomass apportioned to grain. Total crop biomass is resolved predominantly by crop photosynthesis and respiration losses, the two of which are sensitive to temperature. Future crop productions will be affected by complex collaborations between the impacts of increase in atmospheric concentrations of CO_2 and trace gases, for example, ozone (Maggs and Ashmore, 1998) just as the impacts of temperature increase realized by atmosphere change. Worldwide mean surface air temperature increased by 0.5°C in the twentieth century and is anticipated to additionally increase by 1.5 to 4.5°C in this century. In the previous century, day by day least evening time temperature increase at a quicker rate than day by day most extreme temperature in relationship with a consistent increase in atmospheric greenhouse gas concentrations. The impacts of anticipated environmental change on crop yields have been assessed by utilizing crop- simulation models, there are not many investigations on the impacts of observed climate change on crop development and yield (Lobell and Asner, 2003). In the current study, were analysed weather data at the Interrenational Rice Research Institute (IRRI) Farm (Los Ban˜os, Laguna, Philippines) from 1979 to 2003 to assess patterns in mean maxi-mum and minimum temperatures and solar radiation in both dry and wet cropping seasons. Connections between grain yield and temperature or radiation were assessed by utilizing yield information from field experiment under irrigated conditions with optimal management at the IRRI Farm from 1992 to 2003.

Production of Rice Affected by Heat Stress

The world facing many agricultural problems due to heat stress by increased temperature. The constantly high temperatures cause a variety of morphological, anatomical, physiological and biochemical changes in plants, which influence plant development and growth and may lead a radical decrease in economic yield (Wahid et al., 2007). Photosynthesis is one of the most heat sensitive physiological procedures in plants. High temperature impacts the photosynthetic limit of plants particularly of C3 plants than C4 plants (Yang et al., 2006). In chloroplast, photochemical responses in thylakoid lamellae and carbon metabolism of the stroma are considered as the essential destinations of injury at heat stress (Marchand et al., 2005). The photosystem II (PSII) activity is extraordinarily decreased or even stops under heat stress. Heat shock lessens the measure of photosynthetic colours. During reproduction, a short period of heat stress can cause huge decrease in floral buds and flowers abortion albeit extraordinary varieties in affectability inside and among plant species and variety exists(I. Hippolyte et al., 2012). Increasing temperatures coming about because of environmental change significantly impact rice crop production in Asia. Depending on the particular phase of rice development, heat stress decreases tiller/panicle number, reduces grain number per plant and lower grain weight, thus negatively impacting yield formation (Xu et al., 2020). High temperature treatment (>33 °C) at heading stage significantly decreased fertilization and subsequent spikelet fertility and sterile seed in rice due to reduced anther dehiscence and pollen fertility rate, by which reduce in the number of pollens on the stigma (Hurkman et al., 2009). High night temperatures (32 °C) increment in spikelet sterility (by 61% contrasted with control) in rice which was come about because of decreased pollen germination (36%) of rice (Suwa et al., 2010). High temperature regularly causes over the top ethylene (Eth) creation and prompts male sterility of rice pollens. The Eth is hypothesized to inhibit the key catalysts in sugar–starch metabolism which weaken sink quality and limit grain filling and eventually produce sterile grain. Higher temperatures influence the grain yield for the most part through influencing phenological development processes. Heat induced yield decrease was archived in many cultivated crops including rice (Hatfield et al., 2011). It is estimated that rice grain yields decay by 10% for every 1 ◦C increase in least temperature during the growing season (Peng et al., 2004). Rice production is especially susceptible to high temperature, particularly during the flowering and grain-filling stages, which straightforwardly influences grain yields and quality (Shi et al., 2016). High night temperature affected 1000 grain weight, grain yield, grain chalk and amylose content in Gharib and IR64. Hight night temperature enhanced night respiration (Rn) resulted for higher carbon losses during post-flowering stage(Bahuguna et al., 2017).

Conclusion

This study focusses mainly on temperature and atmospheric CO_2 increases, while there are other significant factors on crop yields as well which will be affected by changing environments. Other abiotic stress, like water and nitrogen, also have to be taken into account. Further study and analyzation of available source can lead to a more thorough understanding of the influence of the projected changes of all important abiotic factors combined.

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Aquaponics: Grow your Own Food at your Balcony

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Summary of the Article

During the lockdown period of this recent pandemic situation, all the supermarkets remained close. Even if the stores opened after some days, it became really hectic to go to the stores with a constant fear of physical contact with other people and buying vegetables and herbs which comes contact with many people's hand. In rural areas, at least people could survive on whatever they had grown in their field by their own. But for urban people, that option was not there. So, why not, we apply our theoretical knowledge of aquaponics to grow our own food at balconies of multi-storied buildings, in urban areas. Thus, we can also supply food to ourselves, as well as to other people, everyday even if such pandemic situation strikes again. With faster population growth of this country, land availability per individual equivalent is shrinking. So, crop production should be enhanced to meet food demand of people, by urban farming. This whole approach can be set up on rooftops too, that would be wider concept where a whole community or a team of residents will come forward and that would reach a commercial level, which will require huge investment and participation. But before that we can kick start with a small-scale approach, where each individual start growing food at their own small balcony by adopting small aquaponic tools. With all these aspects, we are also being concerned to the environment by doing aquaponics, where we are reutilizing the water from aquaculture and using it as media for hydroponic crop production. This will make the cities greener, upgrade the urban environment and biodiversity, along with encouraging urban people to consume local produce and creating more job opportunities for urban poor. In this article, the impact of aquaponics and its benefits over other conventional farming systems are discussed in detail.

Introduction

Aquaponics is a revolutionary food production system that integrates aquaculture and hydroponics. This has made a lot of people to re-evaluate their way of farming or food production. The root of aquaponics system is connected with ancient Aztec people who lived in central Mexico at 1000 AD. As their inhabited land was on the shores of lake Tenochtitlan, did not have enough land to cultivate. So, they decided to design rafts made of reeds (chinampas), covered them with soil and planted vegetable crops on them. This was the earliest concept. Then the fish component was added to the system when the people from South China and Thailand started rearing fish alongside rice in paddy fields. Then the modern concept of aquaponics came, which is invented by highly talented individuals from New Carolina Institute and the North Carolina State University. The first known closed loop aquaponic system was set up in mid 1980s by Mark McMurty and professor Doug Sanders. Day by day the whole system became advanced technology oriented, re-circulating and more self-sufficient. With continuous research, further development has made the system more efficient, accessible and more popular to all. It is believed that aquaponics is one of the most profitable and sustainable projects. Along with severe issues of increasing population, degradation of resources and food insecurity aquaponics is a gateway to more prosperous future for the next generation.

What is Aquaponics?

Aquaponics is a an environment friendly, natural food growing method combining aquaculture (growing fish and other aquatic animals in tanks) and hydroponics (which is growing plants without soil /cultivating plants in water); whereby the nutrient rich aquaculture water is fed to hydroponic grown plants, involving a bacterial process with micro-organisms filtering and breaking down the ammonia in fish urine to create the nitrates that allows natural nitrifying bacterial cycles to convert fish waste to plant nutrition without the need to discard any water or filtrate or add chemical fertilizers.

Aquaponics Over Conventional Soil Cultivation and Hydroponics

Traditional cultivation leads to soil erosion, depletion of ground water and other natural resources, contamination of water resources, misuse of synthetic chemical inputs destroying environmental health and ecosystem. That's why soilless cultivation is coming in consideration. At the frontline of soilless cultivation systems, hydroponics and aquaponics both are providing growers with significant benefits of growing plants while minimizing potentially dangerous environmental effects, also lessening soil and water loss.

But when we consider the sustainability point, aquaponics come few steps ahead from hydroponics, as hydroponics cannot be assumed as a fully sustainable system due to its constant need for external artificial nutrient solution. On the other hand, aquaponics is considered sustainable as every component is provided initially, which are enough for the survival of the system, with minimal inputs needed. The addition of fish to the system generates nitrifying bacteria that break down the fish waste into a plant-usable source of nitrogen; this creates an almost entirely self-sufficient, utterly sustainable ecosystem. The maintenance and input cost are higher in hydroponics as nutrient salts and chemicals are added to the water for preparing growth media and those chemicals are super expensive. Aquaponics avoids chemical usage and embraces all micro-organisms which lead to environment safety and the system becomes less prone to pests and diseases.

Socio-Environmental Benefits of Aquaponics

1. Aquaponics needs 6 times less land area for cultivation that conventional farming, resulting in conservation of land resource.
2. Aquaponics uses 90% less water than traditional farming, resulting in water conservation.
3. No fertilizer, pesticide or herbicide is used in aquaponics farming, so no harmful chemical is being added to watershed. Thus, water contamination is avoided.
4. It reduces harmful gas emission.
5. Even with grow lights, it uses less energy than conventional commercial farming resulting in energy conservation. All it uses is electrical energy which can be altered by solar/hydroelectric/wind energy.
6. Through aquaponics we are growing plants in our home, saving money (no need of purchasing huge land), energy and other valuable resources.
7. Soilless cultivation that avoids soil erosion.
8. Plants which are grown without harmful chemicals are much more nutritious and beneficial for our health.

Pros and Cons of Aquaponics

Pros	Cons
1. Environment friendly	1. Not many crops available
2. Soil and water conservation	2. Initial cost

3. Affordable input cost	3. Needs skilled person to handle
4. Easy maintenance	4. Must be professionally installed
5. Space efficient	5. Unexpected failure
6. Nutrient utilization from wastes	6. pH stabilization is technical challenge as pH requirement of three components of the system (fish, plant and bacteria) is different.
7. Good source of income from both plant produces and fishes	7. Nutrient imbalance due to problem in fish feed choice
8. No harmful chemical usage, leading to production of fresh organic fish and vegetables.	8. Pest and disease management can be hard as three components are affected by different categories of pests and diseases.
9. Can be installed at home.	
10. Efficient to produce off-season plant produces.	

Urban Farming Prospect of Aquaponics

Aquaponics can be installed almost everywhere, so this is very convenient to be a part of urban buildings. Every single balcony, every single small space in multistore building can be utilized. If anyone can take initiative to take it at a commercial level, he/she can easily add some other elements like rooftop greenhouse, automation, sensors, etc. to make the whole idea more prominent. It minimizes the distance between growers and sellers, offering fresher vegetables and fishes for ourselves and local market and shortens the supply chain. This eventually reduces the energy consumption and natural resource misuses. Nevertheless, no one should underestimate the rural development, but urban farming can enhance urban people with technology smart agricultural skills and knowledge. Beautification in urban areas along with positive environment effects is another important aspect.

Personal Opinion

Even after knowing about all the benefits of aquaponics system, not all people are engaged in this. Even if of some people want to try it out, they are lacking technical knowledge and required skill. And many of us are being distracted by all the challenges. Our motive should be towards resolving all the problems and overcoming all the challenges to spread the whole prospect among people. More research, development and education are needed on this particular aspect. Commercial development of socially, economically and environmentally sustainable aquaponics cultivation confronts several technical challenges that should be resolved by improving nutrient solubilization, reducing extra mineral addition, adapted compact pest management, use of alternate non-conventional energy resources, innovative pH stabilization methods. If these problems can be resolved, then combining our technological skills to it will bring this idea in front row. Awareness among people is needed. Training programs (online/offline) can be arranged by skilled personnel to train more people who are interested in it but cannot come forward due to lack of required skill. Now-a-days many readymade small aquaponics kits are available in market and online shopping sites. People can easily order one and start aquaponics farming by their own. In this era of easy internet accessibility, lots of videos are available in internet, from where anyone can gain required skills to start their own aquaponics farming at their home.

Conclusion

Aquaponics seems to be a promising way to fight against world problems like population rise, climate change, water scarcity, diminishing natural resources, contamination of air & water, destroying biodiversity and disturbed ecosystem. This is more beneficial in arid zones, where water is scarce. Aquaponics leads us to an integrated approach of food production system. So, we can conclude that aquaponics is an efficient sustainable solution to feed the world, making us self- sufficient in growing food and ensuring food security. Though the system is having minor flaws, those will be easily overcome by further research and investigations. If we overlook current problems regarding agricultural production which are created due to using unsustainable inefficient methods, then both the production and agricultural industries will downfall along with poor environmental health. Among all the farming systems, aquaponics is most eco-friendly, environment safe production system satisfying all the needs of people.

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Basic Principles of Orachard Plan

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It is of great advantage to prepare a plan of the orchard in advance, be it a home or market garden or a commercial orchard. A detailed survey of the site is carried out including the levels and a good map to scale is drawn. A full knowledge of the fruits to be grown and their cultivation is also prerequisite for efficient planning.

The Guiding Principles in the Preparation of Plan are

1. The orchard should be managed most profitably.
2. It should present as attractive look as possible.

The following general principles may be borne in mind while drafting a plan and as many of them as possible should be fulfilled. It should be recognized that not all of them can be adopted in every case. If the entire area is not of the same type of soil, each fruit should be allocated to the soil type it prefers.

The irrigation sources should be marked and channels indicated along gradients with a view to achieve most economical conduct of water.

Irrigated fruits should be close to the source of irrigation to avoid long irrigation channels and consequent loss of water during conduct.

Tall wind breaks should be planted especially on the sides from which high winds are expected. There should be adequate clearance between the wind breaks and the crop.

Roads should be planned to occupy the minimum space consistent with economy of transport of orchard requisites and produce. The space between the wind break and the first row of fruit trees may often be utilized for roads and canals etc. with advantages.

Drains should follow the gradient of the land, should be as straight as possible and concealed from the visitors, if possible. When varieties with pollen preferences are planted, they should have the polliniser in an adjacent block or in alternate rows so as to ensure good crop.

Fruits which ripen at the same time should preferably be grouped together to facilitate easy watching and harvesting. Assign rear areas for tall trees and the front for shorter ones will besides facilitating watching, also improves the appearance of the orchard. The orchard should in general present an aesthetic appearance so as to provide marked attraction. The spacing adopted should be the optimum.

The spacing allowed is usually such that the fringes of the trees will just touch one another cutting out light but should not interlock. Within reasonable limits, closer spacing gives more yields in the earlier age. But in later life, the trees tend to grow taller than broad resulting in difficulty in pruning, spraying and harvesting.

They also suffer from root competition inadequate nutrition, fewer fruits which tend to be smaller with comparatively poorer in colour development. So, adoption of closer spacing to accommodate more plants per acre proves to be a false economy in the long run.

The spacing given to fruit plants depends on the following factors:

a. The habit of growth of the plant: The spacing being equal to the spread of the plants.
b. Rainfall: In the case of rain fed crops closer spacing is given in lighter rainfall areas than in heavy rainfall areas.
c. Nature of soil: Trees on stiffer soils may be given less spacing as both their top and root spread are limited in such soils.

d. The root stock: Root stock influences the spread of the trees and to that extent determines the spacing to be adopted.

e. Pruning and training

f. Irrigation system.

g. The method of layout should be fixed in advance so that the no. of plants required is worked out and arranged for 24.

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Extraction of Pure Genomic DNA and RNA

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Introduction

DNA is a double helical structure with 2nm in diameter. It's a universal genetic material found in most of living organisms. DNA (deoxyribonucleic acid) having stable structure rather than RNA which is in single strand in loop structure may also see. Study on DNA revels the concept of life evolution. There are forms of DNA A, B, D, Z these are the existing forms of DNA but most commonly found structure is B forms in DNA . Simultaneously RNA has less Tm (melting temperature) value and no any hydrogen bonding between RNA due to single strand reason that less stable. The basic extraction methods of DNA from living plant tissue (wheat, rice etc) c-TAB (cetyl trimethylammonium bromide) method of extraction and for RNA extraction method is TRIZOL based extraction. Its purity confirms the reliable study of all molecular research. Along with DNA many other polyphenols and carbohydrates binds with nucleic acid at the time of DNA isolation. The current modification of C-TAB method of isolation leads to higher concentration of beta-2-mercaptoethanol for separation of crude material which bound with DNA (Aboul maaty and sadek obray 2019).

C-TAB Method of DNA Extraction

Genomic DNA of F4 progenies (ILT598 X WL711) was isolated using CTAB method (Saghai Maroof et al 1984) taking equal leaf tissue from 10 plants of each progeny. Leaf tissues were collected from the field of about one-month-old plants and temporarily stored at -80^{0}C. Leaf tissue was grounded in liquid nitrogen (1960C), the powder was transferred to a 2ml of tubes, and 0.8ml of CTAB extraction buffer was added to each tube. The composition of the 2X CTAB buffer is given in Table 9. The suspension was incubated for 45 minutes at 65^0 C in water bath. The tubes were inverted once or twice during incubation period to mix tissue thoroughly in the buffer. After incubation, 15ml of chloroform: isoamyl alcohol (24:1) was added in same tubes and gentle shaking was done on rotary shaker for 45 minutes. Thereafter tubes were centrifuged at 12000 rpm for 10 minutes. The supernatant was transferred to clean sterile 1.5ml tubes and 0.8 ml of chilled isopropyl alcohol were added. The tubes were inverted gently several times. DNA was precipitated like white thread and transferred into sterile 2 ml microcentrifuge tubes. The DNA pellet was washed with 70% ethanol was air dried for an hour. Dried DNA pellet was dissolved in 100 µl TE buffer. Each DNA sample was treated with 0.8 µl of RNAase solution followed by 37^{0}C water bath incubation for 30 minutes.

Composition of 2X CTAB Extraction Buffer

S. No.	Component	Quantity/Litre	Final Concentration
1.	NaCl	81.8g	1.4M
2.	1M Tris HCl (pH 8.0)	100ml	100mM
3.	0.5M EDTA	40ml	20mM
4.	CTAB	20g	2.0%
5.	β-Mercaptoethanol (added just before use)	10ml	1.0%

Checking Quantity and Quality of DNA

Quantity and quality of DNA was measured using using NanoDrop® ND-1000. The pedestal of Nanodrop was cleaned using Molecular grade nuclease-free water and 1.5 µl of extracted DNA sample was used to check quantity and quality.

Total RNA Isolation and Quantification

All the plastic ware, glassware and other experimental material used in RNA extraction as micro- centrifuge tubes, microtips pestle mortar were sterilized by dipping in DEPC solution overnight at 37°C (1ml DEPC in 1000ml distilled water) and then dried completely hot air oven. All dried material was wrapped with Aluminium foil and kept it inside the RNAase free area (Sah et al 2014).

Leaf samples were washed with 60% ethanol to remove extra "RNA Later" solution and crushed to powder in pestle and morter using liquid nitrogen. Homogenized samples transferred into 1.5 ml microcentrifuge tubes and 1 ml of TRI® agent (cat no # 15596-018) was added. The microcentrifuge tube was kept at room temperature for 5 min followed by centrifugation at 12000Xg for 5 min at 4°C. The supernatant was collected and transferred into a new 2 ml microcentrifuge tube without disturbing the pellet at bottom. 0.2 ml of chloroform was added to supernatant and mixed gently for 15 seconds until it turns milky. The solution was kept at room temperature for 5 min, centrifuged at 12000Xg for 15 mins at 4°C resulting in three layers of which topmost layer contain RNA. Top layer was transferred into a new 1.5 ml tube carefully so as not to disturb other layers. 1ml of isopropanol was added to this, mixed gently and kept at room temperature for 10 min followed by centrifugation at 12000Xg for 10 min at 4°C to precipitate RNA. Supernatant was discarded, without disturbing the RNA pellet. RNA pellet was washed with 0.5 ml of 75% cold ethanol, followed by gently tapping 2-3 times and centrifugation at 7500Xg for 5 min at 4°C. Pellet was dried by leaving the tube open for 5-8 min. RNA pellet re-suspended into 20 µl volume RNase-free water by keeping microcentrifuge tube on ice for 5-7 min to dissolved RNA. For quantification 1.2g of agarose powder was dissolved in 87ml of DEPC water. The agarose solution was heated for 2:30 min, cooled and then 3ml of HCHO, 10ml of MOPs buffer and 10 µl of ethidium bromide was added. The gel was poured onto the gel plate for solidification. 5 microliters of RNA were mixed with 5 microliters of 50% glycerol solution and then loaded in the gel. The samples were allowed to run at 80-120 volt and 310 amperes current for two hours.

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Sexual (Seed) Propagation

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Vivek Joya

It refers to multiplication of plants by seed. In sexual process male and female gametes are fused to produce seed. Meiosis division takes place in course of fusion and the chromosome numbers, as in parents is reduced to half, which after fertilization becomes normal. In sexual propagation during meiosis segregation, reassortment or rearrangement of characters takes place. So, the plants thus produced may or may not be similar to their parents and the propagated plants may also be different from each other. It is called as seed propagation, since the propagation is through seed and also sexual propagation because sexes are involved

Seed is the result of fusion of male and female gametes. Seeds are fertilized ovules, containing embryos resulting from the union of a male and a female gamete during fertilization. The embryo in the seed gives rise to a new plant on germination. Plants that are produced from seeds are called seedlings.

Advantages of Seed Propagation

1. Seedling trees generally live longer, bear more heavily and are hardier than vegetatively propagated trees.
2. Seedlings are comparatively cheap, and can be more easily raised than vegetatively propagated materials.
3. Plants which are difficult to propagate, e.g., papaya and phalsa by vegetative method can only be propagated by seed.
4. In breeding for evolution of new varieties, the hybrids are first raised from the seed and it is, therefore, essential to employ this method in such cases.
5. Seed propagation, sometimes results in the production of Chance seedlings with superior characteristics, which may be of great benefit to the horticulture industry.
6. Rootstocks, on which desirable scion variety is budded or grafted, are usually raised from seeds.
7. Seeds of some fruits like citrus and mango varieties are capable of giving out more than one seedling from one seed. They arise from the cells of the nucellus and are called poyembyonic. The nucellar seedlings can be utilized for raising uniform plants, if they can be carefully detected at the nursery stage.

Disadvantages of Seed Propagation

1. Owing to genetic segregation in heterozygous plants, seedling trees are not uniform in their growth, yielding capacity and fruit quality compared with asexually propagated plants. Seedling trees are not usually true to type and show variation.
2. Seedling trees take more time to come to bearing than grafted plants .For example mango seedlings take 8 - 10 years to come to bearing ,compared with 3-4 years for grafted trees.
3. Seedling trees, being very large, pose problems for efficient management of orchard trees, i.e., harvesting, pruning spraying etc. become more difficult and expensive.
4. It is not possible to derive the benefits of rootstocks, if the plant is not propagated vegetatively by means of grafting or budding.
5. Continuous seed propagation leads to inferiority in the progeny.
6. Sexually propagated plants have long juvenile (pre-bearing) period.
7. Choice or chance tress or hybrid trees cannot be multiplied true to type because of segregation of characters.
8. Seeds loose viability within a short period. Eg.Citrus, mango, jack, papaya, jamun etc.

Zero Budget Natural Farming in Tamil Nadu

Article ID: 10700

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Introduction

Zero-Budget Natural Farming (ZBNF) is a holistic alternative to the current concept of high-cost chemical inputs-based agriculture. It is very efficient in addressing the worries of environment change1. Alternative low-input farming practices have emerged in India and across the world likely to reduce input costs and higher yields for farmers, chemical-free food for consumers and improved soil fertility. Zero Budget Natural Farming (ZBNF) is one such low-input, climate-resilient agriculture that inspires farmers to use low-cost and locally-sourced and available inputs, eliminating the use of artificial/ chemical fertilizers / industrial pesticides. Organic / natural farming is native to India. The farmers of ancient India were known to have evolved naturally-friendly farming systems and practices such as mixed farming, mixed cropping and crop rotation3. Organic farming is in a growing stage in India. About 2.78 million hectares of farmland were under organic agriculture as of March 2020, according to the Union Ministry of Agriculture and Farmers' Welfare. This is two percent of the 140.1 million ha net sown area in the nation.

Scope for Zero Budget Natural Farming

1. 70 % of land area are under dry land agriculture with insignificant resource depressed farmers.
2. The average pesticide usage of country is 0.6 kg/ha < China (13kg/ha) <Korea (16.56 kg/ha), So ZBNF can be effortlessly employed.
3. 80 % conventional yield can be achieved with ZBNF
4. The Farmer gets a premium price of 22-35% over conventional produce.
5. Due to diversified cropping farmers get year around income and insurance against crop failures.
6. The income obtained from the farm is high with low input.

Zero Budget Natural Farming for Combating Climate Change

1. ZBNF for warfare Climate change.
2. ZBNF is positioned as an explanation for the debt crisis among Indian farmers.
3. Most recent available figures by the government of India show that about 52% of the agricultural households in the country are in debt (NSSO, 2014).
4. The Government of Andhra Pradesh has decided to change farming to Zero Budget Natural Farming (ZBNF) by the year 2024.
5. AP Government has decided to approach 60 lakh (6 million) farming households to adopt "Climate Resilient Zero Budget Natural Farming (CRBZBNF)" as a farming practice that believes in natural growth of crops without supplying any other external inputs.

Uniqueness of Zero Budget Natural Farming

1. An advance towards sustainability.
2. Expense-free crop growing.
3. Farming up to 30 acres with one citizen cow.
4. Farming with less electricity and water utilization.
5. Producing worth, poison-free food.
6. Agriculture without outside input.
7. Techniques of multi-crop agriculture for higher net profits.

8. Reducing outdoor labour necessity.
9. Farming in the refrain with nature.

Challenges of Zero Budget Natural Farming

1. There is no special market to retail.
2. Takes long alteration period.
3. It is practiced in less parts of India.
4. It is a highly restricted farming.
5. It is practiced in trifling area.
6. The farming type is still under dispute and not much scientific research is done still under appraisal.

Importance of Desi Cow in Zero Budget Natural Farming

1. One gram of Desi cow dung includes 300 to 500 crores of advantageous efficient microbes.
2. Microorganisms decompose the dried biomass on the soil and compose accessible the nutrients to the foliage land.
3. All Indian cow breeds are appropriate for ZBNF.

Four Pillars of Zero Budget Natural Farming

1. Bijamrita (Seed Treatment): It is a mixture of water, cow dung, cow urine, lime and forest soil, which is used to treat seeds, seedlings or any planting substance which protects from soil and seed bear pathogens.

2. Jiwamrita (No Fertilizers No Pesticides):

a. It is a mixture of water, cow dung, cow urine, jaggery (unrefined brown sugar), flour of any pulse when applied over soil promotes biological activity and adds soil microbes.

b. It acts as a catalytic representative to promote biological activity, thereby breaks the nutrients obtainable in the soil by growing soil microbes.

c. When we relate Jiwamrita to the dirt, we pin nearly 500 crores microorganism to the soil.

d. These micro-organisms adapt the non-available form of nutrients - nitrogen, phosphate, potash, iron, sulphur, calcium, etc. - Into accessible forms.

e. Two hundred litres per acre per month is sufficient as a culture to renovate the soil.

f. Once you apply Jiwamrita to the soil, the earthworms begin their work and they can bring the nutrients from 15 feet deeper in the soil to the upper surface and make them available to the roots

g. These earthworms, microorganisms and other insects need a positive micro-climate, i.e. 25 to 32 °C temperature.

h. When we mulch the soil, this micro-climate or humus is shaped automatically.

3. Mulching (Soil, Straw & Live):

a. It is necessary to create the microclimate under which micro-organisms can well develop, that is 25 to 32 °C temperature, 65 to 72 % moisture.

b. It creates darkness and warmth in the soil.

c. It conserves humidity of the soil, cools it and protects its micro-organisms.

d. Mulching promotes humus formation, suppresses weeds and maintain the water requirement of crops.

4. Weaphasa (Soil Moisture):

a. If there is no Waaphasa (soil aeration) in the soil, the plants will die.

b. For this, water is sprayed on degradable materials that are certified to remain on the farmland.

c. This form humus that helps retain the moisture and nutrients in the soil.

d. Farmers need to draw only 10 percent of the required water from the soil for cultivation using this process.

Multi-Cropping

1. Multi-cropping is a good way to reduce the risks for the farmer who is able to enjoy the continuity of yield all through the year.
2. In case of a crop failure, he can also rely on the other crops.
3. It has expanded farmers' income sources.

Pest Management in Zero Budget Natural Farming

1. Agniastra, Bramhastra and Neemastra are three processes under ZBNF which are to control the pests like leaf roller, stream borer, fruit borer, pod borer, sucking pests and mealy bug etc.
2. All these processes use locally available inputs like cow dung, cow urine, green chilies, neem pulp, neem leaves which are always available in farmers' farm free of cost.

Conclusion

ZBNF has been emerged as a farming model for small and marginal farmers to overcome the agriculture distress and satisfying the livelihood and maintenance the health of family on top precedence. It reduces farmers' costs through eliminating outside inputs and utilising in situ wealth to revitalize the soil, concurrently upward income, restoring ecosystem/ soil health and climate resilience through diverse, multi-layered cropping systems. Now Indian government has also proposed in the budget 2019-20 for ZBNF. These types of cultivation models should be adopted and simulated in other state of India.

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Influence of Environmental Factors on Horticultural Crop Production

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Temperature

It is an important determinant of plant growth. High as well as low temperatures influence the growth of plants. Broad leaved, ever green plants are very much susceptible to low temperature. Fall of temperature below 5^{O}C put a strain on the survival of such plants. Deciduous plants by their adoptive mechanism to shed foliage are better able to tolerate low temperature. Such plants pass their lives in dormant stage during winter. Generally, a temperature range of 20 - 30^{0}C is considered ideal for majority of tropical and subtropical plants. Temperate plants require chilling winter. In majority of temperate fruit plants, flowering commences subject to fulfilment of chilling temperature ranging from 2^{O}C to 7^{O}C. High temperature above 40^{O}C causes scorching in plants. The leaves show burning symptom along tip and margin. High temperature causes bolting and seed formation in spinach and lettuce. Development of red colour in oranges is governed by low temperature. More severe winter favours discontinued synthesis of chlorophyll and unmasking of carotenoids which imparts red colour to oranges. The optimum temperature for most of the plants varies in the range of 22^{O}C to 27^{O}C. High fluctuation in day and night temperature badly influences the growth and production of plants.

Humidity

It is a crucial component of climate affecting growth and production of crop. Humidity is essential for growth of the plants and qualitative development of the fruits. The kharief plants and vegetables grow fast with abundant humidity during monsoon season. The colour, TSS (total soluble solids), sugar and acid blend is bettering in dry atmosphere having very little humidity. The oranges grown under high humidity have thin rind and more juice. Low humidity favours better colour development in oranges. High humidity favours resurgence of diseases and pets also. High humidity during March causes powdery mildew disease in mango. Fruit fly incidence is more in mango if there is high humidity in atmosphere at the time of fruit ripening. Fluctuation in atmosphere humidity is the main attribute behind cracking of fruits. Under less humid conditions the fruit skin is smooth, thin and shiny and it is important where the fruit skin is edible like Guava, ber, apple etc.

Wind

High velocity and hot winds cause heavy damage to fruit trees. They cause breakage of limbs of fruit trees. High velocity winds also cause shedding of flowers and dropping of fruits. Dry winds bring scorching and torning impact on the leaves of banana. The increasing wind velocity retards the activity of pollinators. Bee activity is maximum when wind is still, gets little reduced when wind is 2-3 km per hour, gets greatly reduced when wind velocity is 25 km per hour and their activity is altogether ceased when the wind velocity is 40 km per hour. In wind storm, spray of pesticide and other chemicals become difficult.30 For successful cultivation of fruit crops, raising of dense windbreak rows around the orchard is necessary. The trees like eucalyptus. shisham, casuarina, seedling mango, and jamun may be used as wind breaks.

Rainfall

The amount and distribution of rainfall is important factors in growth and development of crop. Rain at the time of flowering washes out pollen grains and greatly reduces the fruit set. A year of normal rainfall creates conducive condition and yields better growth and harvest of plant. The fruits like guava, pomegranate, ber and sapota in which flowering synchronizes to rainy season, normal rainfall brings bumper harvest. Water is required at different stages of plant growth. Water shortage at the time of early growth, bud differentiation, blossoming, and fruit set and development results in undesirable effect. Rains before harvesting cause softening of fruits in banana and date palm and induce infection of fruit fly in guava and peaches. It is generally observed that fruits are juicier where they mature during rainy season due to high atmospheric humidity. Fruits that mature during rainy season contain less sugar and more acid than fruits maturing during dry season. Keeping quality of fruits and vegetables developing under high atmospheric conditions may not be good.

Hailstorms

These causes great damage to the fruit crops. Occurrence of hail at the time of flowering and fruit maturity is very disastrous because flower and fruit drop is heavy and the growers get poor returns for their produce. For successful cultivation of fruit crops, only those areas where hailstorms don‘t occur should be selected.

Solar Radiation

It is the primary source of energy to plants. For the transformation of light energy to chemical energy leading the production of photosynthates, solar radiation is must. Orchard, located on southern side of the slope receiving better amount of radiation, bears better yield than other side. The periphery and top most portions of plants are more productive due to better and direct absorption of solar radiation. Training and pruning of plants are maneuvered in a way; so that the plant may be better able to absorb more solar radiation required for good productivity.

Protected Cultivation of Vegetable Crops

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Introduction

India is a famous for its agro-climatic region. Its ranges from extreme temperate to extreme tropical region between these sub-tropical parts exist in our country. I mean to say that we have all the types of climate. That result in free to grow the all types of crop with suitable climatic condition. As far as vegetable is concern, we have diverse group of vegetable that could be grown from extreme hot to extreme cold climate. The majority of cultivation practices occur in the plain area, but there is vast scope for the cultivation at the hilly regions. Statistics of horticultural crop area and production, productivity stated that for the year 2013-14, production was 277,352 thousand MT with an area of 24,198 thousand ha. Out of these the contribution from vegetable were 162,897 thousand MT and area of cultivation were 9396 thousand ha.

India is a leading country in area and production after china in many crops in the world, but when we talked about the leader in all crops, we see that we are far behind. Vegetable production is much lower than the present requirement to feed the people of India. The reason is predominantly use of years back technology and cultivation practices is also traditional leading to low productivity. Also, there is lack of good management practices for the biotic and abiotic stress. There are different ways to revive from this situation. Bringing additional area under vegetable cultivation, use of hybrid seed and use of improved agro-techniques are some of the important ways to increase the vegetable production. Another approach is cultivation under protected environment. Uncontrolled avail of harsh climate like high wind, hot and humid climate, an extreme cool to extreme hot forces to the farmer and scientist to develop a technology for cultivation of crops under prevailing adverse climate condition.

The majority of hilly (part of northern plain) areas have full of fertile land. Which is perfect for vegetable production but facing extreme temperature ranges at the plain area, during the pre and post rainy season the crop become susceptible to biotic agent e.g., tomato, cauliflower, chilli, and okra. It has been found that the high altitude of hills affected with extreme cold –5° to –30° consequently difficult to grow vegetable during November to March. Protected agriculture, which includes polyhouse, shade net, poly-tunnel, polymulch, etc., protects the agricultural cropsfrom sudden changes in weather and regulates the environment inside these structures. Greenhouse/poly house/net house are suitable technology under this diverse climate for year-round and off-season vegetable production. The protected vegetables cultivation technology can be utilized production of high value, low volume vegetables, crops production of virus free quality seedlings, quality hybrid seed production and as a tool for disease resistance breeding programs. The need of protected cultivation since last 10 years has been dramatically increased.

Cultivation of Vegetable in Protected Area

Protected cultivation is the sustainable approach toward the vegetable production under adverse climate. Besides, from protection to adverse climatic condition, the vegetable under protected production yield high quality vegetable in terms of shape, size and colours. The micro climate can be changed inside the poly house. Certain insect requires UV light their vision purpose, the UV opaque covering material for poly house helps to restrict the insect to enter the house. Consequently, there is minimum use of insecticide. The production of vegetable is higher than the open field condition due to congenial inside microclimate and that provided better price. The protected cultivation comprises different devices and technologies namely windbreaks, irrigation soil mulches etc. and the structures which are greenhouse, tunnel, row covers made the production throughout the year by modifying the natural environment. It will further prolong the harvest period, increase yield, quality improvement, and keep the availability of commodities frequently. It is the conventional production system, which is based upon the control over the nature of root media through tillage, manure, fertilizer application and irrigation scheduling. It is not a matter of care about light, temperature, air quality, relative humidity affects the crop production in the open field condition. Greenhouse production can be used as one of the solutions for above parameters. A high value, short duration and small size vegetable crops are being mostly suitable under protected cultivation. In India, especially in hill the sweet pepper, tomato and cucumber are being raised. However, the leafy vegetables are also suitable for protected cultivation. Cabbage, cauliflower, tomato, brinjal, capsicum, beans, pea, and coriander can be successfully grown under protected conditions at high altitudinal region. Soilless cultivation in recent decades use of the soilless cultivation method has increased significantly due to the use of methyl bromide as a soil disinfectant between crop cycles is or will be banned soon. New types of substrates are increasing in the same way with the objective of increasing yield and quality with respect to the plants grown in the soil. Several types of substrates are used as soil less media and it protect the crops from different soil infections like coconut fiber, perlite, vermiculite, rock wool, peanut hulls, rice hulls and coco peat etc. Hydroponics In this system plants are grown in nutrient and water solution without soil. Terrestrial may be grown with their roots in the mineral solution only or in an inter medium, such as perlite or gravel. Aeroponics Plants are grown in troughs, tubes or other type of chambers and roots are hung in air sprayed with nutrient mist. So, it easily absorbs nutrients and oxygen. This technique has less chance of root diseases. Temperature maintenance the several crops can be grown in a wide range of temperature, but for better growth and development individual crops requires a specific range of temperature. It is possible under protected cultivation.

Dimensions of Climate Control System

Production of vegetable crops during unfavorable climatic conditions, such as high temperature, flooding, and strong winds suffered from incidence of diseases high. It needs to control for the successful crop production. Greenhouse production system is one of the most suitable systems, most efficient mean to obtain high quality fresh vegetables for both domestic and export markets. It is suitable in rainy and cold climate. Inside, the house there is gradually increased in temperature due to heating effect of high irradiation. Actually, the incidence light get trap inside the greenhouse and not escape out leading to temperature rise. Several methods are available for cooling greenhouses like evaporative cooling, shading and natural ventilation. Water is the most important factor that affects the production system of vegetable crops. It is not possible to grow the vegetable crop during the high rainfall, as vegetable are succulent and tender in nature, high rainfall will drop the quality of vegetable crops. To reduce the consequences of high rainfall and high wind, the protected cultivation is the most suitable technique. It will produce the high quality of vegetable throughout the year. Pest and disease control to control the insect pest inside the house, insect-proof screens have been used to cover the ventilation openings. By keeping away the vector (insect), we could control the viral disease. The poly-houses and shade net house (35%), though the peat like the aphid and white fly were able to enter the shade-net but not caused any serious infestation. Higher yield Poly-houses (PHs) and shade-net houses SNHs (35%) were found fairly useful to create favourable microclimate for plant growth and higher yield and also for minimization of pest infestation.

Response of individual crops to protected cultivation tomato requires a relatively cool, dry climate for high yield and premium quality. When the temperature falls below the 10°C, it causes problem with the pollen bursting, while the higher temperature causes premature fruit drops in tomato. Mostly the lower in temperature affected the crop production as there is problem with fertilization and less fruit yield. A thigh temperatures fruits are often badly damaged or misshaped and not marketable, while the red varieties tend to become more orange. These problems can be overcome with the maintained of temperature in protected cultivation. The temperature when rises above the 30°C, both the pollen grain and stigma may dry out, which causes poor fruit set.

Conclusion

The protected cultivation of vegetable crops is an advantageous technology for farming community because is cost effective technique. Vegetables grown by this method is safe to consume due to less use of chemicals. This technique also provides congenial environment to off season cultivation as well as high and quality production. Therefore, increasing demand of vegetables for growing population can be fulfilled by this technology.

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High Density Planting / High Density Orcharding

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Planting of fruit trees rather at a closer spacing than the recommended one using certain special techniques with the sole objective of obtaining maximum productivity per unit area without sacrificing quality is often referred as 'High density planting' or HDP. This technique was first established in apple in Europe during sixties and now majority of the apple orchards in Europe, America, Australia and New Zealand are grown under this system. Based on plant population, HDP is termed as Low HDP with less than 250 trees/ha., higher HDP with 500-1250 trees/ha and ultra HDP with more than 1250 trees/ha. Recently, super high density planting system has been also established in apple orchards with a plant population of 20,000 trees per ha. Still dense population of about 70,000 trees/ha is followed in certain orchards and this system of planting is referred as meadow orcharding as practiced in apple.

The exact limits of plant density to be termed as are not yet well defined. It varies with the region, species, variety, rootstock, cost of planting material, labour and likely return from the orchard and agro-techniques adopted for a particular crop.

High density planting is one of the improved production technologies to achieve the

objective of enhanced productivity of Indian fruit industry. Yield and quality of the produce are two essential components of the productivity. High density planting aims to achieve the twin requisites of productivity by maintaining a balance between vegetative and reproductive load without impairing the plant health.

The underlying principle of high-density planting is to make best use of vertical and horizontal space per unit time and to harness maximum possible return per unit of inputs and national resources. In India, the usefulness / vitality of this technology has been proved in an array of fruit crops eg.; pineapple, banana, papaya, mango, apple and citrus.

Advantages

1. It induces precocity/precocious bearing.
2. Higher yields. The average yield in apple is about 5.0 t/ha under normal system of planting and it is about 140.0 t/ha under high density planting.
3. Higher returns per unit area.
4. Early returns.
5. Easy management of orchard tress.
6. Reduces labour cost resulting in low cost of production.
7. Enables the mechanization of fruit crop production and facilitates more efficient use of fertilizers, water, solar radiation, fungicides, herbicides and pesticides.38.

Dis-advantages of High-Density Planting

1. HDP results in overcrowding, over lapping not only in the tops, but also in the root system and heavy competition for space, nutrients and water.
2. More important is build-up of high humidity, lack of cross ventilation in the orchard, which is more conducive for build-up of pests and diseases.
3. Reduction in yield in the long run after 10-12 years of age.
4. Production of small sized fruits and poor-quality fruits.

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Organic Cultivation of Vegetable Crops

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Introduction

India is an agrarian economy and the agriculture sector in India contributes about 17 percent of country's GDP and provides employment to approximately two third of the population (United Nation Development Programme Fact sheet 2011). India with its varied agro-climatic zones is amenable to grow a wide variety of vegetable crops. India, with production level of 176.2 million metric tonnes of vegetables, is the second largest vegetable producer country after China, in the world, accounting for 14% of the total world vegetable production. Vegetables are important constituents of Indian diet as they are rich source of carbohydrate, proteins, vitamins, minerals, glucosinolates, antioxidants, fibre, etc. Vegetables and fruits are consumed for nutrition, maintenance of health and many for their therapeutic values and prevention of diseases. The indiscriminate use of chemical inputs in agriculture fears/concerns the contamination of foods with agrochemicals. The consumers are concerned about the vegetables they eat.

Concept of Organic Farming

The concept of organic farming is not clear to many concerns (Palaniappan and Annadurai, 1999). Many people consider that traditional agriculture, sustainable agriculture, Jaivik Krishi etc, as organic farming. Some people are of the idea that the use of organic manures and natural methods of plant protection instead of using synthetic fertilisers/ pesticides is organic farming. But this is not true. Organic farming in real sense envisages comprehensive management approach to improve the health of underlying productivity of the soil (Palaniappan and Annadurai, 1999). Above all, the success of organic farming depends to a great extent on the efficiency of agronomic management adopted to stimulate and augment the underlying productivity of the soil resources. All the management practices followed in organic farming are governed by the principles of ecology and are within the ecological means.

Scope of Organic Farming in India

India is bestowed with lot of potential to produce all varieties of organic products due to its various agro-climatic regions. India is endowed with various types of naturally available organic form of nutrients in different parts of the country and it will help for organic cultivation of crops substantially. In several parts of the country, the inherited tradition of organic farming is an added advantage. There is diversity in climates100-10,000 mm rainfall, hill, desert, strong traditional farming system- crop-tree animal, innovative farmers, vast dry lands (60% agriculture land), least use of chemicals. In India, only 40% of total cultivable area is covered with fertilizers where irrigation facilities are available and in the remaining 60% of arable land, which is mainly rain-fed, negligible number of fertilizers is being used.

In these areas often use organic manure as a source of nutrients that are readily available either in their own farm or in their locality. The North-Eastern region of India provides considerable opportunity for organic farming due to least utilization of chemical inputs. It is estimated that 18 million hectares of such land is available in the NE, which can be exploited for organic production. In fact, the rainfed, tribal, north east and hilly regions, of the country where negligible chemicals are used practicing subsistent agriculture for a long period, these areas are organic by default. With the sizable acreage under naturally organic/default organic cultivation, India has tremendous potential to grow crops organically and emerge as a major supplier of organic products in the world's organic market. This hold promises for the organic producers to tap the market which is growing steadily in the domestic market and to the export market. India is an exporting country and does not import any organic products. The main market for exported products is the European Union, USA, Far east and Gulf countries. The report of the Task Force on Organic Farming appointed by the Government of India also observed that in vast areas of the country, where limited amount of chemicals issued and have low productivity, could be exploited as potential areas for organic agriculture (Anonymous, 2001).

Characteristics of Organic Farming in Vegetables

Management of Organic farming is focused on the whole farm system and its interactions with climate, environment, social as well as economic conditions, rather than considering the farm as comprises of individual enterprises. The key characteristics of Organic Farming include:

1. Protecting the long-term fertility of soils by maintaining organic matter levels, soil biological activity and careful mechanical intervention.

2. Nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation, as well as effective recycling of organic materials, including crop residues and livestock wastes.

3. Weed, disease and pests control relying primarily on crop rotation, natural predators, crop diversity, organic manuring, use of resistant varieties and limited thermal, biological and chemical intervention.

4. Supplementing crop nutrients, where necessary, by using nutrient sources which are made available to the plants indirectly but the action of soil microorganisms and chemical reactions of the soil.

5. The extensive management of livestock, paying full regards to their evolutionary adaptations' behavioural needs, and animal welfare issues with respect to nutrition, housing, health, breading and rearing.

6. Careful attention to the impact of the farming system on the wider.

Objectives of Organic Farming in Vegetable Crops

The primary goal of organic vegetable production is to optimize the health and productivity of interdependent communities of soil, plant, animal and people:

1. To produce food of high nutritional quality in sufficient quantity.
2. To encourage biological cycles within farming systems by involving the use of microorganisms, soil flora & fauna, plants and animals.
3. To maintain and increase the long-term fertility of soil and biodiversity.
4. To use renewable resources in locally organized production systems.
5. To work as much as possible within a close system with regard to organic matter and nutrient elements and draw up on local resources.
6. To avoid all forms of pollution that may results from Agricultural techniques.
7. To reduce the use of fossil energy in agricultural practice to the minimum.

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Zero Budget Natural Farming

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What is Zero Budget Natural Farming?

Zero budget farming is a cultivating method for the natural development of yields without using substance composts. It is a unique chemical-free method that involves agro-ecology. For the zero-net expenditure of manufacturing, yields are known as the term zero budget. ZBNF reduces farming expenses and promotes the use of natural fertilizers and local seeds. It uses biological pesticides. To crop protection, farmers can use cow dung, urine, human excreta, plants, natural fertilizers, and earthworms. It protects the soil from degradation and decreases the farmer’s investment. It is one of the best methods for chemical free farming.

How did Zero Budget Natural Farming Start in India?

The Green Revolution started to ruin livelihoods and lands; few farmers started their research to return to alternative systems. One of them was a Maharashtrian agriculturist, and Padma Shri Subhash Palekar developed it in the mid-1990s as a green resolution’s methods alternative, which was driven by chemical, intensive irrigation, and pesticides.

Mr. Subhash Palekar argued that the rising cost of external inputs is the main cause of suicide and indebtedness among farmers. The impact of chemicals on long-term fertility and the environment is devastating. He met with the Japanese philosopher Fukuoka. They both came with techniques of natural farming. They promoted the technique of natural farming widely in Karnataka as zero budget natural farming.

Top 4 Pillars of Zero Budget Natural Farming

1. Jeevamrutha: Jeevamrutha is the first and important pillar of zero budget farming. It is a blend of aged cow urine and fresh cow dung from India’s indigenous jaggery, water, pulse flour, soil, and cow breed. This mixture is one type of natural fertilizer which applied to farmland.

2. Bijamrita: Bijamrita is the second pillar of zero budget farming. It is a blend of tobacco, green chilies, and neem leaf pulp, used for insects and pest control. It’s used to treat seeds, and it provides natural protection to seeds.

3. Acchadana (Mulching): Acchadana (Mulching) is the third pillar of zero budget farming. It helps to maintain soil moisture content. This pillar helps to protect the cover of soil cultivation and does not ruin it by tilling.

4. Whapasa: Whapasa is a condition where water molecules and air molecules are present in the soil. It helps to reduce the extra irrigation requirement.

Why is ZBNF Necessary?

From the (NSSO) National Sample Survey Office data, 70% plus of farmers spend more they earn, and most farmers have debt. The indebtedness level is around 90% in states like Andhra Pradesh and Telangana, where each household has an average debt of Rs 1 lakh. To achieve the promise of the central government to double the income of farmers by 2022, one factor being considered is natural farming methods zero budget natural farming.

Why is ZBNF Important?

1. Farmers depend on loans.

2. The economic survey has highlighted the ecological benefits.
3. Cost of farming inputs is rapidly increasing.
4. The number of farmer's suicide cases is growing continuously.
5. The demand for safe food increased among customers.
6. Unstable market price.

Institutions that Support ZBNF

1. Isha sadhguru foundation.
2. The art of living foundation.
3. Karnataka Rajya Raitha Sangha.
4. Sony India private limited.

Government Schemes and Plans for ZBNF

India's Legislature is advancing natural farming in the nation from 2015-16 through the traditional agricultural development plan's committed schemes and the National Agricultural Development Plan.

In 2018, Andhra Pradesh started a plan to become the first state in India to practice 100% natural farming by 2024. It aims to carry out chemical farming on 80 lakh hectares of land by converting 60 lakh farmers of the state into ZBNF methods.

Features of Zero Budget Natural Farming

According to zero budget natural farming principles, crops get 98% of their supply of nutrients from the water, sunlight, and air. And the remaining 2% can be fulfilled by good quality with lots of favourable microorganisms.
1. Soil microclimate: The soil always covers an organic mulch, which forms humus and encourages good microorganisms.
2. Cow: The farming system requires cow urine and cow dung obtained by only Indian breed cows.

Advantages of Zero Budget Natural Farming

1. Zero budget natural farming reduces the initial cost of farmers.
2. Farmer's income automatically increases.
3. The soil ecosystem improves.
4. Cow dung adds soil value. It is full of nutrients value and available locally.
5. Bacteria of cow dung decompose the organic matter in soil and make soil for the plants.
6. It required less electricity and water.
7. ZBNF improves the productivity of the soil.
8. It decreases the disease attack risk on the crop.

In Zero Budget Farming we use utilizing less chemical fertilizer, farming production quality improves.

Disadvantages of Zero Budget Natural Farming

1. This farming method used in some parts of India.
2. The type of farming being debated, and there is not much scientific research under evaluation.
3. It is highly sustainable farming.
4. This farming technique used in negligible areas.

Implementing States of Zero Budget Natural Farming

Haryana – 80 acres in Gurukul, Kurukshetra
Punjab – 1000 acres
Karnataka – 10 Agro climate zones
Andhra Pradesh – 5.01 lakh acres

Himachal Pradesh – Across the state

Zero Budget Natural Farming V/S Organic Farming

Sl. No	Zero Budget Natural Farming (ZBNF)	Organic farming
1.	No external fertilizers are used in ZBNF.	Organic fertilizers such as compost, cow dung, and vermicompost are used in organic farming.
2.	There is no tilling and no mixing. It requires natural ecosystems.	It requires basic agro methods like tilling, ploughing, mixing, etc.
3.	It is low-cost farming due to the local biodiversity.	It is expensive due to the need for bulk manures.

Zero Budget Natural Farming Success Stories

The first success story of ZBNF is Mr. Annadurai from Musiri Trichy, Tamilnadu, a paddy farmer. He practices ZBNF on 2 acres of land, and he gets a good share of yield per acre. he gained the confidence to spread it 10 acres.

The success story of ZBNF is Mr. Kudankavil, who lives in Idukki. He practiced ZBNF in their field. And he got a high yield and better price. Mr. Kudankavil says if you follow Mr. Palekar's guidelines, you will get the best results.

Mr. T Suryanarayana from East Godavari district. He is a ZBNF farmer who cultivates paddy and oil palm. He got a good yield of oil palm and paddy.

In this way, zero budget natural farming is an excellent farming technique for Indian farmers for farming with high productivity at a low cost. We hope you enjoy this blog and delight in it.

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A Brief View on Propagation of Tamarind

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Tamarind (*Tamarindus indica* L.) belongs to family Fabaceae and commonly known as sweet angle, Plum tree. It is used as a food, wood, medicine, fuel, forage and shelter as well as an ideal tree for semi-arid climatic conditions due to its tolerance to drought.

Fruit pulp is used for seasoning, to flavor confection, curries and also used as major components of some juices and beverages, jam and candies. (El-siddig *et al*., 2006). Seeds are used as feed to livestock after soaking in water. Mode of tamarind propagation is predominantly by seeds and followed by cuttings, grafting and micropropagation.

Now a day's micropropagation plays an important role for producing healthy plants in large number in less duration. MS culture medium with 75 % of salts and added with 2 g L^{-1} of activated charcoal showed healthy seedlings in in vitro conditions.

Five nodal segments of sweet tamarind observed in 45 days after sowing (Ferreira *et al*., 2018). According to Olomola *et al*., (2019) MS (Murashuge and Skoog) and WPM (Woody Plant Medium) media supplemented with BAP and NAA along with 2 mg/L BAP and 2 mg/L NAA gave the best result regards to growth characters of tamarind seedlings.

An Investigation was carried out by Dhutraj *et al*., (2018) g was carried out on 1st March showed significant improvement in grafting success and vegetative attributes in tamarind at Parbhani conditions. Mane and Nalage (2017) conducted an experiment to study the period of defoliation and storage condition of scion sticks for soft wood grafting in tamarind.

Among the defoliation treatment, 8 days prior to grafting (April) shows maximum growth, sprouting percentage and survival percentage than 4 days prior to grafting and on the day of grafting defoliation. The storage of scion by using polythene bag of size 6 x 9" shows highest growth than other but the open condition shows highest survival percentage hence adopt storage of scion stick without using polythene bag.

In tamarind propagation by the method of air-layering is viable. For organic compound and coconut powder, the concentrations of 500 and 1000 mg L^{-1} IBA, respectively, may improve the results obtained by air-layering. With the use of sphagnum as substrate, the use of 500 mg L^{-1} IBA to maximize the results is indicated in this method (Ferreira *et al*. 2017).

Mechanical scarified seeds at the micropyle were the effective treatment for breaking dormancy of Tamarind seeds (Oyebamiji and Ogo, 2019). A research conducted by Soares *et al*., (2017) tamarind seedlings grown under black net (50%) showed higher values for chlorophyll a and chlorophyll b content as well as for total chlorophyll and a/b ratio.

The black net was also responsible for providing the highest density of chloroplasts and area of starch grains, while the chloroplast area was greater under blue and black nets.

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Mycorrhiza: A Potential Tool for Nutrient Uptake and Stress Management

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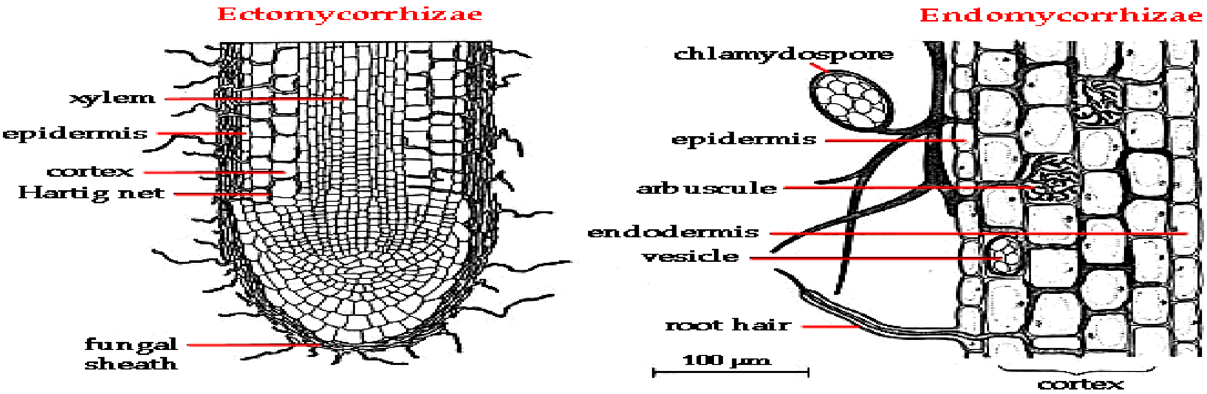
Introduction

Mycorrhiza is a symbiotic association between the root of higher plants and the fungus that colonizes the root of the plant. The term “mycorrhizae” means “fungus root”, “Myco" is a fungus, and "rhiza" is a root. Mycorrhizae are highly evolved, mutualistic associations between soil fungi and plant roots, and provide a critical linkage between the plant root and soil. There are mainly two types of mycorrhizae: Ectomycorrhiza and Endomycorrhiza. While, ectomycorrhiza does not penetrate the root cell wall but forms a sheath around the root, and nutrient structures are known as a "Hartig net”, endo mycorrhizae penetrate the root cortex and form nutrient exchange structures within the root cells (arbuscules, vesicles). Moreover, the prior forms symbiotic relationships with about only 10% of plant families, the latter forms symbiotic relationships with about 85% of plant families that are commonly associated with agricultural, horticultural, and tropical trees.

Arbuscular Mycorrhiza, Arbutoid Mycorrhiza, Ericoid Mycorrhiza, Orchidaceous Mycorrhiza are some common endo mycorrhizae. Among them, Arbuscular Mycorrhiza is most significant in fruit crops. Fungi forming endomycorrhiza belong to the genus *Endogone*, *Glomus, Sclerocystis, Acaulospora, Gigaspora, Enterophophora, Scutellispora.*



Arbuscular Mycorrhizal Fungi (AMF)

AMF is the organisms that penetrate the roots of plants to form a mutualistic symbiotic relationship. They help in the absorption of the mineral nutrients, preferably phosphorus, nitrogen, and water from the soil via the extensive hyphal network and transferred to the plant. In turn, they obtain organic carbon compounds. They are known to improve plant nutrient uptake, protect plants from pathogens and buffer against adverse environmental conditions, especially drought. AMF can promote a rapid increase in plant growth and contribute to the better establishment of seedlings when transplanted to the field while in the nursery, inoculation of these fungi can improve plant growth, reducing the time for seedling production and protecting the plants against soil-borne pathogens.

Contributing to increasing the nutrient uptake and plant vigour, the AMF can act as biological control agents by direct or indirect mechanisms. The exploitation of the symbiotic feature of AM fungi is one of the efficient approaches to improve crop tolerance to the unfavoured environment. AM fungi are probably the most ubiquitous soil microbe that can colonize 80% of terrestrial plant species consisted of many fruit crops. Many beneficial effects from mycorrhizal colonization including increased seedling survival, enhanced growth, fruit yield and quality, uniformity of fruit crops, and earlier and increased flowering as well as induced resistance to abiotic and biotic stresses.

However, products containing AMF are rarely used in commercial horticulture due to several factors such as difficulties in producing AMF inoculum in large quantities, their variable beneficial effects, and uncertainties in the benefits with added AMF in the presence of resident AMF populations.

Substrates such as coir are usually devoid of beneficial microbes such as AMF; thus, introducing them into substrate production is more likely to generate benefits.

Nutrient Uptake

Arbuscular mycorrhizal fungi (AMF), as a biofertilizer, supports plant nutrition by absorbing and translocating mineral nutrients beyond the depletion zones of the plant rhizosphere. One of the most dramatic effects of mycorrhizal infection on the host plant is the increase in phosphorus (P) and Zn uptake, mainly due to the capacity of mycorrhizal fungi to absorb nutrients from the soil and transfer it to the host roots.

Also, mycorrhizal infection results in an increased uptake of other macro-and micronutrients and water. When a nutrient is deficient in the soil solution, the root parameters such as surface area, length, and nutrient exchange capacity control the uptake.

Phosphorus (P) is one of the critical minerals for plant growth and makes up about 0.2% of the dry weight, but it is one of the most difficult nutrients for plants to acquire and the major advantage of the AM symbiosis for plants in acquiring P is that AM fungi provide a very effective pathway by which P is scavenged from large volumes of soil and rapidly delivered to the cortical cells within the root, bypassing direct uptake.

Mechanism of Nutrient Uptake

Despite its coenocytic nature, the mycelium that is formed within the root, the intraradical mycelium (IRM) differs morphologically and functionally from the extraradical mycelium (ERM), the mycelium that grows into the soil. The ERM absorbs nutrients from the soil and transfers these nutrients to the host root.

The IRM on the other hand releases nutrients into the interfacial apoplast and exchanges them against carbon from the host. The fungus uses these carbon resources to maintain and enlarge the ERM, for cell metabolism (e.g., active uptake processes, nitrogen assimilation), and for the development of spores, which can initiate the colonization of the next generation of host plants.

Generally, there are three mechanisms responsible for enhanced P uptake in mycorrhizal plants:
1. The hyphal network of AM fungi extends the plant root system.
2. AMF releases organic acids that solubilize phosphate from insoluble AlP, Fe-P, and Ca-P complexes.
3. AMF produces phosphatase and exudates them to the rhizosphere accelerating the mineralization of organic P to inorganic phosphate.

The external hyphae of AM fungi extend well beyond the depletion zone, accessing supplies of nutrients at a distance and in narrow soil pores.

As the hyphae develop around the root, distributed beyond the root area, nutrient uptake is high and the nutrient depletion zone is extended. When nutrients are removed from the soil solution more rapidly, a nutrient depletion zone develops and that nutrient can be replaced by diffusion.

Mycorrhiza in Combating Biotic Stresses

Microorganisms play an antagonistic role against various pathogens, derived from the resident microbial community or of foreign origin. Arbuscular Mycorrhizal Fungi (AMF) forms one such group of organisms that can act as bio protectors of plants. The mycorrhizal symbiosis involves several mechanisms in the control of plant diseases:

1. Creating a mechanical barrier for the pathogen penetration and subsequent spread.
2. Thickening of cell wall through lignification and production of other polysaccharides which in turn hinder the entry of root pathogen.
3. Stimulating the host roots to produce and accumulate sufficient concentrations of metabolites (terpenes, phenols, etc.), imparting resistance to the host tissue against pathogen invasion.
4. Increasing the concentration of orthodihydroxy phenols in roots, deterring the activity of pathogens.
5. Producing antifungal and antibacterial antibiotics and toxins that act against pathogenic organisms.
6. Competing with the pathogens for the uptake of essential nutrients in the rhizosphere and the root surface
7. Stimulating the microbial activity and competitions in the root zone (rhizosphere, rhizoplane) and thus preventing the pathogen to get access to the roots.
8. Roots colonized by VAM/AM fungi may also harbour more actinomycetes antagonistic to root pathogens.
9. Compensating the nutrient absorption system from damage to roots by pathogens.
10. Changing the amount and type of plant root exudates.

Mycorrhiza in Combating Abiotic Stresses

Mycorrhizal symbiosis helps in the amelioration of different types of plant stresses such as metal, salt, drought, and other biotic stress. All these stresses produce reactive oxygen species (ROS) that cause oxidative stress in plants. ROS negatively affects the cellular activities that cause oxidation of proteins, peroxidation of lipids, and inhibiting the enzyme activity that results in total cellular damage. AM fungi enhance the antioxidant defense level in a host and produce isoprenoid to protect the plant from several stresses.

In case of drought stress, the external hyphae of AM fungi extend well beyond the depletion zone, accessing supplies of water at a distance and in narrow soil pores. As the hyphae develop around the root, distributed beyond the root area, the water uptake is high and the water depletion zone is extended.

In salt stress conditions, mycorrhizal roots have a higher hydraulic conductivity at low water potential and increase stomatal conductance, which increases the demand for transpiration. In presence of mycorrhizal symbiosis, the plant increases its ability to resist salt stress by the accumulation of solutes and improving osmotic adjustment and increases antioxidant production by increasing P uptake and by modification in morphology and physiology of the host plant.

Heavy metal (HM) toxicity adversely affects plant growth, development, and production. HM causes chlorosis, necrosis, senescence, turgor loss, and finally plant death. Similar to other stresses, it also produces ROS and methylglyoxal which is involved in the peroxidation of lipids, oxidation of proteins, inactivation of enzymes, and DNA damage. Endomycorrhizal fungi trap HM in their binding sites and immobilize and accumulate in their mycelia. Additionally, glomalin protein produced by AM fungi provides a binding site for HM.

Conclusion and Future Prospects

Many soils have low fertility and productivity around the world. To achieve optimum plant growth and good fruit yield, chemical fertilizers are being intensively used. Since, excess use of chemical fertilizers negatively impacts viable soil microorganisms, especially, mycorrhizal fungi; mycorrhizae-dependent horticultural trees are negatively affected. Many horticultural fruit species (citrus, cherry, plum, peach, apple, pear, nectarine, apricot, grape, kiwifruit, pomegranate, fig, olive, pistachio, wild black cherry, and pecan) are strongly mycorrhizal dependent. Roots of these plant species are naturally inoculated with arbuscular mycorrhizal fungi.

Mycorrhizal fungi can promote early plantlet root growth before transplanting to marginally poor soils and under environmental stress conditions. Mycorrhiza facilitates the host plant to cope with different stressed environments as heavy metals, toxic chemicals, and water pollution that make the horticulture lands polluted ultimately, decrease the crop production and increase health risk.

In modern agricultural practices, these irreversible changes are managed with many biological tools such as beneficial microbes. However, at present time, decreasing plant diversity and continuous agricultural practices adversely affect mycorrhizal diversification. Therefore, there is an acute need for more insight into the genetics, interaction biology, and tolerance as well as remediation mechanisms among fruit crops and beneficial microbes to maximize fruit productivity.

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Cropping Systems for Sustainable Vegetable Production

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Summary of Article

India grows the largest number of vegetables in the world. Varied agro climatic conditions in India make it feasible to grow several vegetables round the year. As many as 61 annuals and 4 perennials are grown in India. Being short duration crops, vegetables are more susceptible to extremities in environment. And vegetable production is also not consistent due to weather extremities and diminishing natural resources. In countries like India, it is a serious problem in view of large population depending on agriculture, excessive pressure on natural resources and poor cropping mechanisms.

Malnutrition in children in India is also increasing alarmingly. Vegetables play an important role in achieving the nutritional security as they encounter the malnutrition problems in India and also serve as a source of income for the small and marginal farmers. The major objectives of reducing malnutrition and alleviating poverty in developing countries through improved and consumption of safe vegetables that involves adaptation of current vegetable cropping systems like, multiple cropping, mixed farming, intercropping, and relay cropping systems.

Integration of crop production, different farming systems with suitable soil and water conservation measures lead to sustainable production increase in income levels and towards better livelihoods. Major emphasis should be given on development of diverse technologies for optimization of farm resources, increased economic return and improved sustainability.

Introduction

A significant change in climate on a global scale will impact vegetable cultivation and agriculture as a whole; consequently, affect the world's food supply. More erratic rainfall patterns and unpredictable high temperature spells consequently reduce crop productivity. The impact of climate change will hit the developing countries the hardest, and it is in these countries' food security will be most threatened. For ensuring a healthy and prosperous nation, we have to increase our production by modifying our cropping pattern and dietetic habits Horticultural farm is relatively labour- and capital-intensive undertakings, there by its adoption by the farmer is dependent upon whether or not revenues derived from it could at least compensate for all cost spent by farmer. Vegetables are an excellent choice of cash crops as they can be grown easily, produce good yields and generate high price in the market compared to the cereals. Vegetables are generally sensitive to environmental extremes and Environmental stress is the primary cause of crop losses worldwide, reducing average yields for most major crops by more than 50 % (Bhardwaj, 2012).

Moreover, increasing temperatures, reduced irrigation water availability, flooding, and salinity will be major limiting factors in sustaining and increasing vegetable productivity. Extreme climatic conditions will also negatively impact soil fertility and increase soil erosion. Measures to adapt to this climate change induced stresses are critical for sustainable tropical vegetable production. Adoption of suitable cropping system is one such measure which ensures maximum utilization of natural resources and inputs. Farmers may get benefitted by following different cropping systems even under adverse climatic conditions. Success in mitigating climate change depends on how well agricultural crops and systems adapt to the changes and concomitant environmental stresses of those changes on the current systems. Thus, adoption of suitable cropping patterns/systems will be needed to maintain vegetable productivity.

Cropping System

Cropping system is defined as a cropping pattern followed on a farm and its interaction with farm resources, other farm enterprises and production technology. In other words, cropping system refers to a combination of crops in time and space.

When annual crops are considered, a cropping system usually means the combination of crops within a given year (Willey et al., 1989). The term cropping system is often used interchangeably with multiple cropping, which in fundamental nature represents an idea of maximum production per unit area of land within a year or some other relevant time unit with minimum land degradation (Singh, 1972).

The yearly sequence and spatial arrangement of crops and fallow on a given area is termed as cropping pattern. India has over 17% of world's population living on 2.4% the world's geographical area. Capital per capita agricultural land has reduced by 67% from 0.48 hectare in 1951 to 0.12 in 2014 due to explosive increase in the population.

A considerable amount of land remains unutilized and such lands are subjected to many degradative processes. Input and other resources applied to unoccupied portion of land go waste. Not only horizontal utilization of land is ensured but also vertical utilization of land is ensured.

Principles for Arranging Cropping Sequence

1. Repetition of crops having common diseases and pests should be avoided.
2. Vegetable crops of different families grow well after majority of crops. Growing cucurbitaceous vegetables after solanaceous is not profitable.
3. The deep-rooted crops should be followed by shallow rooted ones.
4. Heavy feeding crops should be followed by low feeding crops.
5. Specific nutrition requirement of various crops should be taken into consideration.
6. Leguminous vegetable crops should be included in the cropping sequence which not only upgrade the protein status of the farm produce but also enhance soil fertility.
7. Green manure crops should be accommodated in the rotation in order to increase the organic matter status of the soil.

Types of Vegetable-Based Farming Systems

In order to reduce the impacts of climate change, farmers must follow different vegetable-based farming systems like multiple cropping, mixed cropping, intercropping, relay cropping and agro forestry systems.

Multiple Cropping

It consists of growing of two or more crops on the same piece of land. It is intensified cropping system in which utilization of land in time and space dimensions are ensured. In its simplest form, multiple cropping is a one-year cropping system in which two or more crops are grown in succession within a year.

Harvesting a greater number of crops from the same piece of land during a specified period of time is the main focus of multiple cropping. It is influenced by climate, varieties, crop rotation, farmer's motivation. Both crops and varieties selected for multiple cropping should be suited to the local climate and soil conditions. Short duration and thermo or photo insensitive varieties are preferred.

Short-day onion varieties are not suitable for growing at high altitudes where long day types are adapted. Multiple cropping is labour intensive requiring constant and careful management which may discourage some farmers to adopt it. However, increases in production and net profit may motivate the farmers to undertake it.

Kishore et al. (2014) studied the sequential vegetable production under protected condition in temperate humid region. Under protected condition tomato-pea-carrot-cucumber gave the maximum production efficiency, returns (Rs. 13336.1/100m^2), BCR (4.05) and profitability (36.53/100m^2/day) when compared to pea-coriander-French bean-bitter gourd sequence.

Crop Rotation

Crop rotation is the practice of growing crops on a particular piece of land in a systematic sequence in order to maintain the soil fertility. It may also be defined as growing of crops in recurrent succession on the same piece of land either for a year or for longer period of time. The rotation of crop may be for one year, two year, three or more years. Hence, the cycle of cropping sequence takes more than one year to complete. The crop rotation should be adapted to climate and soil and crops involved may have high market value. In crop rotation non host crops may be included instead of crops of the same botanical family in order to have better protection against diseases and insect pests.

1. Sequence of crops recommended for crop rotation at IIHR, Bangalore for Karnataka region.
2. Okra-Tomato-French bean.
3. Tomato-French bean-Okra.
4. Brinjal-Cauliflower-Chilli.
5. Cowpea-Cauliflower–Okra.
6. Okra-Vegetable Pea-Onion.

Succession Cropping

The system of growing two or more crops in succession on the same land within a year. The cropping system is generally followed in most market gardens where the aim is to keep the high-priced land occupied with the cash crops for most part of the year. The succeeding crop is planted after the preceding crop has been harvested in which crop intensification is only in the time dimension. The sowing of succeeding crop and harvesting of the preceding crop may be done simultaneously or in a quick succession e.g., soon after harvesting of okra, potato is sown or after digging of potato, chilli is planted. It is also called as non-overlapping crop because of no overlapping between two or more crops. The basic advantage of sequential cropping system is there is no intercrop competition and Growers manage only one crop at a time in the same field.

Examples of succession cropping followed in West Bengal:

1. Potato (Oct to Jan) –Onion (Jan-May)-Okra (May-Oct).
2. Chilli (June-Nov)-Pea (Nov-March)-Amaranth (March-June).
3. Pumpkin (Oct-Feb)-Okra (Feb-may)-Brinjal (May-Oct).
4. Radish (Oct-Dec)-Watermelon (Dec.-April)- Bottle gourd(April-Oct).
5. Okra(Feb-July)-Brinjal (July-Feb).

Intercropping

Growing of two or more crops simultaneously on the same piece of land in distinct row arrangement is termed as intercropping. The crops may or may not be sown /planted and harvested at one time. It is mainly aimed at increasing the yield of the companion crop without reducing yield of main crop. Following intercropping, the cropping intensity in space dimension is increased. The crops utilize resources efficiently and productivity of land is increased. The crop also serves as an assurance of crop failure. However, while selecting crops care should be taken that their nutritional requirements should not be overlapping, there should be competition for light and component crop should be complementary for each other.

Table 1: Examples of intercropping in vegetables followed at different part of India (Singh, 1997):

Main crop	Intercrops	Place of work
Okra	Beet root, knol-khol, Pea	Banglore (Karnataka)
Capsicum	Beet root, Knol-khol,Pea	Banglore (Karnataka)
Cabbage	Radhish, Turnip, Methi, Palak	Hisar (Haryana), Akola (Maharashtra)
Cauliflower	Radhish, Palak	Akola (Maharashtra)
Chilli	French bean, Onion	Dharwad (Karnataka)
Tomato	Spinach, Onion, Radhish	Hisar (Haryana)
Pigeon pea	Urd, Moong, Cowpea, Okra	New Delhi

Relay Cropping

It is also the system of growing different crops on the same land within a year but in this system succeeding crop is sown/ planted before the preceding crop is ready for harvest. So, growing span of two crops overlaps for a short period. Relay cropping is practiced in some cases, like planting of Rabi onion seedlings in the standing crop of cabbage which may be almost reaching maturity for harvest. Planting of chilli in sweet corn field and sowing of cucurbits in potato field are the most common example of vegetable-based relay cropping. By adapting this system early crop can be sent to the market for getting premium prices. The main advantage of relay cropping is that, there is no need of land preparation for sowing/ planting thereby reducing cost of cultivation.

Examples of relay Cropping followed in West Bengal:

1. Potato: Pumpkin (Potato is harvested in March and pumpkin seeds are sown in last week of January. After harvesting of Potato, pumpkin is continued up to August.
2. Early Cauliflower-Pumpkin (cauliflower seedlings are transplanted in August and harvested in November. Pumpkin seeds are sown in October in standing crop of cauliflower and continued up to march.
3. Bitter Gourd-Okra (Bitter gourd is grown during October to March. Pre germinated seeds of okra are to be sown in February and continued up to June.

Mixed Cropping

Mixed cropping deals with growing two or more than two crops simultaneously on the same piece of land without define row pattern or fixed ratio by mixing the seeds of crops intended to be grown mixed or sowing alternate rows in various ratios. It is commonly practiced in dry land areas. Sometime intercropping and mixed cropping are treated synonymous to each other or mixed cropping is identified as a type of intercropping. It is practiced with a view of minimized risk in the farming. It is a type of subsistence farming and it favours fulfilment of different needs of the family.

Table 2: Vegetable based mixed cropping systems (Singh, 1997):

Main crop	Associated crop
Potato	Radish
Potato	Coriander
Cabbage	Lettuce + Radish
Cauliflower	Radish
Okra	Radish
Brinjal	Radish
Cowpea	Cluster bean

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Adopting Tunnel Technology for Quality Produce in Hot Arid Region

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Introduction

During the month of May–June the temperature reaches to 45-48 ◦C in hot arid climatic condition which adversely affect the production of cucurbits under open field. Under such circumstances low tunnel technology offers opportunity for early production of cucurbits like watermelon, muskmelon, ridge guard, bottle guard etc. Whole cultivation practice has been standardized for the different cucurbit vegetables under low tunnels. This includes the integrated crop management practices, use of drip irrigation, fertigation and application of micronutrients for the better-quality produce. In recent days low technology become reality and emerged as a viable source of income among farmers of this region. Because of early harvest farmer fetch high prices in the market.

Production of off-season cultivation of cucurbits mainly confined to the river bed cultivation in north India, although the area under river bed cultivation is limited, which cannot be extended further. Meanwhile tunnel technology for cucurbits can be advantageous due to production of crop very early in spring and summer, which results more economic return to the farmer when the produce is not in glut in the market due to off season. Low tunnel are the flexible structures made up of transparent covering, which are installed in the individual bed to enhance the crop growth by providing more heat to the plant from sun and protection from the cool wind especially during the winters.

Low Tunnel Technology

Advantages of Low Tunnel

1. Early and off-season production of cucurbits this fetches more prices.
2. Vegetables can be grown in the areas where they never grown in open field condition before like hot arid region etc.

3. Due to the covering a small microclimate is created around the plants thus, increases photosynthetic activities and ultimately the yield.
4. Also provide protection against hail, rainfall, frost, wind, insect-pest etc.
5. Inexpensive then the other protective structures.
6. It generates better revenue even though the yield may be low due to the higher price during the off season.

Field Preparation and Sowing

First of all, land is ploughed and fertilizers and manures are applied according to the crop recommendations. Nitrogen is applied in three doses. One third should be applied in the soil, about 10 cm away from the seed. Remaining doses of nitrogen applied as a top dressing at the time of earthing-up and the commencement of flowering. Trenches of the width of 45-60 cm and 45-60 cm deep should be made at the distance of 2-2.5 m in east-west direction in the month of December. After the preparation of trenches fertilizers are applied according to crop, because excess of fertilizers leads to the more vegetative growth and less yield. For irrigation, drip irrigation system is used. Each bed provided with one lateral having drippers of 4 l/hr discharge spaced at 60 cm distance.

Before sowing seeds are soaked overnight for better germination. After that seeds are treated with Captan / Thiram @ 2 g/Kg, wrapped in gunny bag and kept in warm place for 2-3 days. Sowing of pre germinated seeds are done from end of December to 1st week of January. Seeds are placed either side of dripper by maintaining optimum plant density.

Table1: Sowing time, harvesting time and crop advancement of cucurbits in arid region under low tunnel:

Crop	Sowing time	Harvesting time	Crop advancement (Days)
Water melon	Third week of Dec. to first week of Jan.	Second week of April to last week of April	30-40
Bottle gourd	Third to fourth week of Dec.	Second to third week of March	40-50
Ridge gourd	Third to fourth week of Dec.	Second to third week of March	40-50
Musk melon	Third week of Dec. to first week of Jan.	Second week of April to last week of April	30-40
Long melon	Third week of Dec. to first week of Jan.	Last week of Feb. or first week of March	30-50

Aftercare

For obtaining full benefit from low tunnel drip irrigation and fertigation plays an important role. Drip irrigation not only provide the water to the root zone also keeps the humidity low leading to less pest and disease problem.

The water and nutrient requirements are varying according to the crop and environment condition. While using the fertigation one must be use fertilizer which is easily soluble in water and do not clog the emitters. Fertilizers should be applied at vine development and flowering stages. Spray of 25ppm boric acid along with 1% of urea increase the no of pistillate flowers, fruit setting and improve quality of fruits in cucurbits. Intercultural operations like weeding and hoeing should be done at the time top dressing of nitrogenous fertilizers which is generally done before emergence of tendrils.

Hardening

When plats start flowering, the covering of the tunnel should be removed partially during the day hours and covered during the night time. When temperature start rising from mid-February, the plastic is completely removed from the plant. Hardening of plants is necessary to insure better survival of the plants. Repeat this process 2-3 days to harden the plants and avoid shock.

Pollination

High temperature leads to the poor pollination. Inadequate pollination leads to the flower drop and formation of malformed fruits. In cucurbits, plants are mainly monocious and andromonocious, hence effective pollination is needed. Pollination is mainly done by honey bee *(Apis Melifera).* For effective pollination, one acre land requires one beehive having 30000-50000 worker bees. The bee working is most efficient when beehive is placed in north-west direction of field.

Harvesting

In tunnels crops are generally sown during third or fourth week of December to get the early harvest then the normal season.

Table2: Yield and expected B:C ratio of cucurbits under low tunnel in arid region:

Crop	Cost of cultivation (rs./ha)	Production (q/ha)	Rate (rs./ha)	Gross Income (rs.)	Net income (rs.)	B:C ratio
Watermelon	80000	240	10	240000	160000	2.00
Longmelon	90000	180	15	270000	180000	2.00
Muskmelon	80000	150	20	300000	220000	2.75

Plant Protection

The one of the most devastating pests of cucurbits is fruit fly. Leaf minor, leaf eating catterpiller, aphid, red pumpkin beetle are the other insects attacking on cucurbits. For safeguard the crop from the pests an integrated approach of pest management should be followed. Soil should be exposed to sun during summer by deep ploughing to kill the pupa of insects if present in the soil. Spray of Dimethoate 30 EC to control the fruit fly. Commercially available cultural traps 7-8 /hectare should be installed to manage the fruit fly.

Diseases like *Fusarium* wilt, *Alternaria* leaf blight and mosaic affect the cucurbits. Seed treatment with Captan or Thirum 2g/kg seed should be done before the sowing. Drenching the soil with Bavisitn 2g/l should be control Fusarium wilt.

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Microbial Communities and Designing of Synthetic Microbes

Article ID: 10710

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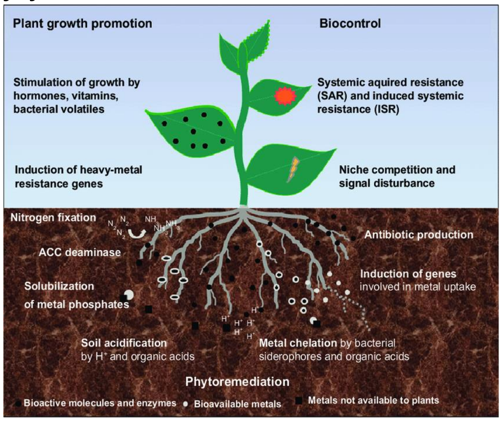
Introduction

A diverse and vast community of rhizosphereic and endophytic microorganisms have a great influence on plant health. The colonization of microbes at rhizoplane and phylloplane provide many beneficial functions to plants.Thus, the dynamic community of microorganisms which associates plant roots are defined as "plant microbiome."

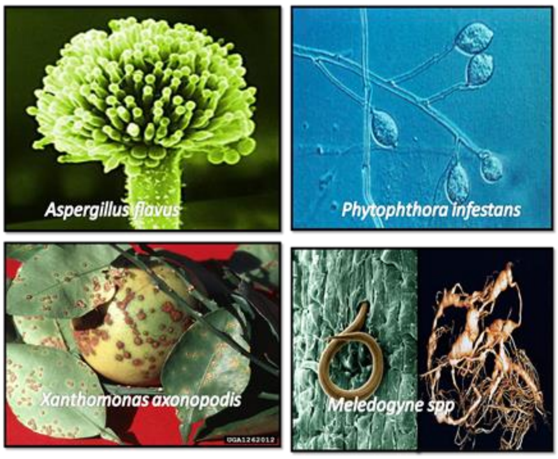
Beneficial Effects of Rhizosphere Organisms on Plant Growth

1. Nitrogen-fixing bacteria, Example: Rhizobium
2. Mycorrhizal fungi, Example: Arbuscular mycorrhizal fungi
3. Biocontrol microorganisms, Example: *Bacillus thuringiensis*
4. Mycoparasitic fungi, Example: Trichoderma
5. Protozoa, Example: Bacteria eating amoeba
6. Endophytes, Example: *Gybberella fujikuri*



Rhizosphere Organisms that are Deleterious to Plant Growth and Health

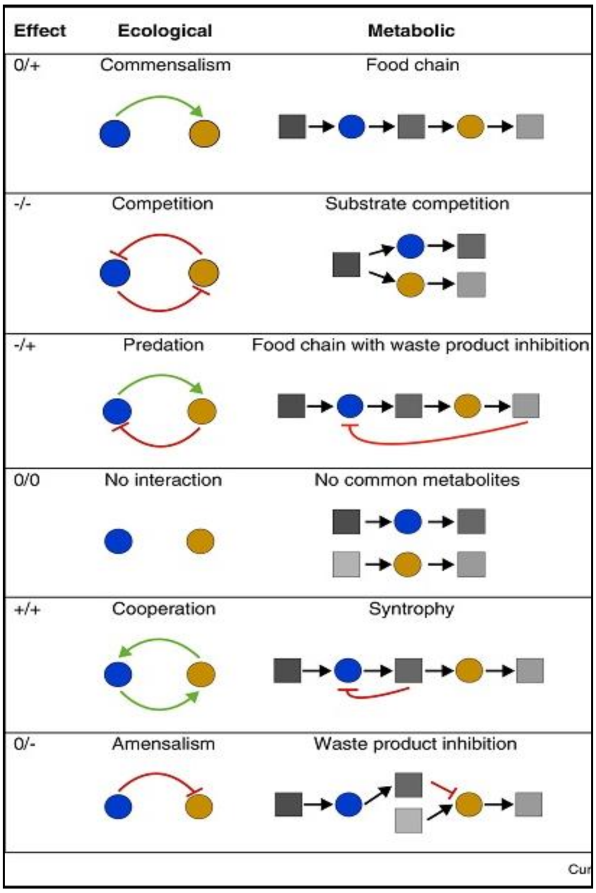
Pathogenic fungi, Oomycetes, Bacteria, Nematodes, and Virus.



Microbial Intercations

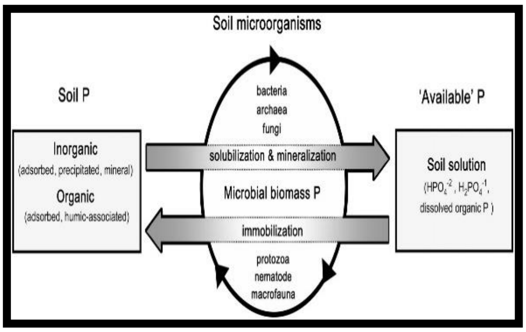
Metabolic interaction patterns are very important to study the community structure and dynamics of the microorganisms, moreover identifying the common interaction patterns, species involved in interactions and process of interaction can allow us to find whether interaction is either by metabolism driven or involvement of social traits.

Social interactions among microbes have attracted attention and several good reviews have summarized the study of these interactions in synthetic as well as natural microbial communities. This article emphasizes and discuss more on the role of metabolism in driving the species interactions in microbial communities. Among the social interactions competition and cooperation are only kinds of all possible and known interactions among microbial species. The interaction between an organism may be neutral, positive or negative.



Since the directionality of a reaction is not of interest for the type of interaction, there are six basal interaction patterns that make up the minimal interaction motifs in microbial communities. While each one of these interactions can be potentially driven through social traits of the involved species or environmental factors like patchiness (i.e., local differences in species abundance), they argue that the simplest driver is metabolic interactions. In figure, the mapping of all possible interaction patterns between two species into an ecological and a corresponding metabolic representation is provided. A food chain for example can be seen as a commensal interaction, where one organism lives off of the waste of another organism, who in turn is not affected by the interaction (0/+).

Syntrophy, a phenomenal competition that arises naturally between two organisms to utilise the same substrate, and an intense form of cooperation is seen between them as they gain by the metabolic reactions of each other. In this way the combination of two different strains allows for six possible interaction states and three strains leading to 729 interaction states, where as one with four strains 531441 possible interaction states. As the interaction states explode in higher numbers by few species, it's a great challenge to find the key motifs that are over represented with significant percolating effects at community level of microbes in natural conditions which help in understanding the stabilizing or de-stabilizing interaction motifs, motifs driving oscillatory or chaotic dynamics.



The physiological and developmental functions of plants are influenced by influenced microbial communities. While some are beneficial and some are destructive, for instant rhizome microbes are beneficial for plant growth and development, on other hand pathogenic microbes try to cause disease by breaking done the protective microbial shield. The rhizosphere microbiome also involves the true and opportunistic human pathogenic bacteria which form the third group.

Bioprospecting Plant-Associated Microbiomes

In the present day new bioactive compounds and biologicals for the pharmaceutical, agro-and food industries are gaining demand. Plant-associated microbes present an attractive and promising source to this end, but are nearly unexploited. Bioprospecting of plant microbiomes is very important and it's gaining more attention, as they are highly specialized, rich in secondary metabolism and the coevolved genetic pool with diversity. Hence, the potentiality of detection and use of secondary metabolites and enzymes, derived from plant associated microbes is essential in present biotechnological era.

Synthetic Microbial Communities

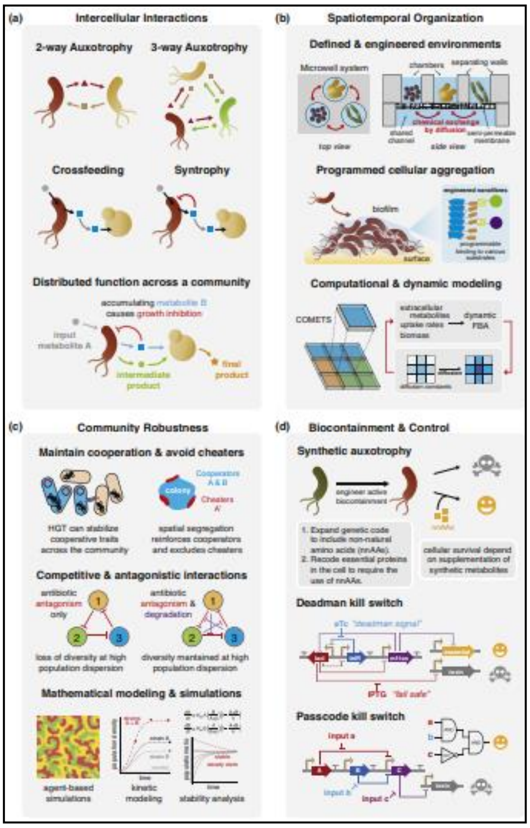
The construction of synthetic microbial communities allows for the generation of defined systems with reduced complexity as compared to natural microbial communities which are composed of a mixture and complex of microbes with unknown functions. Synthetic communities serve as model systems to study performance and stability of microbial communities as top-down approach. On other hand bottom-up approach serves to study and discover the necessary conditions required to generate interaction patterns using synthetic microbial communities. This bottom-up approach provides the lane to know interactions like symbiosis or competition and emergence of higher order community's structure.

Synthetic communities can also open up new avenues and paths for biotechnological applications, besides the value as model systems to study the structure, function and evolution of microbial communities as complex dynamical systems.

Construction of Synthetic Microbial Communities

1. Micro bead encapsulation of a small number of microorganisms
2. Micro fluidic chip technology
3. The sequential layering of microbes on to a synthetic biofilm.

Synthetic microbial communities are the abstractions of natural systems that allow to study and analysis of the fundamental building blocks and processes in detail, that compose a microbial community. Both the top-down and bottom-up approaches summarized above have yielded important results on simple communities and are paving the way for the assembly of higher order communities. With the aid of novel approaches such as micro bead encapsulation of a small number of microorganism micro fluidic chip technology or the sequential layering of microbes onto a synthetic biofilm, we expect the construction of synthetic communities to get easier and potentially becoming high-throughput.



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Entomotherapy

Article ID: 10711

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Entomotherapy refers to the use of insects and insect-derived products for therapeutic purposes. Because of their different properties such as analgesic, antibacterial, anesthetic, immunological insects have been utilized since ancient periods for making different medicines across the world including China, India, America and Africa. Different orders of insects are being exploited for therapeutic purposes like Lepidoptera, Hymenoptera, Diptera, Hemiptera, Orthoptera and many more.

Insect commonly used for medicinal purpose are as follows

1. Honey bees: Utilization of honeybee products for medicinal purpose commonly referred to as apitherapy. Honey is one of the most used products of bees used for medicinal purposes. It is considered effective against cold, digestive problems, cough, throat infections etc.

Other bee products such as bee venom (apitoxin), propolis and royal jelly and bee bread (or bee pollen) are also being used for treating several diseases.

a. Honey bee venom, Apitoxin is prescribed as a shot to relieve diseases like arthritis, polyneuritis, rheumatism, and asthma.

b. Propolis, is said to have antibiotic, anesthetic and anti-inflammatory properties.

c. Royal jelly is commercially employed for the treatment of anaemia, ulcers, arteriosclerosis and hypertension.

d. Bee pollen is consumed as a health restorative.

2. Silkworm: Immature stages of *Bombyx mori* are consumed to treat apoplexy, aphasy, bronchitis, pneumonia, convulsions, hemorrhages, and frequent urination. The excrement of the caterpillar is also consumed to improve circulation and alleviate the symptoms of cholera. They are also applied to heal the wounds. A bacterium resides inside the digestive system of silkworms contains serrapeptase enzyme that appears to offer pain relief for people with back injuries as well as sports injuries.

3. Fruit fly: Fruit fly can detect cancer. Cancer cells are fundamentally altered in comparison to that of normal cells leading to changes in the tumour's microenvironment, in lipid peroxidation activity and to a variety of potential intra-and extracellular cancer-specific markers.

4. Blow fly: Blow fly larvae are utilized in modern scientific treatment commonly referred to as maggot therapy. Maggot therapy is done by introducing the blow flies' larvae into the soft tissue wounds of human and then it selectively cleans out the necrotic tissue.

5. Ants: Mention of ants in treatment of wide variety of diseases is there from ancient world. Diseases like asthma, dizziness, mumps, pain, insect stings and bites, colds, impotence, arthritis, paralysis, rheumatism etc are treated using ants in different parts of Brazil and Columbia. Velvet ants are used in treating bronchitis, iron ants *(Tetraponera rufonigra)* and *Bothroponera ruficeps* are used as medication only for cattle against foot and mouth disease (Rochow, 2017).

6. Locust: Locusts are consumed to cure post-childbirth anaemia, lung diseases, asthma and chronic cough.

7. Grasshoppers: Some studies have suggested that grasshopper toxins stimulate the human central nervous system and dilate blood vessels, thus increasing the circulation. Powdered or sun-dried grasshopper utilized as tea for curing asthma and hepatitis.

8. Blister beetle: Blister's beetle (Family: Meloidae) secretes cantharidin, a toxic agent that is used as an aphrodisiac, an abortifacient, and a veterinary medicine diuretic. The secretions of blister beetle are helpful in reducing the burning pain sensations commonly associated with insect bites, urinary tract infections, burns and kidney problems. Cantharidin also prevents the viral cell reproduction thus effective in treating severe viral infections. In addition, it is also useful in the treatment of cancerous tumours that are resistant to radiation and chemotherapy.

9. Cockroaches: Brain of cockroach contains a chemical compound that can kill Escherichia coli and Methicillin resistant Staphylococcus aureus (MRSA), two harmful bacteria that are resistant to most of the drugs (Lee et al., 2012). Studies have discovered that tissues extracted from the brains and nervous system of cockroaches can kill about 90% of MRSA infections and E. coli.

10. Termites: Many known species of termites are used for the treatment of various human diseases. For example, Microkeratomes exiguous and Nasturtiums macrocephalus used to cure diseases like asthma, bronchitis, influenza, whooping cough, flu, coughs, influenza, sore throat, sinusitis and tonsillitis. Termites and their mounds are also utilized in Ayurveda for treating ulcers, rheumatic diseases, anaemia and pain.

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Aonla – An Immunity Boosting Nutritional and Medicinal Crop

Article ID: 10712

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Introduction

Aonla is indigenous fruit to Indian subcontinent and belongs to family *Euphorbiaceae.* Owing to hardy nature, suitability to its various waste lands, high productivity/unit area (15-20 t/ha), nutritive and therapeutic value, aonla have become an important fruit. Aonla or Indian gooseberry (*Emblica officinalis* Gaertn.) syn. *Phylanthus emblica* L. comprises about 350 (**Hooker, 1937)** to 500 species (**Bailey, 1917),** mostly shrubs, few herbs and trees Its cultivation is common in India, particularly Uttar Pradesh comprising Pratapgarh, Rai bareli, Varanasi, Jaunpur, Sultanpur, Kanpur, Agra and Mathura. Its intensive plantation is being done in salt- affected areas of Uttar Pradesh, including ravenous areas in Agra, Mathura, Etawah, Fetehpur and semi-arid tract of Bundelkhand. Aonla cultivation is also spreading rapidly in semi-arid region of Maharastra, Gujarat, Rajasthan, Andhra Predesh, Karnataka, Tamilnadu, Aravali ranges in Haryana and Kandi areas in Punjab, Himanchal Pradesh extending to Ghar areas in Uttar Pradesh. In Uttar Pradesh, it has occupied approximately 15,750 ha area with production of 63,000 t. As per the recent estimates, Aonla has spread over in 50, 000 ha area in the country with approximate production of 1.5 lac tones. Aonla is much branched trees and ranged 9-12 in height. Tree observed to be deciduous under north Indian conditions. However, it is considered as evergreen in the tropics **(Bajpai, 1965).** Aonla tree bears two type of shoots, on the basis of growth characteristics, these have been categorized as long and indeterminate and short or determinate **(Bajpai, 1965; Ram, 1971)**. The indeterminate shoots are longer and continue to put new growth in the season. These shoots neither fall from the trees nor bear flowers irrespective of period their emergence. While on the other hand determinate shoots appear on the nodes of indeterminate shoots and their number at each node may vary from 3 to 5 in different cultivars. These determinate shoots bear small sized (10-13 mm length, 2-3 mm width) leaves arranged so closely that apparently the shoot appears to be pinnately compound leaf. The internodes are much shorter in the determinate shoots. These shoots are barren or floriferous with imbricate leaves. First few proximal nodes or the determinate shoots are barren (without leaves) which are reduced to small dark brown scarious cataphyllous. All Succeeding nodes are with green but reduced leaves. Subtending of male flowers are followed by nodes each with cymule of one central female flower (rarely two) and several lateral males. Distal half floriferous determinates shoots are normally sterile with typical leaves. Inflorescence is racemose type, flower is minute, unisexual with short pedicel. Male flowers appear first in cluster, parianth-6, yellowish green to deep pink in colour with valvate aestivation. Androecium consists of 3 stamens, each profusely branched, filament attachment is bifixed or innate type, short, and cohesion of anthers is syngenaceous type. Female flower has tiny green perianth and number of segments varies from 5-7 set commonly 6 are observed. Ovary is hypogynous, carpel 3-4, 3 chambered, placentation axile, 2 ovules per locule, margin straight to crescent shaped, ovarian chamber shallow to deep. Aonla is subtropical plant and prefer dry subtropical climate, being a hardy plant, it can be successfully grown variable soil conditions. Heavy frost during winter is not conductive for its cultivation. A mature aonla tree can tolerate freezing as well high temperature of 46^0 C. Warm temperature seems conductive for growth for the initiation of floral buds. Ample humidity is essential for initiation of fruit growth of dormant fruit lets during July- August. Dry spell results in heavy drooping and delay in initiation of fruit growth. The deep root system, reduced foliage, dormancy of fertilized fruit lets (April- June) makes aonla an ideal plant for arid and semi-arid conditions. Aonla can be cultivated in marginal soils- slightly acidic to saline/ sodic (P^H 6.5-9.5) conditions. Heavy soils or high-water table areas are not suitable for its cultivation. In north India, aonla tree begins to shed its determinate shoots from February onwards resulting the indeterminate shoots devoid of foliage by the end of February to mid-March. The new determinate shoots in the previous season begin to appear by the end of February and continue to appear till the first week of April. Blossom bud appears on the newly developed determinate shoots but shoot which emerge after mid-April do not bear flower and remain vegetative. Aonla is cross pollinated plant. Wind, honey bee and gravity all play important role in effective pollination **(Reddi and Bai, 1976)**. Common visiting hours of honey bees are evening and morning **(Bajpai, 1957). Bajpai (1968)** reported that there is no self-incompatibility in aonla and cause of poor fruit set may be due to high percentage of male flowers. However, **Pathak and Srivastava (Accepted, 1994)** have observed self-incompatibility in initial studies in flowering and fruit set in aonla gooseberry. They observed considerable variation with respect to sex ratio which varies from 28.70: 1 to 355.49: 1 in different cultivars. Number of female flowers varied from 2 to 8. NA-6 had the lowest sex ratio followed by NA-7, Kanchan, Chakaiya while, NA-9, Banarasi, Krishna showed higher sex ratio. Pollen viability with acetocarmine showed 82.32 to 96.40%, while only 16.71 to 36.90 pollen germination in the sucrose solution **(Srivastava and Pathak, 1993).** Open pollination showed maximum fruit set and retention, followed by geitonogamy and minimum with bagging. Fertilization takes place within 36 hours after pollination. The zygote rests for 120-130 days and endosperm nucleus for 70-80 days after fertilization **(Bajpai, 1968; Ram, 1971).**Growth studies have revealed that the fruit remains dormant while extension growth of shoots continues at a rapid rate. With cessation of vegetative growth, initiation of fruit growth takes place. Because of resting condition of uninucleate zygote and endosperm, the fertilized ovary of aonla does not show any symptoms of fruit growth from March to July. Fertilized ovaries (young fruit lets) remain encased to gain in a cup like structure. Subsequent to break in the rest period, fruits start growing and continue to gain in size and weight. Stone weight also increased simultaneously as the fruit gain weight and size.

Varieties

1. Early maturing group (Mid Oct. - Mid Nov.): Banarasi, Krishna (NA-5),NA-9, Balwant (NA-10).
2. Mid-season group (Mid Nov. - Mid Dec.): Francis, Neelam (NA- 7), Kanchan (NA-4), Amrit (NA-6).
3. Late maturing group (Mid Dec. - Mid Jan.): Chakaiya, Bhawanisagar (BRS-1).

Medicinal Use

The tree though a minor crop had great significance in Indian Ayurvedic Medicines and therefore is regarded as sacred tree in India. Aonla fruit is valued for its high nutritive values, medicinal properties, processing of value-added products and herbal drugs. Due to its importance and medicinal uses, it is known as ‘Amrit phal’ It has acrid, cooling, refrigerant, diuretic and laxative properties.

Cooling, diabetes, laxatives and livertonic, anti oxidents, blood purifier, used in diarrhea, dysentery, jaundice, anaemia, cough cold, asthma, hair tonic. It is important ingredients of triphala chavanprash, high valued processed products.

Nutritive Value

It is a rich source of Vitamin C (600-900 mg/100g) and also contains carbohydrates (14.10-21.89 %), mineral (iron 1.2%), phyllumblin, tannins, Alkaloids and elagic acid.

Processing

Aonla not popular as table fruits because of its astringent taste. It has great potentiality for processing into number of quality products. The pulp extraction technique, recipe and flow chart for preparation of some important products are as follows: Pulp preservation, Aonla nectar, Aonla squash, Aonla chavanprash, Aonla Jam, Aonla murabba (Preserve), Aonla candy, Aonla Sauce, Aonla Shreds, Aonla Pickle, Aonla Sweet, Aonla Powder, Aonla Supari and Diabetes Powder. Fruits are also used for making various other products such as cider, jelly, fruit bar and various medicinal products. The nutritional and therapeutic values of aonla products have better potentiality for the establishment of agro processing industries in the rural areas.

Advanced Production Technology

Though seed propagation is easy and cheap, it does not ensure true to type plant due to cross pollination. At present aonla is successfully propagated through inarching/patch/modified ring budding, veneering and soft wood grafting. Grafted or budded plants are planted at a distance of 8-10m either during the months of July-August or February. These are generally planted in square system of planting. In young aonla plants branching is allowed after the height of 0.75 to 1m from the ground level. Two to four branches with wide croach angles, in the opposite direction are allowed o grow. The unwanted branches must be pinched off regularly. In the subsequent years, only 4 to 6 branches are allowed to develop. Older bigger trees of inferior types can be rejuvenated and easily changed into superior type of top working. These plants are headed back from the height of 3 to 4 meters from the ground level during the months of December/ January. Only 4-6 shoots, developing in outer directions on main limbs are patch budded with superior scion cultivar. After sprouting, the top portion of the shoot is removed. Care should be taken that only budded shoots develop. The fertilizers dose depends on soil fertility, age of the plant and production. The recommended dose of manures and fertilizers are 1000:500:1000g/tree and 50 kg/tree FYM for more than 10 years tree. Aonla require less irrigation. However, irrigation at an interval of 10-15 days is required during dry summer (April- June), particularly in early years of orchard establishment. Among various systems of irrigation, basin irrigation has been found best. Mulching with organic waste, paddy straw, banana leaves, sugarcane thrash etc. have shown promising results in aonla orchards. Mulching with these organic wastes also improve the organic matter contents of soil and encourages the increases the earthworm population and other beneficial microbes in the rhizosphere.

Problems in Aonla Cultivation

1. Insect Pest:

a. Shoot gall maker *(Betonsa stylophora)*: Young caterpillar bore into tender shoots and feed in pits during August- September, causing gall formation. All varieties are susceptible. Growth of severely infested shoots is checked.

Management: Prune affected shoots and burn. Spray Carbaryl (0.1%) during August to kill the newly hatched larvae before they enter into shoots.

b. Bark eating catterpillar *(Indarbela quaadrinotata, I. tetraonis)*: Feed on bark under silken ribbon-shaped web. It causes damage up to 80% in Uttar Pradesh.

Management: Do not damage trees. Prune dead shoots. Remove silkan galleries and spray with Chloropyriphos (0.07%) or carbaryl (0.1%) on tree trunk. Inject Dichlorvos (0.1%) into bored holes.

c. Fruit Borer *(Duedorix isocrates)*: Cause considerable damage (up to 42%) to fruits.

Management: Collect all fallen, infested fruits at least twice a week. Bagging fruits after single spray of Dimethoate(0.045%) or Deltamethrin (0.003%) with muslin cloth or butter paper bags is very effective.

d. Aphid *(Schoutedenia emblica)*: Serious in some seasons.

Management: Spray Dimethoate (0.03%) or Phosalone (0.05%).

2. Diseases:

Rust (Ravenelia emblica): conspicuous black coloured rust pustules on leaflets and fruits. Affected fruit drop off prematurely.

Management: Wettable sulphur /Chlorothalonil 2g/litre , Bitertanol 1g/litre during December.

3. Physiological disorder:

Internal fruit necrosis: The disorder is characterized by browning of innermost part of mesocarpic tissue at the time of endocarp hardening followed by browning of the epicarp resulting into brownish black areas on the fruit surface. Depending upon the severity of the disorder, mesocarp of the affected fruit turn black and becomes corky and gummy pockets developed. This is due to the deficiency of Boron

Management: Spray 0.6% borax thrice in the month of September and October at about 10 to 15 days interval control the malady.

Conclusion

The Indian gooseberry or aonla (*Emblica officinalis* Gaertn.) has recognized as king of arid fruits and semi-arid fruits. It is highly nutritive and richest source of Vitamin C among fruits except Barbados cherry. Its cultivation has recently gain great significance owing to its adaptability to varied agro-climatic conditions, better tolerance to various pests and diseases and high remunerative returns. The importance of this fruit is also due to presence of high content of tannin. The gallic acid present in aonla fruit has antioxidant property. The stability or retention of Vitamin C in aonla due to the presence of polyphenols is a matter of great concern for processors. The excellent nutritive and therapeutic values of fruit have great potential for processing into various products which can be sold in national and international markets for good remuneration.

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Teff - Nutritional Information and Health Benefits of Underutilized Small Millet

Article ID: 10713

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Introduction

Teff (*Eragrostis tef* (Zucc.) Trotter) is also known as 'Eragrostis Tef' or 'Williams love grass' domesticated about 3,000 years ago. It is a tiny, round and the smallest grain in the world measuring less than 1mm in diameter. The origin of Teff is Ethiopia and belonging to the grass or poaceae family. It is also a staple food to millions of people and cultivated from different regions of Australia, South Africa, USA and the produce is mainly used as forage crop for animal feed. It is more tolerant to extreme environmental conditions (drought and waterlogging), storage pest and two-third of protein intake is mostly from Teff. For thousands of years the Ethiopian people have used Teff as the main ingredient of their staple food 'Injera' - a sourdough bread with spongy texture. Based on the seed colour, Teff can be classified as ivory (white), qey (red/brown) and sergegna (mixed) and different collections of Teff is conserved in Ethiopian Institute of Biodiversity, Ethiopia. The main reason for the increased acceptability as food is due to the gluten-free nature and high efficiency against Celiac disease.

Nutritional Facts of Teff Flour

Teff is highly nutritious cereal and 100 grams of Teff flour contains viz., calories -366, proteins – 12.2 grams, fat – 3.7 grams, carbohydrates – 70.7 grams, fiber – 12.2 grams, iron – 37% of the daily value and calcium – 11% of the daily value. Nutrient composition may vary depending on the variety, brand and growing area. It is also a good source of copper, magnesium, potassium, phosphorous, manganese, zinc and selenium. Rich in amino acid like lysine, which is essential for the production of proteins, hormones, enzymes, collagen and elastin and also supports calcium absorption, energy production and immune function.

Significance and Health Benefits of Teff

Gluten-free nature: Gluten is a group of proteins in wheat and several other grains. Some people cannot eat gluten due to an autoimmune condition called Celiac disease. Celiac disease is a disease of the digestive system increases with conditions such as type 1 diabetics and symptomatic iron deficiency anemia. Some people even without celiac disease may find it difficult to digest gluten. Therefore, Teff is a suitable gluten-free alternate and frequently used for celiac disease patients in Netherland's countries.

Diabetes and low glycemic index (GI): Diabetes is characterized by increased blood glucose level and abnormal insulin regulation. Teff has relatively low GI compared to other grains, with a moderate GI of 57. However, the GI changes based on the preparation methods like ingera, porridge, bread etc. Lower GI is likely due to its being eaten as whole grain contributing more fiber, which can prevent the increasing of blood sugar levels.

Protein: Teff is an excellent source of protein with all the essential amino acids. Among the amino acids, the presence of lysine makes it unique than other grains. Production of protein, hormones, enzymes, collagen and elastin also helps in calcium absorption, energy production and immune function.

Dietary fiber: It has high fiber content than any other grains. Comparing the dietary fiber content per 100g of Teff with other flours, Teff has 12.2 grams, whereas in wheat and rice having only 2.4 grams and 6.4 grams in oat flour. Teff being a good source of dietary fiber including resistant starch which retains maximum portion of bran present in the seed and act as the best source of dietary fiber and supports Colon health. It also helps in the least amount absorption of toxins intake and absorption from the food consumed. A high fiber diet is associated with a lower risk of heart disease, diabetes, stroke, high blood pressure and constipation. Teff supports Colon health and digestion with a high composition (20% - 40%) of "resistant starch," a recently-discovered dietary fibre.

Iron content: Teff contains rich source of iron than other grains i.e., 100 gm of Teff flour provides 37% of daily value (DV) for iron while the wheat offers only 5%. It an essential mineral that carries oxygen throughout our body via red blood cells. The intake of this grains mainly helps to reduce the anemic condition of pregnant women and also helps to avoid iron deficiency in certain people.

Anti-nutrients: The anti-nutrients present in the Teff are phytic acid and tannic acid that hinders the uptake of nutrients by the body. The phytase in Teff can be reduced with the help of individual or combination of various process like soaking, fermentation, germination and other methods. The phytates can reduce blood glucose levels which is beneficial for diabetic patients. It is also anti-cancerous in nature and reduces calcium salts from biological fluids.

Other Uses

1. It is mainly used for making a popular pancake like bread called injera and porridge.
2. Grain is also used to make alcoholic drinks like tela and katikala.
3. Teff straw being the most appreciated feed for cattle, also used to reinforce mud and plaster the walls of tukuls and local grain storage facilities called gotera.
4. Teff grain, due to its high mineral content, it is used in mixtures with soybean, chickpea and other grains in the baby food industry.

Conclusion

Teff, a localised crop of importance only in Ethiopia, has remained an 'orphan crop' but increasing global interests in recent years due to its gluten free nature, high level of essential amino acids, high mineral content, low glycemic index, high crude fiber, longer shelf life and slow staling of its bread products. It is highly related to several health benefits including prevention of celiac disease, diabetes and anemia, these all indicate the potential of teff to be a future global functional food for health promotion and disease prevention.

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Viewing Paddy Stubble Burning through a Behavioural Lens

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Introduction

Rice-wheat cropping system is the most prominent in India. The Indo-Gangetic plains in Northern India accounts for around twelve million hectares of rice and wheat crop rotation and harvesting of these crops with combine harvesters is very popular with the farmers. The mechanized harvesting leaves a large quantity of stubble that takes a lot of time to decompose in the soil and is usually burnt for speedy plantation of the next crop. India generates around 600 Mt of stubble which includes about 90-140 Mt of surplus stubble and is likely to be burned in the field (Jain *et al.,* 2014). Multipurpose use of stubble includes animal feeding, soil mulching, bio-manure, thatching for rural homes and fuel for domestic and industrial use. Despite knowing about alternative methods of stubble management, farmers burn a significant portion of the crop stubble on-farm so that the succeeding crop can be sown on a cleared field. Mechanized farming coupled with lack of availability of farm labour and high cost associated with the process further exacerbates the problem of stubble burning. According to a study conducted by International Food Policy Research Institute, air pollution due to stubble burning in northern India causes an estimated economic loss of around USD 30 billion annually, and is a leading cause of acute respiratory infections, especially among children; apart from various ill-effects to environment. The particulate matter emitted from crop burning across India in a year is more than 17 times the total annual particulate pollution in Delhi from all sources such as vehicles, garbage burning and industries. In Punjab, total cereal stubble generated is 45.58 million tonnes/year and residue burned is 21.32 million tonnes/year. In Haryana, total cereal stubble generated is 24.73 million tonnes/year and residue burned is 9.18 million tonnes/year (Yadav *et al*., 2017). In 2019, the System of Air Quality and Weather Forecasting and Research (SAFAR) by the **Ministry of Earth Sciences (MoES) reported that** the share of stubble burning in air pollution in Delhi-NCR rose to about 46 per cent and thus, public health emergency was declared in the region.

Several research studies have been conducted on various aspects related to stubble burning including the pros and cons of burning the stubble on field (Verma and Bhagat, 1992), amount of nutrient-loss from soil (Gupta *et al.*, 2004), areas in Northern states with maximum and minimum acreage under stubble burning (Punia *et al.*, 2008), problems faced by people in areas where stubble is burnt (Kumar *et al.*, 2015), perception and knowledge level of farmers and extension personnel regarding measures to avoid stubble burning (Lyngdoh, 2018), developing engineering interventions to prevent stubble burning through microbial degradation (Muzamil *et al.*, 2020) etc. The health loss has also been quantified in monetary terms in a study (Chakrabarti *et al.*, 2019) and all of the studies indicate that the stubble burning should be stopped as soon as possible.

The governments at different levels have attempted to restrict the stubble burning through numerous measures and campaigns designed to promote sustainable management methods. The National Green Tribunal banned stubble burning in 2015 but it had little or no effect in northern states. The charging of monetary penalties from the farmers who burn the stubble and FIRs against them has only politicized the issue rather than putting a brake on it. In spite of the provision of the subsidies for mechanized measures, they are also not reaching the farmers due to red tapism and other factors. In 2019, the paddy season overlapped with the 550th '*Parkash Parv*' of the first Sikh Guru, Shri Guru Nanak Dev Ji. The Punjab Government chose to make his holy verse '*Pavan Guru, Pani Pita, Mata Dharat Mahat*' (air is guru, water the father, earth the eminent mother) as the focus of its campaign against stubble burning before the paddy harvesting season began. It was hoped that Guru's eternally-relevant incitement on environment would resonate with farmers more than ever before but the numbers of stubble burning incidents were increased which indicates that tapping the emotional appeal of the farmers was also not enough.

However, it would be interesting to see the latest direction of the apex court to the state governments in Northern states to provide incentives at the rate of Rs. 100 per quintal to the farmers who do not burn the stubble in the upcoming seasons. As of today, despite enormous efforts and measures, the desirable results to bring change in farmers' behaviour to stop stubble burning is still awaited.

It seems that the problem of stubble burning is difficult to be solved by technical or legal interventions alone. The behavioural aspect of the problem has to be considered as well. Thus, it becomes imperative to find out what drives the farmers to burn the stubble in spite of having so many alternatives. An Indian farmer, in general, has undergone a tremendous degree of positive transformation over decades. The farmers are no more just passive recipients of information. They have developed as a character with enhanced socio-economic status, capability and ownership of resources; those who could challenge the scientific opinions with their own experiences. They know what could be the consequences of their actions. Thus, they should not be left out of the equation if we have to find a sustainable solution to the stubble burning. So, its high time that their side of the story is addressed and their motivations, beliefs, perceptions and whatever drives their stubble burning behaviour are explored. Also, several research studies have shown that simply trying to tell people to change, or giving them information and expecting them to act on it, may not work if the determinants of certain behaviours are not considered. Once it is known what causes the farmers to perform such behaviour, only then their behaviour could be changed. As such, the focus should turn towards behavioural objectives and behaviour change techniques over knowledge gain and solely technical and informational approaches when planning and implementing anti-stubble burning programs. The dearth of research studies in context of analysing the stubble burning from behavioural angles is also a point of concern. There exist several alternatives like Pusa Decomposer, Happy Seeder and Super Seeder etc. but still they remain undiffused among majority of the farmer masses due to reasons unknown. No doubt, these interventions are appropriate alternatives for managing the paddy stubble but they need to be diffused into the social system of farmers according after considering their behavioural determinants.

For changing the behaviours of masses, several behavioural theories and models have been applied to find out the behavioural determinants across the disciplines. Some of these theories include Diffusion of innovations theory (Ryan and Gross, 1943) which traces the process by which a new idea or practice is communicated through certain channels over time among members of a social system. The model describes the factors that influence people's thoughts and actions and the process of adopting a new technology or idea (Rogers, 2003). The input/output persuasion model (McGuire, 1969) emphasizes the hierarchy of communication effects and considers how various aspects of communication, such as message design, source, and channel, as well as audience characteristics, influence the behavioural outcome of communication. Stages of change model Prochaska *et al.* (1992) identifies psychological processes that people undergo and stages that they reach as they adopt new behaviour. Changes in behaviour result when the psyche moves through several iterations of a spiral process- from precontemplation through contemplation, preparation, and action to maintenance of the new behaviour. Theory of Reasoned Action, by Fishbein and Ajzen (1975) specifies that adoption of a behaviour is a function of intent, which is determined by a person's attitude (beliefs and expected values) toward performing the behaviour and by perceived social norms (importance and perception that others assign the behaviour). Social cognitive (learning) theory by Bandura (1986) specifies that audience members identify with attractive characters in the mass media who demonstrate behaviour, engage emotions, and facilitate mental rehearsal and modelling of new behaviour. Social influence, social comparison, and convergence theories specify that one's perception and behaviour are influenced by the perceptions and behaviour of members of groups to which one belongs and by members of one's personal networks. People rely on the opinions of others, especially when a situation is highly uncertain or ambiguous and when no objective evidence is readily available. Social influence can have vicarious effects on audiences by depicting in television and radio programs the process of change and eventual conversion of behaviour (Rogers and Kincaid, 1981). Theories of emotional response propose that emotional response precedes and conditions cognitive and attitudinal effects. This implies that highly emotional messages in entertainment would be more likely to influence behaviour than messages low in emotional content (Zajonc *et al.*, 1989).

Some of these theories and model may be utilized in context of stubble burning behaviour of the farmers and identify its behavioural determinants. Based on those determinants, appropriate interventions could be designed and implemented to facilitate the process of behaviour change.

Conclusion

The paddy stubble burning remains the "burning topic" in the news columns during the paddy harvesting season, especially in Northern India. The damage as a result of stubble burning, in terms of pollution and health hazards has only increased over a span of past few years. Several judicial and legislative measures have been implemented to curb the number of stubbles burning incidents in the northern states but no significant success has been achieved. It is high time that the menacing act of stubble burning should be stopped. This article advocates to explore the problem of paddy stubble burning from a behavioural angle, i.e., finding the behavioural determinants of the stubble burning behaviour of the farmers using behavioural theories. This could help in knowing what exactly causes the farmers to burn the paddy stubble amid various available stubble management alternatives, which could probably help in finding a way to stop this act.

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Amla: A Miracle Fruit

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Abstract

Emblica officinalis or *Phyllanthus emblica* commonly known as Indian Gooseberry or Amla or aonla is arguably the most important medicinal plant in the Indian traditional system of medicine, the Ayurveda. Various parts of the plant are used to treat a range of diseases, but the most important is the fruit. The fruit is used either alone or in combination with other plants to treat many ailments such as common cold and fever; as a diuretic, laxative, liver tonic, refrigerant, stomachic, restorative, alterative, antipyretic, anti-inflammatory, hair tonic; to prevent peptic ulcer and dyspepsia, and as a digestive. Preclinical studies have shown that amla possesses antipyretic, analgesic, antitussive, antiatherogenic, adaptogenic, cardioprotective, gastroprotective, antianemia, antihypercholesterolemia, wound healing, antidiarrheal, antiatherosclerotic, hepatoprotective, nephroprotective, and neuroprotective properties. In addition, some experimental studies have shown that amla and some of its phytochemicals such as gallic acid, ellagic acid, pyrogallol, some norsesquiterpenoids, corilagin, geraniin, elaeocarpusin, and prodelphinidins B1 and B2 also possess antineoplastic effects. Similarly, amla is also reported to possess radiomodulatory, chemomodulatory, chemopreventive effects, free radical scavenging, antioxidant, anti-inflammatory, antimutagenic and immunomodulatory activities properties that are efficacious in the treatment and prevention of cancer.

Keywords: Anti-Inflammatory, Aonla, Ayurveda, Emblicol, Phyllemblin and Vitamin C.

Introduction

Amla *Emblica officinalis* or *Phyllanthus emblica* also known as Amla belongs to the Euphorbiaceae family. This fruit ripens in the autumn in wet, forested, hilly areas on the Indian subcontinent. Amla fruits are fleshy, round, attractive, deeply ribbed and yellowish green in colour. India produced 1032.78 mt of amla in 2017–2018. Uttar Pradesh 384.32 mt, Madhya Pradesh 302.18, Tamil Nadu 152.87 mt and Gujarat 81.90 mt are the major states, which accounts 85.80% share in the total production of amla in the country. In India it is considered as a sacred tree. The fruit is very nourishing, but it tastes sour. Both dried and fresh fruits can be consumed for their health benefits. Amla is a tree that grows in India, the Middle East, and some Southeast Asian countries. Amla has been used in Ayurveda medicine for thousands of years. Amla is very rich in vitamin C, vitamin A and vitamin B complex, fiber and also contains various minerals like calcium, potassium, phosphorus, magnesium and iron. It is one of the richest sources of Vitamin C, which is termed as a good antioxidant agent, which makes gooseberries a powerful tool against a variety of conditions, including various types of cancer.

Table.1 Package of Practices Amla (Indian Gooseberry):

Crop	Amla (Indian gooseberry)
Synonyms	Sanskrit: Dhatri, Amlaka Hindi: Amla, Aonla Kannada: Amalak, Bettadanelli Telugu: Amalakkamu
Botanical Name	*Emblica officinalis* *Phyllanthus emblica* Linn.

Family	Euphorbiaceae
Origin	South East Asia (India)
Climatic Requirement	• It is a tropical plant, requires hot and humid climate during rainy season and cold and dry climate during winter season. • The plants can tolerate freezing of 0^{O} C as well as a high temperature up to 46^{O} C. • Annual rainfall of 650-850 mm is ideal for its growth. • The young plant up to the age of 3 years should be protected from hot wind during May to June and from frost during winter months.
Plant Characteristics	• Amla is a deciduous tree of small to medium size and grows up to the height of 5.5-6 meters. • Fruits are fleshy, almost depressed to globose; Average weight is around 5.68 g • Colour ranges from yellow to greenish yellow • The stone of the fruit is ribbed, splitting into three segments, each containing usually two seeds.
Bio Chemical Component	• Ascorbic acid (700 mg per 100 g of fruits), Linoleic Acid, Gallic Acid and Ellagic Acid, • Polyphenols, Tannins, Emblicol, Corilagin, Phyllemblin, Rutin and Pyrogallol.
Uses	• The fruits are used for making preserves and pickles, several Ayurveda medicinal preparations such as juice, tonics. It is also a principal constituent of the famous Ayurvedic restorative tonic called Chayavan Prash. • Fruit is dehydrated and used as candy. • Cosmetics like hair wash powders, hair oils, shampoo. • The fruit and bark are also used in tanning of leather. • The roots are useful in ulcerative stomatitis and gastrohelcosis. • The bark is useful in gonorrhoea, jaundice, diarrhoea and myalgia. • Leaves are useful in conjuctuvitis, inflammation, dyspepsia, diarrhoea and dysentery. • Leaves are also fed to livestock as fodder, especially to sheep & goats. • The Fruits are Useful in curing various diseases like; Diabetes, Cough, Asthma, Bronchitis, Colic, Flatulence, Hyperacidity, Peptic Ulcer, Skin Diseaes, Leprosy, Inflammations, Anaemia, Jaundice, Strangury, Diarrhoea, Dysentery, Haemorrhages, Leucorrhoea, Cardiac Disorders and Greyness of Hair.
Soil	• Well drained Light to medium soils is suitable for cultivation. • Amla is tolerant to Drought and high temperatures. • Amla is slightly resistant to saline soils and alkaline soils.
Pitting	Manually or mechanically dig the pits of 1 m3 during May to June. Pits are exposed to sunlight for 15-20 days. Each pit should be filled with surface soil mixed with 15-20 kg FYM and 0.5 kg of phosphorus before planting.
Planting Time	June-July (Late Planting can be done till September)
Spacing	4.5 m x 4.5 m
No of Trees	500 trees ha-1 can be well adapted.
Manures & Fertilizers	225: 300: 120 NPK (Kg ha-1)

Weed Management	One hand weeding at 60 and 120 DAPs to avoid weed incidence.
Irrigation	• Young plants require watering during summer months at 15 days interval till they are fully established. • Irrigation for fruit bearing plants is advised during summer months at 15-20 days interval. • Drip irrigation will be more beneficial for water and nutrient use efficiency.
Important Operations	**Training and pruning:** Leaving 4-5 well shaped branches with wide angle from the ground level, dead, diseased branches and crisscrossing branches are pruned at the end of December. **Mulching:** During summer, the crop should be mulched with paddy straw or wheat straw at the base of the tree up to 15-20 cm from the trunk. **Intercropping:** Inter crops like green gram, black gram, cow pea and horse gram, can be grown up to 8 years.
Pest Management	**Pest:** Bark Eating Caterpillar *(Inderbella tetronis)* **Control:** spray Monocrotophos 0.03% in holes and plugging with mud is effective in protecting the tree against bark eating caterpillar.
Disease Management	**Disease:** Rust (Ravenellia emblicae) **Control:** Spraying of Indofil M-45 @ 0.3% in the month of September and second spray should be repeated 15 days after first application for effective control over rust.
Varieties	Banarasi, Chakaiya, Francis, NA-4 (Krishna), NA-5, NA-6, NA-7, NA-10 and BSR-1 (Bhavanisagar).
Harvesting	Amla tree starts bearing after 2 years of planting. The fruits are harvested during February when they become pale greenish to yellow colour. The mature fruits are hard, vigorous shaking is required. Fruits can also be harvested using long bamboo poles with hooks.
Yield	A mature tree of about 6–8-year-old will yield 50-70 kg of fruit. The average weight of the fruit is 40-60 g and 1 kg contain about 15-20 fruits. A well-maintained fruit tree yields up to an age of 50 to 60 years.

Table. 2 Nutritional Composition of Amla Fruit Pulp:

Sl. No	Composition	Value Per 100 g	% of RDA
1.	Total Calories	48	2.4
2.	Total Fat	0.5	0.5
3.	Protein	1	--
4.	Total Carbohydrate	10	3
5.	Water	86	--
6.	Phenolic Compounds (Gallic Acid)	3012.5 mg	--
Carbohydrates			
Sl. No	**Composition**	**Value Per 100 g**	**% of RDA**
1.	Total Carbohydrate	10	3
2.	Dietary Fibre	5	18
3.	Sugar	--	--
4.	Starch	--	--
Fat, Lipids & Fatty Acids			
Sl. No	**Composition**	**Value Per 100 g**	**% of RDA**
1.	Total Fat	0.5	1

2.	Saturated Fat	--	--
3.	Monounsaturated Fat	0.1	--
4.	Polyunsaturated Fat	0.3	--
5.	Cholesterol	--	--
6.	Trans Fat	--	--
7.	Omega-3 Fatty Acids	48	--
8.	Omega-6 Fatty Acids	276	--
Vitamins			
Sl. No	**Composition**	**Value Per 100 g**	**% of RDA**
1.	Vitamin A	290 IU	6 %
2.	Vitamin C	478 mg	800 %
3.	Vitamin D	--	--
4.	Vitamin E (Alpha-Tocopherol)	2450 mg	1225 %
5.	Vitamin B1 (Thiamin)	--	--
6.	Vitamin B2 (Riboflavin)	--	--
7.	Vitamin B3 (Niacin)	0.3 mg	--
8.	Vitamin B5 (Pantothenic Acid)	0.3 mg	--
9.	Vitamin B6	0.1 mg	--
10.	Vitamin B12 (Cyanocobalamin)	--	--
Minerals			
Sl. No	**Composition**	**Value Per 100 G**	**% Of RDA**
1.	Calcium	25 mg	2 %
2.	Iron	0.9 mg	6 %
3.	Magnesium	10 mg	2 %
4.	Phosphorus	27 mg	3 %
5.	Sodium	1 mg	--
6.	Zinc	0.12 mg	1 %
7.	Copper	0.1 mg	4 %
8.	Manganese	0.1 mg	7 %

Health Benefits of Amla and its Nutritional Role in Human

1. Anaemia and Brain Health: Being richer in iron, along with its unique combination Vitamin C that increases body capacity to absorb nutrients required for blood production. Due to the high iron in the blood, it provides oxygen to the brain. Also, it improves memory. As it contains a high number of antioxidants, it is effective to prevent degeneration of brain caused due to oxygen free radicals. Thus, it provides complete health benefits to the brain.

2. Anti-Aging: Amla prevents health-related hyperlipidaemia by reducing the number of free radicals in the body through its antioxidant qualities. Generally, Aging is common with the increase in age. But the phase of aging is completely reversed. Skin starts to show sign of aging at an early age. Unhealthy diet, pollution and stress are main causes of aging. Oxidative Radiance Activity Capacity (ORAC) value is 3387 micromole per 100 g. Healthy cells is damaged by free radicals. After damaging the healthy skin and it quicken the process of aging.

3. Calcium Absorption: Calcium is an essential component of our bones, teeth, and nails. So, eating vitamin C-rich Indian gooseberries is a great way to keep body looking and feeling great.

4. Cancer: Amla is a rich source of antioxidants which is effective to prevent DNA cell damage from free radicals. Also due to its high Oxidative Radiance Activity Capacity (ORAC) it protects cell damage from oxidative stress. The Best part of Amla is that it doesn't lose it nutrients value even in powered form. During studies it was found that Amla have tremendous effect on multiple cancers.

5. Diabetes: Amla contains chromium, which has a therapeutic value for diabetic patients. Amla stimulates the isolated group of cells that secrete the hormone insulin, thereby reducing blood sugar in diabetic patients and keeping their body balanced and healthy. In some studies, it was found that emblica has dramatic result in Diabetes patients. Consuming just 3 quarter of tsp of powder showed a drop of blood sugar level from 130-140 to healthy zone to 65- 75 within 21 days.

6. Diarrhoea and Dysentery: Due to its strong cooling and laxative properties, Amla is a useful component in remedies for diarrhoea and dysentery. It provides great relief for gastric syndrome and hyperchlorhydria (burning sensation in the abdomen).

7. Digestion: Amla is a rich source of fiber that improves digestion. Low fiber diet leads many health problems. Constipation is due to the poor digestive system. A healthy diet in fiber can improve digestion by providing roughage. Due to improve in the digestion problems like haemorrhoids can be prevented. Fiber adds bulk to the stool and helps food move through the bowels and keeps your bowel movements regular. Fiber also stimulates the secretion of gastric and digestive juices, so food is digested efficiently.

8. Diuretic Activity: Besides being a fruit that is very high in water, amla is also slightly diuretic in nature. This means that it increases the frequency and volume of urination. Urination helps our body eliminate unwanted toxins and excess levels of water, salts, and uric acid.

9. Eye Care: Amla is healthy for the eye. It cuts the risk and rectifies cataract or near-sightedness. Amla stands higher in the list of antioxidants content compared to blueberry and pomegranate seeds; it shows benefits against free radicals. Free radicals are responsible for degenerative diseases. Vitamin A plays a vital role in preventing eye sight problems. Drinking amla juice with honey is good for eyesight and studies have shown it to improve near-sightedness and cataracts, while reducing intra-ocular tension. Vitamin A and carotenes reduce macular degeneration, night blindness, and strengthen vision before the age-related degeneration from free radicals can occur.

10. Hair Care: Amla is used in many hair tonics. It is a rich source of iron and other nutrients that increase the growth of hair. It is also effective to increase hair pigmentation. It also prevents hair loss as it enriches hair growth and pigmentation. Eating fresh Amla or applying its paste on hair roots improves hair growth and colour. Amla oil is very popular in India because it has been shown to reduce the chances of hair loss and baldness.

11. Heart Disease: Amla juice strengthens the heart muscles, so the heart pumps blood smoothly throughout the body. By reducing excess cholesterol build-up, the chromium can reduce the chances of atherosclerosis, or plaque build-up in the vessels and arteries. This can reduce the chances of strokes and heart attacks. Some studies shown that amla is rich in antioxidants, iron, calcium, anthocyanin, flavonoids and potassium that are required for heart health. It reduces bad cholesterol thus reduce the blockage of blood flow towards the heart. The antioxidants capacity of 1 tsp of Amla is 782 units that make it the healthiest fruit. These provide the fruit with efficiency to fight free radicals, recovery of damaged DNA cells and much more. It improves nerve health thus it supports the proper flow of blood. Antioxidants protect nerve cell damage from free radicals. Also, it plays major in strengthening heart muscles. Along with antioxidants, potassium plays a crucial role in strengthening the nervous system. It also balances the fluid and electrolyte level.

12. Immunity: Amla is the richest source of Vitamin C, which is responsible for boosting immunity. Vitamin C plays a vital role in improving immunity to fight against free radicals. With increased immune system body is resistance towards common disease like flu, cough and also prevent infections.

13. Improve Skin Health: Eating it daily early in the morning improves skin health and gives a perfect glow to the skin. Since it contains antioxidants, it protects skin damage from UV rays. Amla prove beneficial in the production of blood cells due to high Vitamin C, Iron, folic acid, and other nutrients. Skin receives more oxygen with increasing blood cells, which directly improve skin health.

14. Improving Appetite: Consuming Amla powder with butter and honey before a meal improves appetite. It also helps to balance nitrogen levels, thereby increasing weight in a healthy way.

15. Infection: Due to its antibacterial and astringent attributes, Indian Gooseberries protect the body against infection and improves the body's immune response.

16. Menstrual Cramps: Some of the minerals and vitamins in amla combine to make it very useful in the treatment of menstrual cramps. Since it takes a while for the necessary elements to accrue in the body, it is better to consume Alma on a regular basis so it is always in the system and menstrual cramps can be prevented every month for women.

17. Metabolic Activity: Eating foods that are high in protein is one of the most important ways to stay healthy, since proteins are an essential part of our body's metabolic activities. Our enzymes can breakdown plant proteins into amino acids and reassemble them into usable proteins for our body.

Templates of Amla and its Value-Added Products

		
Amla Tree	**Amla Leaves**	**Amla Fruit**
		
Amla Seeds	**Amla Juice**	**Amla Pulp Powder**
		
Amla Roots	**Amla Candy**	**Amla Pickle**

Conclusion

If we consume Indian Gooseberry (Amla) as a fresh fruit, juice, or dried form, it enhances big improvement in the overall health. Amla is a proven complete fruit with medicinal properties. It has been used since the ancient civilization. Even after knowing its benefit, it is underutilized fruit but due to changing food habit of today's generation, it will definitely fulfil the demand of modern people. It can be concluded that Amla plays a role in overall nutrient requirements. Further molecular level research has to be carried out to get new findings out of amla (Indian gooseberry) fruit.

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Urea Molasses Minerals Block (UMMB): A Promising Feed for Growth, Development and Production of Livestock

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Abstract

Minerals and vitamins play a significant role in fertility by maintaining membrane integrity, and are involved in optimum hormones production and maintenance of strong immunity. Besides their role in fertility, antioxidant effects of trace elements, would also contribute to the general health of the animal by enhancing the endogenous antioxidant enzymes activity to overcome with the adverse effects of abiotic and biotic stress. Nutrient deficiency results in poor growth, reduced yield, increased susceptibility to diseases and failure to conceive. Production potential can be augmented by nutrient supplementation especially devised on area specific needs of animals and local feasibility. Based on this nutrient status and local availability of fodders we devised area specific urea molasses mineral block (ASUMMB). It contains all essential nutrients including minerals and vitamins and provides maintenance requirements to livestock. Moreover, area specific urea molasses mineral block (ASUMMB) can serve as an alternate feeding supplement for livestock; hence, minimizing fodder requirements as fodder scarcity is one of the main limiting factors for production performance of livestock.

Introduction

Animal husbandry plays an important role in livelihood security and economic sustenance of farmers, especially in rainfed areas. As per 20th Livestock Census of 2019, the total livestock population in India was 535.78 million in country showing an increase of 4.6% over previous censes GOI, DAHD 2019. The increasing population and diversified food and fodder requirement of the country is expanding at faster rate, enhancing food production for future years is very challenging. Present availability of green fodder is 462 million tonnes and dry fodder is 394 million tonnes and contribution of crop residue, cultivated fodder and grasslands is 54, 28 and 18% respectively. Currently, India is deficit by 35.6% in green fodder and 10.95% in dry fodder and 44% concentrate feed. The fodder production in the country is not sufficient to meet the requirements; also, the forages offered are mostly of poor quality. Dairy animals are an important source of regular income in rainfed agro-eco-system of India. The productivity of dairy animals is greatly constrained by the lack of green fodder and good quality feed during a prolonged dry season. Reduction in milk production and weight losses of animals during the dry season are common features, which culminate in substantial economic losses to the farmers. Feeding balanced ration plays a crucial role in livestock development programme. In order to exploit the genetic potential of animals it is pre-requisite to ensure adequate and balanced supply of nutrients. Crop residues and dry grasses are the major forages used for feeding livestock in India. These crop residues are low in nitrogen, minerals, vitamins and high in fibre and lignin which restrict intake and digestibility in animals. As a result, performance of animal is often sub-optimal that is reflected in stunted growth, delayed maturity, longer inter-calving period and poor milk yield. In this scenario, strategic supplementation of nutrients is essential to improve the utilization of poor-quality roughages. Dietary supplementation of critical nutrients can improve the utilization of poor-quality roughages. Considering the availability and price of concentrate mixture, resource poor farmers can hardly afford them. Animal nutritionists, all over the world, have proved that the nutritive value of crop residues can be enhanced if supplemented with deficient nutrients. Supplementation with the locally available concentrate is a common practice among smallholder farmers in rural area and cottonseed cake as a conventional supplement is often fed to livestock during the lactation. The use of urea molasses mineral blocks (UMMB) through licking provides fermentable nitrogen, energy and minerals intermittently, necessary for optimum microbial growth. Microbial protein can contribute 30-40 percent of crude protein requirement of an animal. As ruminants can produce microbial protein from nonprotein nitrogen, (UMMB) supplementation in the ration is quite beneficial, especially when fed crop-residue based diets. The use of (UMMB) for supplementing crop-residue-based diets for livestock has the potential to increase livestock production and net daily income. Urea molasses mineral blocks (UMMB) can be fed throughout the year but are more beneficially utilized during the dry season or when the animals are grazing low quality fodder. Molasses based liquid supplements with added N, minerals and vitamins have recently been shown as another approach for increasing nutrient utilization to enhance growth rate and reproductive performance in cattle. Further, liquid supplements are also having advantages of supplying nutrients with fixed quantity, better availability and are easy to transport.

Why Supplement with Urea Molasses Blocks?

1. UMMB can be an important source of supplement for ruminant animals to increase feed intake and productivity. This supplemental feed resource is rich in nutrients like carbohydrates, proteins and minerals.

2. Ruminants in India are based on fibrous feeds like mature grass and crop residues. These feeds are deficient in protein, minerals and vitamins and are poorly digestible. Both these characteristics keep intake and productivity low.

3. Supplementation with Urea Molasses Blocks (UMB) can increase digestibility of fibrous feeds by up to 20%, increase the nutrients the animal receives and can increase feed intake by 25 to 30%. If another good quality protein source such as cottonseed cake is added to the block, the animal will grow faster. Animals also benefit if other feed stuffs such as vitamins, minerals, medicines, etc. are added to the block.

4. Blocks are a convenient way to make and store molasses and urea and also feed to animals. They can easily be made and used in villages. A person may make and sell blocks to farmers as a source of income.

5. The high cost of conventional concentrate feeds prohibits their wide scale use, especially by small farmers.

6. Several formulations are available for the production of UMMB, which allows responding to different prices and availability of potential ingredients.

Important Goals of Feeding Urea Molasses Mineral Block (UMMB)

1. Safe and uniform supply of all micro nutrients to livestock.
2. Safe delivery vehicle for NPN.
3. Improve NPN utilization.
4. Delivery vehicle for molasses or rumen fermentable carbohydrates to rumen microbes.
5. Reduce dustiness of concentrate feed.
6. Reduce sorting of the feed.
7. Increase feed intake as a whole, as it has better palatability.
8. Increase ruminal fibre digestion and microbial protein synthesis.
9. Increase bulk density of feed.

How to Make Urea Molasses Mineral Block (UMMB)

1. Urea Molasses Mineral Block (UMMB) is made from different ingredients where each has its own contribution in the mixture.
2. It is usually made up of molasses, urea, minerals, rice bran, wheat bran, protein rich by-products, salt and water which are mixed and processed to the form a block by moulding.

3. Molasses provides energy and minerals like sulphur. It increases its intake by the animal.
4. Urea is a non-protein nitrogen source which is essential to improve the digestibility of the feed by providing fermentable nitrogen.
5. Cereal bran is the most common fibrous feed used and provides energy and helps hold the block together. Oilseed cake is added to supply protein and it is a bypass protein source and provides immediate function for the animal.
6. Salt is added to supply minerals and to control the rate of consumption.
7. Cement is used to make the block. It makes the block hard and provides calcium.

Procedures for Production of Urea Molasses Mineral Block

Urea Molasses Multi-Nutrient Block can be manufactured on the farm. UMMB manufacture is easy and simple and can be afforded by small-holder farmers and commercial producers. Different methods exist which may be used according to local conditions.

The manufacturing of UMMB can be divided into four stages as follows:
1. Preparation of the Ingredients.
2. Weighing and Mixing of Ingredients.
3. Casting and Moulding.
4. Drying

Preparation of the Ingredients

The quantity of the different ingredients is needed to make the UMMB depends on the size of the block to be prepared and the formula to be used. UMMB with different weight and size can be prepared (1 kg, 5 kg, 10 kg and 20 kg etc). The weight of the block to be made determines the amount of each ingredient to be mixed. Using the following standard proportion, UMMB can be produced by thoroughly mixing the accurate quantities of the components viz; molasses 40%, Rice bran 20%, wheat bran 10%, Urea 10%, cementing agent (Calcite powder) 5%, Lime 5%, mineral mixture 8%, salt 2% as shown in (Table.1).

Weighing and Mixing of Ingredients

Before starting production of UMMB preparation of the necessary ingredients is necessary. Thorough mixing is a key for good UMMB making. Urea must be mixed thoroughly by breaking up lumps to avoid pockets of high concentration that could be toxic to animals.
1. Weigh the amount of ingredients based on the proportion of the block.
2. Add urea to the molasses while continuously mixing or stirring until the urea grains completely dissolve in molasses.
3. The molasses can be heated in the sun to improve handling and mixing.
4. Similarly cement and salt will be dissolved in 200 ml of water prior to being added to the first mixture of urea and molasses.
5. After mixing the two mixtures (molasses & urea mixture and salt & cement mixture) together, little by little wheat bran and oilseed cake will be added to make the third mixture and thoroughly mix until the final mixture has a dough texture.

Casting and Moulding

1. Once all the ingredients are thoroughly mixed and homogenous mixture formed, place the mixture into moulds.
2. Any container, such as tin cans or small buckets can be used as a mould.
3. Plastic sheets are used to line the moulds, which make easy to remove the blocks from the mould. The size of the mould to be used depends on the size of UMMB to be manufactured.

4. For example to manufacture 5 kg of UMMB we can use rectangular wooden frame of 20 X 20 X 30 cm Length Width & Depth respectively. Compaction will be applied using a wooden bar and left for solidifying for 24 hours.

Drying

The block will be removed from the mold after 24 hours. The UMMB will be left to dry in a well-ventilated room under a shade for about 5-10 days depending upon the weather condition, after which it will be ready for feeding (Licking) by animals.

Characteristics of a Good Urea Molasses Multi-Nutrient Block

1. A block is considered to be good when it fulfils the following characteristics are:
2. Ingredients are well distributed throughout the block. It does not have lumps of urea.
3. It is hard enough not to be squashed between our fingers and should be broken into pieces when it is through to ground. Our hands should feel the sticky appearance of molasses when we hold the block. It should smell a pleasant or sugary smell.

Advantages of the UMMB Technology

1. Ingredients are easily available in almost all parts of the country. Methods of preparation are very easy and convenient. UMMB prepared by recommended standards has longer shelf life on storage at a dry place.
2. Density of UMMB is much higher than the ingredients, which facilitates long distance transportation at a lower cost.
3. UMMB blocks are suitable for supplementing dry fodder-based diets for sustainability of ruminants during lean period.
4. UMMB Licks are hard enough to control gradual intake limited to about 600-700 g in adult bovines and 800-100 g in growing bovines of about 200 kg body weight.
5. UMMB is much cheaper than other conventional source of proteins such as oilseed cakes.

Table.1 Composition of Urea Molasses Mineral Block:

Sl. No.	Ingredients	Percent (%)	10 Kg (UMMB) Blocks
1.	Molasses	40	4
2.	De-oiled Rice Bran	20	2
3.	Wheat Bran	10	1
4.	Urea	10	1
5.	Cementing Agent (Calcite Powder)	5	0.5
6.	Lime	5	0.5
7.	Mineral Mixture	8	0.8
8.	Common Salt	2	0.2
	Total	**100**	**10**

Table.2 Physical Composition of Different Ingredients Used for Enriching Urea Molasses Mineral Block (UMMB):

Sl. No	Ingredients	Composition (1)	Composition (2)
1.	Molasses	45 %	40 %
2.	Urea	15 %	05 %
3.	Mineral Mixture	15 %	03 %
4.	Salt	08 %	02 %
5.	Cementing Agent (Calcite Powder)	04 %	--
6.	Bentonite	03 %	--
7.	Cotton Seed Meal	10 %	--
8.	De-oiled Mahua Seed Cake	--	10 %

9.	Wheat Bran	--	20 %
10.	Crushed Maize	--	20 %
	Total	**100 %**	**100 %**

Table.3 Chemical Composition of Urea Molasses Mineral Block:

Sl. No	Nutrients	Proximate Analysis (%)
1.	Crude Protein	26.5
2.	Crude Fiber	6
3.	Carbohydrate (Sugars)	22
4.	Fat	1.5
5.	Ash	24
6.	Calcium	5
7.	Phosphorus	2
8.	Zinc & Copper	195 ppm & 175 ppm
9.	Moisture	13
	Total	**100 %**

Prospects of Supplementation of Urea Molasses Mineral Block

The unique ability of the ruminants to synthesize enough protein for maintenance through microbial action permits the use of urea as a NPN source, provided ready source of energy available. Thus, it is now well established that urea molasses mix can provide additional nutrition and enhance the utilization of roughages. However, the use of such supplementary mix has several limitations especially if the system employed is in liquid form. One such system that can possibly overcome some of the limitations is to solidify the urea molasses liquid mix into the form of a block which is acceptable and manageable without having any deleterious effect on the animals. Development of UMMB technology is easily manageable and cost effective. The primary objective of these blocks is to provide supplementary nutrition to animals in the village, subsisting on straws and crop residues.

Precautions While Feeding Urea Molasses Mineral Block (UMMB)

1. UMMB should be avoided for younger animals (< 6 months).
2. UMMB should not be fed to animals which have not eaten fodder throughout a day.
3. Consumption of excess quantity of UMMB should be prevented.
4. Animals should have always been provided with clean drinking water.
5. UMMB must be protected from rainwater so that it does not soften.
6. UMMB should only be fed to ruminants (buffalo, cattle, goats and sheep) and never feed to monogastric species like (chicken, donkeys, horses, pigs, rabbits).
7. UMMB should not be fed alone; a minimum quantity of roughage is needed to ensure that the animals do not consume excess urea, possibly leads to urea poisoning.
8. UMMB should not have higher moisture (Not more than 10 %).
9. UMMB should be stored at a dry place protected from insects, pest and rodents.
10. UMMB should be offered to the animal in the dry manger etc.

Adaptation of Animals

The daily ration of the block should not be offered as soon as the feeding period starts but should be built up to over a period of at least 7-10 days. This is particularly important when animals have suffered a degree of underfeeding. Animals not used to urea and also eating rapidly are the most likely to suffer from urea poisoning. After the adaptation period animals will adjust their intakes as recommended (Cattle and Buffalo, 700 g per day: Sheep and Goats 100 g per day). An easy way to restrict intake during the adaptation period is to limit the amount of time the UMMB are accessible to an animal.

Future Research and Development

Although various research trial has conducted on UMMB and it has a long history, considerable additional research is still needed in order to fully exploit the benefits of incorporating various nutrients, minerals, additives and drugs in the UMMB. Formulation of blocks based on low cost and locally available feed resources that do not compete with human food should be one of the thrust areas for future work. Some regions are deficient in specific minerals. These regions should be properly mapped and blocks tailored to meet the requirements for specific minerals.

Conclusion

Urea Molasses Mineral Blocks can be an important source of supplement nutrition for sheep and goats to increase intake and increase productivity. It may be concluded that the nutritive value of crop residues which are deficient in nutrients can be enhanced by supplementation of urea, molasses and mineral block. In some research experiments it has showed that by feeding UMMB to livestock improving the nutrient utilization, production and reproduction of animals. UMMB provides easily fermentable nitrogen, energy and minerals necessary for optimum microbial growth which in turn provides host animal crude protein. Thus, supplementation of UMMB in the ration is quite beneficial. Apart from all positive responses this supplementation improves economic status of livestock owner by giving more economic returns through increased quality milk production.

Template.1 (Composition Of Urea Molasses Mineral Block):

Molasses

Urea

Rice Bran

Wheat Bran

Calcite Powder

Lime Powder

Mineral Mixture

Salt

Template.2 (Preparation of Urea Molasses Mineral Block):

Preparation of the Ingredients

Mixing of the Ingredients

Adding of Molasses

Mixing of Molasses with Ingredients

Casting and Moulding

Urea Molasses Mineral Block

UMMB Licking by Buffaloes

UMMB Licking by Cattles

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Role of Protease Inhibitor in Plant Resistance

Article ID: 10717

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Introduction

A protease is an enzyme that catalyses (increases the rate of) proteolysis, the breakdown of proteins into smaller polypeptides or single amino acids. They do this by cleaving the peptide bonds within proteins by hydrolysis, a reaction where water breaks bonds. The proteinase inhibitors work to disrupt the enzymatic ability of the digestive or microbial enzymes that are present in the stomach of the attacker resulting in the inability to properly digest the plant material. This causes an interference of proper growth and discourages further wounding of the plant by the attacker. Studies have also recently revealed that some proteinase inhibitors also provide defence for the plant through the possession of antimicrobial properties providing for the inhibition of pathogen growth. On the other hand, many PIs have been shown to act as defensive compounds against pests by direct assay or by expression in transgenic crop plants. These genes have been used for the construction of transgenic crop plants to be incorporated in integrated pest management programmers. This was first demonstrated by Hilder et al. by transferring trypsin inhibitor gene from *Vignaunguiculatato* tobacco, which conferred resistance to wide range of insect pests including lepidopterans, such as *Heliothisand Spodoptera*, coleopterans such as *Diabrotica,* Anthonomnous and orthoptera such as Locusts.(Shrinivasan et al. 2006) .PI is considered to be particularly effective and suitable candidate for genetic engineering of plant because of its production is governed by certain genes with help of QTL mapping and Marker assisted selection we can easily incorporate these genes in breeding programme. PI is an effective against a range of field and storage pest belonging to Lepidoptera, Coleoptera and orthoptera.

Classification of Inhibitors

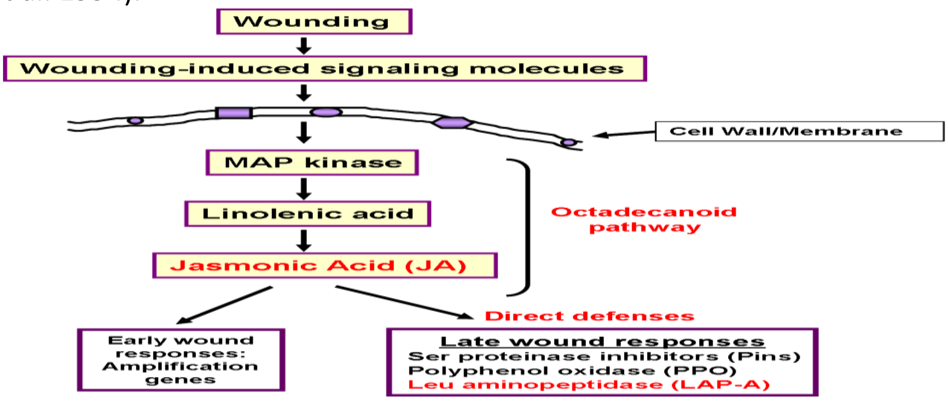
Serine proteinase inhibitors: Serine proteinases have been identified in extracts from the digestive tracts of insects from many families, particularly those of Lepidoptera and many of these enzymeare inhibited by proteinase inhibitors. The order Lepidoptera, which includes a number of crop pests, the pH optima of the guts are in the alkaline range of 9-11. (Volpicellaet al. 2011)

Cysteine Proteinase Inhibitors: The rice cysteine proteinase inhibitors are the most studied of all the cysteine PIs which is proteinaceous in nature and highly heat stable. Inhibitors of cysteine proteinases are now called cystanins as a class and consist of at least three distinct families. Most cysteine proteinase inhibitors have been found in animals.

Aspartic and Metallo-Proteinase Inhibitors: The aspartic and cysteine proteinases would not be active. The cathepsin D inhibitor (27kDa) is unusual as it inhibits trypsin and chymotrypsin as well as cathepsin D, but does not inhibit aspartyl proteases such as pepsin, rennin or cathepsin E. The inhibitors of the metallocarboxypeptidase from tissue of tomato and potato are polypeptides (4 kDa) that strongly and competitively inhibit a broad spectrum of carboxypeptidases from both animals and microorganisms (Laskowskiet. al.1998)

Mechanisms of Inhibition of Protease Inhibitors: In the irreversible trapping reaction ,the protease–inhibitor interaction induces the cleavage of an internal peptide bond in the inhibitor structure, triggering a conformational change. This reaction is not reversible, and the inhibitor never recovers its initial structure. For this reason, the inhibitors that participate in trapping reactions are also known as suicide inhibitors. The other the majority of plant serine protease inhibitors (SPIs) adopt the standard mechanism of inhibition. In tight-binding reactions, the inhibitors interact with the protease active site (P1) in a similar way to the enzyme-substrate interaction. The protease-inhibitor complex co-exists in a stable equilibrium among the intact form of the inhibitor and the modified forms of the inhibitor where the peptide bond of the reactive site is cleaved. Therefore, the inhibitor in the complex is dissociated to its intact or its modified form. Plant SPIs that apply this strategy allow plants to prepare themselves against unwanted proteolytic activity, whether to control development or to defend against pest attack. Thus, the presence of high levels of protease inhibitors on a continual basis can lead to chronic hyper secretion by the pancreas, loss of proteolytic activity in the gut, loss of appetite, starvation and eventually death. The mechanism of binding of plant protease inhibitors to the insect proteases appears to be similar with all the four classes of inhibitors. Inhibitors obeying this mechanism are highly specific and limited proteolytic substrates for their target enzymes.(Rawlings et al. 2017).

Regulation of proteinase inhibitors: Plant proteinase inhibitor proteins that are known to accumulate in response to wounding have been well characterized. Earlier research on tomato inhibitors has shown that the protease inhibitor initiation factor (PIIF) triggered by wounding or injury switches on the cascade of events leading to the synthesis of these inhibitor proteins and the newly synthesized PIs are primarily cytosolic. The studies suggest that the production of inhibitors occurs via the octadecanoid (OD) pathway, which catalyses the breakdown of linolenic acid and the formation of jasmonic acid (JA) to induce protease inhibitor gene expression. There are four systemic signals responsible for the translocation of the wound response, which includes systemin, abscisic acid (ABA), hydraulic signals (variation potentials) and electrical signals. These signal molecules are translocated form the wound site through xylem or phloem as a consequence of hydraulic dispersal.(Barreteet al. 1994).



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Weed Control in Transplanted Paddy by Chemical Herbicides

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Introduction

Weeds are a major concern for rice productivity and are a hindrance to irrigation. Major weeds in rice field are:

1. *Echinochla colonum*
2. *E. crusgalli*

Use of chemical herbicides is an efficient and economical way to weed control to increase productivity due to less labour requirement.

Scientific Classification of Rice

Kingdom	*Plantae*
Order	*Poales*
Family	*Poaceae*
Genus	*Oryza*
Species	*O. sativa*

Commonly used Herbicides in Transplanted Paddy

Dissolve required herbicide in 600 L water for 1 ha.

Herbicides	Quantity	Weeds Controlled
Pre-emergence (3-4 days after transplanting)		
1. Butachlor (50 E.C.)	3-4 L (1.5-2 kg a.i.)	Grassy weeds
2. Pendimethalin (30 E.C.)	3.33-5 L (1-1.5 kg a.i.)	Grassy, sedges & broad leaf weeds
3. Pritlachlor	1.5-2 L (0.75-1 kg a.i.)	Grassy, sedges & broad leaf weeds
Post-emergence: (20-25 days after transplanting)		
4. 2, 4-D ethyl ester (38 E.C.)	2-2.6 L (0.75-1 kg a.i.)	Broad leaf weeds

Limitations

1. Damages health & environment.
2. Herbicide resistance.
3. Experts required.
4. Chances of weedicides' flow to other fields.

Precautions

1. Avoid spraying in strong winds.
2. Don't use power sprayer.
3. Don't use empty containers for domestic uses.
4. Cover your body fully while spraying.
5. Don't intake anything while spraying.
6. Use clean water for spraying.
7. Keep your nozzle at 50 cm height from crop.

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Calibration of Seed-cum-Ferti Drill

Article ID: 10719

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Introduction

With the significant increase in adoption of zero tillage technology in several areas of Indo-Gangetic Plains, zero tillage seed-cum fertilizer drill has become a very useful and important agricultural machine for the farmers. It helps them to seed a crop directly into the cultivated field just after the harvest of previous crop with the least disturbance of soil. It reduces time and energy involved in conventional tillage operations, reducing the cultivation cost. It helps in seed sowing & fertilizer application at proper spacing simultaneously.

It overcomes the following problems of traditional method of sowing:

1. Higher seed rate.
2. Non-uniform germination.
3. Seed damage by external factors.
4. Low nutrient-use-efficiency.

Pre-Requisite Conditions

1. Levelled field.
2. Soil moisture- 50%.

Calibration of Seed-cum-Ferti Drill

1. Measure diameter (D) of drive wheel & calculate its circumference,
$= \Pi D$ (m)
2. Measure effective width of coverage (W) (m) by multiplying number of times with spacing between any two tines.
3. Area sown in one turn,
$= W \times \Pi D$ (m^2)
4. Fill seeds in seed box & fertilizers in fertilizer box.
5. Adjust meter at recommended seed rate.
6. Rotate wheel 10 times in forward direction & weigh quantity of seed dropped from opener.
7. Calculate seed rate (kg/ha) by formula,
= Weight of seeds X 10,0000/ Area sown in 10 turns
8. Repeat the same process if recommended seed rate isn’t obtained.

Advantages

1. Saves’ seed, time & labour.
2. Reduces cost of sowing.
3. Increased productivity.
4. Better establishment of plants.

Limitations

1. Skilled labour required.

2. Requires proper storage & maintenance.
3. Costly machine.

Precautions

1. Don’t use machine in excessive moisture.
2. Don’t run machine in undulating land.
3. Use granular fertilizers only.

Nursery Raising and Transplanting of Late Sown Pearl Millet

Article ID: 10720

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Introduction

Sometimes due to late onset of monsoon or water logging due to heavy rains during early monsoon, timely sowing of pearl millet is not possible. Transplanting of late sown pearl millet by nursery raising leads to higher yield as compared to line sowing in case of late onset of monsoon.

Scientific Classification of Pearl Millet

Kingdom	Plantae
Order	Poales
Family	Poaceae
Subfamily	Panicoideae
Genus	Cenchrus
Species	*C. americanus*

Pre-Requisite Condition

1. Plain irrigated uplands.
2. Water drainage.

Nursery Raising

1. Prepare 500 m^2 nursery bed of dimension 7 m x 1.25 m x 0.12-0.15 m for 1 ha.
2. Apply CAN@20-25kg.

Sowing

1. Sow seeds (2-2.5 kg) at 10 cm spacing & 1.5-2 cm depth by line-sowing in furrows & mulch the bed for 2-3 days.
2. Irrigate the bed at 4-6 days interval in case of no rainfall & ensure proper drainage in heavy rains.

Transplanting

1. Irrigate nursery bed lightly before transplanting.
2. Transplant 18-21 days old, healthy & disease-free seedlings at 50X15 cm spacing & 2-3 cm depth in evening.

Advantages

1. Less seed rate.
2. Optimum plant population/ha.
3. Healthy plants.
4. Early maturity (20-25 days early).
5. Higher yield (20-25%).

Limitations

1. More labour is required.
2. Initial cost is more.
3. Mainly for hybrid seeds.

Precautions

1. Site selection for nursery raising.
2. Avoid damaging roots while transplanting.
3. Transplant one seedling/hill.

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Nursery Raising and Transplanting of Sugarcane by Bud Chip Method

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Introduction

The traditional method of sugarcane production demands higher seed rate, transportation cost and prone to biotic stress and low germination percent. Further, there is lack of storage facilities and limitation in seed treatment. Transplanting of sugarcane by bud chip method is a modern technique of sugarcane production in which sugarcane buds are cut with bud-chipper and planted slantly in plastic tray containing soil mixture and transplanted to main field after 25 to 30 days.

Scientific Classification of Pearl Millet

Kingdom	Plantae
Order	Poales
Family	Poaceae
Subfamily	Panicoideae
Genus	Sacchrum
Species	*S. officinarum*

Pre-Requisite Condition

1. Flat and shady place.
2. Water availability.

Preparation of Bud Chips

1. Select 6-8 months old healthy & disease-free sugarcane stalk.
2. Cut out all buds of the stalk by bud chipper.

Preparation of Nursery Tray and Transplanting to Main Field

1. Mix soil + decomposed dung manure + sand in ratio of 1:1:1.
2. Fill 2/3rd of nursery tray with the prepared mixture.
3. Plant buds in the tray in the slant position.
4. Make a thin layer of soil over it & sprinkle water.
5. Sprinkle water at 2-3 days interval as required.
6. After field preparation, transplant 25-30 days old plants (2-3 leaf stage) at 75-90X30-45 cm spacing.

Advantages

1. Seed rate reduced by 80-90%.
2. Less crop duration.
3. Easy transportation.
4. Increased productivity (20-22%).
5. Higher germination%.
6. Gap filling possible.

7. Re-use of left sugarcane stalks.

Limitations

1. More labour requirement.
2. Initial slow growth rate.

Precautions

1. Plant bud chip in the slant position.
2. Avoid water stagnation in nursery tray.

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Sowing of Maize by BBF (Broad Bed and Furrow) Method

Article ID: 10722

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Introduction

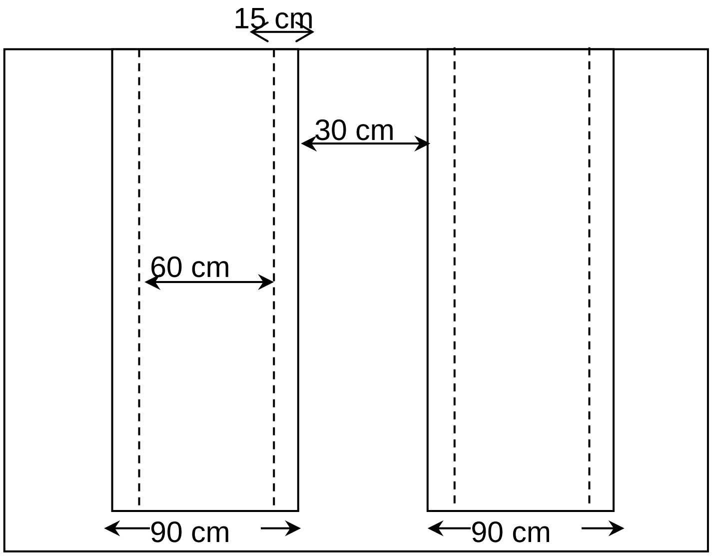
This method is recommended by ICRISAT, Hyderabad in crops like soybean, maize, groundnut, jowar and gram. It overcomes the following problems of conventional method:

1. Waterlogging due to heavy rains.
2. Drought.
3. Soil erosion.

Scientific Classification of Pearl Millet

Kingdom	Plantae
Order	Poales
Family	Poaceae
Subfamily	Panicoideae
Genus	Zea
Species	*Z. mays*

Dimensions of Bed for Maize through BBF Method



Sowing

1. Seed rate: 20 kg/ha (hybrid variety).
2. Spacing: 60 x 20 cm.

Advantages

1. 15-20% increase in production.
2. Less water requirement (half).
3. Moisture conservation.

4. Prevents soil erosion.
5. Avoids waterlogging.
6. Increase soil aeration.
7. Better quality of produce.
8. Increase in soil quality.
9. Easy weed control.

Limitations

1. Suitable for a few crops
2. Not for sloppy areas
3. Not for uneven land

Precautions

Don’t make bed after heavy rains.

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Sowing of Wheat + Mustard in 9 : 1 Row Ratio

Article ID: 10723

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Introduction

Growing two or more crops in the same field simultaneously in definite row pattern is known as intercropping. It overcomes the following constraints of monocropping:

1. Low yield.
2. Deterioration in soil health.
3. Seed damage by external factors.
4. Less germination%.

Scientific Classification of Wheat

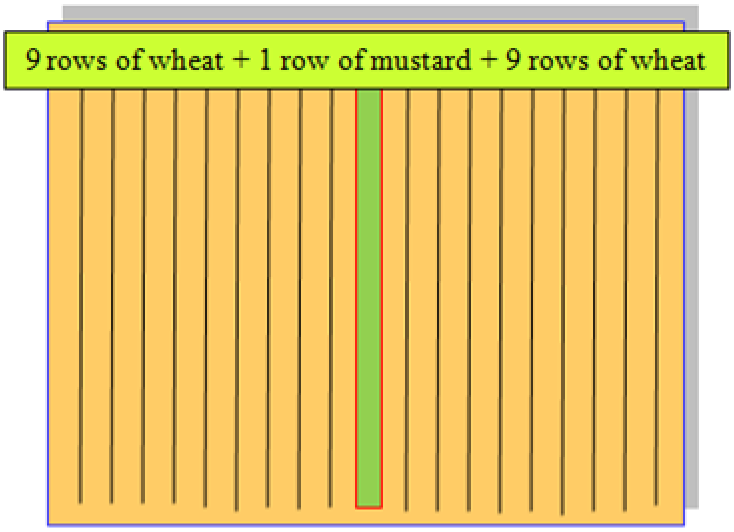
Kingdom	Plantae
Order	Poales
Family	Poaceae
Subfamily	Panicoideae
Genus	*Triticum*

Scientific Classification of Mustard

Kingdom	Plantae
Order	Brassicales
Family	Brassicaceae
Genus	*Brassica L.*

Seed Rate and Sowing

1. Wheat: 90 kg/ha & Mustard: 0.6 kg/ha
2. Sow wheat + mustard in 9:1 row ratio at 20 cm row spacing.



Advantages

1. Less seed rate.
2. Increase in land equivalent ratio (LER).
3. Higher yield.
4. Sustainable production.
5. Additional income from mustard.
6. Weed control by allelopathic effect of mustard.
7. Reduction in rust disease infestation.
8. Phalaris minor controlled.

Limitations

Herbicides' (metsulfuron, sulfosulfuron) compatibility with mustard.

Precautions

Maintain proper spacing between rows.

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Space Transplanting (STP) of Sugarcane

Article ID: 10724

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Introduction

It is a technique of sugarcane production in which in place of 3 budded setts, 35,000 one budded sets are grown in 50m^2 nursery and transplanted to main field at a spacing of 90 x 30 cm. It overcomes the following constraints of traditional method:

1. Higher seed rate.
2. Uneasy and expensive transport.
3. Problem of seed treatment.
4. Less germination %.

Scientific Classification of Sugarcane

Kingdom	Plantae
Order	Poales
Family	Poaceae
Subfamily	Panicoideae
Genus	*Sacchrum*
Species	*S. officinarum*

Site Selection

1. Irrigated area.
2. Elevated land.
3. Water drainage.
4. Near main field.

Preparation of Nursery

1. Make two nursery beds of 13 m x 2 m.
2. Mix dung manure to make soil porous.
3. Plant one budded set-in vertical position.
4. Mulch and sprinkle water over it.
5. Sprinkle water at an interval of 2 – 3 days.

Transplanting to Main Field

After field preparation, irrigate nursery and dig out plants of 3 – 4 leaf stage (25-30 days) and transplant at spacing 75 x 45 cm an irrigate the field.

Advantages

1. Uniform crop.
2. Higher production (40-50%).
3. 70% less seed rate.
4. Bulky yield.
5. Prevention of insects and diseases infest.

6. Good for late planting.
7. Higher yield in ratoon crop.
8. Seed rate : Production = 1 : 30 (traditional 1 : 8).

Limitations

1. Labour intensive.
2. Requires experts.

Precautions

Maintain proper spacing of 75 x 45 cm.

Sugarcane Planting by Ring-Pit Method

Article ID: 10725

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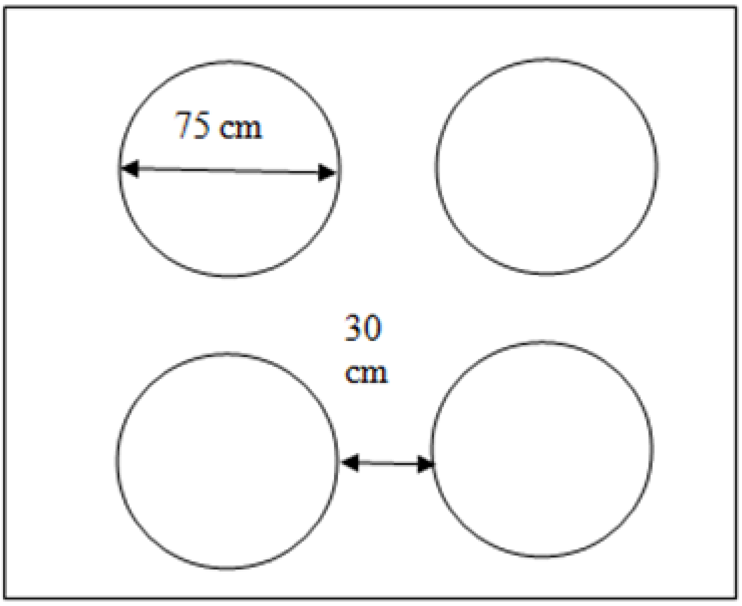
Introduction

It is a technique of sugarcane production in which in place of 3 budded setts, 35,000 one budded sets are grown in 50m^2 nursery and transplanted to main field at a spacing of 90 x 30 cm. It overcomes the following constraints of traditional method:

1. Higher seed rate.
2. Uneasy and expensive transport.
3. Problem of seed treatment.
4. Less germination %.



Scientific Classification of Sugarcane

Kingdom	Plantae
Order	Poales
Family	Poaceae
Subfamily	Panicoideae
Genus	*Sacchrum*
Species	*S. officinarum*

Sowing

1. Cut out 2-budded setts.
2. Leave 65 cm border in field.
3. Dig out 30 cm deep pits.
4. 9000 pits/ha.

5. Plant 20 setts/pit.
6. Cover by 3-4 cm soil.

Advantages

1. 1.5-2 times more production.
2. 30-40% less water requirement.
3. 30-40% more nutrient use efficiency and 30-35% more water use efficiency.
4. Less lodging.
5. 3-4 ratoons possible.

Limitations

1. Costly pit digger & unavailability.
2. More labour requirement.
3. More seed rate (180 q/ha).

Precautions

After planting, fill the pit only up to 3-4 cm height.

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e-Readiness of Rural Market

Article ID: 10726

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Abstract

Digital technologies are fast entering into the agriculture landscape. The next revolution in agriculture is seen as the 'Digital Revolution'. Given the potential disruptive impact of digital agriculture, it is imperative to understand, how ready are the rural markets for such transformation. This study aims at identifying the critical indicators that can make the rural markets ready for digital transformation.

Introduction

The Fourth Industrial Revolution (Industry 4.0) is driving disruptive digital technologies and innovations. Food and agriculture sectors are also at the core of this process. In the recent past, information to or from smallholder farmers, on their basic needs and problems such as access to inputs, markets, prices, microfinance, or learning were not accessible. The spread of mobile technologies (smartphones), and lately the remote sensing services and distributed computing, are opening new opportunities to integrate smallholder farmers in new digitally driven agri food systems (Trendov et.al, 2019, USAID, 2018).

Agriculture has undergone a series of revolutions that has driven efficiency, yield and profitability. The first agricultural revolution enabled humanity to settle, leading to formation of the world's first societies and civilization (Trendov et.al, 2019). During 1960s, the development of new, more resistant crop varieties and the use of agrochemicals ("The Green Revolution" of the 1960s), complemented (from 1990 to 2005) by the rise of genetic modification technologies (Trendov et.al, 2019). The latest revolution, 'Digital Farming'; 'Smart Farming' or 'Agriculture 4.0' has the potential to transform agricultural systems to be more sustainable.

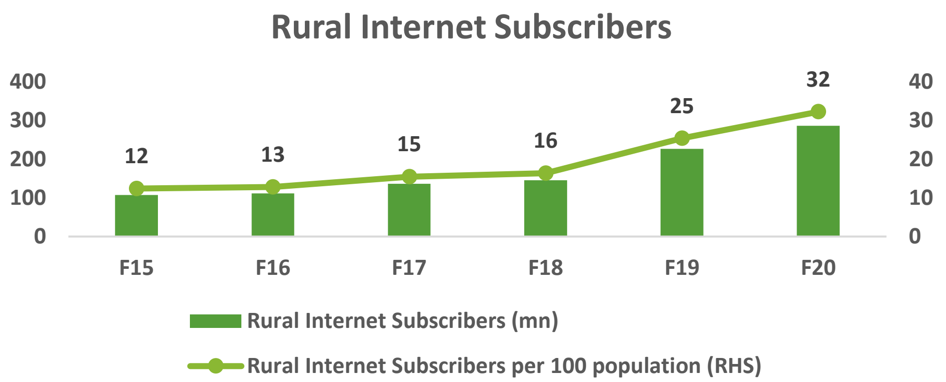
Digital farming technologies cover a broad spectrum, from small mobile apps for decision support, over in-field sensors and remote sensing technologies for data collection, and to drones and robots for the automation of processes (OECD (2019). A sustainable agriculture in the future will need digital farming technologies (Walter et al., 2017), which use Artificial Intelligence (AI), cloud computing, Internet of Things (IoT), and blockchain among others (Torky and Hassanein, 2020). The rise of these technologies and the potential disruptive impact of digital agriculture make it particularly important to understand how ready the rural markets are for adoption of digital farming technologies.

There are several challenges that must be addressed before we proceed in the path of complete digitalization. Access to digital technology is not only important for smallholder farmers and rural businesses offering digitally enabled products and services, but also essential to support all aspects of businesses: linking with suppliers and information, building strategic partnerships; accessing intermediary support services such as training, financing and legal services; and, above all, accessing markets and customers. This paper aims at identifying the readiness of rural markets for digital transformation. A rural e-readiness index is computed at the state level to identify states that are ready for digital transformation.

The following section talks about the trends of internet penetration and digital use in agriculture. The subsequent sections rank the states based on digital readiness in rural market. Section 4 concludes the paper.

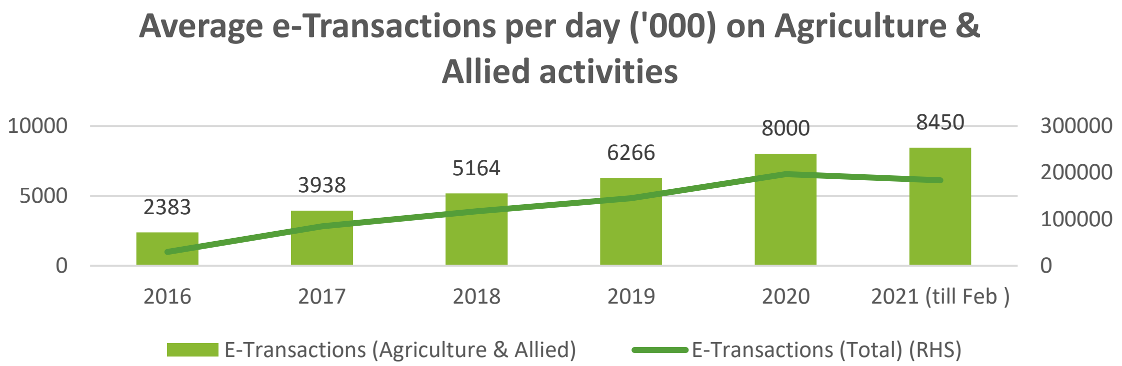
Digital Trend in Rural India

The trends of rural internet penetration suggest that rural population has embraced internet in a big way, resulting in a 2.5X growth in penetration. In last 5 years, the number of rural internet subscribers registered an annual growth of 22%, with penetration level increasing from 12% in F15 to 32% in F30. Based on the number of monthly active internet users, the number of internet subscribers is expected to reach 350 mn in F21, i.e., 40% of the rural population will have access to internet. Local language and video are cited as the reasons for the internet boom in rural markets.



Source: TRAI-Annual Report

The average e-transactions per day on agriculture and allied through government websites increased by almost 28% annually. However, per day e-transactions from all government websites registered a growth of about 40% during the same period.



Source: eTAAL

The most prominent agriculture website that has shown significant increase in e-Transactions is registration of farmers for mKisan portal to receive mobile messages on agri advisory services. Thus, while internet penetration is increasing in rural, mobile messaging is the most effective tool to have a wider reach in rural. mKisan SMS portal enables all state and central government organisations in agriculture and allied sectors to give information/service advisories to farmers by SMS in their language, preference of agricultural practices and location. The SMS portal was inaugurated on July,2013 and since its inception nearly 327 crore messages or more than 1044 crore SMSs have been sent to farmers (mKisan portal).

Rural e-Readiness Index

Evidently, e-readiness of the farmers depends on the digital infrastructure and how convenient is the medium of communication to the farmers. In this regard, Rural e-readiness is computed across all states in India. E-readiness is a measure of the degree to which the infrastructural base of networked tools and the ability of the people to use Information, Communication and Technology (ICT) to their benefits. In other words, e-Readiness index is a quantifiable set of indicators that provides an overview of the status of ICT in the economy which can form a basis for comparison and future planning. Infrastructure and technology, people and human skills, accessibility and connectivity are the key factors that defines readiness to the digital world.

The rural e-Readiness index is defined based on the following three broad heads:

1. Rural e-Infrastructure.
2. Rural e-Participation.

3. Rural e-Governance.

Rural e-infrastructure comprises of tools, facilities and resources that is required for e-Readiness. This category measures the extent to which individuals and business organizations can access mobile networks and internet. It is the optimal representation of the extent to which voice and data services are accessible to the people.

The following set of indicators were assessed to identify the most relevant indicators that can reflect the current rural e-infrastructure of the state:

a. No. of internet service providers.
b. Mobile subscribers with internet access.
c. Schools with computer facility.
d. Post offices equipped with internet and e-mail facility.

Rural e-Participation

Promoting participation of the citizen is the cornerstone of socially inclusive governance. The goal of e-participation initiatives is to improve the citizen's access to information and public services and promote participation in public decision making which impacts the well-being of the society in general and the individuals in particular. To identify the states that have higher participation in a rural ICT environment, the following indicators are reviewed.

1. Ault population with at least primary level of education.
2. E-Transactions on agriculture websites.
3. E-Transactions on social benefits, like, MGNREGA payment, social security pensions.

Rural e-Governance

Over the years, a large number of initiatives have been undertaken by various State Governments and Central Ministries to usher in an era of e-Government. Sustained efforts have been made at multiple levels to improve the delivery of public services and simplify the process of assessing them. The National e-Governance Plan takes a holistic view of e-Governance initiatives across the country, integrating them into a collective vision.

The major core infrastructure components are State Data Centres (SDCs), State Wide Area Networks (SWAN), Common Service Centres (CSCs) and middleware gateways, i.e., National e-Governance Service Delivery Gateway (NSDG), State e-Governance Service Delivery Gateway (SSDG) and Mobile e-Governance Service Delivery Gateway (MSDG).

To identify the states that have taken significant steps for digital transformation, the following indicators are reviewed.

1. No. of Common Service Centres
2. No. of e-Services rolled out in rural.

Given the range of dimensions and large number of variables used in indexation, Principal Component Analysis was found to be the most suitable method for developing Rural e-Readiness Index. Gujarat, Maharashtra, Tamil Nadu, Karnataka, Haryana and Punjab emerge as the top leaders in terms of rural e-Readiness. The key driving factor being the digital Infrastructure, in terms of schools, post offices with internet facility and necessary number of internet service providers.

However, amongst the top states, Karnataka registered low e-transactions in the government agriculture websites as compared to other states. Andhra Pradesh, Uttarakhand and Chhattisgarh are amongst the top in e-Participation. Education level in these states is high and participation in government websites has also been significant. However, the reach of internet facility in schools/ post offices is still way below the threshold.

The North Eastern States, Uttar Pradesh, Madhya Pradesh, Jharkhand and Bihar appear at the bottom and are least ready for digital transformation. The key factors attributing to the low rural e-Readiness are poor rural e-Infrastructure, and inadequate rural e-services rolled out in these states.

Table 1: State wise e-Readiness of Rural Market:

	e-Infrastructure	e-Participation	e-Governance	e-Readiness Index
Gujarat	0.70	0.44	0.72	0.62
Maharashtra	0.68	0.41	0.66	0.58
Tamil Nadu	0.59	0.57	0.46	0.54
Karnataka	0.65	0.30	0.50	0.48
Haryana	0.46	0.65	0.58	0.56
Punjab	0.48	0.47	0.53	0.49
Uttarakhand	0.29	0.52	0.48	0.43
Andhra Pradesh	0.25	0.59	0.35	0.40
West Bengal	0.23	0.30	0.42	0.32
Odisha	0.26	0.35	0.46	0.36
Telangana	0.27	0.37	0.37	0.34
Chhattisgarh	0.11	0.49	0.41	0.34
Rajasthan	0.31	0.23	0.43	0.33
North East	0.17	0.35	0.24	0.26
Uttar Pradesh	0.09	0.27	0.35	0.24
Madhya Pradesh	0.05	0.16	0.48	0.23
Jharkhand	0.03	0.09	0.33	0.15
Bihar	0.02	0.06	0.16	0.08

Conclusion

In the last 4-5 years, numbers of internet subscribers in rural India have more than doubled. Internet penetration rate has increased from 12% in F15 to 32% in F20. The usage of agriculture government websites has also seen a significant increase. The most prominent use has been that of mKisan portal. However, the usage of internet and e-services rolled out by the state governments are not identical across states. To identify states that are digitally ready in rural markets, an e-Readiness index is computed. The e-readiness index is defined based on three broad components – e-Infrastructure, e-Participation and e-Governance.

The key component of being e-Ready is to have a well-developed digital infrastructure which can further lead to increase in e-Participation. Role of the government in terms of facilitating the adoption of digital technologies, like, simplified content, medium of communications and language will be critical in the path to digital transformation. Gujarat, Maharashtra, Tamil Nadu, Karnataka, Haryana and Punjab emerge as the top leaders in terms of rural e-Readiness. It is also seen that the rural e-Readiness index is positively correlated with rural economic development of the states. Clearly e-initiatives by government or private players alone cannot make a society e-ready. Affordability of the common mass towards ICT facilities does play a crucial role.

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One District One Focus Produces of Agriculture in Uttar Pradesh

Article ID: 10727

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Introduction

Every geographical region has its own tag and willingness. Geographical Indication is an emerging movement in intellectual property rights. Geographical Indication is a symbol that is used on products that have an unambiguous origin and keep a good quality reputation due to that Geographical location. It is used to recognize particular goods having a special quality, reputation, or features originating from a geographical territory. Geographical Indication (GI) was first used in international intellectual property laws under TRIPS (trade-related aspects of intellectual property rights) of WTO (world trade organization), which came into strength in 1995. India engages in GI Act as a member of WTO and enacted the Geographical Indication of goods (Registration and Protection) Act, 1999 which came into strength on 15th September 2003. This act spreads to the whole India. GI tag associated with any agricultural, natural, or manufactured goods or any goods of handicraft or of industry and includes foodstuff. Article 22(1) of WTO trade-related intellectual property rights agreement outline geographical indication as “indications which identify a good as originating in the territory of a Member of WTO, or a region or area in that territory, where a given quality, reputation or other characteristics of the good is essentially attributable to its geographical origin” Profits of GI tag are that it confers the legal protection, enhancement export and encourages the quality of products. It averts from the unauthorized use of GI tagged products by others.

List of District Wise Product of Geographical Indication

Uttar Pradesh					
Sl. No	Districts	Product	S.No	Districts	Product
1	Agra	Petha (Ash gourd)	39	Jaunpur	Milk Products
2	Aligarh	Milk Product	40	Jhansi	Basil
3	Ambedkar Nagar	Chilli	41	Kannauj	Potato
4	Amethi	Aonla	42	Kanpur Dehat	Milk Products
5	Amroha	Mango	43	Kanpur Nagar	Bakery Products
6	Auraiya	Milk Product (Ghee)	44	Kasganj	Milk products (Ghee)
7	Ayodhya	Sugarcane	45	Kaushambi	Guava
8	Azamgarh	Basil	46	Kushinagar	Banana
9	Bagpat	Sugarcane	47	Lakhimpur Khiri	Banana
10	Bahraich	Banana	48	Lalitpur	Turmeric
11	Ballia	Lentil	49	Lucknow	Mango
12	Balrampur	Maize	50	Maharajganj	Rice (Kala Namak
13	Banda	Oilseeds	51	Mahoba	Oilseeds
14	Barabanki	Mint	52	Mainpuri	Garlic

15	Bareilly	Milk Product	53	Mathura	Milk Products
16	Basti	Rice (Kala Namak Vr.)	54	Mau	Mango
17	Bhadohi	Onion	55	Meerut	Sugarcane
18	Bijnor	Sugarcane	56	Mirzapur	Tomato
19	Budaun	Guava	57	Moradabad	Honey
20	Buland Shahar	Milk Based Products	58	Muzaffarnagar	Sugarcane
21	Chandauli	Tomato	59	Pilibhit	Sugarcane
22	Chitrakoot	Oilseeds	60	Pratapgarh	Aonla
23	Deoria	Chilli	61	Prayagraj	Guava
24	Etah	Chicory	62	Rae Bareli	Aonla
25	Etawah	Mustard	63	Rampur	Mint
26	Farrukhabad	Potato	64	Saharanpur	Honey
27	Fatehpur	Aonla	65	Sambhal	Mint
28	Firozabad	Potato	66	Sant Kabir Ngr	Rice (Kala Namak
29	G.Buddha Ngr.	Bakery Products	67	Shahjahapur	Sugarcane
30	Ghaziabad	Bakery Products	68	Shamli	Sugarcane
31	Ghazipur	Onion	69	Shravasti	Banana
32	Gonda	Banana	70	Siddarth Nagar	Kala Namak Rice
33	Gorakhpur	Rice (Kala Namak Vr.)	71	Sitapur	Mango
34	Hamirpur	Fisheries	72	Sonbhadra	Tomato
35	Hapur	Petha (Ash gourd)	73	Sultanpur	Mint
36	Hardoi	Groundnut	74	Unnao	Mango
37	Hatharas	Asafoetida	75	Varanasi	Chilli
38	Jalaun	Pea			

Conclusion

India is one of the fastest mounting countries in the world. India made their role in growing forthcoming intellectual property that is Geographical Indication. Total number of Geographical Indications is growing year by year. The concept of GI made the manufacturers, farmers, craftsmen, etc. very responsive. It leads to surges the profits of these persons and assistance to identify the particular goods or services.

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Role of Nanotechnology in Plant Pathology

Article ID: 10728

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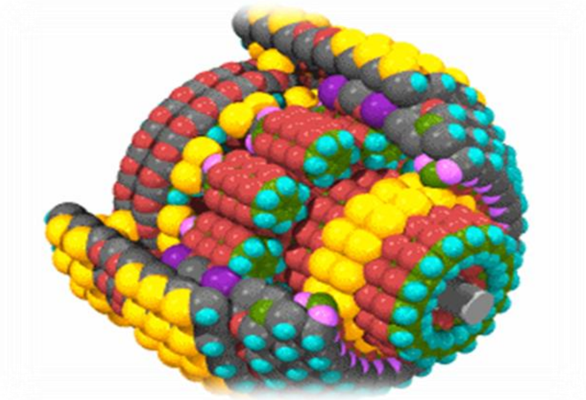
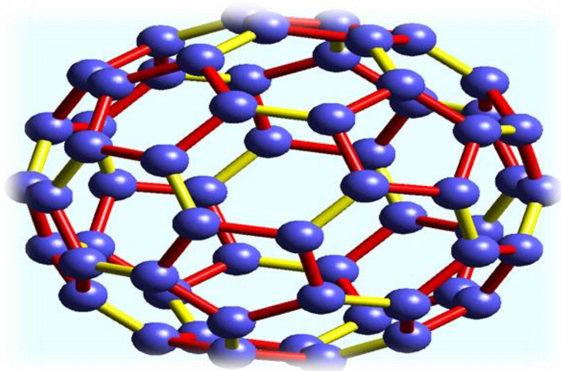
What is Nanotechnology?

It is art and science of manipulating matter at the nanoscale. making small microscopic things advance to the future. manipulating matter on an atomic scale. The term 'nanotechnology' is based on the prefix 'nano'- Greek word meaning 'dwarf.' Word 'nano' means 10^{-9} or one billionth part of a metre. Size range between 1 and 100 nm.

Properties of Nanoparticles

1. Nanoparticles shows unusual physical, chemical and biological properties, which are completely lacked in their bulk molecule.
2. Nanoparticles have a high surface to volume ratio that increase their reactivity and biochemical activity.
3. Nanoparticles possess strong affinity to target such as proteins.

Detection and Other Uses of Nano-Technology in Plant Pathology

1. Nanosized metals as diagnostic probes:

a. Fluorescent silica nanoprobes - rapid diagnosis of plant diseases.

b. Fluorescent silica nanoprobes conjugated with the secondary antibody of goat anti- rabbit IgG (Yao et al., 2009)

c. For detection of a bacterial plant pathogen *Xanthomonas axonopodis* pv. *vesicatoria* (bacterial spot on solanaceous plants).

2. Nanoscale biosensor / nanosensors:

a. Detection of infection in non-symptomatic plant followed by targeted delivery of treatment would be an essential component for precision farming.

b. Use of micromechanical cantilever arrays for detection of fungal spore (*Aspergillus niger* and *Saccharomyces cerevisiae*) was demonstrated by Nugaeva et al. (2005).

3. Quantum dots:

a. Few nm in diameter, roughly spherical (some rod like structures), fluorescent.

b. Important tool for detection of a specific biological marker in medical field with extreme accuracy.

c. They have been used in cell labelling, cell tracking and DNA detection (Sharon et al., 2010).

4. Carbon nano material as a sensor: Carbon nanomaterials have been developed to act as electrode for electrochemical analysis (Sharon and Sharon, 2008). They have the potential to be developed as electrochemical sensor to detect pesticide residue in plants.

Nanomaterials for Management of Plant Diseases

1. Chitosan:

a. Chitosan is a collective name for a group of partially and fully deacetylated chitin compounds (Tikhonov et al., 2006).

b. Chitosan have antimicrobial property, it is obtained from marine animal such as shrimp, crab, prawn etc. from their shell.

c. It is linar polysaccharide. It is used in agriculture for seed treatment, biopesticide, foliar spray. Commercially chitosan is produced by deacetilayation of chitin.

d. Biodegradable and nontoxic properties toward mammalian cells.

e. Antimicrobial activity - bacteria, filamentous fungi and yeasts.

2. Silver Nanoparticles:

a. The powerful antimicrobial effect of silver especially in unicellular microorganisms is believed to be brought about by enzyme inactivation.

b. Silver is also an excellent plant growth stimulator.

c. Antifungal effect of nano silver colloids (average diameter of 1.5 nm) was studied against the root rot pathogen of pumkin caused by *Monosporasus cannonballus*.

d. Silver is now an accepted agrochemical replacement' and maximum no. of patents are filed for 'nano silver' for preservation and treatment of diseases in agriculture field (Sharon et al. , 2010).

3. Silica nanoparticles:

a. Silica is well known to enhance stress resistance to plants including plant diseases.

b. Thus a new composition of nano silica-silver was developed to combat plant diseases.

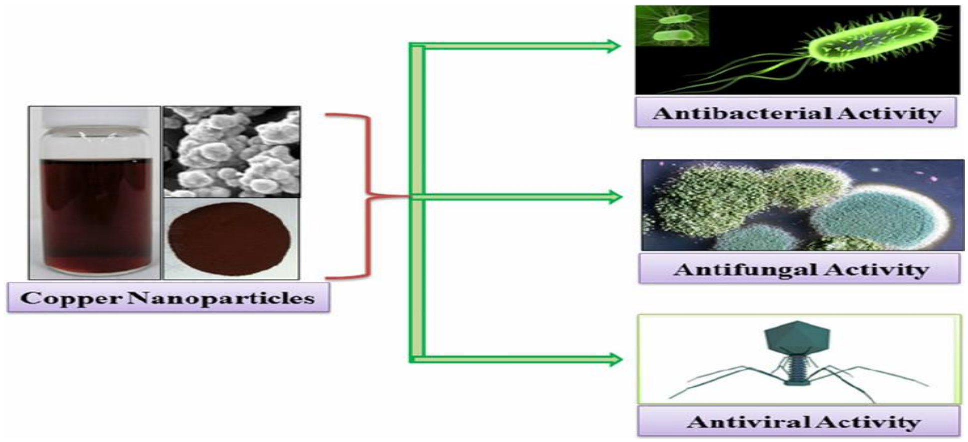
c. Nanosized silica-silver (Si-Ag) particles were produced and tested by Park et al. (2006)

d. In vitro test showed higher effectiveness of silica-silver nanoparticles towards fungi at the dose of 10 ppm causing 100% inhibition of vegetative growth.

e. Most of the bacteria tested were inhibited completely with only 100 ppm of silica-silver nanoparticles.

f. When nanosized silica-silver particles were applied in field condition to control powdery mildew diseases of cucurbits, 100% control was achieved after 3 weeks (Park et al., 2006).

4. Copper nanoparticles:



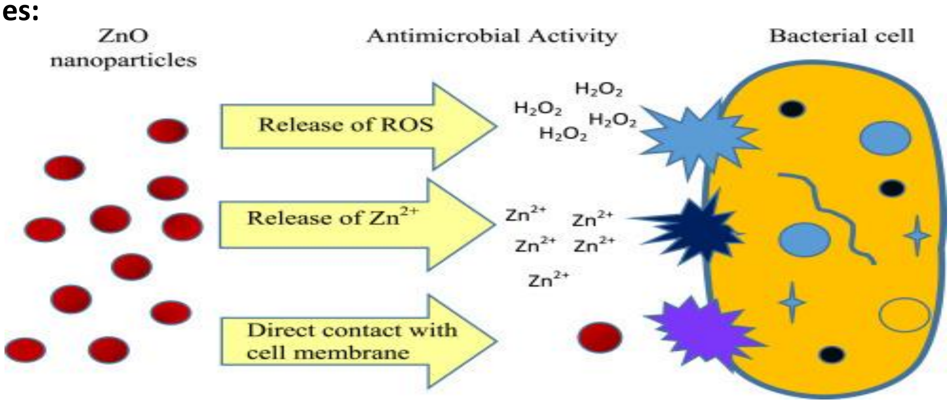
a. Copper-based fungicides produce highly reactive hydroxyl radicals which can damage lipids, proteins, DNA, and other biomolecules.

b. It plays an important role in disease prevention and treatment of large variety of plants.

c. Because of its bio-compatibility, these nanohydrogels are included as a new generation of copper-based bio-pesticides.

d. Nano-copper was reported to be highly effective in controlling bacterial diseases viz. bacterial blight of rice (*Xanthomonas oryzae* pv. oryzae) and leaf spot of mung (*X. campestris* pv . phaseoli).

5. Zinc nanoparticles:



a. Mechanism of action of zinc nitrate derived nano-ZnO on important fungal pathogen *Aspergillus fumigatus* showed hydroxyl and superoxide radicals mediated fungal cell wall deformity and death due to high energy transfer. (Prasun Patra and Goswami,2012).
b. ZnO nanoparticles can cause deformation of fungal hyphae and prevent the conidiophores and conidial development which ultimately leads to the death of fungal hyphae.

6. Iron nanoparticles:

a. Movement and behaviour of nanoparticles and their curative effect is being studied more extensively involving humans.
b. Similar study to deliver the nanoparticles in the targeted site of a diseased plant has been done by Corredor et al., (2009).
c. They applied iron nanoparticles coated with carbon to pumpkin plants for treating specific plant part that is infected.

7. Gold nanoparticles:

a. Gold nanoparticles are widely used in rapid immune diagnosis, and show high application value in DNA identification and detection.
b. Gold nanoparticles (2.5 nm) melt at much lower temperature (300 ^{0}C) than a gold slab.
c. The gold nanoparticles show toxic effect on bacteria *Salmonella typhimurium* in which the macro gold did not exhibits.(Wang et. al. 2011).

Nano-Formulation

1. Banner MAXX Fungicide (active ingredient propiconazole), Apron MAXX (active ingredient fludioxonil) for seed treatments.

2. Similarly, cyclopropyl derivative of cyclohexenone (Primo MAXX) - plant growth regulator but it helps the plant in with standing abiotic as well as biotic stresses including plant pathogens (Gogoi et al., 2009).

3. Nano-5' is a marketed product and is projected as natural mucilage organic solution to control several plant pathogens and pests besides improving crop yield.

4. A product of nanotechnology research in agriculture with the name of 'Nano-Gro' has been launched (Agro Nanotechnology Corp., Florida).

5. Plants treated with 'Nano-Gro' average yield increase of 20% with maximum of 50% in case of grain yield of sunflower; increase in protein and sugar content by about 10% and plants can fight various diseases.

6. 'Nano Green' eliminate blast disease (*Magnaporthe grisea*) from infected rice plant. The test was conducted in University of Georgia and the product was found to outperform any other pesticide or fungicides currently in use in agriculture (Gogoi et al., 2009).

Conclusion

1. By using Nanotechnology on hard core basis, we can arrest the loses caused due to plant diseases.
2. More bionanotechnological studies on physiology of host and pathogen, infection process, disease diagnosis will help in formulating novel disease management strategies.
3. Nanotechnology has potential prospects of use and application in the detection, diagnosis and management of plant diseases.
4. The researches have shown that direct application of nanoparticles significantly suppressed the plant pathogenic fungi and bacteria test.
5. Nanoformulations are viewed to be safer and environment friendly option for plant disease management, but high toxicity of nanoparticles inadvertently released in the environment may pose greater threat to man and other organisms.
6. Use of nanoparticles in disease management is a novel and fancy approach that may prove very effective in future with progress of application aspects of nanotechnology.

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Wheat Rust and their Management

Article ID: 10729

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Rusts are among the earliest known disease of crop plant. Three different types of rusts are commonly infecting wheat.
1. Stem or black rust.
2. Leaf or brown rust.
3. Stripe or yellow rust.

Stem or Black Rust

Pathogen: Puccinia graminis *tritici*

Etilogy: Uredospores are brown and oval. Each cell of teleutospore has one pore. Size is about 25 – 30 x 15 – 20 µm. Microscopically, these red spores are covered with fine spines.

Pre-disposing (environmental) factors:

a. Warm – humid weather conditions with intermittent rains.
b. Hot days 25 -30ºC and mild nights (15 -20ºC).
c. Leaf wetness from rain or dew.

Symptoms:

a. The first symptoms is flecking of leaves, leaf sheath, culms and floral structures.

b. These flecks are the uredosori, which soon developed as oblong, reddish – brown pustules, frequently merging into one another, finally bursts to release brown uredospores and covers an entire leaf blade forming brownish appearance.

c. Later in the season, teleutosori are produced, often merging with one another to cause linear patches of black lesions which account for the name black rust.

d. On maturity teleutosori burst open, exposing mass of black spores.

e. In severe infection diseased part remains stunted produce small spikes and shrivelled grains or no grains at all.

Survival and Spread:

a. Primary spread: Urediniospores and aeciospores are wind borne.

b. Secondary spread: Rain is necessary for effective deposition of uredinospore involved in regional spore transport. Teliospores remain with the straw.

Management:

a. Adjusting sowing date, to escape the crop from disease.

b. Application of balanced fertilizers.

c. Spraying of zineb – zinc sulphate combination 4 – 5 times @ 1 kg/450 lit. of water/acre during crop season controls the black and brown rust.

d. Seed dressing with plantvax protects seedling for about 7 weeks from rust.

e. Two sprays of carboxin 1 % at later stage of plant growth give good control.

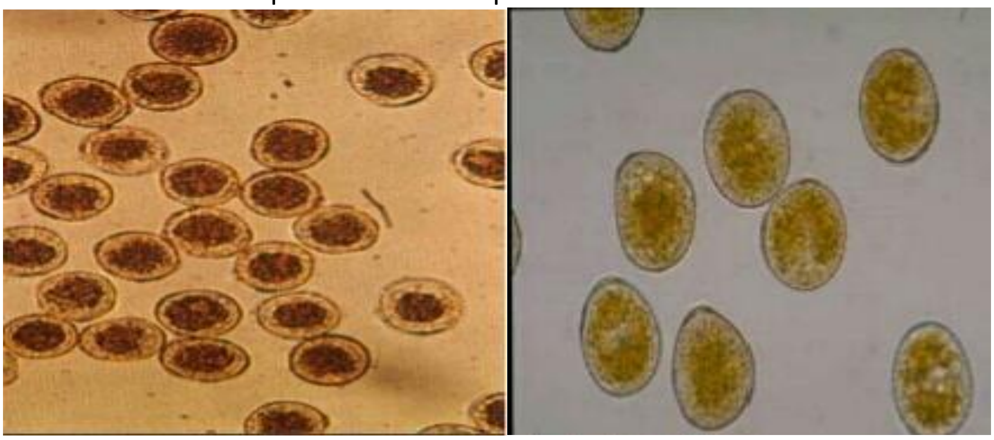
f. N. P. 700 and N. P. 800 are resistant to all three rusts.

g. Lerma Rojo, safed lerma and Sonalika are blight resistant varieties to all the three rusts.

Leaf or Brown Rust

Pathogen: *Puccinia recondita*

Etilogy: Uredospores are brown and spherical. 16 – 28 µm in dimeter.



Pre-disposing factors:

a. Warm humid weather conditions with intermittent rains.

b. Hot days 25 – 30º C and mild nights (15 – 20ºC)

c. Leaf wetness from rain or dew.

Symptoms:

a. Small, circular and orange – brown (rusty red) pustule around main pustule.

b. Black pustules from as the plant approaches maturity (Telia).

c. Pustules scattered over leaves.

d. It appears on leaf sheath, penduncles, internodes and ear heads.

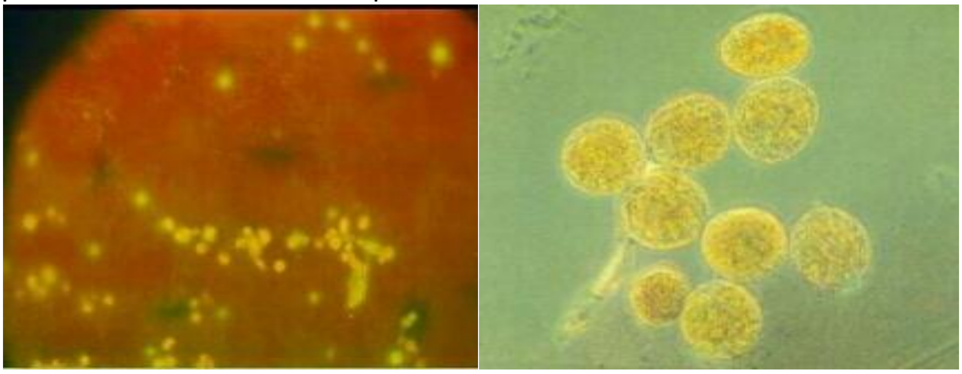
Survival and Spread: Pathogen over – summers in low and mid altitudes of Himalayas and Nilgiris. Primary infections develop from wind deposited urediospores in eastern Indo – gangetic plains in middle of January, where it multiplies and moves westwards by March.

Management:

a. Plant resistant varieties – Vijaya, Rohini BL – 1473, Gautam.
b. Planting on optimum time (Oct 15).
c. Apply only recommended number of fertilizers.
d. Apply fungicides when severe mancozeb 75 % WP (Dithane M 45) 1.5 – 2.0 kg/ha in 750 ltr. Water in 15 days interval.

Stripe or Yellow Rust

Pathogen: *Puccinia striinformis* f. sp. *Tritici*
Etilogy: Uredospores are spherical to ovate in shape, orange coloured. Teleutospores are dark brown and flattened at the top when in contact with the epidermis.



Pre-disposing factors:

a. Cool – humid weather conditions with intermittent rains.
b. Cooler climates (10 – 16º C)
c. Leaf wetness from rain or dew.
d. Heavy dew or intermittent rains can accelerate the spread of the disease.

Symptoms:

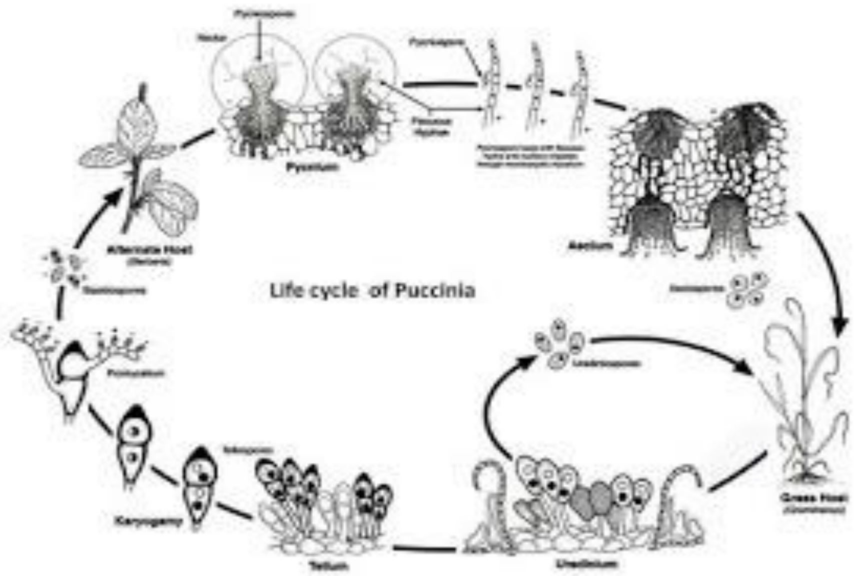
a. In the upper surface of the leaf, yellow-coloured pustules arise in the linear fashion.
b. Appearance of yellow streaks.
c. Small, bright yellow, elongated pustules on the leaves, leaf sheaths, glumes and awns.
d. Mature pustules will break open and release yellow – orange masses of urediniospores.
e. In some varieties, long, narrow yellow stripes will develop on leaves.
f. Tissues may become brown and dry as the plant matures.
g. Severe infection can result in plant stunting.


Survival and Spread: The inoculum survives in the form of uredospores/Teliospores in the northern hills during off season on self-sown crop or volunteer hosts, which provide an excellent source of inoculums and primary spread occur through uredospores from hills.

Management:

a. Plant resistant varieties – WK 1204, Pasanglyamu.
b. Sowing and planting wheat at optimum time (Oct 15).
c. Apply only recommended number of fertilizers.
d. Apply fungicides when severe mancozeb 75 % WP (Dithane M 45) 1. 5 – 2.0 kg/ha in 750 ltr. Water in 15 days interval.

General Life Cycle of *Puccinia*



Comparison Between Different Rust

	Leaf rust	Stem rust	Stripe rust
Pustule location	Leaf, mainly on the upper surface	Stem and leaf, upper and lower surfaces of leaf, occasionally on head and seeds	Leaf upper surface occasionally on heads and seeds
Pustule colour	Orange-Brown	Orange-red to dark-red	Orange-yellow
Pustule arrangement	Single and random	Single and random	Stripes

Pustule shape and size	Round or slightly elongated, small to medium	Oval shaped or elongated too large	Small round, blister-like

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Major Diseases of Rice Symptoms and their Management

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Introduction

Rice (Oryza sativa) is the most important cereal crop in the developing world and is the staple food of over half the world's population. There is various disease reported on rice in India, the most destructive are rice blast, brown spot of rice, sheath blight of rice and bacterial blight of rice. Due to disease yield losses of about 10-30% annually.

Rice Blast

Causal organism: *Pyricularia oryzae* (Sexual stage- *Magnaporthe grisea*)

Symptoms: This is the most severe disease of rice also called rich men's disease. Brown spindle eye/boat shaped lesion appeared on the leaf. The lesion small water-soaked bluish green about 1-3 mm in diameter. The spots are joining together and disease progress leaves dry up and wither. (Leaf blast).
Lesions on the node are blackish to greyish brown. Affected nodes may break up and infected parts above the nodes may die. (Node blast).

At the end of season rotten neck symptoms appeared. Fungus attacks the peduncle which is engirdled and the lesion turn to brownish to black. This stage of infection is commonly referred to as rotten neck. (Neck blast).

Management:

a. Use of disease-free seeds.
b. Grow resistant variety like IR 64, IR 36, Jaya, Ratan etc.
c. Seed treatment with Thiram @ 2.5g/kg. Of seeds.
d. Seed treatment with *Trichoderma viride* @ 4g/kg. or Pseudomonas fluorescence @ 10g/kg. Of seed.
e. Spray Mencozeb @ 0.3% on standing crop.

Brown Spot of Rice

Causal organism: *Helminthosporium oryzae* (Sexual stage- *Cochliobolus miyabenus*).

Symptoms: This disease is severe on the Potash deficiency soil. The disease symptoms appear on the coleoptiles, leaves, leaves sheath and glumes. On the leaves the spots appear from minute dots to circular, eye-shaped / oval lesions. Several spots coalesce and the leaf dries up. The symptoms on the leaf sheath are similar to those on the leaf.

Management:

a. Use disease free seeds.
b. Use crop rotation.
c. Seed treatment with Captan @ 4g/kg.
d. Spray Mancozeb @ 0.2% once after flowering and second spray at milk stage.

Sheath Blight of Rice

Causal Organism: *Rhizoctonia solani*

Symptoms: The lesions are formed on the leaf sheath and culms at the water level. Spots on the leaf sheath are first ellipsoid / Ovoid about 10 mm long and greenish gray. Lesions on the upper parts of plants extend rapidly coalescing with each other to cover entire tillers from the water line to the flag leaf. Five- to Six-week-old leaf sheath are highly susceptible.

Management:

a. Avoid flow of irrigation water from infected field to healthy fields.
b. Deep ploughing in summer and burning of stubbles.
c. Spray Hexaconazole @ 0.2%.
d. Soil application of Pseudomonas fluorescens @ 2.5 kg / ha. After 30 days of transplanting.

Bacterial Leaf Blight

Causal Organism: *Xanthomonas oryzae* pv. Oryzae

Symptoms: Initially 'Kresek' (seedling wilt) occurs, plant wither and dries up. The bacterium enters through the hydathodes and cut wounds in the leaf tips, becomes systemic and cause death of entire seedling. Disease is characterized by linear yellow to straw-coloured stripes with wavy margin, generally on both edges of the leaf, rarely on one edge. These stripes usually start from the tip and extend downwards. This is followed by drying and twisting of the leaf tip. Yellowing bacterial ooze appear on the surface of lesion.

Management:

a. Grow resistance cultivars like MTU 9992, Swarna, Ajaya, IR 20, IR 42 etc.
b. Affected stubbles are to destroyed by burning or through ploughing.
c. Judicious use of nitrogenous fertilizers.
d. Spray streptocycline (250ppm) along with copper oxychloride (0.3%).

Conclusion

Normally in rice crops are affected by different diseases and symptoms plays a major role for identify that diseases. Through identify the disease symptom we are manage the disease by Resistance variety, Fungicide and Antibiotics.

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APMC Women Labourers Participation in Dry Chilli Post-Harvest Activities

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Abstract
India is well known as land of agriculture and it is also known as backbone of Indian economy. Chilli is one the important commercial crop grown in India. India stands first place for exporting most popular dry chilli varieties to many of the countries. Asia's biggest dry chilli APMC yard is located in Guntur district of Andhra Pradesh and Byadgi APMC yard is also well known for exporting most popular dry chilli varieties throughout the world. Both the dry chillies got worldwide attention for its spiciness and colour. Women participation in agriculture and post-harvest activities differs widely between regions. Generally post-harvesting activities which are simple and less laborious are done exclusively by women and some activities which are more laborious and need more physical strength are done exclusively men. Especially in developing nations including in India, women labourers play an important role in agricultural and post-harvest operations. In post-harvest activities of dry chilli at APMC women labours involvement is seen in drying, grading, trampling process, marketing processing and labeling.

Introduction
Agriculture plays an important role in India and it is also known as backbone of Indian economy. India is the largest democratic country. Especially in developing nations including in India, farm women play an important role in agricultural and post-harvest operations. In APMC level also women participation is seen high. They work as paid labourers in APMC and almost all dry chilli post-harvest activities are being carried-out in APMC. Women's role and contribution is no longer a matter of contention because in rural India the percentage of women who depend for their livelihood on agriculture and allied activities is more than 80.00 per cent. Their involvement differs based on the crop and region. In chilli post-harvest activities at AMPC level women labourer's involvement is seen high either individually or alone with men.

Objective
Study helps to understand the list of post-harvest activities in which women labourers involvement is seen at APMCs.

Feminization of Indian Agriculture
According to food and Agricultural Organization feminization of agriculture refers to the measurable increase of women's participation in the agricultural sector.

List of Post-Harvest Activities of Dry Chilli
1. Chilli drying activities - Traditional Sun drying, Solar drying and mechanical drying.
2. Spreading dry chillies to get uniform drying.
3. Weighting and Bagging.
4. Trampling process of dry chilli.
5. Grading/Sorting (Manual grading, Mechanical grading).

6. Removal of chilli stalk.
7. Storage (Cold storage, Central/State warehouse).
8. Transportation (loading and unloading of dry chillies).
9. Marketing.

Role of Women in Post-Harvest Activities of Dry Chilli

1. Chilli drying activities: In chilli drying activity women labourers were involved in traditional sun drying activity either individually or jointly with men and none of them used either solar drying or mechanical drying in both the APMCs. It might be because traditionally sun drying was most followed throughout Asia, Africa, Central and South America as they get more sun shine. Due to the high cost of the solar drier/ mechanical dryer, most farmers do not own them and so the participation was low.

2. Spreading dry chillies to get uniform drying: Women involve in spreading dry chillies to get uniform drying and in this activity, women involvement is seen high either individually or combine with men.

3. Weighting and Bagging: Trampling is a physical process of stamping the chillies so that they become compact to easily fill the bags. This activity involves a little strength and is mostly performed by men with some women also doing the same after trampling women fill the gunny bags with dry chilli which is then tightly tied by the men. The jute bags are then covered with paper. The stitching of the open edges is done by women. Since the activities of trampling, filling bags, tightening up the bags, stitching them up are all done in random by both men and women, the present findings of joint participation in weighting and bagging.

3. Grading/Sorting: In both the APMCs grading activity was done by women. These works are assigned to women because, it was less laborious. During removal of stalk the chillies are sorted based on the criteria fixed by the APMCs. Hence the participation of women was more.

4. Removal of chilli stalk: In both the APMCs chilli stalk removal activity was done by women labourers. For removing stalk of one Kg chilli Rs. 12 -15 /- will be paid to women. Daily they remove 20 -25 kgs of dry chilli. As this activity is less laborious although tedious and need to be carefully done by women. It is a women friendly activity where; all women sit together and do the job. So, we observe a greater number of women involved in removal of chilli stalks.

5. Packaging of dry chilli: Packaging of dry chilli in the gunny bags was done mostly by women, while few men were involved in this activity. Women remove chilli stalks, grade them and immediately bag them. These three activities are done in a sequence and men came into picture at the last stage of packaging which needs strength. Hence few men also were involved in this activity.

6. Transportation, Storage, Marketing: The activities such as transportation, storage, marketing was done mainly by men. These, activities need more physical strength and traditionally these activities which involve mobility. Generally, in rural areas it is perceived that transportation and storage are male dominated activities. This could be the reason why women participation in these activities was low.

		
Women in bagging activity	**Trampling process**	**Women in grading activity**

In marketing activities at Guntur APMC, little less than half of women labourers were involved. Whereas, in Byadgi APMC no women were involved in marketing of dry chilli at APMCs. During earlier days marketing activity was dominated by men as they used to handle all monetary transactions. However, in recent times women equally participate in some of the marketing activities especially women from small and marginal land holdings who produce in small quantities. Such women sit in village shady and market yards to sell the chillies grown by them.

Conclusion

India stands first position for exporting most popular varieties of dry chilli. Large majority of the women labourers in India depends of agriculture of their livelihood. In post-harvest activities also women labourer's involvement is seen high. Asia's biggest APMC yard is located in Guntur and Byadgi APMC yard is also well for its most popular Byadgi chilli variety. In both the APMCs women labours participation is seen high in almost all the activities such as, drying, grading/sorting, weighting and bagging, trampling process, marketing. Equal to men, women are also involving in various agricultural activities.

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Cobb-Douglas Production Function

Article ID: 10732

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Introduction

Charles W. Cobb and Paul H. Douglas studied the relationship of inputs and outputs and formed an empirical production function, popularly known as Cobb-Douglas production function. Originally, C-D production function applied not to the production process of an individual firm but to the whole of the manufacturing production. The Cobb-Douglas production function is expressed by

$$Q = AL^{\alpha}K^{\beta}$$

where Q is output and L and A' are inputs of labour and capital respectively. A, α and β are positive parameters where α > 0, β > 0.

The equation tells that output depends directly on L and K and that part of output which cannot be explained by L and K is explained by A which is the 'residual', often called technical change.

The marginal products of labour and capital are the functions of the parameters A, α and β and the ratios of labour and capital inputs. That is,

$MP_L = \partial Q/\partial L = \alpha AL^{\alpha-1}K^{\beta}$

$MP_K = \partial Q/\partial K = \beta AL^{\alpha}K^{\beta-1}$

The two parameters a and P taken together measure the degree of the homogeneity of the function.

Properties

1. There are constant returns to scale.
2. Elasticity of substitution is equal to one.
3. A and p represent the labour and capital shares of output respectively.
4. A and p are also elasticities of output with respect to labour and capital respectively.
5. If one of the inputs is zero, output will also be zero.
6. The expansion path generated by C-D function is linear and it passes through the origin.
7. The marginal product of labour is equal to the increase in output when the labour input is increased by one unit.
8. The average product of labour is equal to the ratio between output and labour input.
9. The ratio α /β measures factor intensity. The higher this ratio, the more labour intensive is the technique and the lower is this ratio and the more capital intensive is the technique of production.

Importance of C-D Production Function

The C-D production function possesses the following merits:
1. It suits to the nature of all industries.
2. It is convenient in international and inter-industry comparisons.
3. It is the most commonly used function in the field of econometrics.
4. It can be fitted to time series analysis and cross section analysis.
5. The function can be generalised in the case of 'n' factors of production.
6. The unknown parameters a and p in the function can be easily computed.
7. It becomes linear function in logarithm.

8. It is more popular in empirical research.

Limitations of C-D Production Function

It has the following limitations:

1. The function includes only two factors and neglects other inputs.
2. The function assumes constant returns to scale.
3. There is the problem of measurement of capital which takes only the quantity of capital available for production.
4. The function assumes perfect competition in the factor market which is unrealistic.
5. It does not fit to all industries.
6. It is based on the substitutability of factors and neglects complementarity of factors.
7. The parameters cannot give proper and correct economic implication.

Role of Liquid Organic Manures in Low External Input Sustainable Agriculture

Article ID: 10733

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Introduction

Continuing rural poverty, the high cost of purchased inputs and environmental problems, all support the view that farmers should rely as much as possible on locally available inputs to enhance the productivity of their soils. Thus, technologies using low levels of external inputs readily available either on-farm or from nearby off-farm sources are seen by some experts as more appropriate and sustainable (Pretty, 1995).

This approach often referred to as low external input sustainable agriculture (LEISA). The excess use of costly chemical fertilizers in agriculture has resulted in serious environmental problems. The current global scenario firmly emphasizes the need to adopt eco-friendly agricultural practices for sustainable food production.

The liquid organic manures are eco-friendly organic preparation made from the different animal and plant products.

The use of organic liquid products such as panchagavya, sasyagavya, beejamruta, sanjeevani, kunnapajala, vermiwash, seaweed extracts etc. resulted in higher growth, yield and quality of crops. They enhance crop growth and can help in sustainability of safe environment and crop productivity.

What is LEISA?

LEISA is a form of agriculture that optimize local resource utilization, including social and human resources, but the use of external inputs is not excluded and seen as complementary to the use of local resources. LEISA means maximum utilization of local resources with less dependency on external inputs viz., pesticides, fertilizers, herbicides etc for agricultural production.

LEISA Aims

1. Integration between agriculture with nature and natural process.
2. Improving and stabilizing productivity of farming system.
3. Reducing production costs by generating farm inputs locally.
4. Reversing impact on environment- soil, water, biodiversity.

Principles of LEISA

1. Adapting the agricultural system to the environment of the region, including soil, water, climate and biota present at the site.
2. Optimizing the use of biological and chemical / physical resources in the agro ecosystem.

Advantages of LEISA

1. Lower production costs.
2. Overall risk of farmers is considerably reduced.
3. Pollution of surface and groundwater is avoided.
4. Healthy foods with very little or no pesticide residues.
5. This system held promise for both short- and long-term profitability.

Why LEISA?

Majority of farmers in India are resource poor farmers and practice small scale farming (0.1 to 2.0 ha). Pesticides and other chemicals are responsible for extensive environmental problems and for health risks. Over reliance on synthetic fertilizers may cause soil degradation. In many developing countries, input markets are unreliable, inefficient and out of reach for subsistence cultivators.

Liquid Organic Manures

Liquid organic manures are products obtained from the fermentation and/or decomposition of organic matter such as crop residues, animal dung, urine and other plant material. Liquid organic manures provide nutrients for the plants and can work as a pest control.

Advantages of Liquid Organic Manures

1. Use of local resources.
2. Save cost.
3. Use local knowledge.
4. Protects the environment.
5. Improves the soil.
6. Saves our health by reducing use of harmful chemicals.
7. These are very environment, plant and bio-life friendly.

Method of Preparation of Panchagvya

Panchagavya consists of nine products viz., cow dung, cow urine, milk, curd, jaggery, ghee, banana, Tendezr coconut and water. Mix the seven kg cow dung and one kg cow ghee ingredients thoroughly both in morning and evening hours and keep it for 3 days. After 3 days mix ten litters cow urine and ten liters water and keep it for 15 days with regular mixing both in morning and evening hours. After 18 days mix the three liters cow milk, two liters cow curd, three liters tender coconut water, three kg jiggery and twelve numbers of well ripened bananas and keep for one week. The stock solution of panchagavya will be ready after 25 days.

Bijamrut

Take 5 kg cow dung in cotton cloth and dip in water. Another separate vessel takes 100 g lime and dip in 1 litre water keep it for 12-16 hrs. Separate the solid portion of cow dung by squeezing it. In this solution add 5 litre cow urine, 1 litre lime water, 50-gram sajiv soil and 20 litre water. Keep this mixture for 12-16 hrs, filter it and use for seed treatment. For transplanting put the roots in beejamruta for some time before planting.

Jivamrut

Take 100 L water in barrel and add 10 kg cow dung + 10 L cow urine. Mix well with the help of a wooden stick, add 2 kg old jaggery and 2 kg pulse flour (gram, pigeon pea, green gram, cowpea or black gram) and handful soil from rhizosphere area of banyan tree. Mix this solution well with a wooden stick. Keep the solution aside for fermentation for two to seven days. Shake the solution regularly three times a day.

Nutrient Status and Microbial Population of Panchagavya, Beejamrut and Jeevamrut

Parameter	Panchagavya	Beejamrut	Jeevamruth
pH	6.82	8.20	7.07
EC (dSm^{-1})	1.88	5.50	3.40
Total Nitrogen (ppm)	1000	40	770
Total Phosphorus (ppm)	175.40	155.30	166
Total Potassium (ppm)	194.10	252	126
Total Zinc (ppm)	1.27	2.96	4.29

Total Copper (ppm)	0.38	0.52	1.58
Total Iron (ppm)	29.71	15.35	28.20
Total Manganese (ppm)	1.84	3.32	10.7
Bacteria (cfu ml^{-1})	26.10×10^5	15.40×10^5	19.70×10^5
Fungi (cfu ml^{-1})	18×10^3	10.50×10^3	13.40×10^3
Actinomycetes (cfu ml^{-1})	4.20×10^3	6.80×10^3	3.50×10^3
N_2 fixers (cfu ml^{-1})	2.70×10^2	3.10×10^2	4.60×10^2
Phosphate solubilizers (cfu ml^{-1})	5.70×10^2	2.70×10^2	4.20×10^2

Source: Gore and Sreenivasa (2011)

Review of Literature

Naikwade Pratap Vyankatrao (2019) concluded that the seed germination and seedling growth of legume crops i.e., *Arachis hypogaea* L. (Ground nut), *Glycine max* (L.) Merr (Soya bean). *Vigna acontifolia* (Jacq.) Marechal (Moth bean) and *Vigna radiata* (L.) R. Wilczek. (Green gram) was increased by using organic liquid formulation Bijamrut. Root, shoot and total seedling length also increased with Bijamrut. When 100% of Bijamrut is used it resulted in high germination percentage, seedling growth and seed vigour index. Bhargavi *et al*. (2019) stated that the seeds treated with Bijamrut significantly shows higher root length (1.73 cm), shoot length (5.09 cm) and seedling vigour index (654.64) when compared with the water-soaked seeds and control in black gram. Jeevamrut makes easier availability of nutrients to crop by stimulating the soil biota. Maximum growth and yield of crop is mainly due to better microbial activity and growth hormones which build up the soil biota, consequently substantiate the availability and consumption of applied nutrients along with that inhabitant nutrients. When Jeevamrut is applied at two levels significantly shows greater fruit yield, N-fixers, P solubilizers when compared with cow urine (2 levels), Panchagavya (3 levels). (Boraiah *et al*., 2017). The capacity of Jeevamrut is helping the plants to come out of the stress conditions this leads to the superior growth and development of plants by adding various nutrients and rich soil microbes which increases the fertility and soil health. Bagul *et al*., (2018) investigated different organic compounds in papaya and reported that Panchagavya shows effective results than the other treatments. The results are 90.03% of germination percentage, 10.16 days for germination. Along with that it also shows better results in seedling height, no. of leaves, stem girth, leaf area, tap root length, no. of roots/seedling, root: shoot ratio, fresh & dry weight, increased survival rate and decreased mortality rate. Suchitra *et al*. (2017), used Panchagavya as 1% , 3%, 5%, 7% concentrations. Among all these 3% Panchagavya gives best results in increasing the plant growth, yield and quality parameters.

Conclusion

These formulations have potential to move forward crop production, productivity & quality, health of soil, and provide immunity to crop against pest and diseases. These natural formulations are applied in less quantity and helps in rapid decomposition of soil organic matter into humus there by providing nutrients to plants.

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Molecular Biology of Agrobacterium T-DNA Transformation

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Introduction

Agrobacterium is genus of Gram-negative bacteria that causes plant tumours through horizontal gene transfer. The most studied species in this genus is Agrobacterium tumefaciens. Agrobacterium is well-known for its ability to transfer DNA between itself and plants, which has made it a valuable tool in genetic engineering. Crown gall disease is caused by the Agrobacterium tumefaciens bacterium. On the infected plant, the disease is marked by a tumor-like growth or gall, which also appears at the root-shoot junction. The conjugative transfer of a DNA segment (T-DNA) from the bacterial tumour-inducing (Ti) plasmid causes tumours to develop. Agrobacterium rhizogenes, another closely related species, causes root tumours. The bacterial pathogen Agrobacterium tumefaciens is used extensively in plant genetic transformation as a powerful tool for delivering genes of interest into a host plant. The transferred DNA will integrate into the plant genome and be passed down to the next generation within the nucleus (i.e., stable transformation). Agrobacterium tumefaciens, which carries the tumor-inducing (Ti) plasmid, causes galls on the roots and crowns of many dicot angiosperm species as well as some gymnosperms, whereas Agrobacterium rhizogenes, which carries the root-inducing (Ri) plasmid, causes abnormal root production on the host plants. The expression of oncogenes found in transferred-DNA (T-DNA) transported from these bacteria into the plant nucleus and integrated into the plant genome causes neoplastic tumor-like cell growth. The presence of two genetic components located on the bacterial Ti-plasmid is required for the A. tumefaciens-mediated plant genetic transformation process. The T-DNA is the first and most important component, and it is identified by border sequences, which are conserved 25-base pair imperfect repeats at the T-ends. region's the virulence (vir) region is made up of at least seven main loci (virA, virB, virC, virD, virE, virF, and virG) that code for components of the bacterial protein machinery that mediate T-DNA processing and transfer. The VirA and VirG proteins are two-component regulators on the Ti-plasmid that activate the expression of other vir genes. T-DNA from A. tumefaciens is processed, transferred, and integrated into a plant cell by the VirB, VirC, VirD, VirE, and possibly VirF.

Attachment of *A. tumefaciens* to Plant Cells

Bacterial attachment to host cells is an essential initial step in disease development for many plant and animal pathogens. Many genes are involved in the attachment of *Agrobacterium tumefaciens* to plant cells. During attachment, the A. tumefaciens cells synthesize cellulose fibrils that capture large numbers of bacteria at the wounded place.

Mechanism of Activation of vir Genes-Two-Component System

Once the vir gene was defined genetically, studies were expected at understanding how these genes are regulated by the three types of signal molecules. The first evidence came when it was established that mutations in either virA or virG removed induction of all vir genes. Functioned came through gene sequencing and comparing the sequences with other regulatory gene pairs of these two genes. After comparing the sequences of these two systems, both groups determined independently that many regulatory systems that respond to environmental stimuli share strongly conserved domains. VirA and VirG genes are expressed constitutively. VirA gene code to a kinase, that spans the bacterial membrane and act as the receptor for certain phenolic molecules such as acetosyringone that are release by the wounded plant cells. The phosphate group is transferred to the aspartate residue in VirG protein. The activation of VirG acts as transcription activator for other Vir genes. The activated VirG then binds to upstream of each vir genes of a conserved 12 base pair sequence.

Vir Proteins

The Vir proteins are essential for the processing and transfer of the T-DNA from Agrobacterium to plant cell. These involved many Vir gene.

VirA

VirA functions were identified by its sequence. The protein has two hydrophobic regions which imbedded in a membrane. The protein was revealed to be anchored in the inner membrane with ~275 amino acids near the amino terminus situated in the periplasmic space and the rest of the protein placed in the cytoplasm identified using antibodies. VirA occurs as a preformed dimer in the cell. The periplasmic domain is required for the recognizing of monosaccharides. A linker domain links the transmembrane region to the cytoplasmic region which includes the receiver and kinase domains. The linker domain is required for the recognizing of phenolic compounds and acidity whereas the kinase domain comprises the phosphorylatable histidine moiety. The receiver domain works as an increasing region of VirA and is required for vir gene expression.

VirG

Two promoters are normally involved in the expression of VirG gene. P1 and P2 located downstream of P1. The virG gene is transcriptionally activated by plant signal molecules acting on promoters, The P1 promoter functions with phenolic inducers and phosphate starvation and needs the VirA/G system where as the P2 promoter is activated exclusively by acidic conditions which work to increase the level of VirG to the level required to reach maximum induction of the vir regulon by phenolic and monosaccharide inducers.

VirB

VirB encodes protein which produces a conjugative pilus through which the T-DNA is transferred to plant cell. The complete operon was sequenced and 11 open reading frames recognized (virB1-11). The sequence analysis suggested that this operon encodes a transmembrane protein that mediates the route of the T-DNA and certain Vir proteins into the plant cell. VirB2 encodes the synthesis of pilin. Pilin is the subunit of the T-pilus. The synthesis of T-pilin is temperature sensitive.

VirD

The virD operon comprises of five open reading frames. T-DNA transfer is initiated by VirD1 and VirD2 protein. Both are act as endonuclease. VirD2 cut phosphodiester bond and remain covalently attached to the 5′ end through a phosphotyrosine of the nicked T-DNA. VirD2 encode an endonuclease that nicks one of the two strands of the Ti plasmid at two sites which flank the T-DNA. These 25 base pairs border sequence found as direct repeats and their cleavage results in the formation of a single-strand T-DNA molecule.

This protects the 5′ end from exonucleolytic degradation. In addition to the important border sequences, effective T-DNA transmission requires a supplementary sequence, termed overdrive which is situated to the right of the right border and serves to improve the production of T-strands. The VirD2 protein which also has nuclear localization signals (NLSs) directs the transport of the T-DNA into the nucleus of the plant cell. In addition, this protein is in part responsible for the efficiency of transformation and the protection of the ends of the integrated DNA.

VirC

The virC operon comprises of two open reading frames, virC1 and virC2. VirC1 binds to the overdrive sequence and increases the site-specific nicking by the VirD endonuclease thereby subsequent in increased T-strand production. Although the virC operon is not important for endonuclease nicking, VirC1 does improve nicking, most expected because of the interaction between VirC1 and overdrive. More recent studies revealed that VirC2 increases the number of copies of T-strands per cell as a result of the pair-wise interactions with VirD2, VirC1, and VirD1 which most likely exist as multimers.

VirE

The virE operon contains of three open reading frames, of which the most studied is virE2. virE2 encodes a non-specific single-strand DNA binding protein which expected covers the length of the T-DNA. It is carried via the Type IV secretion system into the plant cell autonomous of T-DNA transfer where it probably protects the T-DNA against nuclease degradation and maintains the integrity of the 3' end of the T-DNA earlier to integration. Although VirE2 also contains nuclear localized sequence (NLS), these signals play an important role in the nuclear import of T-DNA. Using several diverse visualization techniques, these investigators revealed that VirE2 travelled from *Agrobacterium* into plant cells where it associated with microtubuli.

VirH

The virH region contains of two genes which encode proteins which such as P-450-type monooxygenases. Such genes are commonly associated with detoxification. Every gene translates a protein that can convert a strong phenolic vir gene inducer, ferulic acid, to a non-inducer, caffeate by demethylating a methoxyl group. Most vir gene inducers are toxic to *Agrobacterium* and their conversion to non-inducers dismisses this toxicity.

VirF

Vir F is an F-box protein. VirF work as ubiquitin ligase complexes in host plant, which facilitate the ubiquitination and later proteasomal degradation of proteins. This recommends that VirF may be involved in proteins proteolysis such as VirE2. Any protein associated with the T-DNA likely must be stripped earlier to DNA integration. In support of this idea, VirF can mediate targeted proteolysis of VirE2 protein in both yeast and plants.

Conclusion

Agrobacterium is natural genetic engineer. Many genes are involved in the attachment and transfer. Agrobacterium tumefaciens is ability to transfer DNA between itself and plant cell through horizontal gene transfer. It is one of the most effective methods of directed DNA transfer presently available.

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Spine Gourd *(Momordica dioica)*

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Summary

Spine gourd (Momordica dioica) is the important vegetable which is belongs to family cucurbitaceous. Spine gourd found in all over the world. It is mainly identifying for its medicinal as well as vegetable use. In India Spine gourd is mainly considered as wild vegetable.

It consisting of anti-cancer, anti-inflammatory, anti-ulcer, anti-hyperglycemic, anti-diabetic and anti-microbial properties and also found high nutrient content Moisture 84.1%, Carbohydrate 7.7 g, Fat 3.1 g, Protein 3.1 g, Minerals 1.1 g, Fiber 3.0 g. and also found the small number of vitamins.

Introduction

Momordica dioica is a perennial, dioecious, belonging to cucurbitaceous family climbing creeper. It is commonly known as spine gourd and teasel gourd worldwide whereas in Bangladesh it is called as Kakrol and in parts of India as Kankro, Kartoli, Kantoli, Kantola, Kantroli, Ban karola, or Janglee karela.

It has presents small leaves and small yellow flowers. It has also small, dark green, round or oval fruits present. It is produced 3 to 5 meters long stems that scramble over the ground or climb onto the surrounding smaller vegetation and attaching self by their tendrils.

Spine gourd plant is sometimes cultivated in India for its edible vegetable fruit. The current study of Indian Momordica, there are different 6 well recognized species of which 4 are dioecious and 2 are monoecious [J. K. Joseph, 2005].

Origin and Distribution

It is native to Asia with extensive distribution in all regions of India and Bangladesh. Although Momordica dioica genus is originated from Indo-Malayan region. Spine gourd is now found to grow mostly in various nations including India, Bangladesh, Srilanka, China, Japan, South East Asia, Myanmar, Polynesia, Tropical Africa, and South America (M. M. Rashid, 1976).

Special Characteristics

1. Leaves are small.
2. Flowers small and yellow in colour.
3. No any circular dot on the base of petals.
4. Fruits are small and round to oval.
5. Fruits dark green in colour.
6. Flowering and fruiting continue for longer period.
7. Individual fruit weight is around 10 -15g and attains upto 30g.
8. Fruit ripening starts from inner to periphery.
9. Smooth and false spines on fruit.
10. It takes 20 days to reach edible maturity from days to bud formation.
11. Roots develop small tuber.
12. Which contains 9-10 hard seeds.



1. Flowers	2. Bud formation	3. Fruits

Chemical Composition

It has more nutritional valued edible fruits found to contains:
1. Moisture: 84.1%
2. Carbohydrate: 7.7 g.
3. Fat: 3.1 g.
4. Protein: 3.1 g.
5. Minerals: 1.1 g.
6. Fiber: 3.0 g.
7. Vitamins: Ascorbic Acid, Carotene, Thiamin, Riboflavin and Niacin.
8. Phytochemical analysis has disclosed presence of traces of alkaloids and ascorbic acid in fruits, such as Lectins, b-sitosterol, Saponins, Glycosides, Triterpenes of ursolic acid, Hederagenin, Oleanolic acid, Aspiranosterol, Stearic acid and Gypsogenin two novel aliphatic constituents.

Uses

1. Headaches are rubbed together with the leaves of Angaras, pepper, blood sandalwood and coconut juice.
2. Tuber is used in kidney stones, all kinds of poisoning, elephantiasis.
3. Kartoli leaves are good for fever, asthma, inflammation, cough, hemorrhoids.
4. Vegetables are delicious and useful for cleansing the stomach.
5. Regular consumption of this vegetable in diabetes lowers blood sugar.
6. Vegetables are very beneficial for the treatment of hemorrhoids and bleeding in piles.
7. This vegetable also reduces fatal diseases like cancer and heart attack to a great extent.

Varieties

Consumer preference in spine gourd vary from region to region depending on size, colour, presence of spine of fruits. Appropriately, a number of different varieties are developed in India.
1. Indira Kankod-1.
2. Ambika-12-1.
3. Ambika-12-2.
4. Ambika-12-3.

Environment

Spine gourd is a hot and humid climate crop. It is growing successfully in those places where average temperature is 20-30 °C.

Spine gourd cultivation can be grown in different types of soil. But its cultivation is good for sandy land having sufficient organic matter and proper drainage system. Along with this, the pH of soil Values should be between 6-7. It is sensitive to acidic soil.

Correct seed having at least 70-80 percent germination capacity during Rainy season (June-July). Therefore, seeds should not be used for Spine gourd crop. To get more production from Spine gourd cultivation, it should be done through vegetative part i.e., root.

Conclusion

The wild variety Spine gourd uses as vegetable and medicine make the crop a promising one for commercial exploitation. It is consisting of anti-cancer, anti-inflammatory, anti-ulcer, anti-hyperglycemic, anti-diabetic and anti-microbial properties. High nutrient content, neutraceutical nature and other medicinal uses makes it to be a potential crop.

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Organic Manures and its Importance

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Introduction

The word 'manures' is derived from two words French word means "manoeuvrer" Latin word means manu (hand) and operate (to work) (Jethro Jull 1700 B.C.) Manures are substances which are organic in nature, capable of delivering plant nutrients in available form, bulky in nature, having the low analytical value and having no fixed composition and most of them are obtained from animal and plant waste products. Manure is an effective source of nutrients in agriculture and horticulture crops. The bulky organic manures contain macro and micro plant nutrients in very small quantities. "Manures is partially decomposed organic matter derived from animals west (such as dung of cattle) and crop residues is called as manure".

Characteristics of Organic Manures

1. Nature bulky as well as concentrated.
2. Plant nutrients in small quantities and organic matter in large amounts. It is applied into the soil it will act as following:
    a. Organic manures supply primary, secondary and micro-nutrients to plants which are liberated in an available form during the process of mineralization carried out by different micro-organisms.
    b. Organic manures also supply organic matter to the soil and hence increase the physical condition of the soil such as soil structure, aeration, water holding capacity etc.
    c. It also arouses the activity of different soil micro-organisms through the supply of energy.
    d. It improves the buffering and exchange capacities of soil and also influences the globality of soil minerals as well as mineral nutrients in soil.

Usefulness of Organic Manure

Manure has some beneficial effect after application to the soil as follows:
1. Plant can derive their required nutrients from the organic manure.
2. Physical and chemical condition of soil is improved on application of organic manure in the soil.
3. The activity and population of beneficial soil micro and macro-organisms in increased the after application of organic manure in the soil.
4. The fertility and soil health restored.
5. The soil remains moist after application of organic manure in the soil.
6. Aeration and movement of water the soil becomes good.
7. Increase the yield and produce quality of crops.

Role of Organic Manure

1. It is the store as a food for the plants.
2. Nutrient's release throughout the year which become available to the plants.
3. Organic manure helps to improve and conserve the fertility and soil health.

4. Soil particles bind organic manure form into structural units.
5. Increase the water infiltration and percolation rate in the soil.
6. The granular condition of soil maintains favourable condition for aeration and permeability.
7. Help to regulate the soil temperature.
8. Increases the water holding capacity of soil.
9. It increases the Buffering capacity of soil.
10. Physical and biological condition of soil improved by organic manure.
11. It makes the soil porous and thus helps in proper aeration in the soil.
12. Organic mulching helps to lower the soil temperature in the summer and keep the soil warmer in the winter.
13. Helps to reduce alkalinity in the soil.
14. Increase the P availability to plants in acid soil.
15. Effect of manure on soil and crop.

Physical Properties of Soil

1. Manure was important for sinking soil bulk density, thus, increasing soil pores to support growth of crop roots.
2. Increased water holding capacity and infiltration rate of the soil due to increased soil organic matter aggregation of soil particles.
3. Depending on the rate, time, and properties of manure applied for soil temperature could increase or decrease. (Rayne, N. and Aula, L. 2020).

Chemical Properties of Soil

1. Animal manure resulted in a higher amount of Soil organic matter (SOM) when compared to inorganic fertilizer.
2. Applied livestock manure increased CEC by as much as 10 cmol kg^{-1} comparative to the control treatment. This is due to the occurrence of organic matter present in manure.
3. Repeated manure application led to the build-up of Phosphorous in the soil with the ability to cause eutrophication.
4. Generally, manure application tended to lead to an increase in soil pH due to the presence of $CaCO_3$ and HCO_3.
5. Type and conditions of soil dictate soil acidity.
6. Leaching of NO_3 was least for manure applied in spring and highest for fall-applied manure.

Biological Properties of Soil

1. Fungal and bacterial diversity in the soil improved by animal manure.
2. A biological property of soil is vital for mineralization and root extension to extract nutrients from lower soil layers.
3. Increased microbial population improved soil organic carbon.
4. Additionally, soil microbial carbon was associated with soil organic carbon.
5. Microbial activities Increased mineralization of soil organic matter, colonization of plant root, soil aggregation e.g., via fungal hyphae and microbial. (Rayne, N. and Aula, L. 2020).

Yield and Yield Attribute

1. Application of Manure enhanced grain yield over no fertilization of crops due to supply of macronutrients.
2. Application based on N leads to P over application.
3. Both manure properties and climatic conditions state whether crops will respond to applied manure.
4. Some studies found 1000-grain weight to reduce and no yield decrease between manure treated and control plots due to the slow-release nature of manure. (Rayne, N. and Aula, L. 2020).

Advantages of Manure

1. It rises the water-holding capacity of the soil.
2. It makes the soil porous and helps the exchange of gases.
3. The texture of the soil improves.
4. The number of microbes rises in the soil.

Disadvantages of Manure

1. Organic manure contains plant nutrients in very low quantity.
2. A huge amount of organic manure has to be applied to meet up the desired amount of nutrient for the plant.
3. Transport and application of huge amount of organic manure costs more.
4. Use undecomposed manures increase the effect of termite in the field.

Composition of Different Organic Manure

Materials	% Oven dried weight		
Animals	**Nitrogen**	**Phosphorus**	**Potassium**
Buffalo dung	1.23	0.55	0.69
Buffalo urine	2.05	0.01	3.78
Cattle dung	1.91	0.56	1.4
Cattle urine	9.74	0.05	7.78
Cheap dung	1.87	0.79	0.92
Human			
Human urine	17.24	1.57	4.86
Human faces	7.24	1.72	2.41
Plant			
Wheat straw	0.49	0.11	1.06
Rice Straw	0.58	0.1	1.38
Cotton stalks	0.88	0.15	1.45
Sugarcane trash	0.35	0.04	0.5

Factors Affecting the Composition of Manures

These are various factors which can affect the composition as follows:

1. Origin of manure (breeds of animals). Sheep and poultry manures are slightly richer in plant nutrients than horse, cow and pig manures.
2. Types of food consumed by animals. This is one of the most vital factors that determine the manure quality. Example richer the food in proteins, the richer will be the manure in nitrogen.
3. Age and condition of animals. Young animals' manure is not rich such as mature animals because young animals retain more nutrients for their growth than that of old or matured ones. The nutrient content composition varies with the ruminant and non-ruminant animals.
4. Nature and amount of litter. FYM composition varies with the nature and amount of litter used for animals (Example paddy straws, wheat straws etc.) Function of the animal. Milk and wool producing animals absorb large amount of nutrients from their food than that of working draft animals. Therefore, manure from bullocks generally contain more nutrients as compared to milch cows.
5. Handling and storage of manures. Potash loss occurs if any drainage is allowed to escape from the manure heap.

Factor Affecting the Decomposition of Manures

The decomposition process is mostly affected by bacteria as compared to other microorganism, present in the manure.

The bacteria are generally introduced into manure through litter, food, air and water used around premises of the barn. The decomposition of manures depends on some conditions as follows:

1. Moisture: The rate of decomposition is affected by moisture condition of the manure. Water present in manure lowers the temperature and thus retards fermentation. Water also affects the supply of air. As a result of which aerobic fermentation is affected. The rate of fermentation is possible to control by watering.

2. Temperature: The rate of decomposition depends on the temperature. The higher the temperature, greater will be the rate of fermentation and more will be the losses of nutrients.

3. Composition of the manures: The decomposition of manure depends on the presence M1516 nitrogenous matter in the manure. The nitrogenous matter provides food for microorganism which causes fermentation. The urine contains soluble nitrogenous matter and it should be mixed with the manure for decomposition of manure.

4. Compactness of heap: Air is essential for the aerobic microorganism, the decomposing agent of the manure. In compact heap, the fermentation is slow but regular fermentation is going on mainly due to anaerobic organism. But in open and light heap, aerobic organism takes part in the decomposition of manures.

Conclusion

Manures are substances which are organic in nature, capable of delivering plant nutrients in available form, bulky in nature, having the low analytical value and having no fixed composition and most of them are obtained from animal and plant waste products. Manure provide nutrient for the growth of plants. Organic manure has no effect on soil compared with inorganic fertilizer.

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Integrated Disease Management

Article ID: 10737

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Summary

This article is based on collective information resulting from available literature and expertise knowledge concerning about need, principle, components and advantages of Integrated Disease Management.

Introduction

Integrated disease management (IDM) is an idea derived from the effective integrated pest management (IPM) systems developed by entomologists for insect and mite control. Inclusion of the term 'IPM' in plant pathology was only after the formal involvement of plant pathologists with entomologists, nematologists and weed scientists in IPM programs under Huffaker project, in the USA. IDM entails the use of pesticides only when disease occurrence reaches economic thresholds, allowing for the development of several bio-control agents in crop ecosystems. Thus, IDM is an effort to encourage ecological, economic, and sociological farming methods through the most successful combination of farming techniques and judicious and restricted use of fungicide, which is a greener alternative to the traditional use of chemicals. In other words, the IDM programme incorporates all disease management methods, including cultural, biological, and chemical, with the primary goal of maintaining disease occurrence below the economic threshold (Singh, 2018).

Need of IDM

1. Plant diseases management defines the effectiveness of other inputs (seed, fertilizer, water, growth hormones) in crop production.
2. Exclusive dependence on fungicides, nematicides, bactericides or viricides resulted in pathogen resistance, development of new pathotype, residues and environmental pollution. This was aimed at the advancement of integrated plant conservation methods, which are key components of environmentally sound agriculture.
3. The primary goals of IDM are to reduce the introduction of disease into the crop and to avoid conditions that promote disease establishment and spread.

Principles of IDM

A good integrated disease management involves six main principles:

1. Exclusion: It is defined as any measure that prevents the introduction of a disease-causing agent (pathogen) into a region, farm, or planting. Major practices include quarantine, inspection and certification, seed treatment and eradication of insect vectors.

2. Avoidance: It includes strategies that inhibit contact among the host and pathogen, presuming that pathogen has crossed the barriers placed by exclusion or it is already present in the area and can attack the host. These tactics includes choice of geographic area, selection of field, choice of time of planting, disease escaping varieties and section of seed and planting material.

3. Eradication: It aims at eliminating a pathogen after it is introduced into an area but before it has become well established or widely spread. The total eradication being not possible, but the main aim is to reduce the density of inoculum to a level where it cannot cause significant damage. This is attempted through biological means, crop rotation, eradication of diseased plants or plant organs, and physical and chemical treatments.

4. Protection: It depends on forming a barrier amongst the pathogen and the host plant or the susceptible part of the host plant. It is usually thought of as a chemical barrier, e.g., A fungicide, bactericide or nematicide, but it can also be a physical, spatial, or temporal barrier.

5. Resistance: It includes selecting plants that possess ability to remain healthy even if the plant is infected.

6. Therapy: It includes disease control methods that are applied after the plant is infected. Chemotherapy, heat or thermotherapy and tree surgery can be done.

Components of IDM

1. Physical control methods: Physical methods for controlling the growth of microorganisms can be divided into heat and non-heat methods. Heat methods are dry heat treatment, hot water treatment, hot water treatment and firing those will kill extensively the microorganisms living in the soil. Non heat methods include radiation, drying, cold temperatures and they may kill both harmful or useful pathogens. For example, control of Sclerotium rolfsii causing root root in many fungi.

2. Cultural control methods: This involves deliberate manipulation of the cultural practices that modify environment to make it less favourable to harmful organism. For example, by disturbing their reproduction cycles, eliminating their food sources, or promising their natural enemies. The principles of avoidance, exclusion and eradication are involved in the management of plant diseases through cultural practices. It requires complete knowledge of nature of pathogen and its behaviour in different conditions of the environment-climate, cropping systems, etc., for the successful disease management through cultural practices. Production and use of pathogen free planting material, use of fertilizers, field and plant sanitation and adjustment of crop culture like crop rotation, fallowing, monoculture, mixed cropping should be done.

3. Biological control: "Biological control is the reduction of the amount of inoculum or disease producing activity of pathogen accomplished by one or more organisms rather than man', (Cook and Baker, 1983). Antagonism, antibiosis, competition or exploitation are the mechanisms of the biological control. In this method, the pathogen actively is reduced using other living organisms for examples hyper-parasites, resulting in a reduction of disease incidence and severity. Destruction of survival pathogen, prevention of inoculum formation and reduction of vigour or virulence of pathogen will also include under the biological control.

4. Host resistance: Resistance is the characteristics of plant that suppress pathogen and disease development. The use of resistant genotypes is a highly effective approach to suppress disease to tolerable levels. In resistant genotypes, disease appears late, build up slowly and results in little damage to the crop.

5. Chemical methods: Use of toxic chemicals in plant is both host management (protection of the host) as well as pathogen management (eradication of the pathogen). Chemicals create toxic barriers between the host surface and the pathogen and eradicate the pathogen present on or in the host including seed, foliage and roots. Based on the type of pathogen against which chemical is used, chemicals are called fungicides, bactericides, viricides or nematicides fugistatic, bacteriostatic, nematistatic or antisporulants.

Based on the Functions Performed, the Fungicides can be Classified as

1. Protectant chemicals: Effective only when used before infection.
2. Eradicant chemicals: Eradicate the dormant or active pathogen from the host.
3. Chemotherapeutants: Eradicate the pathogen after it has caused infection on the host.

Advantages of IDM

1. To stimulate sound structures and healthy plants.
2. To promote the sustainable bio-based disease management alternatives.
3. To ease the environmental risk associated with management by promising the adoption of more ecologically compassionate control strategies.
4. To reduce the potential for air and ground water contamination.

5. To protect the non-target species through reduced impact of plant disease management activities.
6. To reduce the requisite for pesticides and fungicides by using some management methods.
7. To reduce or eliminate issues related to pesticide residue and re-entry interval restrictions.
8. To decrease workers, tenants and public exposure to chemicals.
9. To alleviate concern of the public about pest and pesticide related practices.
10. To maintain or increases the cost-effectiveness of disease management programs

Conclusion

Integrated disease management practices involving, cultural, biological and chemical approaches will be immense help to reduces losses caused by various diseases.

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Management of Crop and Agro-Based Wastes

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Abstract

India is primarily an agrarian economy where a majority of population is related to farming and its allied enterprises. A vast majority of land is used for farming and a wide range of crops are cultivated in its different agro-ecological regions. According to the Ministry of New and Renewable Energy, Govt. of India, it was estimated that about 500 Mt of crop residues are generated every year. The prevailing way of burning residues is creating havoc to environment, in terms of pollution. Agriculture waste is generated as a result of various agriculture related factors such as, excessive application of agro-chemicals, cattle rearing, etc. Reckless application of fertilizers and pesticides has contaminated the water bodies and vegetable export market has taken a hit due to chemical residues on the produce. This can cause serious health diseases in humans including cancer, Parkinson's disease, Alzheimer's disease, birth defects, and reproductive disorders. The occurrence of toxic smog in cities like Delhi is the direct effect of residue burning as farmers find no other method of waste management. This review paper mainly gives a glance on the role of agriculture scientists and community to tackle the menace caused by agricultural residues and lists the available technology at our disposal. The scientific community can arrive at a better remedy for a more sustainable, cost effective and productive ways of agricultural waste management.

Keywords: Crop residue, environment, waste management, agro-chemicals.

Introduction

Agriculture is a way of livelihood for majority of people in the Indian subcontinent and many other developing countries. The roots of origin of farming date backs to pre-historic times when human race started gathering of food and evolved as a massive occupation involving various technologies (Nagendran, 2011). The contribution of many branches of both science and social science are evident in the field of agriculture. The extent of industrialization in this field is so enormous that, it has led to degradation of environment. The brunt of careless farming practices is definitely affecting the ecology of both developed and developing countries. Eco-system is now being damaged more rapidly, thanks to the unpredictable climate change resulting from global warming. To overcome these negative impacts, every stakeholders of agriculture must come together. The first respondent to a crisis in this field must be the Agriculturist which may involve agro-scientists, farmers, extension workers, policy makers etc.

Global agricultural production got a boost with the introduction of mechanization and input intensive- farming. This approach was very much needed to meet the food requirement of an ever-growing population. Such a skyrocketing development in Agriculture came with its own concerns of environmental pollution and waste generation which threatens to leave an everlasting scar (Salah and Haggar, 2007). Hence, the focus of every agriculturist must be on the management of agricultural wastes in both productive and sustainable way. Myriad researches are conducted by nodal agencies such as Food and Agriculture Organization (FAO) which provide timely inputs to various countries, so that they can structure policies to adopt. The major concerns in Agriculture are excessive exploitation of groundwater, lavish use of chemical inputs (fertilizers and pesticides) and adoption of outdated agro-methods in waste management. Burning of crop residues and stubbles has recently caused formation of smog over New Delhi, India. The farmers rely on such unscientific methods, as there are no cheaper and efficient replacement strategies in place. These problems are deeply rooted in the farming community and possess a robust challenge to mitigate this crisis. This review article tries to explain various agro based wastes and productive ways to handle them.

Agriculture Wastes

Agricultural wastes can be defined as waste produced from various farming operations. According to United Nations, 1996, these wastes can be from manures, bio-materials from poultry and slaughter houses, harvest wastes, chemical contamination and leached soil salts. This implies that the amount and distribution of agricultural waste heavily relies on the farming practices of an individual country or a region. Agro-based wastes can be classified into four namely (Figure 1), crop waste (paddy husks, sugarcane bagasses), animal waste (excreta, carcasses), processing waste (packing material) and hazardous waste (agro-chemicals) (Agamuthu, 2009). These factors cause air, water and land pollution due to the improper management (Nagendran, 2011).

Waste Management

Management of agro-wastes involve more tiresome processes, as it involves many factors such as run-off water, chemical inputs, crop wastes (stubbles and straw) and animal wastes. The scenarios involving these factors are discussed hereunder:

Irrigation water: Arable lands under irrigation have been on an increasing trend, as a consequence of intensive farming. According to FAO, more than 90% of arable land has come under irrigation by the year 2000. Up-land cultivation is now the priority for many developing countries like India and China. Even a considerable amount of budget of these countries was allocated to irrigation projects. Irresponsible usage of irrigation water has resulted in soil erosion, soil salinization (Ongley, 1996) and run-off water being mixed with water bodies (Galbraith, 2005).

To overcome this situation, farmers must strictly stick to the recommended water requirement. Adoption of irrigation methods such as, flooding should be avoided which will cause stagnation of water and thereby, results in salt deposition. Agriculturists need to formulate a viable cropping system and irrigation technologies that will ensure minimum exploitation of water resources.

Fertilizers and agro-chemicals: In the wake of green revolution, chemical fertilizers were the sole flag bearer of increased food production and productivity (Williams, 2005). The nutrient trio of nitrogen, phosphorous and potassium were the mainstay of this revolution and farmers started to use fertilizers like there is no tomorrow. Such an unconditional usage has led to eutrophication of water bodies (Nagendran, 2011). The infiltration of these chemical components into the soil will lead to sick soil and contamination of ground water. To overcome this crisis, proper studies on source-sink relationship of nutrients (N & P) must be carried out, so that the agriculturists can minimize the indiscriminate use of fertilizers (McIsaac, 2003; Howarth et al., 1996). An integrated approach of both organic and inorganic nutrient supply could only be beneficial.

Agro-chemicals mainly involve pesticides, herbicides and fungicides that are being efficiently used to control weeds, diseases and pests. The deployment of these chemicals has resulted in a cotton boom in India. The nature of contamination is quite different from that of fertilizers, as agrochemicals come in different composition. These chemical components can interact with each other to yield more persistent chemical residues on the crop cultivated. Such persistent chemical residues are the talk of the town, as it causes various health related problems to both animals and human (Ding et al., 2005; Mai et al., 2005). The agriculture export industry from developing countries is the most affected due to ban on chemical treated products. Though, agro-chemicals cannot be avoided completely, we should reach a middle ground which will be suitable for every shareholder. To overcome this situation, integrated approaches coupled with robust research data is essential.

Use of genetically resistant/tolerant varieties is another viable option for reducing the usage of agro-chemicals. The scientists and extension experts must work together to ensure the wide reach of such alternatives. The manufacturing industries should research on nano-technology which seems to have very negligible residual effect.

Crop residues: Crop residues refer to the leftovers in an agricultural field after harvesting of the crop. Usually, in India the farmers from northern parts harvest sugarcane and wheat crops in bulk and burn the remaining stubbles or rattoons present in the field. Such burning causes toxic smog and results in poor air quality. Even, if the farmers left the remnants to decompose on its own, there arises the problem of pests and weeds from these wastes. The major chunk of this crop residues is from the main crops such as, rice, cotton, wheat, corn, sorghum etc., (Salah El-Haggar, 2007). Many ways to overcome the menace of crop residues will be discussed briefly here under.

Utilization of crop waste, in the form of animal, fish and poultry feed is a prime example of value addition to the waste materials. The major problem in this solution is that the crop residues may not be suitable for direct consumption by animals, hence scientific processing of crop waste is required (Salah El-Haggar, 2007). The residues of certain crops can be used as a supplement with another main feed which will reduce the cost of feed input. For example, Ojewole and Lange (2000) substituted cowpea hull with that of maize in chicken feed which not only reduced the feed cost but also increased egg productivity.

Another approach for crop residue management is briquetting where the crop residues are compressed in the form of solid briquettes (pellets). Burning of crop waste is not controllable, hence its use as fuel is very limited but when these wastes are in the form of solid pellets, it improves combustion process manifolds. Such an approach by an agriculturist can reduce the volume of waste and protect the environment from the ill effects of crop burning. This process is suitable for raw materials like rice straw, cotton stalk, maize stalk, fruit branches etc., (Salah El-Haggar, 2007). Crop residues can also be employed in the production of biogas which is good source of energy. The efficiency of plant residues in producing methane has been tested by many researchers. Thakur and Singh (2000) carried out studies using various crop wastes and found banana stem to be more efficient than cow dung in biogas production. Similarly, every organic constituent can be composted and utilized as organic manures. In view of this, composting is also a viable way for waste management. The main crops such as, rice, corn and cotton are rich in organic matter which when added as composted manure will improve soil health. Animal wastes such as, excreta and urine can also be properly treated, so that it can be used as manures (Karunanithi et al., 2015).

Future Prospects

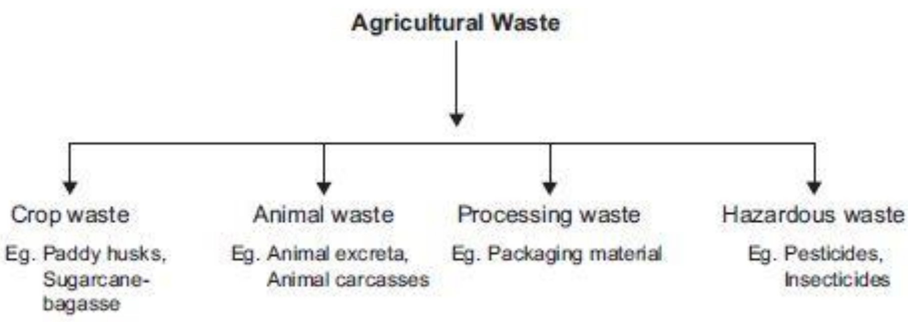

Figure 1. Classification of Agricultural wastes [Agamuthu, 2009]

Globally, environment and eco-system are taking a hit due to unprecedented climate change events. Agriculture is one of the major factors which is adding more damage to our environment by means of crop residues, chemical residues and other related wastes. As humans march forward in the path of development, the challenges lying ahead are steeper. In order to overcome the negative impacts and to maintain food security, sustainable solutions accompanied with pro-active policies and adoption of knowledge with broad mind is the need of hour.

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Agroforestry – An Efficient Practice to Enhance Soil Health

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Enhancing agricultural production will continue as an inevitable demand to meet the food, fibre and fuel needs of burgeoning population. Soil health assumes significance as a major component contributing towards enhancing crop production. There are various factors governing soil health status, among which climate, land management techniques and cultivation practices hold prominence. Soil health is strongly linked with cultivation practices. Agroforestry could be adopted as a viable practice to enhance soil health.

What is Agroforestry?

"Agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land-management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence. In agroforestry systems there are both ecological and economical interactions between the different components".

An agroforestry system will have more than one output, and its ecology and economics will be more complex than in a monocultural system of agriculture or forestry. Four key "I" words are sometimes used to denote the essence of agroforestry: intentional, intensive, interactive, and integrated. The term "intentional" implies that systems are intentionally designed and managed as a whole unit, and "intensive" means that the systems are intensively managed for productive and protective benefits, although agroforestry based on unimproved (wild) trees is not intensive. Agroforestry systems are characterized by three basic sets of attributes (Figure 1).

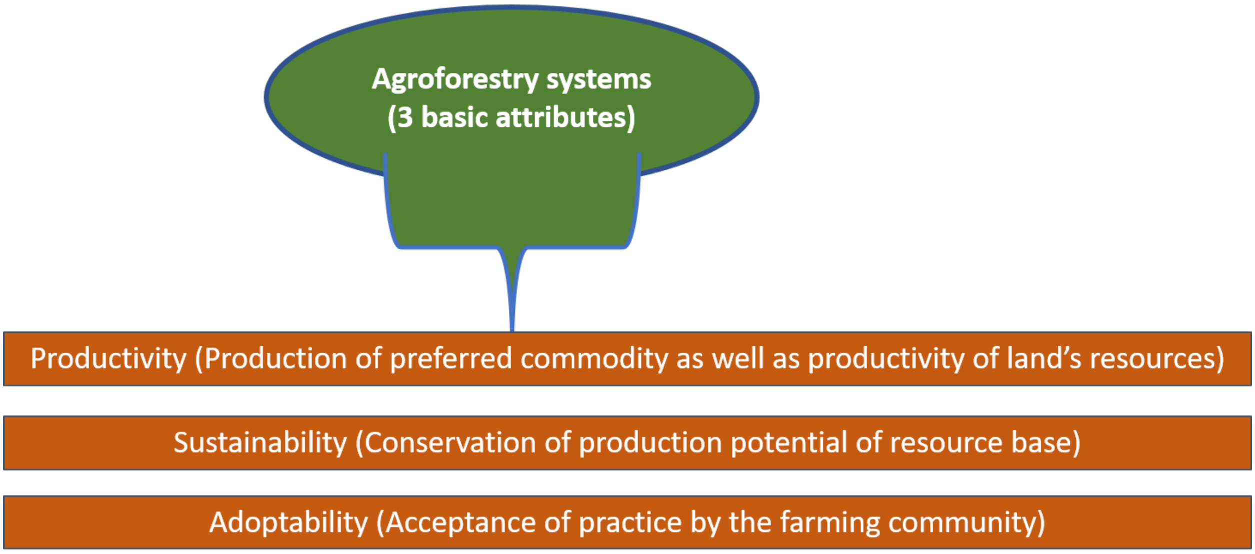

Figure 1. Basic attributes of agroforestry systems

How Agroforestry Contributes to Enhance Soil Health?

Agroforestry benefits soil health enhancement by providing multiple benefits. Agroforestry enhances soil organic carbon (SOC). SOC is a function of rate of decomposition and replacement of organic matter in the soil. The tree component in agroforestry system enhances soil organic matter by addition of litter both above and below ground. SOM improves soil aggregation and enhances soil stability curtailing erosion of top fertile soil. SOM also serves as energy source for soil microorganisms and effects soil biodiversity and associated soil biological functions. Pollutants and toxic elements also alter soil health. Inclusion of certain plant/tree species aid in phytoremediation of contaminated sites. Nitrogen fixing tree species support N2 fixation, can contribute to increase soil nitrogen availability and eventually enhance soil fertility. Tree components serve as wind breaks and shelter belts and protect the soil and minimize the impacts of wind erosion retaining nutrient rich top layer of soil.

Conclusion

Agroforestry systems' adoption would serve as cost effective and environment friendly approach towards enhancing soil health which eventually will enhance crop productivity. Increase in crop productivity coupled with less investment on soil health management help farmers achieve better profits.

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Benefits of Stevia Leaf to Stevia Sweeteners

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Abstract

Stevia is an intensely sweet-tasting plant that has been used to sweeten beverages since the 16th century. The plant is originally native to Paraguay and Brazil but is now also grown in Japan and China. It is used as a non-nutritive sweetener and herbal supplement. Stevia has been used throughout the world since ancient times for various purposes. The leaves of Stevia plants have functional and sensory properties superior to those of many other high-potency sweeteners. Stevia is likely to become a major source of high-potency sweetener for the growing natural food market in the future. Although Stevia can be helpful to anyone, there are certain groups who are more likely to benefit from its remarkable sweetening potential. These include diabetic patients, those interested in decreasing caloric intake, and children. Stevia is a small perennial shrub that has been used for centuries as a bio-sweetener and for other medicinal uses.

Keywords: Calorie Intake, Medicine, Stevia , Sweetener.

Introduction

Stevia is a naturally sourced, zero-calorie sweetener that has been used as a natural sugar substitute and flavoring ingredient for hundreds of years. The stevia plant is native of South America and was first consumed there over 200 years ago when the indigenous people used leaves of the plant to sweeten beverages or chewed them for their sweet taste. The plant leaves, often called “sweet herb,” were dried and used to sweeten tea and medicines.

The stevia plant was first scientifically recorded in 1899 as *Eupatorium rebaudianum* by Moises Santiago de Bertoni, in Paraguay. In 1905, it was later defined as *Stevia rebaudiana*, a member of the sunflower (Asteraceae) family.

Figure 1 Stevia Leaf

Stevia, as a plant extract, was first commercially adopted as a sweetener by Japan in the 1970s, where it is still a popular ingredient today. Stevia is cultivated mostly in Paraguay, Kenya, China, and the United States and within many other parts of the world, including Vietnam, Brazil, India, Argentina, and Colombia.

Stevia is the generic term used to refer to different forms of the sweetener, including the whole plant *(Stevia rebaudiana Bertoni)* and the leaves where the sweet compounds are found. Stevia extract is a generic name for a preparation made by steeping the leaves of the Stevia plant to extract the sweet compounds from the leaf material.

On the other hand, high-purity stevia leaf extract contains 95% or greater steviol glycosides. Only high-purity stevia extracts meeting this specification are approved by major regulatory agencies, including the Joint Food and Agriculture Organization/World Health Organization (WHO) Expert Committee on Food Additives and Codex Alimentarius for use in foods and beverages.

Possible Health Benefits

As an alternative to sucrose, or table sugar, using stevia as a sweetener carries the potential for considerable health benefits. Stevia is considered as "no-calorie" and strictly contain zero calories, but it is significantly less calorific than sucrose and low enough to be classified as such. The sweet-tasting components in stevia sweeteners occur naturally. This characteristic may benefit people who prefer naturally-sourced foods and beverages. The low-calorie count qualifies Stevia to be a healthful alternative for diabetes control or weight loss.

Here are some of the possible health benefits of Stevia:
1. Diabetes: Researches have shown that stevia sweeteners do not contribute calories to the diet and also demonstrated no effect on insulin level. This allows people with diabetes to eat a wider variety of foods and comply with a healthful meal plan. Another review of five randomized controlled trials compared the effects of stevia on metabolic outcomes. The study concluded that stevia showed no effects on blood sugar, blood pressure and weight of the body. In one of the studies, with type 2 diabetes reported that stevia triggered significant reductions in glucagon response after a meal. Glucagon is a hormone that regulates glucose levels in the blood, and the mechanism that secretes glucagon is often faulty in people with diabetes.

Figure 2 Stevia –Calorie Free Sweetner

2. Weight control: There are many causes of increased weight of the body such as physical inactivity and increased intake of energy-dense foods that are high in fat and added sugars. The intake of added sugars has been shown to contribute an average of 16 percent of the total calories in the American diet. This has been linked to weight gain and reduced control of blood glucose levels.

Stevia contains no sugar and very few, if any, calories. It can be part of a well-balanced diet to help reduce energy intake without sacrificing taste.

3. Pancreatic cancer: Stevia contains many sterols and compounds, including kaempferol.Studies have found that kaempferol can reduce the risk of cancer.

3. Blood pressure: Certain glycosides in stevia extract have been found to dilate blood vessels. They can also increase sodium excretion and urine output.

A 2003 study showed that stevia could potentially help lower blood pressure. The study suggested that the stevia plant might have cardio tonic actions. Cardiotonic actions normalize blood pressure and regulate the heartbeat.

4. Children's diet: Foods and beverages containing stevia can play an important role in decreasing calories from unwanted sweeteners in the diets of children. There are now thousands of products in the market containing naturally-sourced stevia, ranging from salad dressings to snack bars. This availability allows children to consume sweet foods and drinks without the added calories while transitioning to a lower sugar diet.

5. Allergies: In 2010, the European Food Safety Committee (EFSA) to determine if there was any cause for concern regarding the potential for allergic reactions to stevia. The reviewers concluded that "steviol glycosides are not reactive and are not metabolized to reactive compounds; therefore, it is unlikely that the steviol glycosides under evaluation should cause by themselves allergic reactions when consumed in foods."

Figure 3 Stevia Leaf, Cubes and Powder

How to Use Stevia Leaves?

Stevia is a calorie-free sugar substitute that is created from the stevia plant. Stevia is popular among health foodies, dieters, and diabetics because it does not increase blood glucose levels. Stevia leaf is used in its refined liquid or powder form, or sweetens the food with fresh stevia leaf. Although high-quality refined stevia is "generally recognized as safe". In the U.S., stevia sweeteners are primarily found in table sugar products and reduced calorie beverages as sugar substitutes.

Extracts from the stevia leaf have been available as dietary supplements in the U.S. since the mid-1990s, and many contain a mixture of both sweet and non-sweet components of the stevia leaf. The sweet components in stevia sweeteners are naturally occurring. This may further benefit consumers who prefer foods and beverages they perceive as natural.

Method No 1 - Using Stevia in Liquid or Powder Form

1. Use pure stevia drops: Perhaps the most popular way to use stevia is in its liquid form. A few drops of stevia can be used to replace 1-2 teaspoons of white sugar. Use stevia drops in drinks (hot or cold), sauces, salad dressings, or soups.

2. Add flavored stevia to beverages: Stevia drops are also available in flavored varieties, such as lemon-lime or root beer. Add a few drops of flavored stevia to sparkling water for a low-calorie alternative to soda.

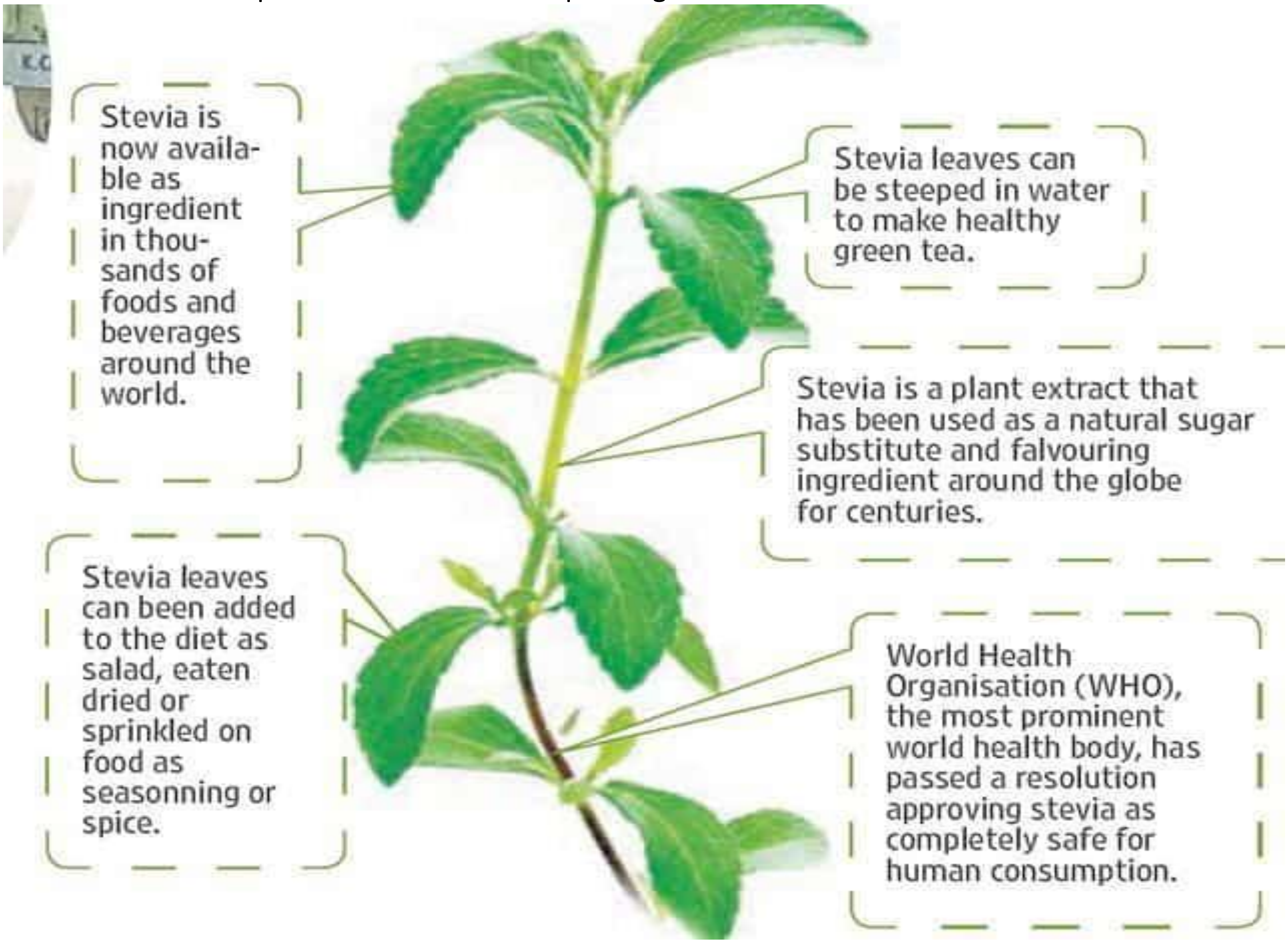

Figure 4 Different Uses of Stevia

3. Try pure stevia extract powder: Another popular way to use stevia is in its pure powder form. This refined stevia looks similar to sugar, and can be used anywhere would normally use powdered sweetener. Stevia extract powder is more potent than sugar, however. Stevia extract powder can be used in drinks (hot or cold), on cereal, or in recipes.

4. Bake with stevia: Stevia extract powder can be used to replace sugar in baking. While baking with stevia, only 1/2 the amount of sugar would normally use. This means need to add more bulk (such as flour) and liquid (such as milk, applesauce, or butter) to account for this difference.

5. Read all labels and avoid additives: Many packaged stevia products contain additional additives--such as sucrose or aspartame--to mask this. These additives are often artificial, and (unlike pure stevia) can have negative effect on the blood sugar.

Method 2 - Using Fresh Stevia Leaf

1. Use stevia leaves for sweeten tea: Access fresh stevia plant leaves (if available fresh) are used as a sweetener. This helps to eliminate the presence of additives and save money. To sweeten a cup of hot tea, simply remove 1-4 small leaves from the plant and place them in hot water with the tea bag. Remove the leaves after several minutes.

Figure 5 Fresh Leaves of Stevia

2. Create dry leaf powder: There are two options for drying the stevia leaves. Either pluck 8 or more leaves from the plant and place them between 2 paper towels, or simply remove an entire stevia stalk and hang it upside down. In either case, leave stevia leaves in a cool, dry place for a few days. Then grind the dry leaves using a mortar and pestle.

Figure 6 Stevia Powder in Sachets

a. Use this green powder to sweeten drinks, breakfast cereal, or curries.
b. 1 teaspoon of this stevia powder is equal to approximately 10 teaspoons of sugar.
c. This pure form of stevia will have a licorice-y or slightly bitter aftertaste.

3. Make stevia syrup: Once stevia dry leaf powder is prepared it can be used to make stevia syrup. Boil 2 cups of distilled water and add 1 teaspoon of dry leaf powder. Reduce the heat to low and simmer for 10-15 minutes, or until the water is the consistency of syrup. Use cheesecloth to strain out the powder. Store the stevia syrup in an air-tight container in the refrigerator.
a. Use this syrup in cold drinks, fruit salads, or sauces.
b. Remember that this sweetener will be more potent.

Figure 7 Stevia in various Forms

Conclusion

Stevia is a natural-origin sweetener that is increasing the options for reduced sugar and reduced energy foods and beverages. Stevia shows promise as a tool to help lower energy intakes, which may lead to the reduction and prevention of obesity.

Stevia is an herb that is used extensively in various areas of the world as a non-caloric sugar substitute. Various reports in animals and humans indicate that the safety of this herb is not yet completely determined. The current status of using this herb in the USA is as a 'dietary supplement'. Until further information is available, pharmacists should be advised to conform to the FDA recommendation when counselling patients about this herb. Specifically, mild to moderate use as a supplement should be safe, but increased use for other pharmacological effects may not be warranted.

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Decentralized Public Approach: ATMA (Agricultural Technology Management Agency)

Article ID: 10741

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Summary

ATMA is a society of key holders involved in agricultural activities for sustainable agricultural development in district. Is an act as a platform for integrating research and extension activities and decentralizing day to day management of public agricultural technology system (ATS) of the districts. It is a registered society responsible for technology dissemination at the district level. As a society, it can receive and spend project fund, enter into contracts and agreements and maintain the revolving accounts which can be used to collect fees and thereby recovering the operational cost.

What is ATMA?

In order to address the key constraints faced by extension system in the country with respect to reducing capacity of public extension services, its lack of decentralized and demand driven focus, the Innovations in Technology Dissemination component of National Agricultural Technology Project (NATP) was implemented in seven States in the country namely, Andhra Pradesh, Bihar, Himachal Pradesh, Jharkhand, Orissa, Maharashtra and Punjab through four project districts in each State. This component aimed at pilot testing new institutional arrangements for technology dissemination at district level and below in order to move towards an integrated extension delivery. The project process involved adopting bottom-up planning procedures for setting the research and extension agency in order to make the technology dissemination farmer driven and farmer accountable. The extension delivery was oriented towards group approach catering to the location specific requirement of the farmers. Gender concerns have been given adequate emphasis under the project. It functions as a registered society at District level and serves as a focal point for integrating research and extension activities and helps in decentralizing the management of agricultural technology transfer.

The purpose of NATP's innovation in Technology Dissemination Component is to pilot test new organizational arrangements and operational procedures not merely strengthen the existing extension system. One key concept or goal is to decentralize decision-making to the district level through the creation of Agricultural Technology Management Agency (ATMA). A second goal is to increase farmer input into programme planning and resource allocation, especially at the Block level, and to increase accountability to stakeholders. A third major goal is to increase programme coordination and integration, so that the programme thrust such as farming System innovations, Farmer organization, Technology gaps and Natural Resource Management can be more effectively and efficiently implemented.

The ATMA at district level would be increasingly responsible for all the technology dissemination activities at the district level. It would have linkage with all the line departments, research organizations, non-governmental organizations and agencies associated with agricultural development in the district. Research and Extension units within the project districts such as ZRS or substations, KVKs and the key line Departments of Agriculture, Animal Husbandry, Horticulture and Fisheries etc. would become constituent members or Key stake holders of

ATMA. Each Research-Extension(R-E) unit would retain its institutional identity and affiliation but programmes and procedures concerning district-wise R-E activities would be determined by ATMA Governing Board to be implemented by its Management Committee (MC).

This Scheme was approved on 29th March, 2005. The Scheme has made extension system farmer driven and farmer accountable. 237 Agricultural Technology Management Agency (ATMA) at district level have been set up to operationalise the extension reforms with active participation of farmers / farmer groups, NGOs, Krishi Vigyan Kendras, Panchayati Raj Institutions and another Stakeholder operating at district level and below. The release of funds is based on Strategic Research and Extension plan (SEWP)/ State Extension Work Plans (SEWPs) prepared by the State Governments. State level Extension Plans have been developed keeping in mind the strategic extension needs of the farmers. 252 districts across all the States/UTs in the country were covered under the scheme during the 10th Plan.

Objectives

The objectives of ATMA are:

1. To strengthen research – extension – farmer linkages
2. To provide an effective mechanism for co-ordination and management of activities of different agencies involved in technology adaption / validation and dissemination at the district level and below.
3. To increase the quality and type of technologies being disseminated.
4. To move towards shared ownership of the agricultural technology system by key shareholders.
5. To develop new partnerships with the private institutions including NGOs.

Salient Features of ATMA

1. Creating Farmer Advisory Committee to improve feedback.
2. Using NGOs to organize farmers.
3. Encouraging private sector involvement in technology transfer.
4. Validation and refining technologies through research units in the district.
5. Bottom-up planning procedure.
6. Increased use of Information Technology (ARIS, WWW)
7. In-service training to increase staff competence.
8. Developing new Public-Private partnerships.
9. Formation and strengthening of farmer's interest group.

Funding

The scheme is supported by the Central Government. The funding pattern is 90% by the central Government and 10% by the state government. The 10% state's share shall consist of cash contribution of the State, beneficiary contribution or the contribution of other non-governmental organizations.

Organizational Structure of ATMA

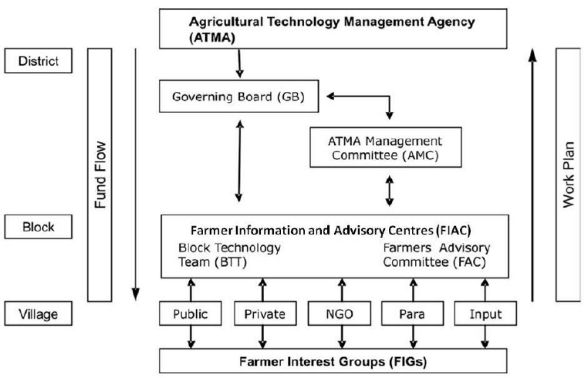

Fig.1 Organizational structure of ATMA programme

It has a well-structured administrative setup with various committees, viz. Governing Board (GB) and ATMA management Committee (AMC) at the district level; Farmers Advisory Committee (FAC) and Block Technology Team (BTT) at block level; and Farmer Interest Groups (FIGs) at village level (fig.1).

Beneficiaries of ATMA Programme

Individual, Community, Women, Farmers / Farm Women groups.

Benefits

Exposure visit, Melas/ Fairs, Empowerment of farmers and farm women groups, Rewards and Incentives.

Doubled Haploid Technology: Tool for Crop Improvement

Article ID: 10742

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Double Haploid Lines

Haploid: An individual with the gametic chromosome number (n) it's in somatic cell.

Double haploid: is genotype formed when haploid cell (n) eg. egg or sperm cell. undergoes chromosome doubling. The resulting genotypes is completely homozyogous.

Why we need Double Haploids (DH):

Development of homozygous lines, Fixation of heterosis, Mutation studies and easy to induce mutation. Production of biotic and abiotic stress, resistant plants, Cytogenetical research, Induction of genetic variability at haploid level , Double haploids in genome mapping , Evolutionary studies.

History: Blakslee et al. (1922) - Published first report on haploid plant of *Datura stramonium*. Chase (1946) - Pioneered the use of haploids in breeding: exploited spontaneous parthenogenesis. Guha and Maheshwari (1964)- Anther culture in *Datura innoxia*. Kasha and Kao (1970)-Wide crossing in barley. Laurie and Bennet (1986) –Wheat x Maize (wheat haploid). Stadler and Randolf (1929)-Reported spontaneous induction of haploid maize plant. Chase (1947)- suggested to use haploids for line development in hybrid breeding and reported 0.1% induction rate. Coe (1959)- made crosses with Stock6 to increase the maize haploid induction rate upto 2-3%.

Traditional Breeding / DH Breeding

S. no.	Traditional breeding	DH Breeding
1	After 7 yrs homozygosity attained is 98.4%	After 2yrs homozygosity attained is 100%
2	Hetrosis cannot be fixed	Hetrosis can be fixed
3	New cultivar is formed in 8-10 yrs	New cultivar is formed in 3-5 yrs
4	Recessive mutant identification is difficult	Recessive mutant identification is easy
5	Temporary mapping population	Permanent mapping population achieved

1 Doubled Haploid Production Technology

Step 1: Haploid Development.

a. Alien cytoplasm: Salmon with Aegilops species
b. Haploid inducing genes: ig gene in maize, hap gene in barley'
c. Delayed pollination:
d. Irradiation treatment.

Delay in pollination (Days)	Haploid per 1000 (maize)
8	0.37
16	0.72
18	1.50

e. Wide Hybridization: *Solanum tuberosum* x *S. phureja*

f. Semigamy: cotton.

Stock	Frequency of haploid per 1000 seed	
	Untreated pollen	**X-rayed pollen**
An inbred	1.03	1.26
3-way hybrid	0.62	0.96
A tester	0.11	0.25
Mean	0.64	0.96

Step 2. Chromosome Doubling: Immersion of seedling in colchicine (Deimling et al.,1997). Due to high toxicity of colchicine, most breeding institutes are interested in less hazardous substances. Herbicides- Pronamid, APM, Trifularin, Oryzalin. Nitrous oxide gas- Maize.

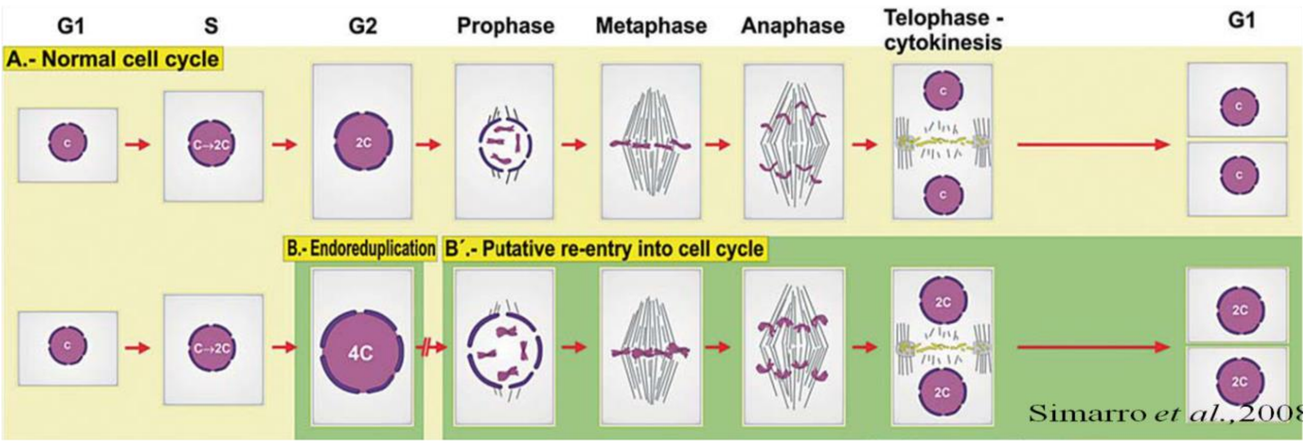
Chromosome Doubling

Haploid Plants:

1. Reduced vigor.
2. Smaller.
3. One set of chromosomes- no meiosis- no seed set.

Mechanisms of Chromosome Doubling

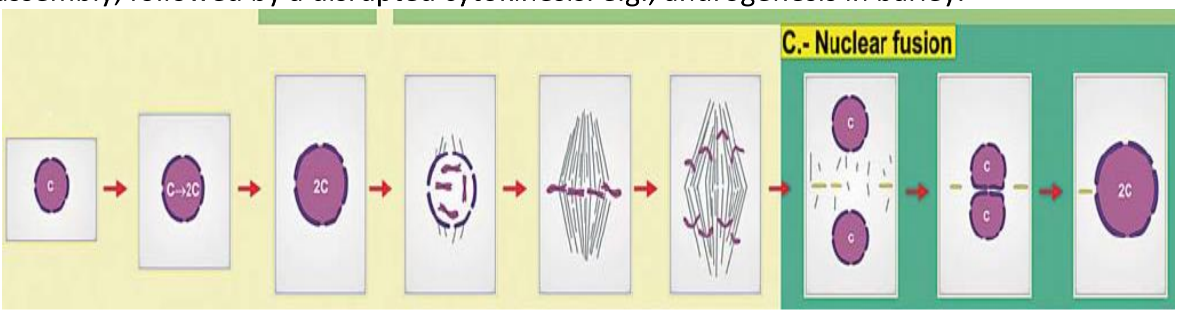
1. Endoreduplication: Characterized by one or more extra rounds of chromatid duplication, in addition to the normally-occurring during the phase of DNA synthesis (S-phase) of the cell cycle.



2. Nuclear Fusion: Two possible ways of nuclear fusion:

a. Fusion of mitotic nuclei: Chromosomes of generative and vegetative nuclei intermix. e.g., induced datura pollen grains.

b. Fusion of nuclei at interphase. It consists of a normally- occurring karyokinesis and nuclear reassembly, followed by a disrupted cytokinesis. e.g., androgenesis in barley.



3. C-Mitosis: Colchicine binds to tubulin dimers, which hampers de novo polymerization of microtubules (MT) and promotes depolymerization of the existing ones.

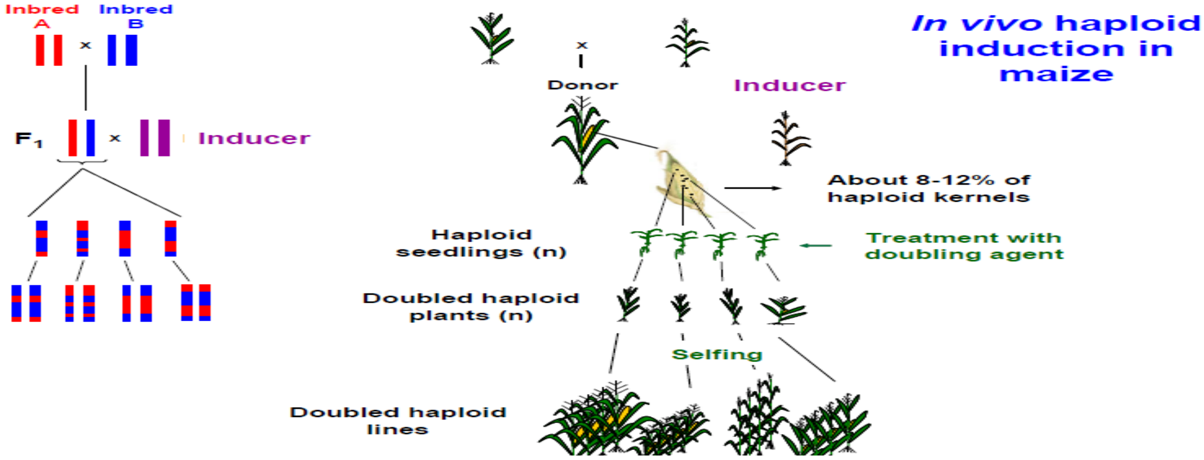
Factors Affecting Haploid Induction

Genotype of the donor plants. Physiological condition of donor plants (i.e., growth at lower temperature and high illumination). Developmental stage of gametes, microspores and ovules. Pre-treatment (i. e. cold treatment of inflorescences prior to culture, hot treatment of cultured microspores). Composition of the culture medium (including culture on "starvation" medium low with carbohydrates and/or macro elements followed by transfer to normal regeneration medium specific to the species). Physical factors during tissue culture (light, temperature).

Practical Production of Doubled Haploids

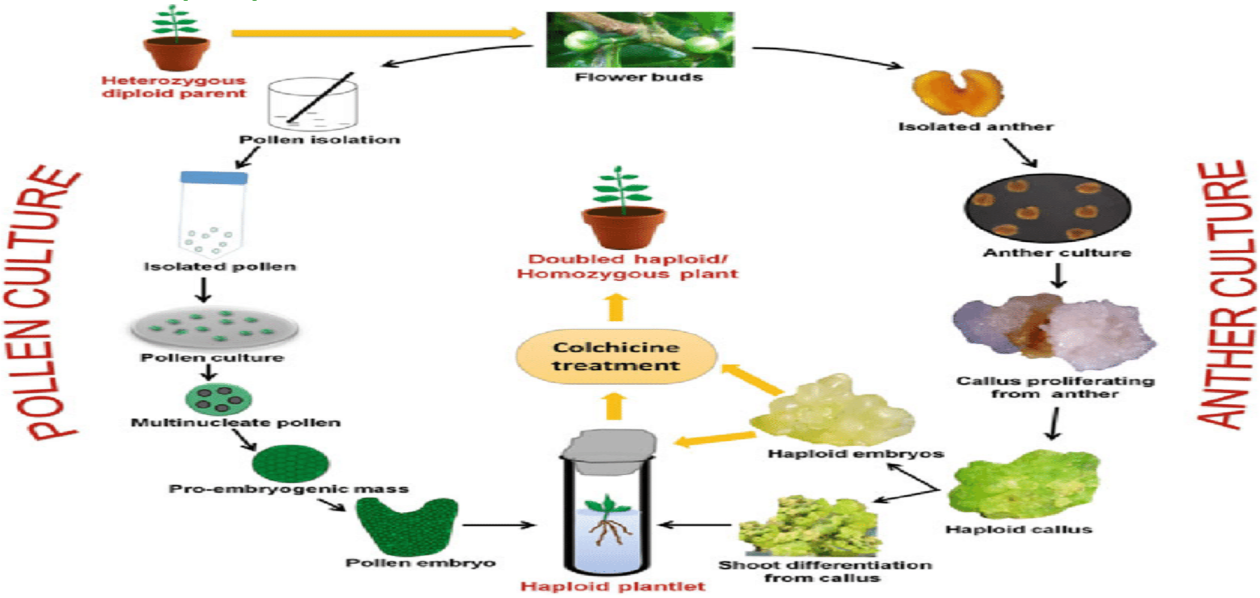
In Vivo Haploid Induction in Maize: Pollination of maize plants to specific genotypes called inducers, which leads to kernels with haploid embryo and regular triploid endosperm. Widely used in line development in commercial hybrid maize breeding. Only moderate influence of donor genotype and induction environment compared to in vitro haploid induction.

Haploid Identification in Maize

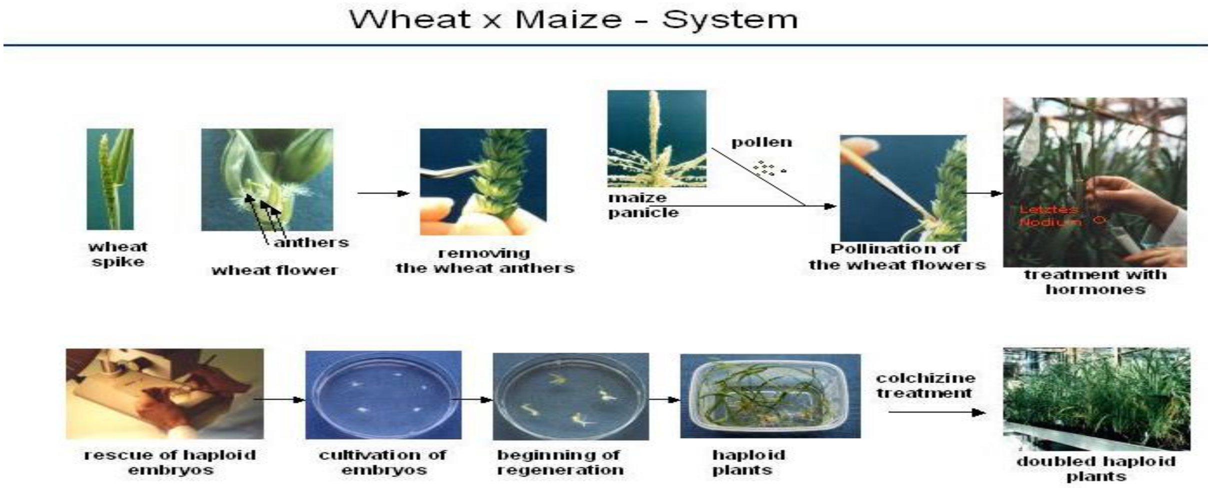


Dominant grain colour marker gene R1-nj (In conjugation with dominant pigmentation genes A1 or A2, and C2). Causes pigmentation in the aleurone (endosperm) and in the scutelum (embryo tissue). Need's donor with colourless seeds. Expression may be suppressed by inhibitor genes (e.g., C1-I) carried by female parent. Dominant colour marker genes expressed in the primary roots and coleoptile (e.g., Pl1 in conjugation with B1).

Use of DH for Crop Improvement



Wheat X Maize: Laurie and Bennet demonstrated elimination of maize chromosome from hybrid zygote. Application of 2,4-D is essential to recover haploid embryo. Features- Efficient for all genotypes, Stable DH line, Simple and Easy, Higher rate of Green plant recovery.



Mechanism of Chromosome Elimination: Bulbosum Method

Hordeum vulgare

Barley

2n = 2X = 14

X

Hordeum bulbosum

Wild relative

2n = 2X = 14

Haploid Barley

2n = X = 7

H. bulbosum

This was once more efficient than microspore culture in creating haploid barley. Now, with an improved culture media microspore culture is much more efficient.

Merits of DH Technique

Develop 100% homozygosity for all loci in one step. Shorten the time to cultivar release. DH lines can be induced as soon as from F1 generation. Improve the precision of genetic and mapping studies. Perfect compliance with DUS criteria for variety protection. Facilitates marker assisted selection and reverse breeding.

Demerits of DH Technique

More expensive, expertise, facilities required. Mutagenic treatment. Genotype dependent in another culture or microscope and bulbosum method. Need improvement of haploid regeneration frequency. Chances of gametoclonal variation leads to contamination. Over-usage of DH may reduce genetic variation in breeding germplasm.

Conclusion

Combining DH technique with hybrid breeding , backcross breeding, transgenic, induced mutagenesis, functional genomics, MAS, would accelerate crop improvement. In vivo induction method and wheat x maize cross will improve pace of cereal crop research and breeding. DH technique is now yielding real and tangible results in both basic and applied biology.

World Water Day Celebration and its Importance

Article ID: 10743

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Introduction

Water is the natural resource and the main constituent of Earth. It is widely used for both domestic and industrial uses such as drinking, washing, cooking, etc. Earth is also known as a blue planet because of the vastness of water presence. There are various sources of water such as wells, rivers, lakes, oceans, big dams, and streams but only 1-2 % water is suitable for human use.

World Water Day is observed on March 22 every year. It seeks to focus attention on the global water crisis. People and organizations mark World Water Day every year by taking action to tackle the water crisis in different ways. Water is one of the necessities for every living being on this planet.

This day was first formally proposed in Agenda 21 of the 1992 United Nations Conference on Environment and Development in Rio de Janeiro. In December 1992, the United Nations General Assembly adopted resolution A/RES/47/193 by which 22 March of each year was declared World Day for Water.

'When the well is dry, we learn the worth of water.' -Benjamin Franklin

The importance of water towards "World Water Day" celebration on 22 March every year since 1993, focuses on the importance of freshwater. World Water Day celebrates water and raises awareness of the 2.2 billion people living without access to safe water. It is about taking action to tackle the global water crisis.

The World Water Day celebrates water and raises awareness of the global water crisis, and a core focus of the observance is to support the achievement of Sustainable Development Goal (SDG) 6: water and sanitation for all by 2030.

The theme of World Water Day 2021 is valuing water. The value of water is about much more than its price – water has enormous and complex value for our households, food, culture, health, education, economics and the integrity of our natural environment. If we overlook any of these values, we risk mismanaging this finite, irreplaceable resource. SDG 6 is to ensure water and sanitation for all. Without a comprehensive understanding of water's true, multidimensional value, we will be unable to safeguard this critical resource for the benefit of everyone.

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Importance of World Water Day

A new World Water Development Report is released each year on or near World Water Day, to provide decision-makers with tools to formulate and implement sustainable water policies. This report is coordinated by UNESCO's World Water Development Programme (WWAP) on behalf of UN-Water. The annual theme for World Water Day is aligned with the focus of the report. The development of the UN WWDR, coordinated by the World Water Assessment Programme (WWAP), is a joint effort of the UN agencies and entities which make up United Nation -Water, working in partnership with governments, international organizations, non-governmental organizations and other stakeholders prepared report to make awareness every year.

2014	Water and Energy
2015	Water for sustainable world
2016	Water and Jobs
2017	Waste water – the untapped resources
2018	Nature based solution for water
2019	Leaving no one behind
2020	Water and Climate change

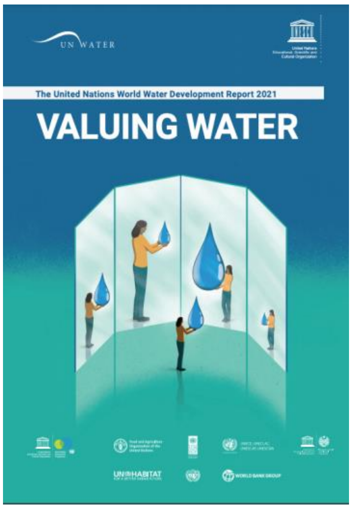
We can celebrate World Water Day by practising ways to conserve water in your daily routine. Here are some important and easy ways for the conservation of water:

1. Keeping the tap closed when not in use and don't ignore any water leaks
2. Use the collected rainwater for different purposes as required.
3. Do not prolong your bathing, have a quick shower.
4. Practise rainwater harvesting.
5. Other events are held globally during World Water Day.
6. Visual art and musical shows related to water.
7. Educational and informative events on the importance of clean water and protecting water resources.
8. Campaigns on rainwater harvesting methods.
9. A trip to local rivers, lakes and reservoirs.

World Water Day Theme - 2021

World Water Day will focus on the theme, Valuing Water this year. This target will extend beyond concerns of cost to include the environmental and socio-cultural value placed on water resources. World Water Day 2021, is about what water means to people, it's value and how we can protect this essential life resource.

The World Water Day celebrates water and raises awareness of the global water crisis, and a core focus of the observance is to support the achievement of Sustainable Development Goal (SDG) 6: water and sanitation for all by 2030.



The 2021 edition of the United Nations World Water Development Report (UN WWDR 2021) entitled 'Valuing Water ' groups current methodologies and approaches to the valuation of water into five interrelated perspectives: valuing water sources, in situ water resources and ecosystems; valuing water infrastructure for water storage, use, reuse or supply augmentation; valuing water services, mainly drinking water, sanitation and related human health aspects; valuing water as an input to production and socio-economic activity, such as food and agriculture, energy and industry, business and employment; and other sociocultural values of water, including recreational, cultural and spiritual attributes. These are complemented with experiences from different global regions; opportunities to reconcile multiple values of water through more integrated and holistic approaches to governance; approaches to financing; and methods to address knowledge, research and capacity needs.

Theme of World Water Day in the past years:

1993 : Water for the city.
1994 : It is everyone's job to take care of our water resources
1995: Women and Water
1996 : water for the thirsty city
1997 : Water of the World: What's Enough
1998: Ground Water - Invisible Resources
1999: Everyone is living towards the flow
2000 : Water for the 22nd Century
2001 : Water for health
2002 : Water for Development
2003 : Water for the future
2004 : Water and Disaster
2005 : 2005-2015 Water for Life
2006 : Water and Culture
2007 : Mundar with water rarity
2008 : Cleanliness
2009 : Across the Water
2010: Clean water for a healthy world
2011 : Water for cities
2012 : Water and Food Security
2013 : Water cooperation
2014 : Water and Energy
2015: Water and Sustainable Development
2016 : Better Water, Better Jobs
2017 : Why Waste Water?
2018 : Nature for Water
2019 : Leaving No One Behind
2020 : Water and Climate Change
2021 : Valuing water

Conclusion

A water crisis is a global crisis. Without sustainable access to water, we will be unable to achieve goals such as quality education or the development of more prosperous, fairer societies. History has demonstrated this. Given the urgency of the situation, the coming decade needs to be one of action. The value of water is about much more than its price – water has enormous and complex value for our households, food, culture, health, education, economics and the integrity of our natural environment. If we overlook any of these values, we risk mismanaging this finite, irreplaceable resource. Without a comprehensive understanding of water's true, multidimensional value, we will be unable to safeguard this critical resource for the benefit of everyone.

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Miscellaneous Approaches for Doubling Farmers' Income in Fruit Crop

Article ID: 10744

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India is an agriculture-based country. Farming in India is characterized by small and fragmented holdings and high dependence on monsoon rains that is unviable for being a profitable business or enterprise to the farming community.

Also, from some past time farm resources have also been degraded in many states, due to regular mono-cropping and intensive input practices done by farmers. These factors directly affect the farmers' income, which is already increasing at a very steady rate.

In India average monthly income is very low only Rs. 8.931.00 (per capita household), among states highest in Punjab i.e., Rs. 23,133.00 and lowest in U.P i.e Rs. 6668.00 (Anon 2016-17). Fundamentally income of farmers may be enhanced by increasing the production and reducing the costs of production.

Since, there is limited scope of increase in area under present scenario of agriculture in India, but enhancement in crop productivity, increasing crop intensity, diversification with high value crops; minimum support price and crop insurance are some possible routes to increase the farmers' income.

Higher yield per ha can be achieved by modification of planting system like intensive cultivation (Gogoi et al 2015), High density planting and medow orcharding (Singh and Singh 2007). Diversification can be a major game changer in increasing fruit farmers' income. Fruit based cropping system (Kumar et al 2016) proved to be high income generating system.

Medow orcharding in guava

Micro-irrigation in papaya

Water and fertilizer productivity can be improved by micro-irrigation and fertigation respectively. Water saving up to 20-60 per cent and increase in yield upto 60-80 per cent can be achieved though drip irrigation in fruit crops. Through fertigation about 50 percent fertilizer use efficiency can be increased in various fruit crops (Ganeshmurthy et al 2016). Implementation of some other modern approaches like precision agriculture and nano-technology in fruit culture can also be helpful in decreasing the cost of fruit production.

Government intervention held as a key to face the challenges and stabilizes the farmers' income. Subsidies to the farmers should be provided for adoption of micro-irrigation system, mechanization, natural calamities for the fruit crops. Govt. should fix base price for fruit crops in the country to secure annual farmers's income.

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Meadow Orcharding in Guava

Article ID: 10745

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Introduction

Guava is an important fruit crop in tropical and subtropical regions of the country due to hardy nature of its tree and prolific bearer even in marginal lands. Guava is rich in vitamin C (75–260 mg per 100 g pulp), pectin (0.5–1.8%), good source of thiamine (0.03–0.07 mg per 100 g pulp) and riboflavin (0.02–0.04 mg per 100 g pulp). Besides, guava fruit is also a good source of minerals, like phosphorus 22.5–40.0 mg per 100 g, calcium 10.0–30.0 mg per 100 g and iron 0.60–1.39 mg per 100 g (Singh et al. 2003). Its cultivation requires little care, management and inputs, but this crop has exhibited a paradigm shift in the production system. Guava is cultivated through a traditional system, by which, it is difficult to achieve desired level of production because large trees provide low production per unit area. Moreover, trees are growing with traditional take many years to come into full bearing and increased overall cost of production per unit area. Currently, there is a worldwide trend to plant fruit trees at high density to control tree size and maintain desired architecture for better light interception and ease in operations such as pruning, pest control and harvesting. Meadow orcharding in guava is the best techniques where higher number of plants per unit area is accommodated compared with the conventional planting system. It not only provides higher yield but also provides higher net economic returns per unit area. Meadow Orcharding enhances production and quality of fruits. Under meadow orcharding where fruiting start from the first year a precise level of pruning is also required to manage the plant canopy between vegetative and reproductive phase. Further, to maintain soil fertility and plant nutrient status, supply of proper nutrition is also required for sustaining the desired crop productivity.

Meadow Orcharding

The Meadow Orchard is a new planting system of fruit cultivation using dwarf tree with modified canopy. Better light penetration within tree canopy increases the number of well illuminated leaves. It also increases photosynthesis rate that leads to high yield per unit area. This system of guava planting is going to revolutionize the guava industry by enhancing productivity coupled with reduction in production costs. Topping and hedging in guava are helpful in controlling tree size and extending fruit availability. A comparison between meadow orchard system and the traditional system of fruit growing is necessary to evaluate the potentiality of this technique. (Singh et al., 2010).

Difference Between Traditional System and Meadow System of Planting

Traditional system	Meadow system
Fruiting start after two years	Fruiting starts from first year
Due to low sunlight penetration and large canopy, quality of fruits is poor	Good quality fruits because there is good air and light penetration
Production of cost is higher	Production of cost is lower
Labour requirement is more	Labour requirement is low
Difficult to manage due to larger size of tree	Easy to manage due to small size of tree
Average yield is 12 to 20 tonnes per ha	Average yield is 40 to 60 tonnes per ha

Spacing is 8 m X 8 m	Spacing is 2 m X 1 m
Number of plants= 156 per ha	Number of plants= 5000 per ha
Yield 25 tonnes/ha/year	Yield 55 tonnes/ha/year

Meadow Orcharding

↓

Field planting (2×1m)

↓

Top tree height of 30-40 cm from the ground level after 1-2 month of planting

↓

New shoot emerges below the cut surface

↓

Retain 3 to 4 shoot only

↓

Prune the shoot after 3-4 month of emergence (cutting back to 50% of their total length)

↓

Multiple shoots emerge below the cut end

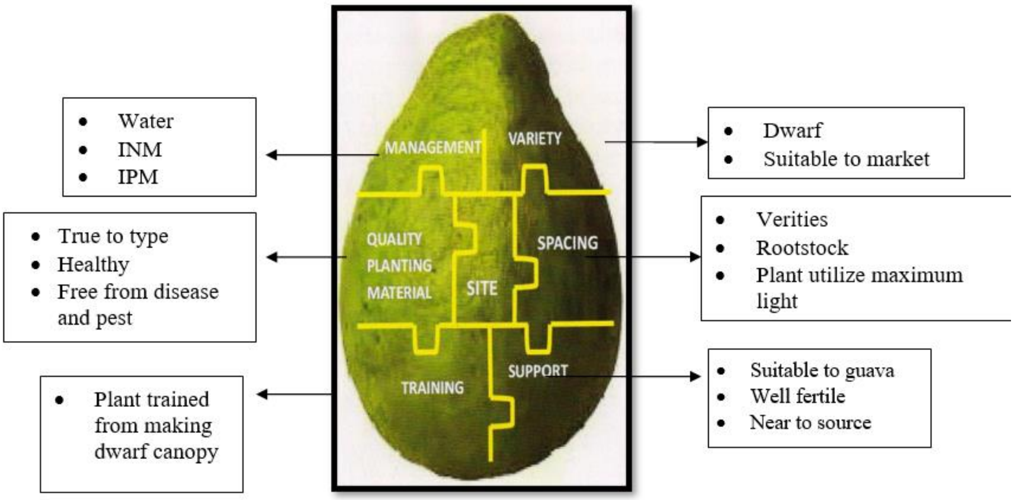
↓

Further prune the shoot after 3-4 month of emergence (cutting back to 50% of their total length)

↓

Continue shoot pruning (50%) on tree every year

Component for Meadow Orchard System



Advantages of Meadow Orcharding

1. Maximum fruiting branches
2. Minimum structural branches.
3. Better utilization of solar radiation
4. Increase the photosynthetic efficiency
5. Due to the dwarf tree minimum operation cost
6. More trees per unit area leading to higher income.

Canopy Management in Meadow Orcharding

First pruning: The tree is pruned and trained three times in a year to get maximum production of quality fruits during the first year. A single trunk tree with no interfering branches up to 30-40 cm from the ground level is desirable to make dwarf tree architecture.

After a period of 1-2 month of planting trees are topped at a uniform height of 30-40 cm from the ground level initiation of new growth below the cut and no side shoot or branch should remain after topping. This is done to make a single trunk straight up to 40 cm height.

Second pruning: After 15-20 days of topping new shoots are emerge. In general, 3-4 shoots are retained from below the cut point after topping. Shoots mature generally after a period of 3-4 months; they are reduced by 50 percent of their total length so that new shoot emerges below the cut Point. This is done to attain the desirable tree canopy architecture and strong frame work.

Third pruning: The emerged shoots are allowed to grow for 3-4 months before they are again pruned by 50 per cent. After pruning, new shoot emerge on which flowering takes place. This leads to desired canopy development, though fruiting starts in the same year.

Pruning is continued so that plants remain dwarf. After a year, pruning operation is done in May-June, September-October and January-February.

Suitable Varieties of Guava for Meadow Orcharding

Sardar, Allahabad safeda, Shweta, Lalit, CISH-G-5, CISH-G-6 and Hybrid (Lalit X Shweta).

Conclusion

India is the largest producer of guava in the world but the productivity is very less as compared to developed countries because of the absence of improved production and protection technologies. Meadow orchard planting system is one of the improved technologies with use of improved cultivars, cultural practices like canopy management and mulching leads to revolutionize the guava industry by enhancing productivity coupled with reduction of production cost along with best quality fruits. Thus, it is clear that farmers should have to adopt this technology for improving its productivity.

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Carbon Sequestration and its Importance in Agriculture

Article ID: 10746

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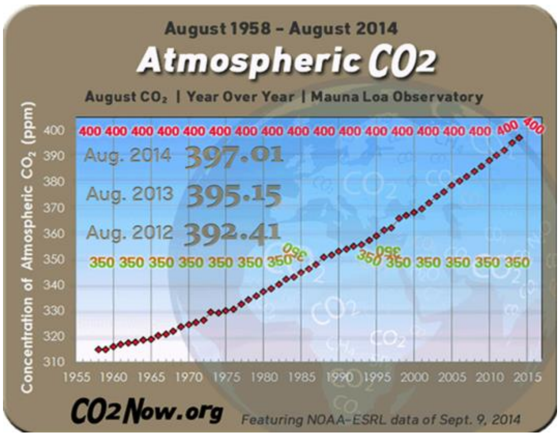
Introduction

Earth is warmer due to natural events and human activities because these activities have caused an imbalance in natural carbon cycle, consequently greenhouse effect and global warming. When fossil fuels are burnt for transportation, heating, cooking, electricity and manufacturing, it is noticed that increases in "greenhouse" gases such as Carbon Dioxide (CO_2), as a result global warming and climate change refer to an increase in average global temperatures.

Earth's average temperature has risen by 1.4°F (0.72°C) over the past century. It is projected that it will further likely to rise another 2 to 11.5°F over next century. Globally, carbon dioxide concentration increases from 316 ppm in 1960 to 411 ppm in 2019. If such situation continuously occurs, then it will lead to greater loss of biodiversity and ecosystem.



Such global climatic changes will affect agriculture through their direct and indirect effects on crops, soils, livestock and pests. Increase in temperature can reduce crop duration, increase crop respiration rates, affect the survival and distribution of pest populations and hasten nutrient mineralization in soils, reduce fertilizer-use efficiencies and enhance evapo-transpiration.

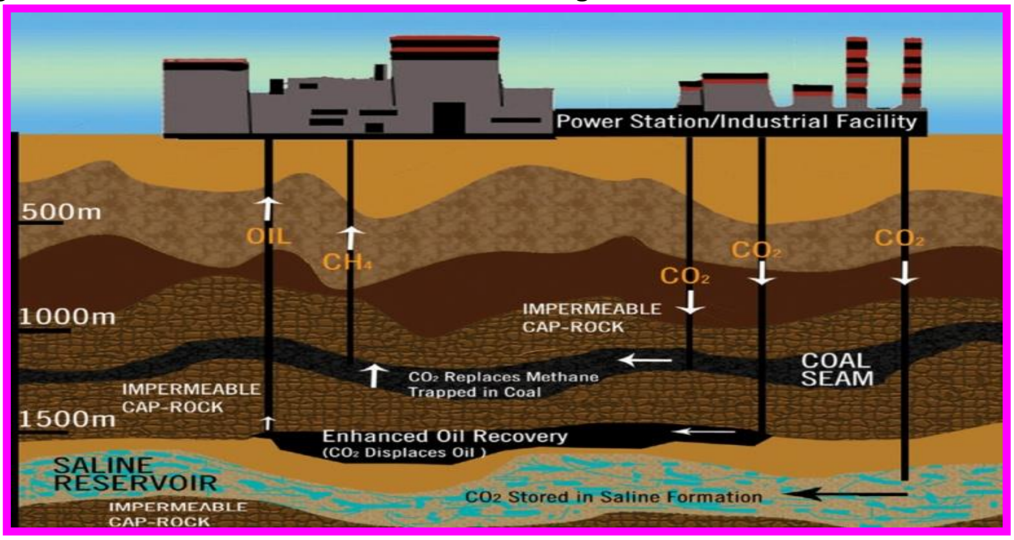
There may be considerable impact on agricultural land-use due to snow melt, availability of irrigation, frequency and intensity of inter- and intra-seasonal droughts and floods, soil organic matter transformations, soil erosion, decline in arable areas (due to submergence of coastal lands) and availability of energy.

Carbon Sequestration

Carbon sequestration is the capturing, transporting and secure storage of carbon that would, otherwise, be emitted or remain in the atmosphere. Carbon dioxide is absorbed by plants through photosynthesis in the presence of light and stored as carbon in biomass in plant parts (tree trunks, branches, foliage and roots) and soils. Increasing soil carbon by 1 Pg through carbon sequestration is equivalent to reducing atmospheric CO_2 concentration by 0.47 ppm.

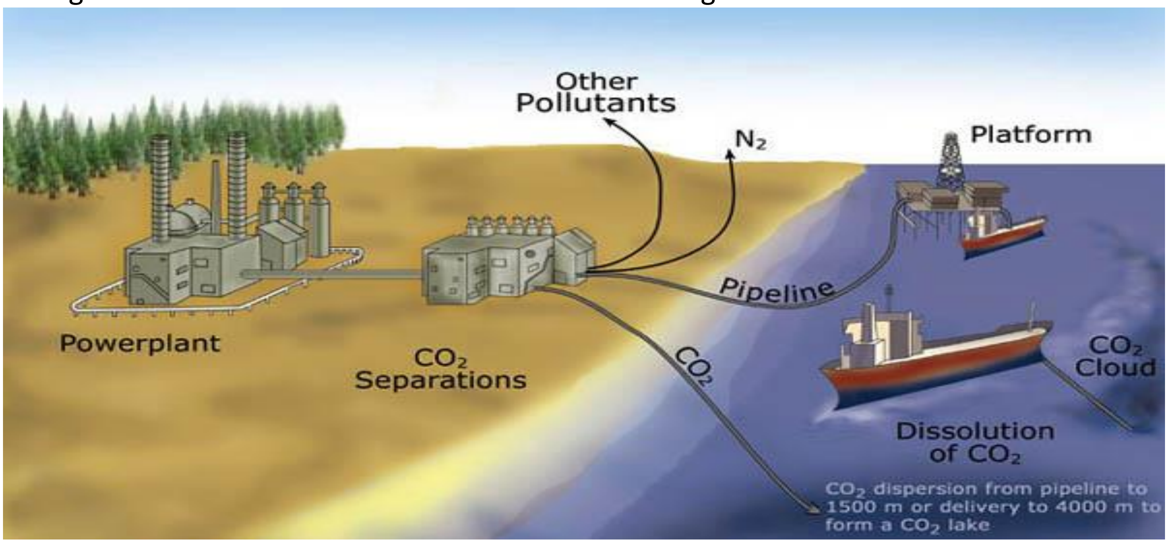
Ways that Carbon can be Sequestered

Geological sequestration: Geologic Storage involves capturing anthropogenic CO_2 before it enters the atmosphere and injecting it into underground formations. Once CO_2 is injected deep underground (typically more than 800 meters) it is trapped in minute pores or spaces in the rock structure. Impermeable cap rocks above the storage zones act as seals to ensure the safe storage of CO_2.



Ocean Sequestration

Carbon is naturally stored in the ocean via two pumps, solubility and biological and there are analogous man-made methods, direct injection and ocean fertilization, respectively. At the present time, approximately one third of human generated emissions are estimated to be entering the ocean.



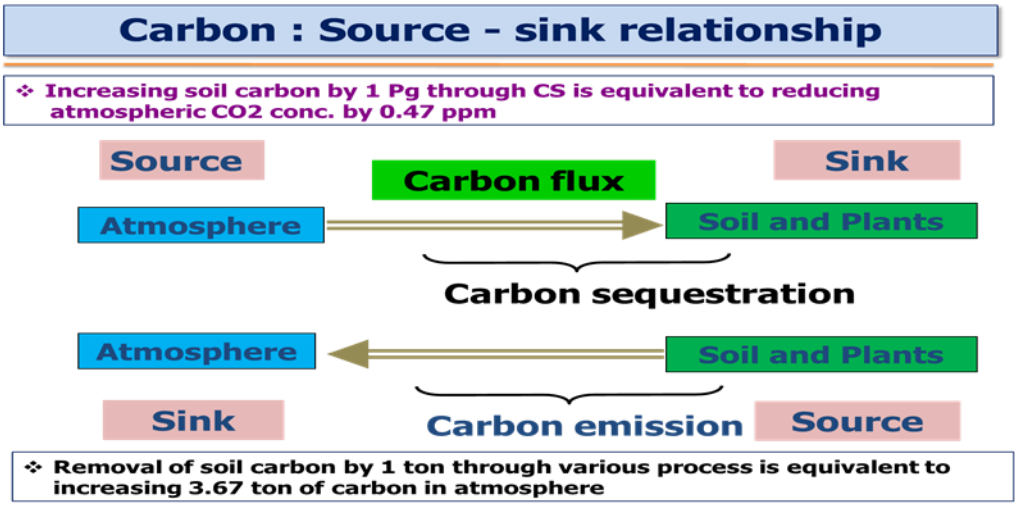
Terrestrial Sequestration

The process through which carbon dioxide from the atmosphere is absorbed through photosynthesis and stored as biomass and soils.

Carbon: Source - Sink Relationship

Carbon source: A forest is considered to be a carbon source if it releases more carbon than absorbs. Anthropogenic activities such as the burning of fossil fuels have released carbon from its long-term geologic storage as coal, petroleum and natural gas and have delivered it to the atmosphere as carbon dioxide gas.

Carbon sink: The main natural carbon sinks are plants, ocean and soil. Plants grab carbon dioxide from the atmosphere and use in photosynthesis; some of carbon is transferred to soil as plant die and decompose. The oceans are major carbon storage for carbon dioxide.



C-sequestration needed because of higher soil fertility status, overall enhancements of soil quality (Physical, chemical and biological properties improved), increased crop yield, income of farmers, rehabilitation of degraded land, reduced animal pressure on land, benefits for global climate change, reduced C losses from soil and increased CO_2 uptake from the air etc.

Agronomic Practices to Enhance C-Sequestration

Conservation till or no till: Conservation tillage is the collective umbrella term, commonly given to no-tillage, direct-drilling, minimum-tillage and ridge-tillage. Usually, the retention of 30% surface cover by residues characterizes the lower limit of classification for conservation tillage.

Residue returns as mulch: Cropland offers a huge potential for sequestering Carbon, mainly when crop residues are managed properly. Crop residues significantly influence the soil physical, chemical, and biological properties. It helps in water conservation through enhanced water infiltration, and reducing evaporation, and wind and water erosion.

Laser land leveling: This alters fields having a constant slope of 0-0.2% using laser-equipped drag buckets and gives a smooth land surface (± 2 cm). Large horsepower tractors and soil movers equipped with global positioning systems (GPS) and/or laser-guided instrumentation help to move soil either by cutting or filling to create the desired slope. Laser leveling provides a very accurate, smooth, and graded field, which helps in saving of irrigation water up to 20% and improves the use efficiency of applied N.

Bed Planting (Narrow/Broad Beds): In bed planting, crops are grown on the raised beds alternated by furrows. Beds are usually made at 0.6-1.0 m wide; and two to three rows of crops are sown on the beds. The furrow-irrigated raised-bed system (FIRBS) of wheat cultivation has been shown to result in saving of seed by 25-40%, water by 25-40%, and nutrients by 25%, without affecting the grain yield (Das, 2012).

Direct-Seeded Rice: Direct dry seeding of rice with subsequent aerobic soil conditions reduces overall water demand; saves labour, fuel, and time; and gives similar yield to transplanted rice, if weeds are effectively controlled. The technology does not affect rice quality and can be practiced in different ecologies such as upland, medium, and lowland and deep water and irrigated areas (Pathak et al. 2012).

Leaf Colour Chart (LCC): Leaf colour chart (LCC) is an easy-to-use and inexpensive tool for site-specific N management in crops. Use of the LCC would promote timely and efficient use of N fertilizer in rice and wheat to save costly fertilizer and minimize the fertilizer-related pollution of surface and groundwater. It is a promising eco-friendly and inexpensive tool in the hands of the farmers.

INM: The general recommended management practices leading to improve soil C sequestration under integrated nutrient management include the use of manures, compost, crop residues, and bio-solids, mulch farming, conversation tillage, agro forestry, diverse cropping systems, and cover crops. The addition of fertilizer on a regular basis leads to an increase in SOC and soil microbial biomass. Soil organic carbon is reported to increase by the continuous application of different combinations of N, P, and K, whereas it decreased in unfertilized soils. Accordingly, integrated use of FYM and fertilizers either maintained or improved SOC. The use of FYM/GM along with incorporation with crop residues has been found to be even more beneficial (Singh et al. 2007).

Restoring wetlands: Many wetland systems are degraded and in need of restoration. So, restoring mangroves, salt marshes and sea grasses would return in carbon benefit led to carbon sequestration.

Agro Forestry and Bio-Char in Carbon Sequestration

Agro forestry has greater potential to sequester carbon because of ability for greater capture and utilization of growth resources. Carbon sequestration rates ranging from1.5 to 3.5 Mg C per ha per year in agro forestry systems.

Bio-char is a carbon-rich solid - a by-product of high-temperature pyrolysis of biomass formed under complete or partial exclusion of oxygen at high temperatures between about 400 and 500º C. Majority of bio-char has 70-80% carbon therefore, it can potentially contribute more carbon sequestration.

Conclusion

Carbon is primarily added to the soil through plant residue and is primarily removed through CO2 respiration and the burning of fossil fuels. The addition of carbon to the soil improves many physical soil properties and is beneficial to plant growth. Carbon accumulation in agricultural soils can be accelerated by no till farming practices, planting cover crops, rotating crops, conservation agriculture, organic farming, agro forestry and bio-char application can easily be adopted and these practices have positive impact on soil carbon sequestration and crop productivity. Agricultural practices that remove carbon from the soil include tilling agricultural fields, leaving land fallow after harvest, and under fertilizing fields. Carbon sequestration is viable option in offsetting the abundance of carbon that has been released into the atmosphere by human activity and there are many tools that can be accessed that provide both soil and forest carbon sequestration.

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Replacement Heifers Crucial for Profitability of Dairy Farms

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Abstract

The dairy farmer's goal should be to raise healthy, well-grown heifers that calve and enter the milking herd by 22 to 24 months of age. Producers should strive for an average calving age of 23 months. Lifetime production and profitability increase with calving slightly below 24 months of age.

Introduction

The replacement heifers and bulls are crucial for the profitability of dairy farms. Therefore, the success of dairy enterprises depends to a greater extent on the proper management and care of the calves. Well-grown dairy calves and heifers play an important role in the future success of all dairy farms. A heifer is defined as any female calf up to her second calving. Dairy replacement heifers are usually separated from their mothers (dams) within two days of birth and managed to achieve specific growth rates throughout the rearing period until calving at the planned age, weight and body condition. The progressive dairy farmer of today realizes more and more that heifers have to receive the correct type and amount of feed if a high-quality dairy cow is to be produced at a relatively early stage. The progress of the herd depends largely on the way in which heifers are raised for replacement purposes. A sound herd cannot be establishment by the continual purchased of new heifers of whose history not much is known. The costs are relatively low when compared with prices at which heifers are sold. The best way in which the dairy farmer can determine the efficiency of his managerial programme is by measuring the performance of his heifers in accordance with accepted standards. Rearing replacement heifers has not always been seen as a fundamental part of the dairying enterprise but, when correctly planned and when specific feeding programmes have been used overall improvement in herd longevity and farm profitability results. Feeding and managing replacement heifers must be given as much priority as dealing with the milking cow. Rearing heifers must be seen as an investment in tomorrow's profit generators. They represent the highest genetic potential in the herd, so the opportunity for continued productivity should not be wasted.

Care to be taken at Birth

At the time of parturition, the cow should be attended for any assistance. Let the cow lick the calf or otherwise wipe and clean the mucous from the nostril and body of the new-born. Keep both the cow and calf warm by providing dry and clean bedding materials. Cut the naval cord of the new-born calf with a sterile scissors or knife leaving at least 1-2 inch from the naval area. Dress the cut end with 10% iodine solution for 2-3 days and let it dry. Record weight of the calf for future purposes

Colostrum Feeding

The new-born calf should be fed colostrum during the first few days after birth for reducing health problems and ensuring better growth. The calf may be allowed to suckle the mother's udder or may be pail or bottle fed within one hour of birth. The calf is needed to be trained for pail feeding as follows:

At the beginning offer a finger to the calf for suckling and then slowly dip the finger in the milk pail. Subsequently the finger has to be lowered and gradually taken out of the pail till the calf begins to drink directly from the pail. Pail feeding is suggested for the organized dairy farms to inhibit the development of mother neonate bonding so that the cow can be milked without the calf. A new-born calf ideally should receive 10% of their body weight, the fresh, creamy colostrum during its first 24 hrs of life.

Colostrum feeding of Calves: It will vary with the system followed, but whatever system may be practiced, the calf must receive the first milk which the cow gives after calving. Be sure to feed the calf enough of colostrums between 2 to 2.5 liters daily for the first 3 days following its birth.

Any excess colostrum may be fed to other calves in the herd in amounts equal to the amount of whole milk normally fed. If possible where a cow is milked before calving, freeze some of the colostrums for later feeding to the calf. None of it should be wasted. The digestibility of colostrums increases when it is given at a temperature between 99oF and 102oF. The importance of colostrums can be felt more from the following virtues.

The protein in colostrums consists of a much higher proportion of globulin than that of normal milk. The globulins are presumed to be the source of antibodies which aid in protecting the animal from many infections liable to affect it after birth. The protein content of colostrums is 3 to 5 times as that of normal milk. It is also rich in some of the materials, of which copper, iron, magnesium and manganese are important. Colostrums contain 5-15 times the amount of Vitamin A- found in normal milk, depending upon the character of the ration given to the mother during the rest period. Colostrums is also superior to milk in having a considerably greater amount of several other vitamins which have been found essential in the growth of dairy calves, including riboflavin, choline, thiamine and pantothenic acid. Colostrums act as a laxative to free the digestive tract of faecal material.

Feeding whole milk: In feeding whole milk, calves may be fed as per feeding schedule. While feeding whole milk the following points should be remembered. As far as possible provide milk from the calf's mother. Feed milk immediately after it is drawn. The total amount of milk may be fed at 3 or 4 equal intervals up to the age of 7 days and then twice daily.

Feeding skim milk: On many farms, large quantities of separated milk are available for feeding to calves and other livestock. Excellent dairy calves can be raised by changing them from whole milk gradually after two weeks of their age. Here again the feeding schedule should be followed.

Feeding dried skim milk, whey or buttermilk: The above dried products are mixed with water at the rate of 1 kg per 9 kg of water and then it is fed as skim milk. To avoid digestive troubles the mix should always be fed to calves after warming it up to 100oF.

Feeding calf starters: Calf starter is a mixture consisting of ground farm grains, protein feeds and minerals, vitamins and antibiotics. After a calf attains the age of 2 weeks the amount of whole milk given to it may be cut down. One should then rub a small amount of starter on the calf's mouth, after each milk feeding for a few days when the calf will be accustomed to it. When they reach four months of age, one should then transfer the calves to a "growing" grain ration.

Feeding grain mixture: Better growth and greater resistance to calf ailments result from consumption of grain and milk by the calf then when the calf is fed only on milk. At the age of 7-15 days the feeding of grain mixtures may be started. In order to get calves accustomed to grain mixtures, place a small handful of grain mixture in the used pail. As the calf is finishing its milk it may consume a portion, or one may offer a little in the hand immediately after feeding milk. Excessive protein rich grain mixture is not desirable as milk is already rich in proteins. A medium protein grain mixture is most suitable when milk is fed freely. A grain mixture of oats 35%, linseed cake%, bran 30%, barley 10% and groundnut cake 20% may be fed to the calves. Another good mixture consists of ground maize 2 parts and wheat bran 2parts. Calf starter is a highly nutritious concentrate mixture containing all the nutrients in proper proportion required for optimum growth and is used as a partial substitute for whole milk in the ration of calves. Since quality of protein is very important to calves until their rumen is fully functional, animal protein supplements such as fish meal should be included in calf starters. Urea should not be included in calf starters.

Feeding of growing animals (From 6 months onwards): For calves below one year of age it is always desirable to give sufficient concentrates in addition to good roughage so that they make optimum growth. Feeding concentrate can be considerably reduced in the case of calves over one year of age fed on high quality roughage. A judicious mixture of roughage and concentrate is essential for obtaining optimum growth without undue fat deposition. From six months onwards, calves can be given the same type of concentrate mixture (14-16% Digestible Crude Protein and about 70% Total Digestible Nutrients) as used for adult cattle. Examples of concentrate mixtures are given separately. Generally, calves are fed milk upto 3 months of age. Milk may be substituted gradually with milk replacer/substitute that has to be equally nutritious as milk. A well-balanced milk replacer developed at National Dairy Research Institute, Karnal consisting of wheat flour 10 kg, fish meal 12 kg, linseed meal 40 kg, coconut oil 7 kg, linseed oil 3 kg, butyric acid 0.3 kg, citric acid 1.5 kg, molasses 10 kg, mineral mixture 3 kg, aurofac 0.3 kg (antibiotic), rovimix 15 g and milk 13 kg (21% crude protein, 13.5% ether extract, 4% crude fibre, 50% nitrogen free extract and 11.5% ash) has been found to give satisfactory growth and health. This milk replacer has to be diluted with clean water at the ratio of 1:8 prior to feeding. Feeding calf with milk replacer saves milk and renders more profit to the farm. Fresh, clean and good quality water should be made available for drinking throughout the day.

Growth performance: The potential for attaining optimum body weight is an important factor that affects the economy and success of a dairy farm. Growth parameters at an early age can be used as one of the important selection criteria. The ideal birth weight of a calf may range between 15 to 35 kg depending on the breed and sex. The body weight of calves should be recorded at weekly intervals. Under adequate nutrition, dairy calves gain 400 to 500 g live weight per day, which is adequate for attaining satisfactory body weight at the end of six months.

Weaning: Weaning or discontinuing milk feeding in calves is a major challenge. The primary criteria for determining weaning of calves are age, grain intake and body weight gain. Depending on various factors and preferences, in a dairy farm, calves are weaned between 4 to8 weeks of age. The most important point is that the calf should be healthy enough before weaning and should be able to consume at least 0.5 to0.8 kg of concentrate in a day.

Health and Disease prevention: Calf hood diseases have major implications on economic viability of a dairy farm. The calf has to be observed for scouring and concomitantly the dam has to be observed for mastitis. The complications of calf scours are dehydration that may lead to stunting growth and impairment of immune system resulting in respiratory complications like pneumonia and finally death. Calves essentially require a constant supply of readily digestible energy when combating diarrhea and dehydration. Calves should receive ample amount of water till four weeks of age that facilitates adequate consumption of calf starter, lessens few scouring days and accelerates body weight gain. It is also very essential to follow a routine deworming and vaccination schedule given below.

Care and management immediately after calving: Cleaning the udder and hind quarters of cattle. Mucus removal from the face and nostrils of calf and induction of respiration. Allowing the calf to suck the colostrum. Naval cord ligation. Watching of cow for placenta expulsion. Essential requirements in a calf house: Dry bedding. Well ventilated environment. A specific minimum cubic air capacity per calf.A draught free environment at calf level. Feeding and watering space requirements for calves: Feeding space (cm) and watering space (cm) should be 50 cm per calf.

Table 1. Feeding schedule for calves from birth to above 20 months

Age of calf	Bodyweight(kg)	Quantity of milk(kg)	Concentrate	Green fodder
From birth to 4h week	25	2.5	Smaller rate	Smaller rate
4 to 6th week	30	3	50-100gm	Smaller rate
6 to 8th week	35	2.5	100-250gm	500gm
8 to 10th week	40	2	250-350gm	750gm
10 to 12th week	45	1.5	350-500gm	1.0kg

12 to 16th week	50	-	500-750gm	1.5kg
16 to 20th week	55	-	750-1000gm	2.0kg
20 to 24th week	60	-	1-1.25kg	3.kg
6 to 9th month	70-100	-	1.25-1.5kg	5-8kg
9 to 15th month	100-150	-	1.5-2.0kg	8-15kg
15 to 20th month	150-200	-	2.0-2.25kg	15-20kg
Above 20 months	200-300	-	2.25-2.5kg	20-25kg

Conclusion

Heifer live weight gain is the best indication of meeting nutritional requirements as well as adequate minerals and water provision. Farmers should focus on meeting key weight for age -live weight targets for heifers rather than a particular pattern of weight gain. Feeding and nutrition is vital for the growth of young heifers. Well-grown heifers will produce more milk, compete better with mature cows and survive longer in the herd.

Ash Gourd-Petha Kaddu

Article ID: 10748

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Ash gourd also known as *Benincasa hispida*, Winter melon, wax gourd, white pumpkin, Chinese watermelon, tallow gourd, ash pumpkin, winter melon, Chinese preserving melon is a fruit native to southern Asia. It is a vine grown for its very large fruit, eaten as vegetable when mature.

Benefits of Ash Gourd

Ash gourd contains plenty of moisture and petite amounts of fat, protein, carbohydrates and fibre, apart from calcium, phosphorous, iron, riboflavin, thiamine, niacin and Vitamin C.

1. Ash gourd is good for people suffering from weak nervous system (nervousness) and debility.
2. The ayurvedic “ Kooshmanda Asayan” is prepared from Ash gourd.
3. Agra Petha is a famous sweet prepared from ash gourd.
4. Helps to eliminate gall bladder stones.
5.Reduces dandruff.
6. Helps to cure skin irritations.
7. Cure’s acidity and ulcers.
8. Have low caloreific value and helps in weight loss.
9. Diabetic friendly vegetable.
10. Due to its alkaline property, it is used as a diuretic or bladder purifier.
11. Ash Gourd also acts as an Appetizer.

Preparation of Petha

Cutting ash gourd into cubes

↓

Soaking in lime

↓

Boiling

↓

coating in a flavoured sugar syrup

With growing demand and innovation, more varieties of the original preparation are available. Many flavoured variants are available, e.g., kesar petha, angoori petha etc. There are some other variations based on content, one with coconut mixed, another with some nuts put into it. Sometimes kewda essence is used to flavour petha.

Preparation of Juice from Ash Guard

Take required quantity of juices from the extraction of ash gourd(100 ml), amla(20%) and ginger(2%)

↓

Mix all the above three juices and blend

↓

Add sugar (15%)

↓

Cardamom for taste(pinch)

↓

Serve cold

1. In South Indian cuisine, the ash gourd is most used in preparing the sambar or curry.
2. Occasionally, it is used to produce a fruit drink which has a very distinctive taste. It is usually sweetened with caramelized sugar that enhances the taste.
3. Winter melon tea is a special drink that is prepared in Southeast Asia.

The ash gourd grows in warm weather but could be kept through the winter much like the winter squash. The melons are used in stir fry or to make winter melon soup, which is often served in the scooped-out melon, which has been intricately decorated by scraping off the waxy coating. The shoots, tendrils and leaves of this plant is also eaten as greens.

Varieties of Ash Gourd

1. Pusa ujjwal: Ideal variety for petha preparations
2. Kashi Dhawal: petha preparations
3. Kashi ujwal: suitable for candy/petha
4. Kashi surbhi: Distant hybrid.

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Snake gourd – A New Rootstock for Ridge Gourd and Bitter Gourd

Article ID: 10749

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Snake gourd is herbaceous annual climber with perennial rootstock belongs to family cucurbitaceae. Widely grown in tropical and subtropical regions for its long fruits. Monoecious plant which bears white flowers having long lacy fringes on the five petals opens at night and cultivated during both summer and rainy season.

Specific Characteristics of Snake Gourd

1. Strong and vigorous taproot system.
2. Strong and vigorous vine.
4. Tolerance to soil borne diseases.

Grafting of cucurbitaceous species using bottle gourd and pumpkin rootstock is most popular all along the world. Best suitable rootstocks for bitter gourd are pumpkin and bottle gourd and also many researchers have got greater percentage of graft success using these rootstocks. But the use of snake gourd as a rootstock in cucurbits grafting study is meager.

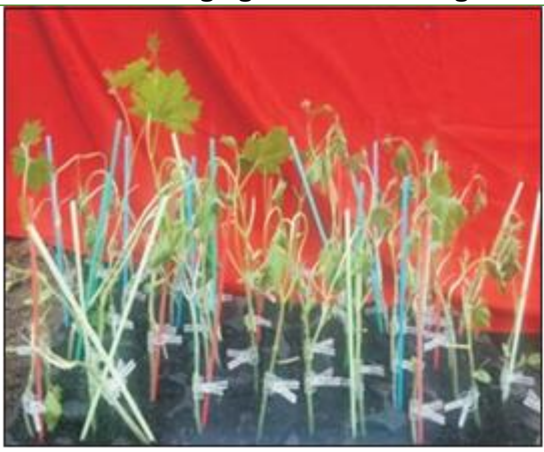
In our study we used bottle gourd, Pumpkin and snake gourd rootstock to graft bitter gourd and ridge gourd scions using Wedge grafting method. After 10 days of grafting 96.33 % of graft success in ridge gourd scions grafted on snake gourd rootstock and 89.33 and 88.17 percentage of graft success in bitter gourd scions grafted on both pumpkin and snake gourd rootstock respectively. Throughout our research work we didn't notice any wilt disease attack on crop.

Table 1. Graft compatibility of cucurbitaceous rootstocks and scions:

Treatment	Graft compatibility	
Rootstocks	Scions (% success)	
	S_1	S_2
R_1	64.83	75.17
R_2	89.33	84.66
R_3	88.17	96.33
SEm±	0.66	
CD at 5 %	2.11	
CV (%)	1.39	

Rootstocks:
R_1 - Bottle gourd.
R_2 – Pumpkin.
R_3 - Snake gourd.

Scions:
S_1 – Watermelon.
S_2 – Muskmelon.

	
Ridge gourd on Snake gourd	**Ridge gourd on Pumpkin**
	
Bitter gourd on Snake gourd	**Ridge gourd on Bottle gourd**
	
Bitter gourd on Pumpkin	**Bitter gourd on Bottle gourd**

Conclusion

Grafting of ridge gourd and bitter gourd using snake gourd rootstock using wedge grafting method can help in reducing the cost of cultivation by achieving greater percentage of graft success.

Future Line of Work

1. Further there is a need to Screen the snake gourd rootstocks against biotic and abiotic stress.
2. Assessing the yield and quality parameters.

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Organic Seed Treatment- A Supersede to Chemical Techniques of Seed Treatment

Article ID: 10750

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Seed borne infestation of insects and diseases pose devastating consequences to crop production. The concept of organic seed treatment is the use and application of biological and natural products that basically can control or contain primary soil and seed borne infestation. This helps to improve crop safety which in turn leads to good establishment of healthy and vigorous plants which results in better yields. It is estimated that 80% of the seeds sown in our country is untreated as against 100% seed treatment practice in developed countries.

The benefit of seed treatment leads to increased germination and ensures uniform seedling emergence. Overall seed treatment leads to improved plant population and thus higher productivity. The users can choose the method of treatment depending on the availability of the resource or disease / pest prevalent in their region.

Organic Seed Treatment Sources

The organic seed are treated normally with materials from organic sources are:

Botanicals	Biofertilizers	Cow's product	Biocontrol agent	other
Neem leaf extract	*Rhizobium*	Panchagavya	*Pseudomonas spp.*	Coconut milk
Mint leaf extract	*Azatobacter*	Cow milk	*Trichoderma spp.*	Tender coconut
Prosopis leaf extract	*Phosphobacteria*	Cow dung		
Arappu leaf extract	*Azospirillum*	Cow urine		
		Butter milk		

Organic Seed Treatment Techniques for Various Crops

1. Seed treatment with butter milk (125 ml / kg of seeds) to prevent fungal diseases in crops.
2. Soaking of paddy seeds in Panchagavya (35 ml per litre of water) for 30 hours before sowing enhances seed germination.
3. Soaking of paddy seeds in 20% mint *(Mentha sativa)* leaf extract for 12 hours before sowing. This will also help in the control of Helminthosporium leaf spot disease in paddy.
4. Cotton seeds for rainfed and summer sowing should be hardened using 1% Prosopis and Pungam leaf extract (10 ml of each extract in 980 ml of water) to resist water stress.
5. Smear seeds with mustard oil @ 100 ml / 40 kg of seeds before sowing to prevent wilt disease in chickpea. Similarly smearing of cumin seeds with castor oil @ 2 litres / 25 kg of seeds before sowing for the prevention of wilt disease.
6. Mix seeds with well fermented (sour) butter milk and shade dry before sowing. The acidic nature of the butter milk reduces the incidence of wilt and dry root rot diseases in pulses.
7. Treat the seeds with asafoetida solution (75 – 100 gms in 1 litre of water) and shade dry before sowing. This seed treatment method prevents ergot disease in sorghum.
8. Soak the oil seeds in Jeevamirtham / Amirthakaraisal / Panchagavya for 4 - 6 hours and shade dry before sowing.

9. Treat the Bhendi seeds with 15% or 25% raw cow's milk (150 ml of milk in 850 ml of water or 250 ml of milk in 750 ml of water) for 6 hours and then sow. This will increase the germination percentage and seedling vigour. It will also reduce the intensity of the vein clearing disease and increase the yield.
10. The brinjal seeds should be soaked in a solution of cow's urine (1 part cow's urine + 5 parts of water) for 30 minutes prior to the sowing. This will inhibit the seed borne diseases like fruit rot and die back.
11. Soak the bottle gourd seeds in warm water for 30 minutes before sowing. This helps in the softening of the hard seed coat.
12. Soak the chilly seeds in sweet flag extract or cow's urine at 1:5 ratio (1 part of extract or cow's urine with 5 parts of water) for 30 minutes before sowing. This will inhibit the seed borne diseases like fruit rot and die back.

Advantages of Seed Treatment

1. Protects germinating seeds and seedlings against soil and seed borne pathogens/insects.
2. Seed germination enhancement.
3. Early and uniform establishment and growth
4. Enhances nodulation in legume crop.
5. Better than soil and foliar application.
6. Uniform crop stand, even in adverse conditions (less/high moisture).

Conclusion

Maintaining the quality of seed is dependent on many environmental factors, some of which are moisture, temperature, humidity, and storage conditions. Even though these factors are properly accounted for, seed quality may still be reduced by certain seedborne diseases or destroyed by insects and other pests. Research has shown that treating seed with one or more pesticides is the most economical and efficient way to protect seed from these pests and improve seed quality. Hence, seed treatment is an important solution to protect the seeds from pathogens, insects and unusual conditions.

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Diseases of Sponge Gourd and its Management

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Sponge gourd is one of the popular vegetables similar to ridge gourd, the only difference is sponge gourd has smooth surface. Sponge gourd belongs to the family of 'Cucurbitaceae'. This vegetable contains vitamin A and C.

It is an important multipurpose vine crop extensively grown in Rajasthan. It has widely accepted nutrients used in desert areas. It suffers from a number of diseases. Fruit losses are greater during wet weather especially flowering stage relatively dry weather conditions.

Sponge Gourd in Other Languages

This vegetable is known by various names in different regions of the world such as:

• Torai in Hindi & Urdu • Bhol in Assamese • Jhinga in Bengali • Janhi in Oriya • Gisoda in Gujarati • Beerakaya in Telugu • Heeray kayi in Kannada	• Peechinga in Malayalam • Pirkanga in Tamil • Wetakolu in Sinhala • Patola in Tagalog • Kabatiti in Ilocano • Gambas or oyong in Indonesian.

Downy Mildew: *Pseudoperonospora cubensis*

Symptoms: Symptoms resembling mosaic viz, pale green areas separated by dark green areas appear on upper surface of leaf.

During wet season, corresponding lower surface is covered with faint purplish fungal growth.

The entire leaf dries up quickly.

Management:

Use of bed system with wide spacing with good drainage and air movement and exposure to sun help to check the disease development.

Spray with Moncozeb 0.2 % or Chlorothalonil 0.2% or Difolaton 0.2% or Ridomil MZ 72 0.1%

Seed treatment with Apron SD 35 @ 2 g./kg. followed by spraying with Mancozeb 0.2% is effective in reducing the disease.

Powdery Mildew: *Erysiphe cichoracearum*

Symptoms:

a. Powdery mildew, is especially prevalent in hot dry conditions.

b. White or brown mealy growth will be found on upper and lower surfaces and stems. Under severe infestations, the plant will be weakened and stunted.

Management: The disease can be controlled by spraying Wettable sulphur 0.1%.

Mosaic: PRSV/CMV

Symptoms:

a. A virus distributed worldwide, affecting most cucurbits but rarely affecting watermelon.

b. New growth is cupped downward, and leaves are severely mottled with alternating light green and dark green patches.

c. Plants are stunted, and fruits are covered with bumpy protrusions. Severely affected cucumber fruit may be almost entirely white.

Management:

a. The virus is readily transferred by aphids and survives on a wide variety of plants.

b. Varietal resistance is the primary management tool, and eliminating weeds and infected perennial ornamentals that may harbor the virus is critical.

c. Spray with any one of the systemic insecticides.

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Vertical Gardening – A New Era of Gardening

Article ID: 10752

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Introduction

Vertical Gardening is a special kind of urban gardening suitable to small spaces particularly for decorating the walls and roofs in various styles. This is an alternative method for gardening by expanding the scope of growing plants in a vertical space. Intensive urbanization has left hardly any horizontal space for outdoor gardens. Green walls are not only spectacularly beautiful, but also helpful in enlivening the ambiance. Green walls can absorb heated gas in the air, lower both indoor and outdoor temperature, providing a healthier indoor air quality as well as a more beautiful space.

Types of Vertical Gardening System

1. Green façade
2. Living/green wall
    a. Modular green walls.
    b. Vegetated mat wall.

Green Facades

Green facades are a type of green wall system in which climbing plants or cascading groundcovers are trained to cover specially designed supporting structures. Plants are either grown in the ground or in the elevated containers where they are watered and fertilized. Green facades can be anchored to existing walls or built as freestanding structure, such as fences or columns.

Green Walls / Living Walls

Living wall system composed of pre-vegetated panels, vertical modules or planted blankets that are fixed vertically to a structural wall or frame. These panels can be made of plastic, expanded polystyrene, synthetic fabric and support a great diversity of plants species (eg: a lush mixture of ferns, ground covers, perennials and edible plants).

1. Modular green wall: Vertical Garden Modules is made up of recycled poly propylene material. It has attractive look, highly durable in nature and it can be easily installed. It provides instant solution for making garden in your residing place.

2. Vegetated mat wall: This system, pioneered by Patrick Blanc, is composed of two layers of synthetic fabric with pockets filled with the plants and growing media .The fabric walls are supported on a framework and backed by a waterproof membrane against the building wall Nutrients and water are delivered through an irrigation system at the top of the wall.

Building and Installation of Green Walls

1. Structures and components for green wall system.
2. Suitable Plants.
3. Growing media.
4. Irrigation and plant nutrition.
5. General considerations for green walls.

Plants Suitable for Vertical Garden

Outdoor plants Peperomia, Syngoniums, Philodendron, Epipremnum, Begonia, Anthuriums, Nephrolepis, Chlorophytum, Lantana, Pilea, Rheo discolor, Cuphea, Fittonia, Spathiphylum, Schefflera.

Indoor Green Walls / For Shaded Areas

Herbaceous perennials	*Pepromia, Syngoniums, Philodendron, Epipremnum, Begonia, Anthuriums, Chlorophytum, Pilea, Rheo discolor, Fittonia, Spathiphylum, Schefflera*
Shrubs	*Schefflera, Ficusspp*
Succulents	*Rheo discolor, Zebrinapendula, Setcreaseapurpurea*
Ferns	*Nephrolepis*

For Outdoors / Exterior Green Walls

Herbaceous perennials	*Asparagus spp., Pileamicrophylla, Alternenthera, Mentha spp.*
Succulents	*Jade plant, Sedums, Portuluca*
Shrubs	*Dusty miller, Cuphea*
Ground covers	*Baby's tear, Callisarepens*
Grass like foliage forms	*Ophiophogon, Dianellatasmanica*

Growing Media

Cocopeat, Perlite, Sphagnum moss, vermiculite, vermicompost, shredded bark and leaf moulds are the common media combinations used. Soil in not used since it increases the weight of the green walls.

Irrigation and Plant Nutrition

The irrigation system is designed to minimize water consumption. It consists of an automation-unit with equipment for control of nutrient injection and irrigation cycles. Plant nutrition is delivered by a fertilizer injection system that releases controlled doses of fertiliser into the irrigation system (fertigation).

Design / Process

Each vertical garden is given a unique design and selection of species. The composition of plants takes in consideration the specific environment where it will be built, such as the local- and micro climate, sun exposure and the surrounding context. The aim is to create a one-of-a-kind and site-specific garden that stands beautiful through all the seasons of the year.

General Considerations

1. Watering: Appropriate time.

2. Careful selection for wind prone areas (Succulent and hardy plants).
3. Removing the dried leaves.
4. Keeping the structure clean.
5. Disposing the water from drainage system.
6. Pruning if necessary.
7. Timely application of fertilizers.

Benefits of Vertical Gardening

1. Aesthetic effects
2. Acts as natural insulation for hot and cold air and a save energy for your building.
3. Reduces CO_2 levels and increases oxygen and improved air quality.
4. Conserve's water and watering takes less effort.
5. Sound absorption and noise absorption.
6. Improves thermal insulation and energy efficiency.
7. Provides protection to buildings from adverse temperature and hence improves the life expectancy of the buildings.
8. Mitigate urban island heat effect.
9. It holds rain water, providing food and shelter for wildlife.

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Alternatives to Use of Antibiotic Growth Promoters in Poultry Production

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Poultry especially commercial broiler and layer farming has witnessed a tremendous growth in India over the last two decades. The sector was valued at INR 2049 billion in 2019 and is projected to reach INR 4340 billion by 2024 (Sharma and Negi, 2020). The ever-increasing demand for poultry meat and egg has transformed the traditional system of back yard rearing to an intensive system of industrial scale. The intensive systems of rearing contribute around 80% to the overall supply of poultry meat and egg.

This system of rearing promotes productive efficiency at the cost of welfare of the birds, which often results in flaring up of diseases. As a result, antibiotics are used in poultry production both as therapeutic and for growth promoting purposes (at sub-therapeutic doses). The use of antibiotics improves animal health, reduce or eliminate pathogens and reduce production costs, which are reflected in terms of improved feed conversion efficiency, fast growth, reduced morbidity and mortality.

However, residues of these antibiotics can find way in the human food chain if proper withdrawal schedule is not followed. Moreover, the likely hood of zoonotic bacteria becoming resistant to antibiotics poses a serious threat to animal and human health alike. The issues concerning the health and over all welfare of birds has shifted the paradigm from productive efficiency to one of environmental, food and public safety. Because of the changing consumer preferences and public outcry many countries across the globe have banned or restricted the use of antibiotics in animals for growth promoting purposes. The changing preference of consumers and issues related to overall human, animal and environmental wellbeing emphasizes the need to look for alternatives to use of antibiotic growth promoters. Among the available alternatives, the most popular are probiotics, prebiotics, phytogenic feed additives, organic acids, enzymes, bacteriocins and bacteriophages.

Probiotics

Live non-pathogenic and nontoxic microorganisms which when administered orally confer health benefits to the host. It is through competitive exclusion that probiotics block the attachment of pathogenic bacteria by occupying these sites. Probiotics help in maintaining normal gut microbiota, increase digestive enzyme activity, reduce bacterial enzyme activity and ammonia production which is reflected as enhanced feed intake, digestion and immune stimulation.

Probiotics contain yeast cells, bacterial cultures or a mixture of both that positively impact the gut environment. Probiotics used in poultry industry are *lactobacillus bulgaricus*, *lactobacillus acidophilus*, *lactobacillus salvarus*, *Bifidobacterium bifidum*, *Enterococcus faecium*, *Clostridium butyricum*, *Streptococcus thermophilus*, spores of *Bacillus subtilis. Pedicoccus acidilactus*, *Streptomyces* and *Saccharomyces cerevisiae* etc. The feeding of probiotics has a positive effect on the overall poultry meat quality parameters.

Their inclusion improves meat colour, fatty acid profile, water retention capacity, oxidation stability, juiciness and flavour of broiler chicken (Liu *et. al.,* 2012, Popova, 2017). It is suggested that feeding probiotics to poultry may help in mitigating the impact of coccidiosis, which can help in reducing the spread of these parasites and maintain gut health.

Prebiotics

Non digestible but fermentable feed components that beneficially affect the host by stimulating growth or activity of bacteria in ileum and caecum. In other words, they provide substrate to beneficial gut microbes. These generally consist of short chain oligosaccharides or polysaccharides, which are metabolized by gut microbes to produce fatty acids like propionate, acetate and butyrate. These components positively impact the health of birds by modulating the gut environment in way that enhances the growth of beneficial microbes, number of villus cells of intestines, nutrient utilization and decrease environmental pollution, and production costs. This results in reduced colonization of the intestine by pathogenic bacteria thereby decreasing diseases incidence. The most commonly used prebiotics include fructo-oligosaccharides and inulin type mann oligosaccharides, xylo-oligosaccharides, galacto-oligosaccharides and isomalto-oligosaccharides.

Phytogenic Feed Additives

Feed additives of plant origin have been used for growth improvement, immune stimulation and reducing stress. Use of phytogenic feed additives enhances feed efficiency, reduces medicinal costs and emissions of ammonia. They increase nutrient digestibility, reduce gut inflammation and help in amelioration of negative impact of pathogenic bacteria. Extracts of dandellon, mustard and safflower inhibit tumor cell growth, stimulate innate immunity and exert antioxidant effects in poultry. Cinnamaldehyde a constituent of cinnamon is used as an immune stimulant and has a positive impact on growth performance. Extracts from fennel, Melissa balm, peppermint, anise, oak, clove and thyme are comparable to bacitracin methyl salicylate in controlling inoculated *Clostridium*, *Salmonella* and *E. cloi* infection in poultry (Wati et al 2015). These feed additives contain many components which have antibacterial, antioxidant and conservative activities. These promote growth by enhancing nutrient uptake and reducing incidence and severity of subclinical infections. Curcumin a phenolic compound found in turmeric has antioxidant, anti-inflammatory and antitumoral activities.

Organic Acids

Organic acids are organic compounds which have a carboxylic group. Due to their lipophilic nature, they can diffuse through bacterial cell membrane and cause disruption of enzymes and transport system. Organic acids such as lactic, fumaric and citric acid reduce the acid sensitive bacteria indirectly by reducing the stomach pH. However, butyric, formic, acetic, propionic and sorbic acid act directly on the cell wall of gram-negative bacteria. These acids have been found effective against *Campylobacter* and *E. coli* in young chicken. Supplementation with citric acid can improve cell proliferation, epithelial and villus height of the gut. It has been found that supplementation of drinking water with a blend of formic and propionic acid (0.0525%) generates more homogenous microbiota in the gut and helps in colonization of *Lactobacillus* spp. in ileum of chicken (Nava *et. al.,* 2009). Addition of butyric acid helps to improve ileal digestion of less digestible protein. it acts as a source of readily available energy for intestinal epithelial cells, stimulates their multiplication and differentiation resulting in enhanced feed efficiency in chickens. Feeding organic acids to birds improves their performance, carcass characteristics, immunity and reduces mortality.

Enzymes

Enzymes produced through bacterial and fungal fermentation, are widely used in animal feed. Enzymes are actually biological catalyst capable of enhancing the chemical reactions. Enzymes are substrate specific, meaning that they can breakdown specific substrates at specific sites of reaction. Supplementation of exogenous enzymes in wheat, barley or sorghum-based diets improves performance of birds at par with those fed corn-soya based diet. They are mainly used to enhance bird performance through improved digestion of the ingredients. Inclusion of enzymes in feed enhances the digestibility of poorly digestible ingredients, which improves gut health by shifting the balance of gut flora towards favourable bacterial species. Use of enzymes reduces excreta moisture and incidence of wet litter. Amylases, phytases, proteases and cellulases are some of the enzymes used alone or in combination in poultry ration.

Bacteriocins

Extracellular proteinaceous compounds synthesized by bacteria having antibacterial properties. These compounds are pepsin, trypsin and protenase K labile. these are stable at pH3.0 to 9.0 and are extremely heat resistant. The bacteriocin producing strains protect themselves against the toxicity of their own bacteriocin by expressing specific immunity proteins. These are either bacteriostatic and bacteriocidal in nature and exert their action by binding to specific receptors on the surface of the microorganisms, which transports them across the cell membrane. Bacteriocins derived from lactic acid bacillus are mostly used in food preservation; as they inhibit growth of undesirable bacterial improve its sensory qualities. Colonization of chicken caeca by *Campylobacter jejuni* is greatlt reduced by bacteriocins producing *lactobacillus salivaris*. These bacteria colonized caeca without doing any harm. Bacteriocin isolated from *Enterococcus faecium* from free range chickens show antibacterial activity against *Salmonella pullorum.*

Bacteriophages

Viruses that specifically target and infect bacteria are called bacteriophages. They are globally ubiquitous and are found in every habitat colonized by bacteria. The gut viral community (virome) predominated by bacteriophages is called phageome. Like other viruses phages are also obligate intracellular parasites. Phages having specificity for only one type of bacterial species are called mono-valent phages and those capable of attacking two or more than two species are called polyvalent phages. A number of factors determine the efficacy of phage therapy including its persistence in host, dosage and virulence. Phage therapy has great potential as an alternative to antibiotics, which are commonly used for therapeutic and growth promoting purposes. Phage therapy has proven successful in treating various bacterial diseases like salmonellosis, campylobacteriosis and *Clostridium perferengenes* infection. Phage therapy has also been found effective against *E. coli*, a leading cause of mortality in poultry. Administering phage therapy in chicks significantly reduces mortality; however, its effectiveness is determined by site and route of administration. Mortality in chicks challenged with *E. coli* was avoided, when phage therapy was administered through intramuscular route and the birds did not manifest any clinical signs.

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Natural Farming Method-Desi Cow Curd (Yoghurt) with Copper, 95 Percent More Benefits than Urea, Pesticide, Irrigation in Agriculture

Article ID: 10754

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Introduction

Crisis of Indian agriculture is very pertinent at this moment as green revolution is gradually losing its hope. Excessive, pointless exploitation of broods of green revolution has left bad footprints on country's food security and environmental safety. With the motto to ensure food security by reviving Indian agriculture in environmentally safe way as well as to release farmers from debt cycle and suicides, Andhra Pradesh natural farming (APCNF) has come in the picture, which discards uses of all the chemical farming inputs and relies on natural way of farming (Khadse & Rosset, 2019).

Background of Indian Agriculture

Agriculture is the most important sector of Indian Economy. In its prevailing form, agriculture requires farmers to rely heavily on inorganic external chemical inputs such as fertilizers and pesticides. These contaminate groundwater and other water dependent ecosystems, reduce soil fertility over time, and contribute to biodiversity loss in farmlands. The use of such inputs exposes smallholder farmers to a high degree of credit risk and traps them in a perpetual cycle of debt. An agricultural system with such exposure to risk favours large farming, and adversely impacts the 2.5 billion people who are involved in full- or part-time smallholder farming worldwide. Small holdings are a critical source of livelihoods and smallholders in developing countries produce about 80 per cent of the food consumed. They are also integral to addressing the global food security challenge, which will compound multi-fold by 2050. Prevailing agricultural practices such as mono-cropping decrease soil moisture content, causing tremendous stress on water resources.

Agriculture, today, accounts for almost 70 per cent of the world's freshwater consumption. The use of external inputs by adoption of uniform, hybridized, and genetically modified crop varieties erodes genetic diversity of seeds, and reduces their capacity to adapt to changing climatic conditions. These practices, coupled with widespread farmland degradation, make agriculture a major contributor to global greenhouse gas (GHG) emissions, and climate change.

Alternative low-input farming practices have emerged in pockets across the world promising reduced input costs and higher yields for farmers, chemical-free food for consumers and improved soil fertility. Andhra Pradesh Community Natural Farming (APCNF) has been emerged as a farming model for small and marginal farmers to overcome the farming distress and sustaining the livelihood and keeping the health of family on top priority.

Zero Budget Natural Farming V/S Organic Farming

S. No.	Zero Budget Natural Farming	Organic Farming
1.	No external fertilizers are used in ZBNF.	Organic fertilizers such as compost, cow dung and vermicompost are used in organic farming.

2.	There is no tilling and no mixing. It requires natural ecosystems.	It requires basic agro methods like tilling, ploughing, mixing, etc.
3.	It is low-cost farming due to the local Biodiversity.	It is expensive due to the need for bulk Manures.

Concept behind Andhra Pradesh Community Natural Farming (APCNF)

The concept behind APCNF is that over 98 per cent of the nutrients required by crops for photosynthesis - carbon dioxide, nitrogen, water, and solar energy- are already available “free” from the air, rain and Sun. Only the remaining 1.5 per cent to 2 per cent nutrients need to be taken from the soil, and converted from “non-available” to “available” form (for intake by the roots) through the action of microorganisms. To help the microorganisms act, farmers must apply ‘Jiwamrita’ (microbial culture) and ‘Bijamrita’ (seed treatment solution), and take up ‘mulching’ (covering plants with a layer of dried straw or fallen leaves) and ‘Waaphasa’ (giving water outside the plant’s canopy) to maintain the right balance of soil temperature, moisture, and air.

Andhra Pradesh Community Natural Farming (APCNF) in Andhra Pradesh

APCNF is a local and regional grassroots agrarian movement and regenerative agricultural practice that has the potential to enhance the socio-ecological resilience of smallholder farmers to climate and land use change. In Andhra Pradesh, the expansion of APCNF is a state-wide agricultural priority that is being facilitated by a centralized organization called “Rythu Sadhikara Samstha (RySS)”.

It is a broad state policy with multiple objectives including enhancing farmers’ welfare, consumer welfare, and the conservation of the environment. The work is done through farmer–to–farmer mentoring, short tutorials and films, and modern communication methods.

Identification of New Natural Farming Method in Kadapa, Andhra Pradesh

A new method was identified by an NGO (NON- Governmental Organisation) named K. Nageswar Reddy having a Non-profit Voluntary Organisation called “People’s Action in Development (PAID)”, Kadapa, Andhra Pradesh.

He was also a farmer and fascinated in performing new natural farming methods in his work and also assisting various natural farming methods to the farmers in different areas at low cost. One such method he found, while he was performing in his own field named “Yoghurt (Desi Cow) Fermented in a Copper Jar”. This method helped to control pest attack in his field from the initial stage onwards.

Preparation of Yoghurt (Desi Cow)

“Yoghurt (Desi Cow) fermented in a Copper Jar” is a powerful method which helps to manage various pest, growth enhancer, increase soil fertility and crop yield. First take 2lt Desi cow milk and pour in a Copper Jar. Then add few drops of Desi cow curd in it.

Keep it aside in the shade for 8-15days for fermentation. During fermentation various reactions takes place between the milk and copper jar results in conversion of Desi Cow curd with the release of hydrogen and salt. Then after fermentation, spray by mixing it in 100lt of water in the field with two days interval. By doing this, the plant will remain green for 25 to 45 days. Nitrogen is no longer needed. The crop will turn green.

Benefits

Copper (Cu) is one of eight essential plant micronutrients. Copper is required for many enzymatic activities in plants and for chlorophyll and seed production. Deficiency of copper can lead to increased susceptibility to diseases which can cause significant yield loss in small grains.

However, copper deficiency can occur in high organic matter and sandy soils. There are many benefits of using yogurt. Yogurt farming saves 95 percent of the cost and increases agricultural production by at least 15 percent.

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Success Story of a Farmer in Kadapa, Andhra Pradesh

In Sitharamapuram cluster, Chapadu Mandal, Kadapa, Ramanjaneyulu a Mandal Activist (M.A) in APCNF and a Farmer - in her one-acre field of Paddy field, there is severe Brown plant hopper attack due to severe rains. After the guidance of FNGO- K. Nageswar Reddy of People's Action in Development (PAID), Voluntary Organisation and with the assistance of Agricultural Technical Officer- K. Sowndarya he prepared "Yoghurt (Desi Cow) fermented in a Copper Jar. After few days of spraying in the field there is almost disappearance of pest and got more yield in his field.

1. Due to more rains, crop is attacked with Brown plant hopper

2. Copper Jar with 2lt Desi Cow milk added with few drops of curd (Desi Cow)

3. After 15 days, Ramanjaneyulu (farmer) collected 2lt Desi cow curd mixed with 100lt water

4. Farmer spraying in the field with Knapsack sprayer

5. Appearance of the field after sprayed 3rd day

6. Appearance of the field after sprayed 5th day with 95% reduction of pest

Fig. Preparation of Yoghurt (Desi Cow) in various steps

APCNF is Unsecure for Present Situation

In the 1960s, the Green revolution increased food grain production with the aim of achieving food security and prevented famines. At present India's population is increasing. So, we need an abundant food supply. This may not be possible if we completely switch to natural farming.

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Reverse Breeding (RB) is a New Plant Breeding Technique in Crop Improvement

Article ID: 10755

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Introduction

One of the most important insights in plant breeding was the observation that hybrid (F1) progeny typically are superior in size, growth characteristics and yield in comparison to their homozygous parents, a phenomenon known as heterosis. Its underlying driving mechanisms may be multiple and are unfortunately poorly understood (Springer and Stupar, 2007). The unpredictable nature of heterosis confronts breeders with considerable difficulties: how does one optimize the performance of crop varieties when the constituents for success are unknown?

Breeders can evaluate heterosis by controlled crosses of inbred lines (i.e., by apriori selection and combination of unknown alleles). The hit-or-miss nature of this approach makes it difficult to optimize the effects of heterosis.

Here, we propose an alternative strategy based on the reversal of crop selection: the generation of defined populations with high levels of heterozygosity and random variation. These populations are then assessed in a variety of environmental conditions (latitude, salinity, humidity, etc.) and the best performing heterozygous germplasm is selected for further breeding.

A barrier to achieving high levels of variation in current plant breeding programs is that uncharacterised heterozygotes are difficult—if not impossible—to reproduce by seeds. Favourable allele combinations of the elite heterozygote are lost in the next generation due to segregation of traits. Reverse breeding (RB) is a novel plant breeding technique designed to directly produce parental lines for any heterozygous plant, one of the most sought-after goals in plant breeding.

RB generates perfectly complementing homozygous parental lines through engineered meiosis. The method is based on reducing genetic recombination in the selected heterozygote by eliminating meiotic crossing over. Male or female spores obtained from such plants contain combinations of non-recombinant parental chromosomes which can be cultured in vitro to generate homozygous doubled haploid plants (DHs).

From these DHs, complementary parents can be selected and used to reconstitute the heterozygote in perpetuity. Since the fixation of unknown heterozygous genotypes is impossible in traditional plant breeding, RB could fundamentally change future plant breeding.

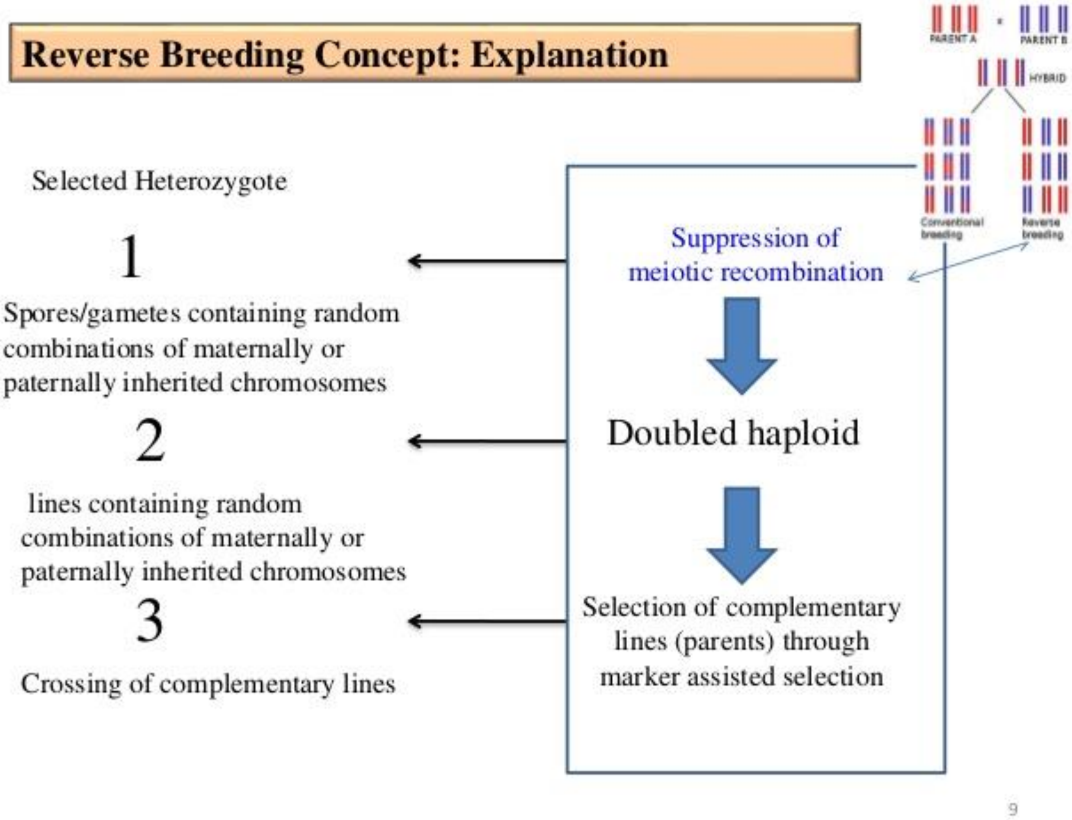
Reverse Breeding

Reverse breeding (RB) is a novel plant breeding technique designed to directly produce parental lines for any heterozygous plant, one of the most sought-after goals in plant breeding. RB generates perfectly complementing homozygous parental lines through engineered meiosis.

Reverse breeding comprises two essential steps: the suppression of crossover recombination in a selected plant followed by the regeneration of DHs from spores containing non-recombinant chromosomes. Crossing over is suppressed in this plant and achiasmatic gametes are collected, cultured, and used to generate DHs. The DH lines can then be used to recapitulate the elite heterozygote on a commercial scale.

In another application, RB can be applied to plants of known background. If crossing over is eliminated in the F1 hybrid rather than the F2 generation, RB can be used to generate chromosome substitution lines. These lines contain one or more chromosomes from one parent in the background of the other parent. By backcrossing the chromosome substitution lines to the original parental lines, one can obtain populations that segregate only for the heterozygous chromosome(s).

Reverse breeding, in theory, allows the re-shuffling of chromosomes between two homozygous plants in all possible way. The intended goal of the reverse breeding technique is to generate perfectly complementing homozygous parental lines through a suppression of meiotic crossovers and the subsequent fixation of nonrecombinant chromosomes in homozygous doubled haploid (DH) lines. Reverse breeding is a very young technique and technical problems and to fully exploit its potential.

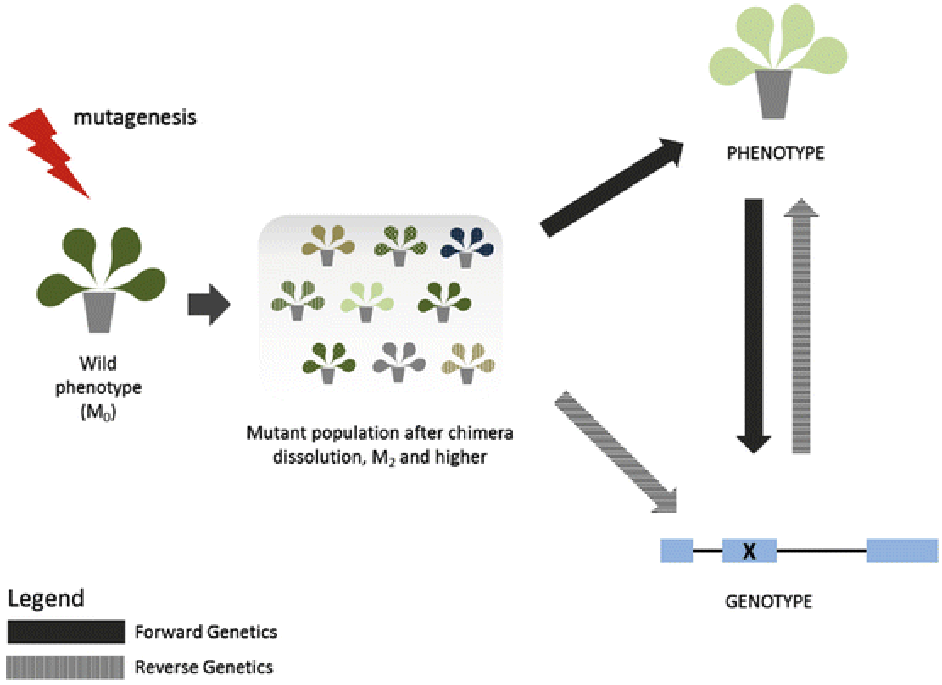


The recent developments to manipulate the meiosis and crossing over promise to further enhance these capabilities to produce haploids by centromere heterochromatin (CNH3) mediated genome elimination. Additional research is needed to improve the efficiency of DH formation.

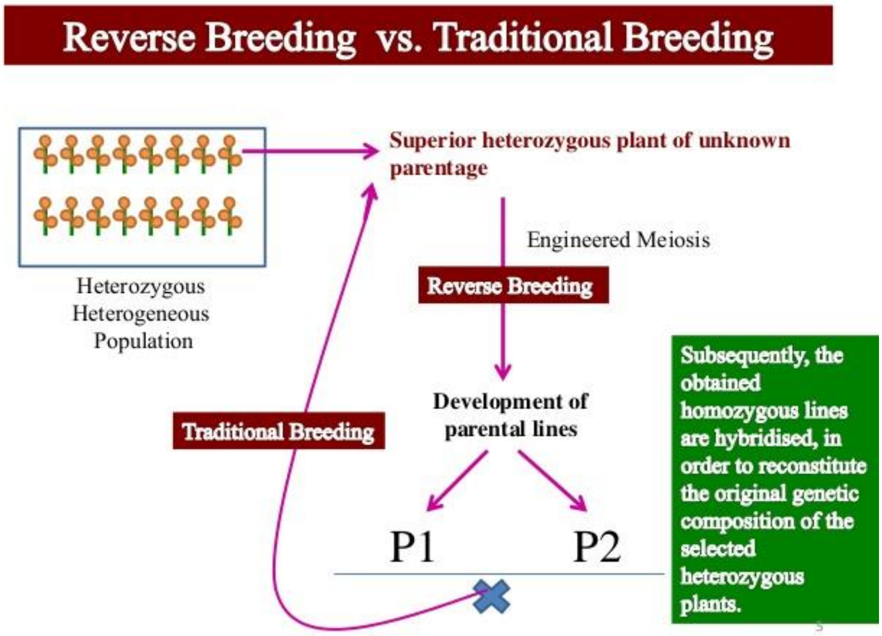
The combination of crossover suppression, followed by the regeneration of haploid spores into DHs results in novel and powerful breeding applications. One important application is the production of complementary homozygous lines that can be used to generate specific F1 hybrids.

Additionally, when RB is applied to F1 heterozygotes, it is possible to generate chromosome substitution lines that allow targeted breeding on the single chromosome scale. RB is fully compatible with commercial CMS lines that are frequently used in modern agriculture. The technique however is limited to crops with a haploid chromosome number of 12 or less and in which spores can be regenerated into DHs. In polyploids or species with high chromosome numbers, another reconstruction method has been proposed that is based on the omission of the second meiotic division, leading to unreduced second division restitution (SDR) spores.

The use of these SDR spores enables the near reconstruction of desired phenotypes, and also provides the possibility of obtaining chromosome substitution lines. There is growing interest in the development of plant breeding techniques that are based in modifications of meiosis.



However, most techniques are merely extensions of the 'classic' plant breeding practice aimed at more efficient introgression of traits from alien backgrounds into crops. Pivotal for understanding the expected impact of germplasm fixation on plant breeding should be the realization that plant breeding relies heavily on the human eye for the selection of breeding lines. It is not difficult to imagine that selection for (overdominant) complex traits or QTLs is a daunting task. Visual selection is therefore always accompanied by extensive testcrosses aimed at control avoiding the loss of valuable traits during selection. Methods that allow the fixation of elite germplasm (apomixis and reverse breeding) provide alternatives to this selection process. Though reverse breeding may appear more complex than apomixis at a first glance, it does not suffer from the drawback of the current knowledge of apomixes. As a plant breeding tool, reverse breeding may be regarded more versatile as its controlled deconstruction of complex genotypes into homozygous parental lines allows the further improvement of these lines by classic breeding methods.



Reverse Breeding Applications

Reconstruction of heterozygous germplasm: For crops where an extensive collection of breeding lines is still lacking, RB can accelerate the development of varieties. In these crops, superior heterozygous plants can be propagated without prior knowledge of their genetic constitution.

Reverse breeding and marker assisted breeding: Especially in combination with (high throughput-) genotyping, reverse breeding becomes a versatile tool. Evidently, high throughput genotyping speeds up the process of identification of complementing parents in populations of DHs in early stages. But perhaps more powerful is its use in the study of gene interactions of the various heterozygous inbred families (HIFs) that can be produced by crossing and backcrossing the products of RB (as was explained above). The screening of populations that segregate for traits on a single chromosome allow the quick identification of QTLs, when genotyping is combined with –for example- transcriptome or metabolome profiling. Such HIFs further aid the generation of chromosome specific linkage maps and the fine mapping of genes and alleles. RB can as such provide highly valuable insights into the nature of heterotic effects.

Conclusion

There is growing interest in the development of plant breeding techniques that are based in modifications of meiosis. However, most techniques are merely extensions of the 'classic' plant breeding practice aimed at more efficient introgression of traits from alien backgrounds into crops. Pivotal for understanding the expected impact of germplasm fixation on plant breeding should be the realization that plant breeding relies heavily on the human eye for the selection of breeding lines. It is not difficult to imagine that selection for (overdominant) complex traits or QTLs is a daunting task. Visual selection is therefore always accompanied by extensive testcrosses aimed at control avoiding the loss of valuable traits during selection. Methods that allow the fixation of elite germplasm (apomixis and reverse breeding) provide alternatives to this selection process. As a plant breeding tool, reverse breeding may be regarded more versatile as its controlled deconstruction of complex genotypes into homozygous parental lines allows the further improvement of these lines by classic breeding methods. Since the fixation of unknown heterozygous genotypes is impossible in traditional plant breeding, RB could fundamentally change future plant breeding.

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Pyrosequencing and its Application

Article ID: 10756

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Abstract

Pyrosequencing technology is a different DNA sequencing technology, developed at the Royal Institute of Technology (KTH) Sweden. It is the alternative of Sanger method for de novo DNA sequencing. Pyrosequencing principle based on the sequencing by synthesis.

It involves a series of four enzymes to exactly detect nucleic acid sequences during the synthesis. The method used for single nucleotide polymorphism analysis and sequencing of short stretches of DNA.

Introduction

Pyrosequencing method based on sequencing by synthesis principle on the detection of released pyrophosphate (PPi) during DNA synthesis. It Involve four enzymes to detect nucleic acid sequences during the synthesis.

Single-stranded DNA template is biotin-labeled. hybridizing with sequencing primer. DNA polymerase, ATP sulfurylase, luciferase and apyrase used as enzyme and adenosine 5′ phosphosulfate (APS) and luciferin used as substrates in pyrosequencing.

Principle

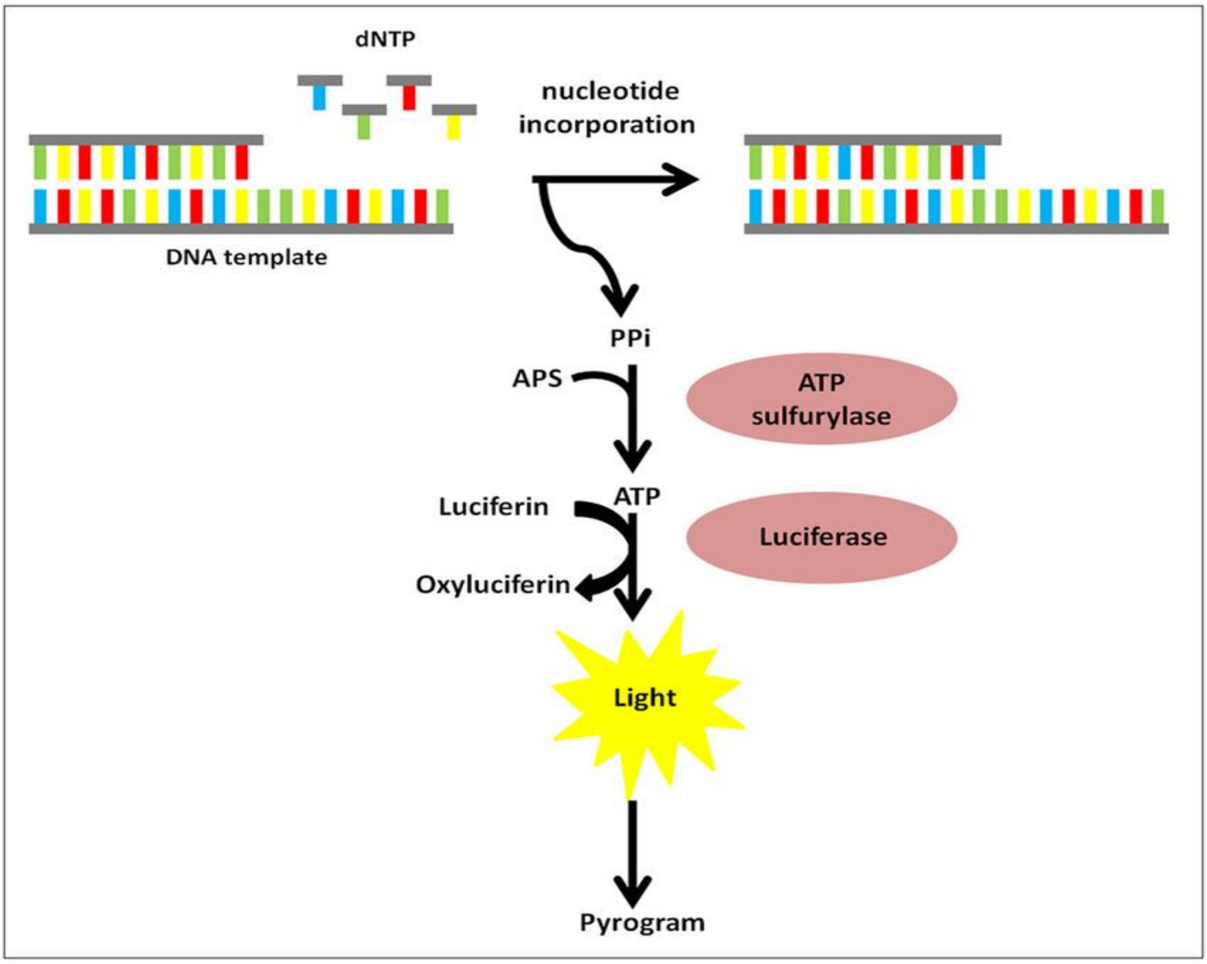
Four dNTP are separately added to the reaction mixture. The first reaction starts with a nucleic acid DNA polymerisation occurs in which inorganic pyrophosphate (PPi) is released as a result of nucleotide incorporation by polymerase. Release of inorganic PPi leads to quantify the amount of incorporated nucleotide. Subsequently, the released PPi is converted to ATP-by-ATP sulfurylase in the presence of adenosine 5′ phosphosulfate (APS).

Luciferase convert luciferin to oxyluciferin, generating light in amounts that are proportional to the number of ATPs. Luciferase reaction -catalysed and produce light with a maximum of 560 nanometer wavelength is then detected by a photon detection device such as a charge coupled device (CCD) camera or photomultiplier.

Apyrase is included in pyrosequencing technology for nucleotide-degrading enzyme, which continuously degrades ATP and non-incorporated dNTPs in the reaction mixture after each cycle. Certain time interval (usually 65 sec) between each nucleotide to allow complete degradation. That reason, dNTP addition is performed one at a time because the added nucleotide is known, the sequence of the template can be determined.

During duration of synthesis process, the DNA strand is synthesized using complementary sequence, and the DNA sequence is display by the pyrogram on a screen. DNA polymerization reaction detect light takes place within 3–4 sec at room temperature ATP sulfurylase converts PPi to ATP in around 1.5 seconds and the generation of light by luciferase in less than 0.2 seconds.

Klenow fragment from *Escherichia coli* DNA Pol I used in standard pyrosequencing. The ATP sulfurylase used in pyrosequencing is a recombinant version from the yeast *Saccharomyces cerevisiae* and the luciferase is from the American firefly *Photinus pyralis* the apyrase is from *Solanum tuberosum (*Pimpernel variety).



Pyrosequencing Technology

In pyrosequencing, removal of nucleotide is achieved by two following ways:

1. The solid phase pyrosequencing, which utilizes a three coupled enzymatic procedure with washing steps.
2. The liquid-phase pyrosequencing technique, which employs four enzymes cascade with no washing steps.

Solid Phase Pyrosequencing

This is based on a combination of the sequencing-by-synthesis technique. The four nucleotides are incorporate sequentially in the reaction system and a washing step removes the unincorporated nucleotides after each addition. In solid-phase pyrosequencing different immobilization techniques that can be used. The biotin labelled DNA template is immobilized to streptavidin coated magnetic beads. The immobilized template DNA annealed with primer is incubated with three enzymes: DNA polymerase, ATP sulfurylase and luciferase. DNA template is immobilized by a magnet bead and the unincorporated nucleotides are removed by a washing step after each reaction. In washing procedure loss of DNA templates, repetitive addition of enzymes, unstable baseline fluctuations and automation difficulties are drawbacks of this approach.

Liquid Phase Pyrosequencing

Liquid-phase pyrosequencing employs a cascade of enzymes and the DNA sequencing is observed in real-time. The sequencing reaction is beginning by annealing a sequencing primer to a single-stranded DNA template. In liquid-phase pyrosequencing have nucleotide-degrading enzyme, called apyrase. Apyrase enzyme in the pyrosequencing system excluded the use of solid phase separation and eliminated extra steps such as washes and repetitive enzyme additions. Apyrase shows high catalytic activity. Low amounts of apyrase in the reaction system efficiently degrade the unincorporated dNTP to dNTP and subsequently to dNMP. Additionally, apyrase enzyme helps to stabilize the baseline in the pyrosequencing as the same enzymes catalyse the reaction continuously.

Applications of Pyrosequencing

1. It emerged new possibilities for performing sequence-based DNA analysis.
2. It is well suited for de novo sequencing and resequencing.
3. Pyrosequencing method is broadly being used in many applications such as Single Nucleotide Polymorphism (SNP) genotyping identification of bacteria, fungal and viral typing.
4. The method has demonstrated the ability to determine difficult secondary structures and perform mutation detection.
5. DNA methylation analysis multiplex sequencing tag sequencing of cDNA library.
6. Highly significant application is whole genome sequencing.

Conclusion

The pyrosequencing method has arisen as a useful DNA sequencing technology suitable for numerous applications in the field of modern biology. In future, pyrosequencing technology is expected to reach longer read length, to reduce time of sequencing, to decrease the sample quantity and to make further improvements in automation.

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Double Haploids: New Insight into Vegetable Breeding

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Introduction

Vegetables are the foods packed with vitamins and minerals and play a major role in nutritional security. According FAO, consumption a minimum of 400g of fruit and vegetables per day (excluding potatoes and other starchy tubers) is necessary for prevention of chronic diseases such as heart disease, cancer, diabetes and obesity, as well as for alleviating several micronutrient deficiencies, especially in less developed countries. So, enhancing the production and productivity still remains the preliminary objective of vegetable breeding.

Various conventional and non-conventional approaches are used by breeders for genetic advance. Recent advances in biotechnology coupled with breeding will help to enhance the efficiency and shorten the time required to reach the fixed goals in a crop improvement program. Among these, haploid (H) and doubled haploid (DH) production through gametic embryogenesis can be considered as a valuable tool. Haploids are the sporophytes with a gametophytic chromosome number and doubled haploids (DH) are haploids that have undergone chromosome duplication (Murovec and Bohanec, 2012). They occur spontaneously in nature at very low frequency. There are various techniques for the induction of haploids and double haploids artificially.

Routes of Double Haploidization

1. Wide hybridization followed by chromosome elimination: Hybridization between unrelated parents (inter specific/ inter generic) results in the preferential elimination of one of the chromosomes sets and haploid embryos are formed. It was first reported in barley, commonly known by the name, bulbosum technique. In barley, wide hybridization was done between cultivated barley and wild barley. Chromosomes of the wild relative were preferentially eliminated from the cells of developing embryo in the later stages due to the failure of endosperm development, which lead to the production of a haploid embryo. The haploid embryo was then extracted and grown in vitro. (Kasha and Kao, 1970). Among vegetables this technique is applicable in potato.

2. Haploidization via pollination with irradiated pollen: Use of irradiated pollen (using gamma rays from Cobalt-60) or pollen from a triploid parent is found to induce maternal haploids. In this case the irradiated pollen will fail to fertilize the egg cell, but induce the development of haploid embryo. First ever haploid induction using irradiated pollen was successfully done in musk melon, Cucumis melo, by using irradiated pollen from C. ficifolius. This technique is still a popular way for haploidization in cucurbits (Kurtar and Balkaya, 2010).

3. Haploidization via gynogenesis: Gynogenesis, is the in vitro induction of haploid embryos from the haploid cells, especially the unfertilized egg cell inside female gametophyte. Usually, in vitro culture of un-pollinated flower parts, such as ovules, placenta attached ovules, ovaries or whole flower buds is done to obtain the haploid plants. This method has been successful in several species, such as onion, sugar beet, cucumber, squash, gerbera, sunflower, wheat, barley etc. (Forster et al., 2007, Kumari et al., 2018), but its application in breeding is much popular in onion and sugar beet.

4. Haploidization via androgenesis: Androgenesis refers to the production of haploids from pollen /microspore derived haploid cells. It has two routes, another culture and isolated microspore culture. In another culture, anther is dissected out from the flower bud and cultured on a suitable medium where as in isolated microspore culture, microspores are isolated from the flower buds by various techniques followed by culturing in the suitable medium. Presence of extraneous sporophytic tissues is a challenge in another culture. Androgenesis is widely used for haploidization in capsicum, tomato, brinjal, potato, cucumber, cauliflower, broccoli, carrot etc.

Chromosome Doubling

Doubling of haploids occur spontaneously in nature, but for producing fertile double haploids artificially, chromosome doubling is required.

Mechanisms of Chromosome Doubling

1. Endomitosis: Endomitosis is described as chromosome multiplication and separation but failure of spindle leads to one restitution nucleus with chromosome number doubled. It has also been called 'Nuclear Restitution'.
2. Endo-reduplication: Endo-reduplication is a phenomenon of DNA or Chromosome doubling without Cytokinesis.
3. C-mitosis: C-mitosis is nothing but endomitosis under the influence of colchicine.
4. Nuclear fusion: it occurs when two or more nuclei divide synchronously and develop a common spindle. Thus, two or more nuclei could result with doubled, polyploid or aneuploid chromosome number.

Chromosome Doubling Agents

1. Acenanaphthene.
2. Chloramphenicol.
3. Nitrous oxide.
4. Parafluorophenyl alanine.
5. 8- hydroxyquinone.
6. Colchicine.

The most commonly used doubling agent is colchicine which can be applied in vivo. It is a toxic natural alkaloid and secondary metabolite, extracted from plants of the genus Colchicum (autumn crocus, *Colchicum autumnale*, also known as "meadow saffron"). It is extracted from seeds and corms of Colchicum. Colchicine inhibits the microtubule polymerization by binding to tubulin, and thus mitosis will not take place. Therefore, colchicine is also referred to as "mitotic poison" or "spindle poison".

Different Methods of Haploidization and their Application in Various Vegetables

Mode of haploidization	Applicable in
Pollen irradiation	Capsicum, Onion, Melon, Cucumber, Squash
Another culture	Asparagus, Cucumber, Tomato, Brinjal, Capsicum, Cabbage, Cauliflower, Broccoli, Summer squash, Carrot, Potato
Isolated microspore culture	Cauliflower, Chinese Cabbage, Broccoli, Brinjal, Radish, Carrot, Turnip
Gynogenesis	Onion, Tomato, Cucumber, Pumpkin, Melon, Squash

Importance of Double Haploids

1. Double haploids may be released as a new variety (self-pollinated crops) or used as parental inbred line in hybridization programmes (cross pollinated crops).
2. Daouble haploidization serves as an easy way for production of homozygous inbred lines (especially in biennials and those having self-incompatibility, higher inbreeding depression and long juvenile phase).
3. Double haploidy along with marker assisted selection can be used as an alternative option for backcross breeding.
4. Suitable for mutation studies and they can be used to fix useful mutations.
5. Construction of genetic maps.
6. Useful for genomic studies and mapping Quantitative Trait Loci (QTL).

Limitations of Double Hapolids

1. Selection is not possible on the population in DH based breeding.
2. The cost benefit ratio in haploid breeding is often not favourable
3. Haploids will express recessive deleterious traits and deleterious mutations may arise during another culture;
4. In haploids produced from another culture, it is observed that some plants are aneuploids and some are mixed haploid-diploid types.
5. The over-usage of doubled haploidy may reduce genetic variation in breeding germplasm.
6. Other constraints associated with use of this technology are the low rate of embryogenesis and regeneration, high frequency of albinism, segregation distortion, and the low frequency of chromosome doubling to obtain DH.

Conclusion

Genetic improvement of vegetables through conventional breeding approaches consumes longer time. Use of double Haploid (DH) in conventional breeding can minimize the this and they can also serve as tool for other genetic studies.

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Panchagavya – An Organic Wonder

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Introduction

Panchagavya, an organic product has the potential to play the role of promoting growth and providing immunity in plant system. Panchagavya is prepared by using five components derived from cow viz. milk, curd, ghee, urine, dung and all these five products are individually called 'Gavya' and collectively termed as 'Panchagavya'.

Preparation of Panchagavya

Ingredients:

1. Cow dung - 7 kg.
2. Cow ghee - 1 kg.
3. Cow Urine - 10 litres.
4. Water - 10 litres.
5. Cow milk - 3 litres.
6. Cow curd - 2 litres.
7. Tender coconut water - 3 litres.
8. Sugarcane juice – 3 litres / Jaggery – 500g dissolved in 3 litres of water (1:6 ratio).
9. Well ripened poovan banana – 12 nos.

Preparation

Mix cow dung and cow ghee thoroughly both in morning and evening hours and 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 the remaining ingredients and panchagavya will be ready after 30 days.

(Note:

1. All the above items can be added to a wide mouthed mud pot, concrete tank or plastic can as per the above order.
2. The container should be kept open under shade.
3. The content is to be stirred twice a day both in morning and evening.
4. The Panchagavya stock solution will be ready after 30 days. (Care should be taken not to mix buffalo products. The products of local breeds of cow are said to have potency than exotic breeds).
5. It should be kept in the shade and covered with a wire mesh or plastic mosquito net to prevent houseflies from laying eggs and the formation of maggots in the solution.
6. If sugarcane juice is not available add 500 g of jaggery dissolved in 3 litres of water.**)**

Physical, Chemical, Biochemical & Microbiological Properties of Panchagavya

S. No	Physical properties		Chemical properties		Bio chemical properties		Microbiological properties	
1.	pH	6.82	Total N (ppm)	229	IAA (ppm)	8.5	Fungi	38800
2.	EC (dS/m2)	10.22	Total P (ppm)	209	GA (ppm)	3.5	Bacteria	2610000
3.			Total K (ppm)	232	Acetate	60.05-68.28%	Lactobacillus	2260000
4.			Na (ppm)	90	Propionate	14.39-17.79%	Total anaerobes	10000
5.			Ca (ppm)	25	Butyrate	6.40-7.65%	Acid former	360
6.			OC	17.45%			Methanogen	250
7.			Total Zn (ppm)	1.27			Actinomycetes	4.20 x 103
8.			Total Cu (ppm)	0.38			Phosphate solubilising organisms	5.70 x 102
9.			Total Fe (ppm)	29.71				
10.			Total Mn (ppm)	1.84				

Recommendation of Panchagavya for Crops

1. Foliar application: 3% solution was found to be most effective compared to the higher and lower concentrations investigated. 3 litres of Panchagavya to every 100 litres of water is ideal for all crops.

Time of foliar application:

- **a. Pre flowering phase:** Once in 15 days, two sprays depending upon duration of crops.
- **b. Flowering and pod setting stage:** Once in 10 days, two sprays.
- **c. Fruit/Pod maturation stage:** Once during pod maturation.

2. Application through irrigation water: The solution of Panchagavya can be mixed with irrigation water at 50 litres per hectare either through drip irrigation or flow irrigation.

3. Seed/seedling treatment: 3% solution of Panchagavya can be used to soak the seeds or dip the seedlings before planting. Soaking for 20 minutes is sufficient. Rhizomes of Turmeric, Ginger and sets of Sugarcane can be soaked for 30 minutes before planting.

4. Seed storage: 3% of Panchagavya solution can be used to dip the seeds before drying and storing them.

Beneficial Effects of Panchagavya on Different Crops

Paddy:

a. Increase's tillering.
b. Absence of chaffy grains.
c. Grain weight is increases by 20%.
d. Improved cooking quality.
e. Harvest is advanced by 15 days.
f. Reduced percentage of broken rice during milling.

Maize, Sorghum, Barley:

a. Increased plant growth.
b. Increased palatability.
c. Increase's nutrients in plants.
d. Harvest is advanced by 10 days.

Brinjal:

a. Green and healthy plants.
b. Attractive fruits.
c. Resistance against *Leucinodes arbonalis* (Shoot and Fruit Borer) and sucking pests.
d. Increased fruit size and keeping quality.

Other vegetables:

a. Increase in yield.
b. Extended shelf life.
c. Vegetables with shiny skin.

Mango:

a. Induces dense flowering with more female flowers.
b. Irregular or alternate bearing habit is not experienced and continues to fruit regularly.
c. Enhances keeping quality by 12 days in room temperature.
d. Flavour and aroma are extraordinary.

Acid lime:

a. Continuous flowering is ensured round the year.
b. Fruits are plump with strong aroma.
c. Shelf life is extended by 10 days.

Guava:

a. Higher TSS.
b. Shelf life is extended by 5 days.

Banana:

a. In addition to adding with irrigation water and spraying, 3% solution (100 ml) was tied up at the naval end of the bunch after the male bud is removed. The bunch size becomes uniform.
b. One-month earlier harvest was witnessed.
c. The size of the top and bottom hands was uniformly big.

Turmeric:

a. Enhances the yield by 22%.
b. Extra-long fingers.
c. Ensure low drainage loss.
d. Narrows the ratio of mother and finger rhizomes.
e. Helps survival of dragon fly, spider etc which in turn reduce pest and disease load.
f. Sold for premium price as mother/seed rhizome.
g. Enriches the curcumin content.

Jasmine:

a. Exceptional aroma and fragrance.
b. No incidence of bud worm.
c. Continuous flowering throughout the year.

General Advantages of Panchagavya

1. It improves soil health and fertility.
2. It is used against pest and diseases.
3. It increases yield and quality of produce.
4. No chemicals are used.
5. Eco-friendly approach.
6. Cost required for preparation is less.
7. No special techniques are required.
8. It gives multiple uses.
9. Reduces cost of cultivation by reducing chemicals like fertilizers, pesticides, fungicides, growth regulators etc.
10. Farmer friendly method.

Conclusion

The increasing concern for environmental safety and global demand for pesticide residue free food has evoked keen interest in crop production using eco-friendly products which are easily biodegradable and do not leave any harmful toxic residues besides conserving nature. So, it is necessary to use natural products like Panchagavya to produce chemical residue free food crops and hence Panchagavya can play a major role in organic farming.

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Nutrition Powerhouse: Black Rice

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Summary

Black rice has a magnificent high level of anthocyanin present in pericarp, also called “emperor’s rice” or “forbidden rice”. A rice variety formed by the mutation of Kala4 gene. Mainly cultivated in Southeast Asian countries like China, India and Thailand. In India black rice is grown in eastern states like Manipur, Mizoram, Meghalaya, Assam, and Odisha. Manipur black rice also known as Chakhao got its GI tag recently in 2020. The higher level of anthocyanin content increases its nutritional value and also added health benefits. It is rich in iron, antioxidants, fiber and several vitamins and proteins. Thus, black rice imposes lots of health benefits such as anti-ageing, anti-diabetic, anti-inflammatory, cardiovascular and anti-cancer effects. All these extraordinary properties make it a valuable nutritional food and adds it in a daily diet.

Introduction

Black rice (*Zizania aqatica* L.) Aboriginal to the genus Oryza sativa L. and it has been part of Asian culinary culture for last 10,000 years. Also known by purple rice, forbidden rice, king’s rice, emperor’s rice, heaven rice, and prized rice. Black rice was initially grown in china before the Chinese dynastic period and was called ‘luck rice’ because it was believed that it spans the age and has medicinal properties which cures the diseases.

In India it is being cultivated in eastern states. It is known as Chak-hao Ambi in Manipur (chak-hao means ‘delicious’ and Ambi means ‘black’) thus refers to delicious black rice, recently got GI tag. It is popular as kalabati (kala means ‘black’ and bati means ‘rice’) in Odisha. It is cultivated also in Tami Nadu, and called ‘Kavuni rice’

Historical events said that rice first appeared in eastern part of Asia then spread to across the world. This cultivated species came in several colours including red (wild rice), brown, white and black due to natural changes in the grain’s pericarp. (The difference between brown and white rice is due to the processing not to varietal) The colour of rice grain is determined by the colour pigment which they accumulate. Black color of rice is due to accumulation of excessive anthocyanin pigmentation. Which is a rich in antioxidant and is naturally present in many fruits and vegetables like blueberry, black current and eggplant. Black rice is a rich source of iron, antioxidants and vitamin E, thus it ensures good health and raise the overall life span of human beings. Black rice is a variety of rice that is formed by the mutation of Kala4 gene that stimulates the production of the dark purple or black pigment anthocyanin.

Properties of Black Rice

Figure 1.

The pericarp of black rice is black in color due to the presence or accumulation of excessive anthocyanin pigment which is rich in antioxidants and it offers the variety of health benefits such as anti-cancer, anti-aging, anti-diabetes, lowering the risk of obesity, it boosts heart health, eye benefits and overall fitness. Similar to normal white rice black rice is also cholesterol and gluten free, low in sugar, salt and fat. Black rice is generally consumed along with the bran due to the presence of anthocyanin and sold as unmilled rice. Cooked rice appears in purple color with a shiny indigo finish and has a mild nutty flavor and its chewy texture is smooth and firm (figure 1).

Black rice is rich in amino acids, fatty acids, antioxidants, flavonoids, anthocyanin and other phenolic compounds. There is mixture of 18 types of essential and non-essential amino acids which play a crucial role in body functioning and repair skin and tissues to improve energy level.

Black Rice is Good Source of

1. Vitamin E
2. Riboflavin (B2)
3. Niacin (B3)
4. Beta-carotene
5. Lutein
6. Zeaxanthin
7. Calcium
8. Chromium
9. Phosphorus
10. Iron
11. Manganese
12. Potassium
13. Zinc
14. Copper
15. Magnesium.

Common Varieties of Black Rice

Varieties of black rice is now cultivated everywhere from china and Indonesia to Thailand, Japan and India. There are some variations in grain size by which they vary in starch content, and gives a lower glycemic index.

1. Black japonica rice: This type of rice is a mixture of 25 percent short grain and 75 percent medium sized grains. It has an earthy flavour with a mild sweet spiciness.

2. Black glutinous rice: Also known as 'black sticky rice' has a short-sized grains and sticky texture. The grains are unevenly coloured and generally used to make sweet dishes.

3. Thai black jasmine rice: It is a medium sized grain and originated from Thailand that combines Chinese black rice with jasmine rice. It is native of Thailand and has a subtle floral aroma which is also observed in Thai black jasmine rice due to the combination.

4. Italian black rice: It has long rice grains and has the characteristics of Chinese black rice and Italian rice with a buttery aroma.

Benefits of Black Rice

Health benefits- the chief component present in black rice is the anthocyanin, which possess anti-oxidants and antimicrobial activities, and improve neurological, visual health and many more health concerns. Which are as follows:

Rich in antioxidants: The dark purple or the black color of black rice is a minter of its high anti-oxidant properties. The outer layer of the grain (bran and hull) contains huge amount of antioxidant in form of anthocyanin. In fact, it contained higher amount of anthocyanin than any other grain such as brown rice, red rice, red quinoa or other coloured whole grain cultivars. Anthocyanin can prevent cardiovascular disease, restricting free radical movements which can cause several diseases like diabetes and even cancer. It can also improve brain functions and reduce inflammation. Other refined grains are stripped of their high nutrient content and beneficial properties in the hulling and milling process. Several of nutrients of rice are present in the pericarp, which are only retained in whole grains. Since black rice does not go through any refining process, it is able to retain its antioxidants, minerals, vitamins and fibres. Black rice also contains vitamin- E, which is helpful to maintain eye, skin and immune health. The phytonutrients present in black rice help cleanse the body of disease-causing toxins. Black rice helps the liver eliminate unwanted substances through its antioxidant activity.

Preventing Risk of Obesity: For people battling obesity, black rice is the excellent kind variant of rice to consume. Full of fiber content on the bran helps in weight management. It not only gives you the feeling of being full, thus preventing overeating, also decreases the fatty acid synthesis thus resulting in intercellular lipid accumulation in between the tissues.

Preventing Cardiovascular disease: It is found out that anthocyanin of black rice lowers the LDL (low density lipoprotein) sometimes called bad protein and raise the HDL (high density lipoprotein) which is good for heart and decrease the chances of heart attack or cardiac arrest.

Diabetes management: The natural low sugar and high fibre content in black rice prevents the occurrence of diabetes. Flavonoids like anthocyanin also influence level of blood sugar and manage the diabetes. Phytochemicals have a positive influence on our body, improves insulin sensitivity so our body can better use of glucose. They also help by reducing sugar digestion in small intestine, which lowers sugar level in our blood.

Anemia: Black rice is rich in iron content thus involved in the generation of new RBCs which raise the hemoglobin content and prevents anemia.

Improve eye health: Along with protective anthocyanin, black rice contains high amount of lutein and zeaxenthin, these two carotenoids known for their supporting role for eye health. These antioxidants help to protect the cells of eyes and reduce the adverse effects of UV rays.

Nutritional Account of Black Rice in Comparison with White and Brown Rice

It is well known fact that black rice has high nutritional value than all other rice varieties. Also, the nutritional property of brown rice is almost comparable with that of black rice.

Nutritional value of different rice grains in per 100g serving:

Rice Type	Carbohydrate (g)	Protein (g)	Fat (g)	Fiber (g)	Iron (mg)	Zinc (mg)
Black	34	8-8.5	1-1.5	4.9	3.5	3.16
Red	23	6.5-7	0.8	2	5.5	1.91
Brown	24	7-7.9	0.8	1.8	2.2	1.8
White	28	2.5-2.7	0.2	0.6	1.2	1.41

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Fruit Cake Movement - Innovation in Horticulture

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Introduction

Horticulture is such a subject which makes a way to do wonders in fruit and vegetable production. There is a proverb called 'START FROM THE SCRATCH', Maharashtrian horticultural farmers are following the same thing in their agriculture lands.

Ancient day farmers are sticked to traditional agricultural practices but modern farmers are handling modern problems with utmost ease.

Covid-19 fruit losses due to uncertain changes in the year 2020, horticulture farmers in the country faced huge economic losses. Lockdown, fear of virus, closing of markets led farmers in confusion and finally wasted huge number of fruits in the country.

After easing the lockdown restrictions, competition and the supply is increased whereas demand decreased. If demand decreases it leads to decrease in the cost of fruits. Here the demand of fruits is directly proportional to the cost of fruits.

Overcoming the Hurdles

To overcome those hurdles rural farmers in Maharashtra have started practicing a new idea i.e., fruit cake moment. Farmers are preparing cakes with fruits like apple, banana, pomegranate, mango, pineapple etc. and decorating them with strawberries which are grown in their own fields.

Farmers and their family members are cultivating the fruits like grapes, watermelon, oranges and papaya and making special cakes with these fruits and supplying them for special events. As this innovation is in primary stage, cultivators are hoping and determined to make it as a revolution all over the nation.

This movement is gaining popularity all over the social media and other state farmers are also inspired by this innovative idea and conducted a competition on this same concept by hoy amhi shetkari, a famous farmer organization has received more than 150 entries for this competition.

Agriculture and Horticulture are the subjects which cannot be restricted to certain extent. Hence Government should consider this movement as revolution in fruit production as it is showing new ways to use the fruits and also providing employment to the rural people.

Role of Bhaji Bazaar

Bhaji bazaar is a pune based agriculture start up impressed with this idea and came forward to sell these cakes and make them popular all over the city. This company is helping the farmers in generating income and more employment in the horticulture fields.

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Application of Nanocomposite Based Fungicides in Agriculture

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Introduction

In this recent era, the most important solution we are searching for plant protection is how to fight against pathogenic microorganisms (Rubina et al. 2017). Fungal pathogens are one of the major threats for noteworthy economic loss during crop growth period as well as in postharvest handling of fruits and vegetables. The multi-drug resistance of microbial strain, high-cost fungicide and other disadvantages of chemical control of fungal pathogen are some critical challenges, which need to be addressed by developing alternative strategy to control plant disease. An alternative to enhance the efficiency of agrochemicals is the use of systems that could present a slow or controlled release of the desired compound. Polymer composites are the most likely investigated systems, where agrochemicals are embedded within the matrix that hinders the diffusion of agri-inputs to the environment. In history, it is envisaged that field of medicine, environmental science, and food processing have already employed the successful and safe use of nanomaterials; combination of biotechnology with engineered nano material expand the application domain of nanotechnology (Chen et al. 2016). However, use of nanomaterials in agriculture, especially for crop protection and production, is an under-explored area in the research community (Khot et al. 2012). Nanomaterials particularly nanocomposites have gained attention in present era in crop production as well as crop protection sector due to their target specific sustained delivery systems (Paul et al. 2020, Sarkar et al. 2021). The application of nanocomposite-based fungicides in crop protection has been summarized in the present article.

Nanocomposite Based Fungicides in Agriculture

Example of some nanocomposites designed for controlled release of fungicides and/or effective management of fungal pathogens are presented in following Table 1 and effect of these nanocomposites in disease management have been critically evaluated in the following section.

Table 1: Nanocomposite based fungicides:

S. No.	Nanocomposites	Fungicide used/ Effective against	Effect	Reference
1.	Graphene oxide-silver nanocomposite (GO-AgNPs)	*Fusarium graminearum* (Leaf spot disease)	This nanocomposite exhibited a three- and seven-fold increased inhibition efficiency over pure AgNPs and GO suspension, respectively.	Chen et al. (2016)
2.	Chitosan-silver nanocomposite	Antracol®	The antimicrobial ability of this nanocomposite synergised fungicide showed some promising result against *Phytophthora capsici* causing phytophthora blight in pepper.	Le et al. (2019)
3.	Bimetallic blends (BBs) and chitosan nanocomposites (Cu & Zn-chitosan)	*Rhizoctonia solani* (Damping off of cotton)	The BBs and Cu-chitosan nanocomposite showed the highest antifungal efficacy against of *R. solani* in vitro.	Abd-Elsalam et al. (2018)

4.	Silver nanocomposites inspired by titanate nanotubes (AgTNTs)	*Botrytis cinerea* (Grey mould disease)	The unusual synergetic properties of the silver/titanate nanomaterials show that these composites are promising green materials that can successfully photo kill pathogenic fungi such as *B. cinerea* within minutes.	Rodríguez-González et al. (2016)
5.	Composite films of pullulan and Ag nanoparticles (NP)	*Aspergillus niger* (Black mold disease)	Fungal growth inhibition was observed in the presence of such silver nanocomposite Films. Disruption of the fungal spores in the presence of the nanocomposites due to Ag NP dispersed as fillers in pullulan.	Pinto et al. (2013)
6.	Gelatine-based nanocomposite films containing chitin nanoparticles (N-chitin)	*Aspergillus niger* (Black mold disease)	The results of differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA) confirmed improved stability of nanocomposite films against melting and degradation at high temperatures in comparison to neat gelatine film.	Sahraee et al. (2017)
7.	Chitosan–copper nanocomposite	*Sclerotium rolfsii* & *Rhizoctonia solani*	A loss of the cytoplasm content, cytoplasmic coagulation, irregular shape of mycelia, or destruction in the hyphae was confirmed.	Rubina et al. (2017)
8.	Zinc/Aluminium-layered double hydroxide (ZALDH)	Hexaconazole®	The intercalation process enhanced the thermal stability of the hexaconazole moiety and nano delivery system shows better inhibition towards the *Ganoderma boninense* growth than the counterpart, free hexaconazole.	Mustafa et al. (2018)

The combined antimicrobial effect of inorganic nanoparticles with bioorganic pesticides for controlling plant diseases may increase antifungal activity by synergistic interaction, which may reduce fungicide dose and consequently avoid development of fungal pathogen resistance. Abd-Elsalam et al. (2018) observed that chitosan nanocomposites are mainly used to study *in vitro* efficiency against plant pathogenic microorganism, so it is essential to perform a complementary greenhouse assay to find eco-friendly alternatives for plant disease management. They prepared Cu-chitosan, Zn-chitosan nanocomposite and bimetallic blend (BBs) based on nanoscale Cu $(OH)_2$ and conduct *in vivo* and *in vitro* antifungal activity study against two anastomosis groups of *Rhizoctonia solani* (*R. solani*) for controlling damping off of cotton seedling. The result of this study indicated that BBs and Cu-chitosan nanocomposite are highly efficient against both anastomosis groups of *R. solani in vitro* and BBs, Cu-chitosan nanocomposite may suppress cotton seedling disease caused by *R. solani in vivo*. Light micrographs of mycelia treated with BBs also showed the disruption of the hyphal structures of the fungal pathogen. Metallic nanoparticles have recently received a great deal of attention for biomedical applications due to their optical, catalytic and antimicrobial properties.

A number of silver salts and their derivative have been examined as biocides. Silver nanoparticles have been used as antibacterial and antifungal agents due to their antimicrobial activity against bacteria and fungi. In an experiment, conducted by Le et al. (2019), silver-incorporated chitosan nanocomposites (Ag@CS) were first prepared in which CS was used as reducing and stabilizing agent and then these nanocomposites were synergized with fungicide Antracol (An), and antifungal activity of Ag@CS/An, has been evaluated against *Phytophthora capsici* which cause Phytophthora blight in pepper. These results showed that Ag@CS and

Ag@CS/An were successfully synthesized with spherical shape AgNPs having diameter of 20.3 ± 0.7nm and 44.6 ± 0.3nm, respectively. More importantly, Ag@CS/An was found to have stronger antifungal ability than each component alone, analyzed by agar diffusion method. It might be anticipated that Ag@CS/An has a promising future as nano-antibiotic materials for agriculture. Graphene oxide (GO)-Fe_3O_4 nanocomposites was developed by Wang et al. (2017) that could effectively supress the germination of sporangia and inhibit the development of downy mildew. Result suggested that 50 µg mL^{-1} GO-Fe_3O_4 is efficient for showing excellent protective and fungicidal activities. 250 µg mL^{-1} GO-Fe_3O_4 on grapevine leaves in the field could significantly decrease the severity of downy mildew, suggesting its potent curative effect.

Mustafa et al. (2018) successfully intercalated hexaconazole into the intergalleries of zinc/aluminium-layered double hydroxide (ZALDH) using ion exchange method. The fungicide loading was estimated to be 51.8 %. The nano delivery system also shows better inhibition towards the *Ganoderma boninense* growth than the counterpart, free hexaconazole. The results from this work have a great potential to be further explored for combating basal stem rot (BSR) disease in oil palm plantation.

Conclusion

More effective applications of agrochemicals through composite materials are desired because they can reduce possible economic losses and, in particular, environmental damage. However, further research is still needed to find out the best materials to formulate highly efficient carrier composites and create cost-effective routes of Preparation, because the use of composite materials is still limited by the additional cost derived from the manufacturing process, which increases the cost of the final product and, consequently, the cost of crop protection. Another point to be emphasized relates only to the application of biodegradable carrier matrixes. Any alternative to rationalize the use of agricultural inputs should not become a new environmental or economic problem. Therefore, new compounds must be produced in such a way so that it can be easily biodegraded or integrated into the soil after use.

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Importance of Scanning Electron Microscope in Food Product Analysis

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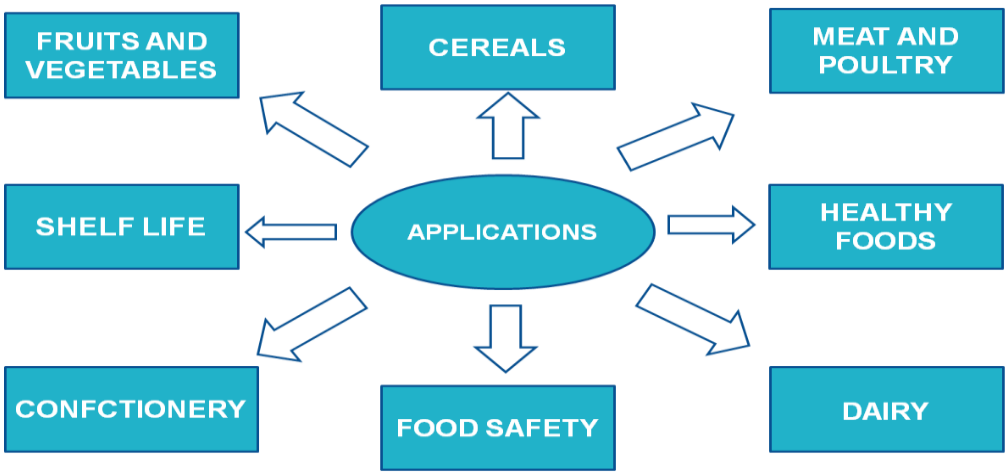
Abstract
The study of the internal microscopic structure of a food product is crucial in studying the various changes that happen in it during the process of processing, preservation, and storage. Such microscopic changes are interrelated to changes in various macroscopic attributes of a food product such as texture, its Physico-chemical, and functional characteristics. Scanning Electron Microscope (SEM) is a widely used imaging technique that produces images with a resolution of 20X to approximately 30,000X which is sufficient to study the structure and conformation of food products.

Introduction
The scanning electron microscope (SEM) is widely used to analyze the surface morphology of any food material. In addition to studying the morphology of food products, it can also be extended for analysis of particle size, microstructure, and studying the arrangement of food particles granules, novel formulations, crystallography study and for orientation of grain-crystals, thus can be utilized for analyzing the final quality of food products (Sakhare et al., 2013. Kal et al., 1995). Since SEM incorporates the best aspects of light microscopy (LM) and transmission electron microscopy (TEM), it is a very useful method for visualizing the effect of various processes on the microstructure of food ingredients. The microstructure of food plays a major role in organoleptic, nutritional and textural attributes to retain products quality. SEM used to identify contamination found from foreign food materials such as raw materials, packaging, stores and distribution sites which may cause consumer illness or injury.

Principle
The sample is scanned with the help of primary electron beams, the electrons interact with atoms in the sample, producing various signals that contain information about the surface of the sample and composition of the sample. Some electrons are reflected, some are absorbed, and some transmit from the sample, the reflected electrons (secondary electron) are detected by the detector and utilized for creating the 3-D image, secondary and backscattered electron beams produced are detected by a specially designed detector (Sharma & Bhardwaj, 2019).

Advantage and Disadvantages
The Scanning Electron microscope having many advantages and some disadvantages, SEM can capture high-resolution images from a small area (several micrometres) of a sample, the surface structure, detailed 3-D topological, chemical, and crystallographic information. The technological advances in modern SEMs allow for the generation of data in digital form ensuring product quality, product development process and any process failure with minimal analysis time. SEM has some disadvantages such as it cannot see the inside of the product; it can only provide the product surface information (Sharma & Bhardwaj, 2019).SEMs are large, expensive and needs steady voltage and currents to electromagnetic coil and circulation of cool water. It should be housed in an area away from electrical, magnetic and vibrational interference.

Applications



S.no.	Products	Applications	Reference
1	Dairy products- while the production of various products milk goes in various processing, so many physical and chemical changes occurred such as changes in casein and fat globules. Condensed milk	SEM can analyze the changes in microstructure characteristics of fat and protein and the final quality of the product can be determined. To study the Lactose crystal formation.	Sharma & Bhardwaj, 2019; Rosell et al., 2000
2.	Cereals	To study the different layers, changes in structure component, To study the arrangement of molecules.	Rosell et al., 2000
3.	Wheat flour	To study the complex microstructure of bread crumbs, Protein matrix in chapatti crumbs, Inside Structure of gas cell in bread, Functional properties of dough, Characteristics of an open structure of bread, Quality attributes of bread,	Rosell et al., 2000
4.	Corn, Rice,	Examination of resistant starch	Qualities, 2003
5.	Millet	To study the molecular structure and organization in starch molecules	Sharma & Bhardwaj, 2019; Rosell et al., 2000

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Role of Nanocomposites as Herbicide Delivery Tools in Crop Protection

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Introduction

Weeds are generally considered to hinder or alter the use of nutrients, water, light or useful space by the cultivated plants. Herbicides play an important role in agricultural production by protecting the crops from weeds. Herbicides are chemical compounds used to specifically, partially or totally control or kill plants. The mode of action of herbicides is either biochemical or physical which includes absorption into plant system, translocation to the site of action and disrupting or altering one or more metabolic processes resulting in plant death (Hashim et al., 2014).

The extensive use of herbicides causes serious environmental issues through leaching and run-off from the site of application leading to increase in the level of herbicide residues in natural water, soil and foodstuffs (Itodo et al., 2017). The design of herbicides in nano form is intended for better plant protection from the damaging influences of weeds in comparison to the bulk application of its active ingredients. The use of lower concentrations and fewer applications of herbicides is one of the prime objectives of the sustainable agriculture as it decreases the toxicity of herbicides to the non-target organisms and their risk of wider environmental contamination (Maruyama et al., 2016).

Nano-enabled products has gained popularity over conventional ones due to their higher efficacy in slow/controlled release of agri-inputs, smaller dose, less filler materials, low waste products etc. (Paul et al., 2020) Nanocomposites are special class of heterogeneous solid materials. These have continuous matrix phase and discontinuous reinforced phase having at least one-dimension up to 100 nm (Sarkar et al., 2021). The application of nanocomposites in agro-formulation sector has gained importance due to their site-specific sustained delivery of agri-inputs. In this article, the application of nanocomposites as delivery tool of herbicides and their effect in crop protection have been summarized.

Nanocomposite Based Herbicides

Representative examples of different nanocomposite-based herbicide formulations and their effects have been shown in table 1.

Table 1: Nanocomposite based herbicide formulations:

S. No.	Nanocomposites	Herbicide used	Effect	Reference
1.	Alginate/chitosan nanoparticles	Paraquat	Alteration of release profile of the herbicide as well as its interaction with the soil	dos Santos Silva et al., 2011
2.	Agro-polymer and nanomontmorillonites clay-based materials	Ethofumesate	Slow-release of test herbicide due to higher affinity of ethofumesate with the composite in presence of hydrophobic clay than of the	Chevillard et al., 2012

			hydrophilic montmorillonite	
3.	Al3+ cross-linked carboxymethyl starch-based microparticles containing sodium montmorillonite	Isoproturon	75% encapsulation efficiency of the test herbicide and reduced leaching after eight irrigations as compared to the conventional one	Wilpiszewska et al., 2016
4.	Copper-chitosan nanoparticle-based composite matrix	Pendimethalin	57.5 - 92.7% of encapsulation efficiency of the composite matrix and controlled release of pendimathalin as compared to the conventional one.	Itodo et al., 2017
5.	Light responsively controlled herbicide particle (LHCP) has been developed using a nanocomposite composed of biochar, attapulgite (ATP), glyphosate (Gly), azobenzene (AZO), and amino silicone oil (ASO)	Glyphosate	Proper adhesion of glyphosate on weed leaves and reduction in herbicide loss	Chen et al., 2018

To reduce the environmental impact of herbicides, uses of biopolymer-based nanocomposites are viable options. Chitosan is a biopolymer that has been used for the synthesis of pendimethalin copper-chitosan nanoparticles using Chitosan as stabilizer and capping agent as a controlled release herbicide formulation (Itodo et al., 2017). Biopolymer starch-based nanocomposite containing montmorillonite clay exfoliated in polymer matrix has been developed to encapsulate ametryne and the prepared material has showed higher retention behaviour of ametryne showing synergistic interactions among the constituents (Giroto et al., 2014). For use in paddy cultivation, another nanocomposite has been developed by using Zinc Hydroxide Nitrate intercalated with Bispyribac anions in presence of Sodium Dodecylsulphate as a surfactant (Sharif et al., 2020). One rice herbicide, Quinclorac based nanocomposite was developed from zinc/aluminium layered double hydroxide and quinclorac anion using the co-precipitation method (Sharif et al., 2018). A released study of dichlorprop phenoxy herbicides from the interlayer of a Zn/Al-layered double hydroxide-dichlorprop nanocomposite was also performed by Hashim et al., 2019 with various concentrations of sodium chloride, sodium carbonate, and sodium phosphate and their mixtures in an aqueous solution to study their release behavior. This study revealed the potential of layered double hydroxides as hosts for controlled release formulations of phenoxyherbicide dichlorprop.

Conclusion

After green revolution, Agricultural production have been increased several folds due to application of conventional herbicide formulations. However, injudicious and indiscriminate use of these chemicals have resulted into several environmental and human health complications. Therefore, to ensure food security, demand of application of alternative green approaches are increasing. Nanocomposites are potential eco-friendly approach in this regard. However, few limitations such as field level experiments, ecotoxicity and environmental fate, uniform legislative frameworks across the globe etc. are needed to be addressed in future researches for large scale adaptation of nanocomposite-based products in crop protection sector.

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Land Capability Classification – An Overview

Article ID: 10764

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Summary

Land capability classification is a system of grouping soils primarily on the basis of their capability to produce common cultivated crops and pastures without deteriorating over a long period of time. The structure of LCC is capability class (8), capability subclass (4) and capability unit. Land suitable for agriculture and other uses falls under classes I to IV lands and land not suitable for agriculture but very well suited for forestry, grass land and wild life were included under class V to VIII.

Introduction

1. Land capability classification (LCC) may be defined as a system of grouping land in to various classes based on inherent limitations imposed on sustained use by soil attributes, topography, drainage and climate.
2. The guiding principle underlying LCC is "use land according to its capability and treat it as per its need". The capability classes fall in two groups, one suited for cultivation and other not suited for cultivation.
3. Each group is further sub-divided in to four capability based on intensity of hazards and limitations of use. The subclasses are further divided into unit based on a specific management practice.
4. Thus land is classified in to eight land capability classes under two broad groups as:
    a. Land suitable for agriculture and other uses which include class I to class IV lands.
    b. Land not suitable for agriculture but very well suited for forestry, grass land and wild life which include class V to class VIII lands.
5. On map, the capability classes are indicated in different colours as Green (I), Yellow (II), Pink (III), Blue (IV), Dark green (V), Orange (VI), Red (VII), Purple (VIII). Detailed characteristics of each class are given in Table.

Salient Features of Land Capability Classes (LCC)

LCC	Characteristics
Land Suitable for Cultivation	
I	Very good cultivable, deep, nearly level productive land with almost no limitation or very slight hazard. Soils in this class are suited for a variety of crops, including wheat, barely, cotton, maize, tomato and bean. Need no special practices for cultivation
II	Good cultivable land on almost level plain or on gentle slopes, moderate depth, subject to occasional overland flow, may require drainage, moderate risk of damage when cultivated, use crop rotations, water control system or special tillage practices to control erosion
III	Soils are of moderate fertility on moderate steep slopes subject to more sever erosion and severe risk of damage but can be used for crops provided adequate plant cover is maintained, hay or other sod crops should be grown instead of row crops.
IV	These are good soils on steep slopes, subject to severe erosion, with severe risk of damage but may be cultivated occasionally if handled with great care, keep in hay or pasture but a grain crop may be grown once in 5 or 6 years.
Land unsuitable for cultivation but suitable for permanent vegetation	

V	Land is too wet or stony which make it unsuitable for cultivation of crops, subject to only slight erosion if properly managed, should be used for pasture or forestry but grazing should be regulated to prevent cover from being destroyed.
VI	These are shallow soils on steep slopes, used for grazing and forestry; grazing should be regulated to preserve plant cover; if the plant cover is destroyed, use should be restricted until cover is re-established.
VII	These are steep, rough, eroded lands with shallow soils, also includes droughty and swampy land, severe risk of damage even when used for pasture or forestry, strict grazing or forest management must be applied
VIII	Very rough land, not suitable even for woodland or grazing, reserve for wild life, recreation or wasteland consideration.

Capability Subclass

It is the second category in the land capability classification system. Class codes e, w, s and c are used for land capability subclasses. Subclasses are not assigned to soils in capability class I and subclass e is not used in class V. brief descriptions of subclass are given below.

Subclass	Description
e	Erosion is the dominant hazard
w	Excess water is the dominant hazard
s	Soil limitation within root zone hazard
c	Climate is the dominant hazard

Capability Unit

It is the lowest category listed in land capability classification system. It is a grouping of one or more individual soil mapping units having similar potentials and continuing limitations.

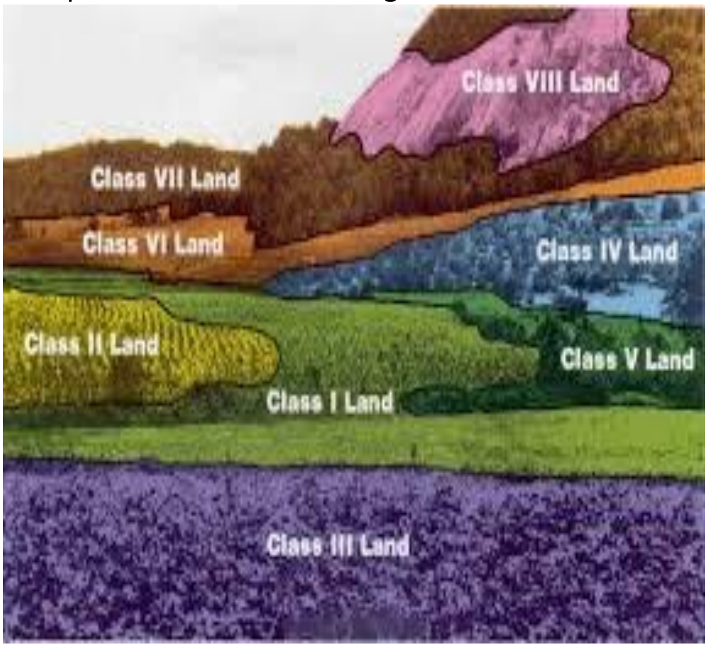

Fig. 1 Illstration showing lands of different capability classes (Source: Jhariya et al., 2018).

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Potential Application of Biofertilizers for Sustainable Agriculture

Article ID: 10765

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Biofertilizers are substances that contain microorganisms, which help in promoting the growth of plants and trees by increasing the supply of essential nutrients to the plants, which when added to the soil increase its fertility. Biofertilizers provide nutrients to the soil and enrich its quality. But, increased application of chemical fertilizers to crops to meet the rising food demand has hampered the soil health by affecting its chemical composition as well as soil biodiversity. Moreover, when it rains, the fertilizers wash away from the soil and pollute surface water and groundwater. They also enter the human body through drinking water and the food we consume, having a detrimental effect on our health.

In this light, biofertilizers are environmentally-friendly alternatives which do not have ill-effects on the environment and human health. They aid sustainable agricultural practices by improving the fertility and productivity of the soil. They are applied to seeds or soil to make naturally abundant nutrients in soil and atmosphere, available to plants. Biofertilizers contain different types of beneficial organisms such as bacteria, algae and fungi. Every microorganism, and hence every kind of biofertilizers, has a specific capability and function for enhancing plant growth. Biofertilizers containing nitrogen-fixing microorganisms such as Azotobacter, Clostridium and Rhizobium convert atmospheric nitrogen into ammonia with the help of an enzyme called nitrogenous. Nitrogen is an essential component of chlorophyll, a compound required by plants for photosynthesis. Nitrogen fixation is defined as a process of converting the dinitrogen molecules into nitrogen compounds. For instance, some bacteria convert insoluble forms of soil phosphorus into soluble forms. As a result, phosphorus will be available for plants. Another critical group of biofertilizers contain phosphate solubilizing microbes such as Pseudomonas and Bacillus. They convert insoluble phosphorus into a soluble form that can be absorbed by plants. Phosphorus is an essential component of nucleic acid as well as proteins and is required by the plants for cell division and proper growth. Similarly, other prominent groups of biofertilizers enhance plant growth by producing various essential enzymes and hormones. Although biofertilizers are cost-effective and eco-friendly alternatives to chemical fertilizers, they have specific limitations. They have a shorter shelf-life than chemical fertilizers, can be easily contaminated by unwanted microbes, and there is a lack of knowledge of its use among farmers. However, scientists are working on developing carrier materials that increase the effectiveness of biofertilizers, liquid formulations of biofertilizers with a longer shelf life, and optimizing production methods to prevent contamination.

Types of Biofertilizers

Symbiotic Nitrogen-Fixing Bacteria: Rhizobium is one of the vital symbiotic nitrogen-fixing bacteria. Here bacteria seek shelter and obtain food from plants. In return, they help by providing fixed nitrogen to the plants.

Loose Association of Nitrogen-Fixing Bacteria: Azospirillum is nitrogen-fixing bacteria that live around the roots of higher plants but do not develop an intimate relationship with plants. It is often termed as rhizosphere association as this bacterium collect plant exudates and the same is used as a food by them. This process is termed as associative mutualism.

Symbiotic Nitrogen-Fixing Cyanobacteria: Blue-Green algae (BGA) or Cyanobacteria from the symbiotic association with several plants like Liverworts, cycad roots, fern, and lichens are some of the Nitrogen-fixing Cyanobacteria. Anabaena is found at the leaf cavities of the fern. It is responsible for nitrogen fixation. The fern plants decay and release the same for utilization of the rice plants. Azolla pinnate is a fern that resides in rice fields but they do not regulate the growth of the plant.

Free-Living Nitrogen-Fixing Bacteria: They are free-living soil bacteria which perform nitrogen fixation. They are saprotrophic anaerobes such as *Clostridium beijerinckii*, Azotobacter, etc. Among all the types of biofertilizers, Rhizobium and Azospirillum are most widely used.

What is the Need of Using Biofertilizers?

Biofertilizers are required to restore the fertility of the soil. Prolonged use of chemical fertilizers degrades the soil and affects the crop yield. Biofertilizers, on the other hand, enhance the water holding capacity of the soil and add essential nutrients such as nitrogen, vitamins and proteins to the soil. They are the natural form of fertilizers and hence, widely used in agriculture.

Applications of Biofertilizers

Seedling root dip: Suspend 1 to 2 kg each of nitrogen-fixing (Azotobacter/Azospirillum) and phosphate-solubilizing biofertilizers into just sufficient quantity of water (5–10 L depending upon the quantity of seedlings to be planted in one acre). Dip the roots of seedlings in this suspension for 20–30 min before transplanting. In case of paddy, make a bed of sufficient size (2 m x 1.5 m x 0.15 m) in the field, fill it with 5 cm of water and suspend 2 kg each of Azospirillum and phosphate-solubilizing biofertilizers and mix thoroughly. Now dip the roots of seedlings in this bed for 8–12 hours (overnight) and then transplant.

Seed Treatment: One package of the inoculants is mixed with 200 ml of rice kanji to make slurry. The seeds required for an acre are mixed in the slurry so as to have a uniform coating of the inoculants over the seeds and then shade-dried for 30 minutes. The shade-dried seeds should be sown within 24 hours. One package of the inoculants (200 g) is sufficient to treat 10 kg of seeds.

Soil Treatment: The biofertilizers along with the compost fertilizers are mixed and kept for one night. This mixture is then spread on the soil where the seeds have to be sown.

Mechanism of Biofertilizers: Biofertilizers utilise certain microorganisms. These microorganisms trap atmospheric nitrogen and convert it into nitrates and nitrites and make it available to the plants. They also convert insoluble phosphates into the forms required by the plants. Make the root rhizosphere livelier, more root proliferation, better germination; improve the fertilizer use efficiency, higher biotic and abiotic stress tolerance. Biofertilizers protect the environment from pollutants since they are natural fertilizers; improve soil texture and yield of plants. They do not allow pathogens to flourish; they are eco-friendly and cost-effective and destroy many harmful substances present in the soil that can cause plant diseases.

Conclusion

Biofertilizers increase the availability of plant nutrients and can help in maintenance of the soil fertility over a long period. As discussed earlier, some microorganisms have the beneficial role of biological nitrogen fixation to supply nitrogen to crops, solubilizing insoluble phosphates to plant-available (soluble) forms and synthesizing biomass for manuring of crops like rice. Biofertilizers are, therefore, economical, renewable and eco-friendly, but they cannot totally replace chemical fertilizers. Biofertilizers use is an important component of Integrated Nutrient Management and organic farming. These technologies are becoming vital in modern-day agricultural practices. The changing scenario of agricultural practices and environmental hazards associated with chemical fertilizers demand a more significant role of biofertilizers in coming years.

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Diseases of Betelvine, a Plantation Crop, and their Eco-Friendly Management

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Betelvine (*Piper betle* L.) is an important plantation crop of India belonging to the family Piperaceae. It is also known as Pan, Nagaballi, Nagurvel, Saptaseera, Sompatra, Tamalapaku, Tambul, Tambuli, Vaksha Patra, Vettilai, Voojangalata, etc., in different parts of the country. Betelvine is a native crop of tropical south East Asia. The most probable place of origin of betel is Malaysia [1].Betelvine is cultivated in many parts of the world including India for its leaves and is used for mastication along with the arecanut due to its stimulatory aromatic taste [7] [5]. It is also known for its medicinal attributes containing some vitamins, enzymes, thiamines, riboflavin, tannin, iodine, iron, calcium, minerals, proteins, essential oil and medicine for liver, brain and heart diseases [2] [4].Its leaves also contains antioxidant properties due to the presence of phenols: particularly hydroxychavicol (4- allyl pyrocatechol) and its aromatic volatile oil contains a phenol called chavicol, which has powerful antiseptic properties. The presence of aromatic volatile oil also gives rise to a sensation of warmth and well-being in the mouth and stomach. It is also known to produce a primary stimulation of the central nervous system and the betel leaf is also believed to be a common household remedy for various ailments [3] [6].

Among various causal agents of plant diseases in betelvine, fungi and bacteria are most important. Although several diseases caused by fungi and bacteria have been reported, only economically important diseases are described below.

Name of Disease	Causal organism
Leaf Rot and Foot Rot	Phytophthora spp.
Leaf Spot, Marginal Blight or Anthracnose	Colletotrichum capsici
Sclerotial wilt, stem rot or collar rot	Sclerotium rolfsii
Powdery Mildew	Oidium piperis
Bacterial leaf spot, leaf blight or stem canker	Xanthomonas campestris pv. betlicola

Leaf Rot and Foot Rot

It is caused by *Phytophthora* spp. This is the most destructive fungal disease that produces both a wet rot symptom on leaves and wilting due to foot rot. At first Circular, dark brown spot appear which becomes wet and rot under continuous high humid conditions. Otherwise, dark brown necrotic spots with alternate light brown zonation appear. The loss of lustre of the leaves in the foot rot condition followed by complete wilting and drying of the vines occur in a quick sequence. Root system of the affected plant is damaged. Lateral roots are completely destroyed. Disease occurs mostly in patches and the vines wilt and die. In a week's time, 80 to 90 per cent of the vines wilt and die.

Favourable Conditions, Survival and Spread

Fungus survives in disease plant debris as well as soil. These vines may recover after the rains and survive for more than two seasons till the root infection culminates in collar rot and death of the vine. Rains during July onwards favour the development of disease.

Management:

a. Removal and destruction of dead vines along with root system from the garden is essential as this reduces the build-up of inoculum (fungal population).

b. Planting material must be collected from disease free gardens and the nursery preferably raised in fumigated or solarized soil.
c. The freshly emerging runner shoots should not be allowed to trail on the ground.
d. They must either be tied back to the standard or pruned off.
e. The branches of support trees must be pruned at the onset of monsoon to avoid build-up of humidity and for better penetration of sunlight.
f. Improved drainage system is the basic requirement to reduce the severity of the disease.
g. For resistant / tolerant varieties consults ICAR Institute / KVK's / SAU's.

Leaf Spot, Marginal Blight or Anthracnose

It is caused by *Colletotrichum capsici*. The leaf spot symptom is irregular in shape and size, light to dark brown surrounded by diffuse chlorotic yellow halo. Marginal leaf tissue becomes black, necrotic and gradually spreads towards the leaf centre. Occasionally diffused yellow, halo also develops. In the anthracnose stage circular, black lesions that occur rapidly increases in size and girdle the stem culminating in the death of the vine.

Favourable conditions, Survival and spread: The primary infection by sowing infected seeds and secondary by winds. Rain and high humidity are responsible for the development of disease.

Management:

a. Eradication of affected vine from vineyard.
b. Apply phytosanitation process.
c. Irrigation by rose can.

Sclerotial Wilt, Stem Rot or Collar Rot

It is caused by *Sclerotium rolfsii*. Betelvine of all ages are vulnerable to the infection particularly at the collar region. White cottony mycelial growth creep over the infected area of the stem and soon many small mustards like sclerotia appear in the soil near the collar region of the vine. At this stage the vine wilts and totally dries off .Darkening of the stem at the foot of the plant, near ground level. The leaves turn yellow, become flaccid and droop off. Ultimately the whole vine wilts and dries up. The darkened portion of the stem becomes shrinked, soft and turn black. On the affected stem portion, white ropy fan shaped mycelial strands develop. Brown to dark brown sclerotia appears on the infected portion.

Favourable conditions, Survival and spread: Disease is soil borne and pathogen survives in soil which is the source of primary infection. The disease is mainly noticed in nurseries during June to September and is caused by *Sclerotium rolfsii*.

Management: Clean cultivation reduces the disease incidence considerably.

Powdery Mildew

It is caused by *Oidium piperis.* White to light brown powdery patches appears on lower surface of the leaves, later these increases in size. Early leaf infection appears as light grey spot which gradually enlarges and soon powdery mass of fungal growth covers the lower surface of the leaf. Under ideal conditions both the leaf surfaces get covered by the white floury mass of fungal growth resulting in early leaf fall.

Favourable conditions, Survival and spread: The fungus survives in the form of a resting mycelium or encapsulated haustoria in the crop debris. Secondary spread occurs through wind borne conidia. Cool weather coupled with mild temperature favour the development of disease.

Management:

a. Cultural practices that reduce humidity within the vineyard, enable good air circulation through the canopy, and provide good light exposure to all leaves and clusters aid in managing powdery mildew.
b. Use an under-vine irrigation system and manage it carefully; excess can favour the disease.

Bacterial Leaf Spot, Leaf Blight or Stem Canker

It is caused by *Xanthomonas campestris* pv. betlicola. Bacterial leaf spot, leaf blight or stem canker disease is becoming a serious in many of the betelvine growing parts of the country. Brown leaf spots, surrounded by translucent water-soaked area on all over the leaf blade which is delimited by veins and yellow halo appears on the corresponding upper surface. Elongated brown spots of variable length appear on the vine that results in stem canker. In severe infection, stem cracks and large area of leaf lamina are covered causing blighted leaf. The affected leaves defoliate prematurely.

Favourable conditions, Survival and spread: The pathogens survive in soil, bacteria spread through irrigation water. High temperature and high relative humidity favour the development of disease.

Management:

a. Collecting and burning the infected plant parts minimizes the spread of the disease.
b. Increase air circulation in the vineyard.
c. Remove diseased vine from the vineyard during normal pruning operations in the dormant season.
d. Follow up hand pruning.

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Nutritional and Health Importance of *Hibiscus sabdariffa*

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Introduction

Hibiscus sabdariffa L. (Hs), also known as roselle, is an ideal crop for developing countries as it is relatively easy to grow, can be grown as part of multi-cropping systems and can be used as food and fibre. In China the seeds are used for their oil and the plant is used for its medicinal properties, while in West Africa the leaves and powdered seeds are used in meals. Additionally, it is used in the pharmaceutical and food industries. Hibiscus sabdariffa L has been widely used in local medicines. In India, Africa and Mexico, infusions of the leaves or calyces are traditionally used for their diuretic, cholerectic, febrifugal and hypotensive effects, decreasing the viscosity of the blood and stimulating intestinal peristalsis. It is also recommended as a hypotensive in Senegal. In Egypt, preparations from the calyces have been used to treat cardiac and nerve diseases and also to increase the production of urine (diuresis). In Egypt and Sudan, an infusion of ‘‘Karkade’’ calyces is also used to help lower body temperature.

Nutritional Composition of *Hibiscus sabdariffa*

Roselle is mainly cultivated for its calyx, which is of three types: green, red and dark red. The red calyxes are the most used are characterized by their concentration anthocyanin. Delphinidin 3-Sambubioside and Cyanidin3-Sambubioside are the major anthocyanin. Roselle is also rich in organic acids, minerals, amino acids, carotene, vitamin C and total sugar in its calyx, leaves and seeds at variable levels depending on the variety and geographical area.

Table. 1- Nutrient contents of different part of Hibiscus sabdariffa per 100 grams:

Nutrients	Calyxes	Seeds	Leaves
Protein [g]	2	28.9	3.5
Carbohydrates[g]	10.2	25.5	8.7
Fat [g]	0.1	21.4	0.3
Vitamin A [I.E.]	-	-	1000
Thiamine [mg]	0.05	0.1	0.2
Riboflavin [mg]	0.07	0.15	0.4
Niacin [mg]	0.06	1.5	1.4
Vitamin C [mg]	17	9	2.3
Calcium [mg]	150	350	240
Iron [mg]	3	9	5

Nutritional and Health importance

Roselle, the safe medicinal plant, having various medically important compounds called phytochemicals is well known for delicacy and also for its nutritional and medicinal properties.

Roselle is used in many folk medicines. It is valued for its mild laxative effect, ability to increase urination, relief during hot weather and treatment of cracks in the feet, bilious, sores and wounds. Traditionally in Sudan, Roselle has been used for relief of sour throat and healing wounds. In African folk medicine, Roselle leaves are used for their, antimicrobial, emollient, antipyretic, diuretic, anti-helmentic, sedative properties and as a soothing cough remedy, whereas in India, leaves are poultice on abscesses.

Hypo-Lipidemic Effects

According to a study conducted among hyper-cholesterolemic patients, two capsules of Roselle extract (1g), given three times a day (for a total of 3g/day), significantly lowered serum cholesterol. Another scientific study also confirmed that ethanolic extract from the leaves of Roselle significantly exhibit hypo-lipidemic effect.

Roselle extract was also studied among subjects, some with and some without metabolic syndrome. Subjects with metabolic syndrome receiving ethanolic extract of Roselle had significantly reduced glucose, total cholesterol and low-density lipoprotein, while increasing high density lipoprotein.

Blood Pressure Lowering Effect

The effectiveness of an aqueous extract of Roselle on mild to moderate hypertension was investigated in many researches. Aqueous extract of Roselle was as effective as captopril in treating mild to moderate hypertension and there is no adverse effect with the treatment, confirming the effectiveness and safety of the extract.

Even though the possible mechanism(s) of action of Roselle extract is not investigated, daily consumption of an aqueous Roselle extract resulted in decrease in systolic and diastolic blood pressure.

Anti-Diabetic Activity

Extracted the polyphenolic components of Roselle and studied their effect in a type II diabetic rat model (high fat diet model). Studied revealed anti-insulin resistance properties of extract at a dose level of 200mg/kg, and reduction in hyper glycaemia and hyper insulinemia.

The extract was found effective in lowering serum cholesterol, triacylglycerol, the ratio of low-density lipoprotein/high-density protein (LDL/HDL), and also (AGE) formation and lipid per oxidation. Intestinal α-glycosidase and pancreatic α-amylase help in digestion of complex carbohydrates present in the food into bioavailable monosaccharide and plays an important role in postprandial hyperglycaemia; therefore, inhibition of these enzymes has been reported as an effective mechanism for the control of postprandial hyperglycaemia.

Hibiscus acid (hibiscus- type (2S,3R)-hydroxycitric acid lactone) have been shown as a potent inhibitor of pancreatic α-amylase and intestinal α-glucosidase and pancreatic α-amylase activity.

Anti-Diabetic Activity

Roselle is known for its antibacterial, antifungal and anti-parasitic actions. Oil extracted from seeds of Roselle has been shown to have an *in vitro* inhibitory effect on *Bacillus anthracis* and *Staphylococcus albus*. Aqueous and ethanol extracts were also found to be effective against *Schistosoma mansoni* and other microorganisms. Afolabi et al., demonstrated the antibacterial effect of hibiscus extract on *Streptococcus mutans*, a bacterium from oral cavity. In a similar study, antibacterial potential of hibiscus was also observed on *Campylobacter* species. An ethanol extract of the dried leaves of Roselle reduces aflatoxin formation and have *in vitro* inhibitory effect against some fungi.

Anti-Oxidant Effect

Protective property of a compound to inhibit the oxidative mechanisms by scavenging reactive oxygen and free radicals is known as antioxidative activity. It protects lining organelles from premature cell damage and reduces ageing. A large number of in-vitro and in-vivo studies have shown that Roselle's calyxes contain potent antioxidant. According to Augustine, both the whole aqueous and anthocyanin-rich extracts of Roselle are effective antioxidant. Studies have also highlighted that poly-phenolic acid, flavonoids and anthocyanins which are found in Roselle are potent antioxidants.

Other Pharmacological Effects

Roselle has been reported to possess a lactogenic activity. Okasha et al., observed enhancement in the serum prolactin level of lactating female Albino Rats on administration of seed extract of Roselle. Bako et al., studied the lactogenic effect of ethyl acetate fraction of *Hibiscus sabdariffa*, from 3-17days of lactation. The results showed an increase in serum prolactin level and milk production in lactating female albino rats, which confirms the lactogenic property of *Hibiscus sabdariffa.* Studies have shown that Roselle tea contains an enzyme inhibitor which blocks production of amylase and it is possible that drinking a cup of hibiscus tea after meals can reduce the absorption of dietary carbohydrates and assist in weight loss. It was also reported that Roselle is considered as a possible anti-obesity agent. Extracts from Roselle are also known to have effect on inflammatory disease and cancer.

Conclusion

Hibiscus sabdariffa or "Roselle" is medicinal plant with a worldwide fame. Roselle, having various medically important compounds called phytochemicals, is well known for its nutritional and medicinal properties. Seeds, leaves, fruits and roots of the plant are used as food and herbal medicine. Extracts from Roselle plays a crucial role in treating different medical problems including many cardiovascular disorders and cancer but further researches are required to know its exact mechanism of action and to formulate food products using Roselle with locally grown food items.

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Speed Breeding to Achieve Global Food Security

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Introduction

The global population is increasing over the last several years and is estimated to increase by at least 25% in geometrical way, but the food resources are still limited. The traditional or the conventional methods of breeding will not be adequate to meet the requirements of future generations, so the breeders are in continuous pressure to improve the crop productivity and to develop new varieties of crop which are of higher quality and gives higher yield. Currently, the plant breeders are provided with innovative technologies which can help to overcome these crises in future and to improve crop productivity. The development of automated high-throughput phenotyping technology systems has aided to increase the selection strength and improves selection precision. Another approach is to use the 2nd & 3rd generation sequencing platforms which mean that breeders can use DNA markers which are affordable for them. It assists in facilitating gene discovery and analytical breeding technology which helps to increase the production quantity and quality. Although, all these technologies help to give the best results, but one of the limitations is that it only produces one or two generations per year. The problem for the crop production in terms of quantity has been resolved by 'Speed Breeding' protocol that uses the light and temperature control systems and are capable of producing at least six generation of crops in a year.

Speed breeding is a potential tool to improve the crop varieties in less time period. An artificial environment is created with enhanced duration of light to induce longer day light which helps to manipulate the life cycle of photo- insensitive crops. In general, for development of a new variety through conventional method requires 8- 10 years, but speed breeding reduces the required time to a great extent. Speed breeding protocols are available for different varieties of crop plants which works on the chromosomes and are provided with optimal light quality, light intensity , proper temperature which enhances the process of photosynthesis and which increase the growth and breeding . This process results in the production of at least six generation of specific species. Speed breeding apart from enhancing the growth also has several advantages over other technologies; it can accelerate the back crossing, pyramiding traits, transgenic pipelines etc. The first variety of spring wheat crop by speed breeding was produced in 2017 in Australia and it was named as 'DS Faraday'.

Integrated Phenotyping with Speed Breeding as a Tool for Improving Yield

Phenotyping is defined as the evaluation of complex plant traits which are related to growth, development, and related to all the characteristics which form the basis for complex trait evaluation. As the temperature is having various fluctuations throughout the year in every part of the world, so it affects the crop production and reduces the crop yields. Christopher et al., 2015 carried out an experimental research on the Australian environment as there was evidences in continuous increase in the temperature and drop in the rainfall in that region. The experimental research was conducted to analyse the effectiveness of combining the phenotyping and speed breeding to improve root adaptation in changing environment and water-limitation. A multi-purpose approach was used to improve the yield by integrating phenotyping and speed breeding. The results determined that overpopulation development of more than 1000 recombinant inbred lines of wheat was advanced to the generation within 18 months. So, this research offers a solid history that integrating phenotyping techniques with speed breeding will accelerate genetic advancement towards improved adaptation to water limited environments.

Gene Editing in Combination with Speed Breeding for Crop Improvement

As the traditional way of plant breeding has already proven to be successful in generating the great crop varieties, but in the modern era there is degradation of genetic quality because of continuous selection and long-time domestication of the crops. So, this is one of the limiting factors for the improvement in crop quality. Genome editing technology has proven to be of advantage in this era. Wolter et al., 2019 examined the power of CRISPR / Cas to generate guided genetic diversity at several sites. The CRISPR / Cas method provides new ways for genetic diversity. It has the ability to multiplex, and the number of targets can be effectively altered simultaneously. It targets the actual problem and a high yielding variety can be generated, but this process takes longer duration of time and requires large amount of effort. So, integrating genome editing and speed breeding has power to overcome this crisis and a greater number of generations can be developed in a single year.

Boosting Genetic Gain by Speed Breeding and Genomic Selection

For improving the genetic benefit, speed breeding along with genomic selection is used. Some researchers have provided evidence that speed breeding and genomic selection is capable of increasing the genetic benefit in various crops. Genomic selection was first suggested by Meuwissen et al., 2001. The main advantage of applying genomic selection is that it reduces the length of breeding cycle and produces the superior quality of plant variety at very short time duration which improves the genetic gain. Researchers have proved that the Integration of genomic selection with other modern breeding strategies may further enhance its efficiency on improving the quality of crops. The recent development of ‘speed breeding’ protocols have the potential to accelerate breeding programs significantly for different crops by developing the generations in a shorter period of time.

Speed Breeding to Accelerate Domestication

Plant domestication is the process where wild variety of the plants has been evolved into crop plant through artificial methods. In this process early hybridization is followed by selective breeding technique. Plant domestication is particularly linked with polyploidy crop. It is a lengthy process and it takes large amount of time. Therefore, to overcome this problem it has been combined with the speed breeding which reduces the time duration and number of generations of that crop has been developed. The evidences regarding the plant domestication in combination with speed breeding has to be found in polyploidy plants such as peanuts and banana. O’Connor et al., 2013 conducted an experiment regarding the assessment of potential use of speed breeding method in peanut breeding. This study results in the reducing the time in producing the several generations in shorter duration of the time as compared with the normal breeding phase.

Multiple Disease Resistance by Speed Breeding

To respond in a faster way to the changing climate, evolving pathogens, the plant breeders are exploring different ways to enhance the quality of crop production. Hickey et al., 2017 conducted a research in which they applied the two-rowed barley cultivar Scarlett with novel methods for rapid trait introgression. They used 4 donor lines incorporating multiple disease resistance in a revamped backcross strategy that integrated phenotypic multi-trait screens as well as rapid generation advance technology ‘speed breeding’, to develop 87 BC1F3:4 Scarlett introgression lines (ILs) within two years.

Speed-Breeding with SNP Marker-Assisted Reducing Salt Tolerance

Climate change would intensify a number of plant abiotic stresses including salinity, heat, drought, etc., thus reducing growth. Rice is considered to be one of the crops which are salt sensitive. Salinity is having severe effect on the metabolism, growth and productivity of rice. Rana et al., 2019 conducted a study to improve the salt resistance of locally yielding rice crop. In this experiment precisely introgressed the hst1 gene, transferring salinity tolerance from “Kaijin” into high-yielding “Yukinko-mai” (WT) rice through single nucleotide polymorphism (SNP) marker-assisted selection. It uses a biotron speed-breeding technique.

Conclusion

In agriculture sector, the conventional methods of breeding take longer duration of time, although the crop is of high yielding variety. The breeding cycle is approximately for about 8-10 years. As the population of the world is growing continuously, so it will be difficult to overcome food scarcity in the future generation. In this context, speed breeding facilitates rapid generation advancement and improves the genetic gain. So, speed breeding is a ray of hope for our future generation in terms food security which is the main concern for everyone around the world.

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Production Technique for Quality Seeds of Maize

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Introduction

Maize (Zea Mays, referred to as corn in North America) originated in central Mexico in around 5,000 BC. The crop was introduced to Europe in the sixteenth century, from where it spread to Africa and Asia. It is now one of the most widely-grown crops around the world in both temperate and tropical regions. Maize is common millet of India with wider industrial and household utility. It is used a feed, food and raw material in soft drink industry. Botanically it is known as Zea mays and belongs to the family poaceae.

Botanical Description

Zea mays have diploid chromosome number 2n = 20 and Panicle cob type as the crop is monoceious in nature and having two types of flower; female flower called as cob or silk (axillary inflorescence) while male known as tassel (terminal inflorescence). Zea mays is a cross pollinated crop due to presence of protandry. Pollen shedding begin 1 to 3 days before the silk emerge from the cob. Within 12 to 18 hours after silk emergence, the entire silk is receptive. Silk will be pinkish and sticky at the beginning (receptive) after fertilization it will be chocolate / brown colour.

Types and Methods of Seed Production in Maize

In maize, open pollinated varieties, synthetics, composites and hybrids are available.

Open pollinated varieties: Raise the varieties under isolation of 400 m in foundation seed stage and 200 m in certified seed stage and allow the plants to openly pollinate among themselves and set seed.

Synthetics varieties: In cross pollinated species, a variety obtained by in mating in all possible combinations, a number of lines (>5) that combine well with each other. COBC 1 (Baby corn).

Composite varieties: These are produced by open pollination among a number of outstanding strains usually not selected for combining ability with each other e.g., K1, Jawahar, Vikram, Sona, Amber, CO 1 and Kisan.

Inbreds: It is relatively true breeding strain resulting from repeated selfing (5 times.).

Varietal Seed Production Technique

Open pollination under isolation is the common method of varietal seed production.

Stages of seed multiplication: In maize seed (varieties composites and synthetics) is multiplied adopting three generation system, as breeder seed, foundation seed and certified seed as the crop is highly cross-pollinated crop , where the chances for genetic contamination is high.

Popular Varieties

Varieties Classification Based on Duration: Five different maturity groups are recognized for cultivation in India.

Full season maturity: Genotypes mature at 105-110 days or more. They are either rainfed or irrigated e.g: Ganga-5, Ganga-9, Deccan 103.

Medium maturity: Varieties need 95-100 days to mature and suit well to regions with assured rainfall. e.g; Composites.

Early maturity: Varieties need 89 to 90 days to mature. Suit either in monocropping or inter cropping.

Very early maturity Varieties: Reqire 75-80 days. They are suited as summer season crops or for inter cropping under rainfed conditions e.g., Diara, Diara-3 and D765.

Extra early maturing: Suitable for cultivation under rainfed conditions at a very high altitude (>2500m). Growing season is very short and temperature relatively low.
e.g., composite Auli.
Season: The best season for production is June - July, November- December and January – February and the flowering should not coincide either with rain or high RH and the maturation should coincide with dry weather. The temperature of 37°C is favourable for better seed setting.

Land Requirement

The land required for open pollinated variety, composites and synthetics should be fertile and problem soils will lead to low pollen fertility and will adversely affect the quality and the seed set will be poor. The previous crop should not be the same crop to avoid the occurrence of volunteer plants and if to be the same crop it has to be the same variety and should be certified and has to be accepted for certification. The field should not have any volunteer plants.

Isolation Distance and Modification of Isolation Distance

Composite, Synthetics and OPV = (FS: CS 400: 200 m). Differential blooming dates are permitted for modifying isolation distance provided 5.0% or more of the plants in the seed parent do not have receptive silks when more than 0.50% of plants in the adjacent field (s) within the isolation distance are shedding pollen. Distances less than 200 meters may be modified by planting border rows of male parent, if the kernel colour and the texture of the contaminant are the same as that of seed parent. The number of border rows shall be determined by the size of the field and isolation distance from the contaminant.

Selection of Seed

For production of foundation seed, breeder seed is used as the base material, while for certified seed, foundation seed should be used as the base material. The seed used should be from authenticated source with tag and bill. The required seed rate will be 20kg /ha or 8kg/ acre.

Pre-Sowing Seed Treatment

The seeds are given with any one of the seed treatments or in combination. Seeds are soaked in 2% KH_2PO_4 for 16h with a seed to solution ratio of 1:0.06 and are dried back to their original moisture content of 8-9% .This management could be used both for dryland agriculture as well as gardenland. Seeds are also treated with 5% carbofuran 3g to protect the seed from shootfly infection.

Seed treatment with chloropyriphos @4 ml /kg is also recommended against the attack by shootfly. Seeds are dry dressed with bavistin @2g/kg of seed to protect against seed borne pathogens and soil borne pathogen. Seeds are also treated with azospirillum @50g/kg of seed to fix atmospheric nitrogen. Any one of these treatment or combination of treatment is adopted for better productivity.

Seeds are also treated with polycoat @ 3g/kg of seed diluted in 5ml of water to invigorate the seed towards better marketability and production. Pink coloured polycoat performed better than other colour polymers. On adoption of sequence of treatment physiological should be followed with physical seed treatment.

Sowing

The seed are sown at a spacing of 45 x 10 cm or 60 x 20 cm at a depth of 2- 4 cm based on the specific features of the variety. Nursery production will not be suited to this crop. In the main field seeds are sown either in ridges and furrows or under beds and channels. The seedlings are thinned and gap filling should be done 7-8 days after sowing.

Seed Rate

20-25 kg /ha

Nutrient Application

At last ploughing apply 12.5 tonnes of compost per hectare.

Fertilizers (Varieties) 150:75:75

1. Basal 40:75:40 NPK kg/ha
2. 1st top 20 DAS 50:0 :0 kg/ha
3. 2nd top 40 DAS 60:0:35 kg/ha.

Micronutrients

2% DAP is sprayed at 50% flowering stage to enhance uniform flowering and increased seed set. If Zn deficiency is found apply 20 kg of zinc sulphate / ha. If Fe deficiency is found apply 12.5 kg /ha micronutrient mixture. The crop is mostly affected by micronutrient deficiencies by N, P Mg, Mn, Zn, Fe and K. Apply 12.5kg of micro nutrients in furrows and the mixture in the soil.

Weeding

Application of atrazine @ 500g per ha as pre-emergence herbicide control the growth of weeds upto 20-25 days.(If pulses is used as intercrop do not use atrazine) One hand weeding at 17-18 days after sowing keep the field free of weeds. Weeding after boot leaf stage is not economical and shade will also minimize the weed flora. On organic production, 2 hand weeding at seedling stage and other at boot leaf formation will keep the field weed free.

Irrigation

The crop should be irrigated once in 10-15days for enhanced seed set and formation of bolder grains. The critical stages of irrigation are primordial initiation stage, vegetative stage, flowering, milky and maturation stage. If the irrigation is withheld in these stages seed set will be poor and seed size will be reduced.

Pest and Disease Management

Shoot fly	Monocrotophos 0.03%
Stem borer	Rogar 0.3% / Carbaryl 50 WP 1kg.per heactre on 20th day
Lesion nematodes	Carbofuron 3 G@30kg./ha.in seed holes at the time of sowing.
Downy mildew	Mancozeb @ 1kg/ha.
Leaf spot	Mancozeb or captan @ 1kg/ha
Cob borer	Apply carbaryl 10% dust @ 25kg/ha. At milky stage repeat it 15 days thereafter. (50 lt. Spray fluid per ha)

Roguing

It is specific to seed crop and is done from seedling stage to harvesting stage based on the phenotypic characters. Off types can be identified through stem colour, plant structure, number of leaves ,auricles, nodal colour, tassel colour, sheath colour ,grain colour etc.

Seed Certification

Number of Inspections: A minimum of two inspections shall be made at flowering and another during flowering.
Field Standards: In general Maize field should be isolated from contaminants as follows:

Contaminants	Minimum distance(meters)	
	Foundation stage	Certified stage
Fields of other varieties	400	200
Fields of same variety not confirming to varietal purity requirements for certification and teosinte	400	200

In maize hybrid alone increasing the border row and minimizing the isolation is permitted.

Specific Standard: These are Verified at the Final Inspection

	Maximum permitted (%)	
	FS	CS
Off types plants that have shed or shedding pollen at anyone of the inspections during flowering when 5% or more of the plants in the seed field have receptive silks.	1.0	1.0

Pre-harvest sanitation spray: Spraying of endosulphan @ 0.07% and bavistin @10g/lit 10 days prior to harvest prevent the seed weevil *(Sitophilus oryzae)* infestation at storage.

Seed Maturation

1. 14-20 DAA milky stages (starch in fluid stage)
2. 35 DAA : Soft dough stage
3. 45 DAA : Glazed dough stage
4. 55 DAA : Ripe dough stage

Symptom of Physiological Maturation

1. Cob sheath turn straw yellow colour.
2. The funicular degeneration.
3. Formation of sunken layer.
4. Moisture content of seed 35%.

Harvesting

The crop attains physiological maturity 30-35 days after 50% flowering and the seed moisture at this stage will be around 25-30%. The crop is harvested as cob harvesting when the sheath of cob dries and attains straw yellow color. The crop is harvested as once over harvest for seed purpose.

Dehusking: After harvest manually the sheath are removed, which is known as dehusking.

Cob sorting: Based on the kernel arrangements on the shank as irregular discolored, diseased and ill filling cobs are sorted out and cobs with characteristic kernel colour and shank colour and regular row arrangements are selected for seed purpose. The kernel discoloration should not 10% for certification

Zenia and metazenia: The discoloration in cobs may be due to disease infection or genetic contamination. The effect of foreign pollen on kernel colour is known as Zenia, metazenia effect which causes genetic contamination in the seed lot. Zenia is the effect of foreign pollen of same generation and metazenia is the effect of foreign pollen in next generation.

Shelling: The cobs are dried under sun and threshed with feasible stick for extraction of seeds the moisture content of seed at the time of threshing will be 15-18%.On large scale production cob shellers are used, but care should be given to avoid mechanical damage, which can reduce the seed quality and storability.

Drying

The seeds are dried to 8 to10 % moisture content either under sun or adopting mechanical driers for long term storage as the seeds is orthodox in nature.

Processing

Mechanical grading can be done with cleaner cum grader, which will remove the undersized immature and chaffy seeds .The middle screen size should be 18/64" round perforated sieves. The size can vary depending on the variety from 14/64 to 20/64 inch round perforated sieves.

Seed Treatment

The seeds are infested with several storage pests, to protect against these pests the seeds are given protective treatment with bavistin @2g/kg of seed with carbaryl @200mg/kg of seed as slurry treatment. Bifenthrin @5mg /kg of seed or diflubenzuran @ 200 ppm per kg of seed or imidachlopride @ 3 ml per kg of seed is also recommended for better seeds storage.

Seed Packing

Seeds are packed in gunny bag for short term storage while in HDPE and polylined gunny bag for long term storage.

Storage

The treated seed can be stored up to 12 months provided the seeds are not infected with storage pests. Seed can be stored up to 3 years if the seeds are packed in moisture containers and are stored at low temperature. The godown should be kept clean as the possibility of secondary infestation with *Tribolium castaneum* (red flour weevil) is much in these crops. The major problem in storage is incidence of grain weevil which will powder the seed material in a short period of time.

Seed Yield

3 to 4.0 tones.

Seed Standard

The processed seed should have the following seed quality characters both for certification and labelling. Seed ears inspected after harvest shall not contains in excess of 1.0% of off type ears including the ears with off-coloured kernels.

Shelling

Shelling of the seed ears is to be done after obtaining approval from the Certification Agency.

Factors	Standards for each class	
	Foundation	**Certified**
Pure seed (maximum)	98.0%	98.0%
Inert matter(maximum)	2.0%	2.0%
Other crop seed (maximum)	5/kg	10/kg
Weed seed	None	None
Other distinguishable varieties based on kernel colour and texture (max)	10/kg (by number)	20/kg (by number)
Germination (Minimum)	90%	90%
Moisture (maximum)	12.0%	12.0%
For vapor proof container (maximum)	8.0%	8.0%

Mid Storage Correction

The seeds lose their quality during storage due to deterioration and pest infestation, when the germination falls below 5-10 % of the required standard the seeds are imposed with mid storage correction, where the seeds are soaked in double the volume of 10-4 M solution of potassium dihydrogen phosphate (3.6mg/lit of water) for 6 hours and the seeds are dried back to original moisture content (8-9%).

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Beware: Plants Can Harbour Human Pathogens

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Summary

"Human pathogens on plants" (HPOPs) is the term used to describe human pathogens that are capable of entering and inhabiting the plant system. Fruits and vegetables eaten raw or with minimal food processing, often form a part of a healthy diet. However, they may at times be possible contributors to outbreaks of foodborne illnesses.

Introduction

Human pathogens can survive under the harsh environments in plants, adhere and actively invade plants. Adaptation to persist and grow on plants and associated environments like soil, rhizosphere etc. is a natural part of the life cycle for human pathogens, just as it is for plant pathogens. Like plant pathogens, human pathogens can persist in soil and in crops for prolonged periods.

Numerous studies have examined the survival, internalization and interaction of human pathogens with plants and it is hypothesised that human enteric pathogens adapt well to plant environments. The contact of enteric pathogens with the flowers, stems or fruits of plants leads to infiltration and colonization of plant tissues.

A variety of enteric pathogens have been isolated from fresh fruits and vegetables, leafy greens, sprouts, berries and raw tomatoes (Fletcher et al., 2011). The most noted outbreaks recorded are:

1. Shiga toxin-producing Escherichia coli O157:H7 infection linked to lettuce and spinach.
2. Salmonellosis linked to cantaloupes, tomatoes, and hot peppers.
3. Hepatitis-A linked to green onions.
4. Shiga toxin-producing *E. coli* O104 infections linked to fenugreek seed sprouts.
5. Listeria monocytogenes infections linked to cantaloupe.

Survival in Soil

Enteric pathogens can be introduced into fields by applying inadequately composted or raw animal manure or sewage onto soil (Natvig et al., 2002). The feces of wild animals is also a source of contamination. The enteric pathogen Escherichia coli O157:H7 has been found in birds, cattle, deer, dogs, horses, sheep, and swine. The faeces of these animals can transmit the pathogen into soil.

Temperature and moisture can affect the survival of *E. coli* in soil. It has been found that at a temperature of 25°C and soil moisture of 100%, *E. coli* can survive for more than 80 days (Cools et al., 2001). After the survival and acquisition of nutrition in soil, some E. coli strains produce filamentous structures that extend from the cell surface to facilitate cell attachment to the surface of the plant. Thus, *E. coli* originating from the soil may colonize plants. Salmonella survival was greater in soil containing poultry compost than in soil containing dairy cattle manure compost (Islam et al., 2004). In contrast to E. coli, Salmonella can survive and multiply for at least one year in soil environments.

Colonization of Plants

Enteric pathogens prefer to attach to cut surfaces or natural openings, such as stomata, using appendages such as pili, fimbriae, curli and cellulose. Further, their survival in the phyllosphere depends on the availability of nutrition, UV irradiation, toxic compounds from plants and desiccation.

Although they are not plant pathogens, human pathogens too can successfully invade and be internalized into plants. *Salmonella* can infect various *Arabidopsis* tissues and proliferate in apoplastic compartments, resulting in wilting and chlorosis (Schikora *et al.,* 2008). Lettuce plants infected with *Salmonella* showed reduced root formation, stunted growth and yellow spots on the leaves. *S. enterica* is known to contaminate carrots, radish, lettuce and parsley following treatment with contaminated manure compost or irrigation water.

Some HPOPs, like some phytopathogenic bacteria, even manipulate the opening or closing of those stomatal pores by signalling the encircling guard cells, whose turgor pressure changes control the pore size. It has been reported that *E. coli* O157 uses a specific type III secretion system effector to manipulate the stomatal guard cells of spinach leaves so that they open (Saldana *et al*., 2011). Human bacterial pathogens may even spread within a plant during the reproductive process, as *Salmonella* spp. placed on the pistil of a tomato or cantaloupe flower can travel to the ovule and colonize new fruits as they form there (Guo, 2001).

Insects are another potential source of contamination, and bacteria have evolved to exploit insects as hosts or vectors. Several plant pathogenic bacteria in the family Enterobacteriaceae, which includes *Salmonella* and *E. coli* O157:H7, are known to use insects as vectors for long distance transmission. In addition to the effect of insect feeding on the survival or transfer of enteric pathogens on plants, insect excrements were also involved in the dissemination of pathogens on plants.

Control Measures

Adoption of good agricultural practices such as providing well-drained soils, use of well decomposed organic manure, avoiding low, frost-prone or water-logged areas, and applying fertilizers at the right stage of crop growth would promote healthy, robust plant growth and enhance plant defence responses. Identifying and treating pathogen reservoirs such as contaminated water, soil and equipment helps eliminate or reduce inoculum. Prevention of spread by insect pests that can disseminate bacteria would also help reduce inoculum. More importantly, washing the final produce well before consumption is utmost important, to protect us humans from getting infected by the HPOPs.

Conclusion

It is clearly evident that human pathogens can survive in plants. They have adapted to the harsh environment on plant surfaces and can also enter inside the plant system and multiply; however, to a lesser extent than the plant pathogens. It cannot be completely ruled out that a host of adaptations and gene transfers can make human pathogens as plant pathogens too. Hence it is the need of the hour to investigate on this dangerous aspect in order to protect ourselves from possible infections of human enteric pathogens.

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Benefits of Power Tiller Operated Farm Machinery in Small / Marginal Farmers

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Power tiller a two-wheeled walking tractor widely used for agricultural implement in dry and wet puddle soil. For small & marginal farmers a power tiller is the best choice. It replaces the animal power more effectively & helps in raising demand for human labour. This power tiller used for 1.5 HP engine & designed as such to push forward or backward various agricultural equipment. Power tiller is capable to perform the operations of different farm implements like rotary, puddler, leveller, trailers, plow disc, cutter, mover & thresher. The most important functions of power tiller are that prepares an accurate seeded for the crop to be planted & warms the soil before planting by burying its ruminant into it. By controlling weeds, it helps in the proper growth of the crops.

Benefits of Power Tiller

Power tiller helps in preparing the soil, sowing seeds, planting seeds, adding and spraying the fertilizers, herbicides and water. In addition to it also helps in pumping water, harvesting, threshing and transporting crops. A power Tiller is ideal where the land side is small. We are to clear you about tiller agriculture, for better productivity on the farms. The power tiller uses follow.

1. Power tiller used for cultivation, sowing, weeding, and tillage.
2. It used with attachments that enhance its sowing machine, spray machine, router, and blood.
3. Power tiller uses in Sugarcane farming, Rice cultivation, Wheat farming, and Paddy cultivation.

Power Tiller Machine

Puddler: Pudding operation machine is done before transplanting the paddy seedlings. For this filed operation power tiller is fitted with lugged wheels or drum type cage wheels depending upon the soil conditions after removing the rubber tyres for better traction. Rotary is fitted with bent types. Tail wheel is also to be replaced with tail wheel float for adjusting the depth. Minimum two pudding operations are required and at least 8-10 cm of water should be available in the field for best puddle and power leveling off the field. Field coverage/Day 2.5 to 3 acres, average fuel consumption 1.25 to 1.50 liters/hr, depth of tilling 150 to 225 mm and width of rotary 540 to 600 mm.

Power tiller Peddler

Power tiller dry tilling

Dry tilling: In case of dry tilling either bent or straight tines can be fitted depending upon the moisture in the field. Normally this operation is done immediately after harvest to remove the roots or weeds in the field or loosening the soil for better aeration. Dry tilling is also done prior to planting seeds for dry crops such as Ground nut, chilies etc. Also, for inter cultivation, dry tilling operation is done. Field coverage/Day 2 to 2.5 acres, average fuel consumption 1.5 to 1.75 liters/hr, depth of cut 125 to 200 mm and rotary width 540 mm to 600 mm.

Cultivator: Five Tyne Cultivator fitments is commonly used as a secondary tillage equipment mostly in dry lands for loosening the soil, removal of crop roots. Weeds and for Inter cultivation in orchards etc. A little moisture in the field increases the tilling efficiency. Cultivator can be converted into a seed drill or a seed cum fertilizer drill with slight modifications for fitment of seeding & fertilizer applications device. Field coverage/Day 2.5 to 3 acres, average fuel consumption 1.25 to 1.5 liter/hr, depth of cut 100 mm to 150 mm and Width of cut 600 mm.

	
Power tiller cultivator	**Power tiller plough**

Two share plough: This attachment has two shares to plough tilling in unidirectional whereas coverage is twice compared to reversible Mouldboard plough. Suitable for plugging virgin land which is not tilled for long period. Tills the soil which has deep roots, unwanted plants, shrubs and weeds. Field coverage/Day 1 to 1.5 acres, average Fuel Consumption 1.5 – 2 liters/hr, depth of cut 200-250- mm, width of cut 300 mm.

Ridger: The Ridger is used for making ridgers for row crops such as Sugarcane, Potato, chilies, tobacco, banana, etc. as well as for opening furrows for water flow. The ridger should be used when the soil is slightly moist and only after tilling the land once or twice. The ridger is fitted on the rotary assembly with the help of a special bolt & nut. Field coverage/Day 1 to 1.25 acres, average fuel consumption 1.5 to 2 liters/hr, depth of furrow 250 to 300 mm and width of furrow 375 to 450 mm.

	
Power tiller ridger	**Power tiller shorter rotary**

Shorter rotary: Power tiller fitted with a shorter rotary (340 mm) and extended lugged wheel is used for inter cultivation operation for deseeding and loosening the soil in Sugarcane fields. A smaller furrower specially designed for Sugar cane field. Can be used for bund formation which also helps in irrigation. After Sugar cane harvesting, shorter rotary can be used for stubble removal of Sugar cane. The stubble is pulverized and is mixed with the soil thereby forming organic manure. Field coverage/Day 1 to 2 acres, short rotary width 340 mm, No. of tynes 10 Nos. and average fuel consumption 1.5 to 2 liters/hr.

Trailer: Trailer of 1.5 tans capacity can be fitted for transport of goods. Water tanker of capacity 1000 liters can be fitted with power tiller foe carrying drinking water. Average Fuel Consumption 1.0-1.25 liters/hr.

Power tiller trailer

Power tiller pumping

Pumping: Self-Priming Pump with tanker can be fitted for cleaning septic tanks, CASs pools, clogged drainage, community wells etc. Suction head 25 feet, delivery head 25-30 feet, discharge 440 liters/min and average fuel consumption 1.25-15 liters/hr.

Spraying: The sprayer is used for spraying pesticides and insecticides for controlling the pests in following areas: Coconut, Chiku, Pomegranate, Grapes, Guava, Banana, Papaya and Mango etc. Discharge 36 liters/mm and average fuel consumption 1.25-1.5 liters/hr.

Power tiller spraying

Power tiller auger digger

Auger digger: Attachment used for making holes varying from 6-8 inches in diameter and 18-24 inches deep in 15-20% moisture soil. Mostly used for planting: Banana, Papaya, Mango, Pomegranate, Guava and Chiku etc., Capacity 12-15 holes/hr and average fuel consumption 1 liter/hr.

Generator: The engine can be used as a prime mover to couple to a suitable standard generator available in the market. Submersible can be used for operating, water Pump and domestic requirements. Generator Capacity 7.5 kVA and average fuel consumption 1.5 to 1.75 liters/hr.

Power tiller generator

Power tiller seed cum fertilizer drill

Seed cum fertilizer drill: Exclusive attachment used with rotavator of power tiller. Drill seed & fertilizer in row. It consists of seed and fertilizer boxes separately, shoe type opener and spiked ground wheel. It is suitable for sowing seed of Wheat, Soya Bean, Bengal Gram etc. Field coverage/Day 1.25 to 2.2.5 acres, and average fuel consumption 1.25 liters/hr.

Reaper: Power reaper is one of the most reliable farming tools which works excellent in all reaping processes. It is a high expensive and high labour consuming method of harvesting. Harvesting is a highly time constrained job resulting economic losses to the farmers, if it is delayed. This reaper is the most choice of Indian farmers (small/marginal) due to its all-ultimate performance and long-life expectancy.

	
Power tiller reaper	**Power tiller transplanter**

Transplanter: Power tiller rice transplanter is a manually-operated machine which transplants rice seedlings in rows with a field capacity of 0.45-0.55 ha/day. A seedling mat, cut exactly 20 cm wide by 40 cm long, is used with the transplanter. It is easy to operate and maintain. It transplants seedlings with a 20 cm row spacing and depth of 1-3.5 cm. About 3-4 seedlings are transplanted per hill. Seedlings of 21 days is used. Two persons, operator and helper are required to operate the machine. When planting, the handle is pulled up and pushed down. With each downward stroke, the picker picks a number of seedlings out of the mat and puts them into the mud. At the upward stroke, the transplanter is pulled towards the operator. The attached seedling tray then moves horizontally to feed new seedlings into the slot.

Power Tiller Company in India

Power tiller mostly used by small/marginal farmers. We showed below the best power tiller company in India.

1. VST Shakti Power Tillers.
2. Bull Agro Power Tillers.
3. Kubota Power Tillers.
4. KMW Kirloskar Power Tillers.
5. Kranti Power Tillers.
6. KAMCO Limited Power Tillers.
7. Southern Agro Engines Power Tillers.

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Pitaya: An Exotic Fruit having Potential Health Benefits

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Pitaya popularly known as dragon fruit is a tropical fruit that bears on the Hylocereus cactus. It is native to places such as southern Mexico and Central America. The fruit holds various health benefits and nutritional values, apart from its exotic appearance. The fruit is said to resemble a dragon, known for its bright red skin and green scales which is why it is called a dragon fruit

Types of Dragon Fruits

There are three types of dragon fruits:

1. *Hylocereus undatus*: Also known as white-fleshed pitaya, *Hylocereus undatus* is a vine-like cactus. It consists of bright red skin, scattered with green scales and white flesh (Figure 1).

2. *Hylocereus megalanthus*: Native to northern South America, *Hylocereus megalanthus* is a cactus species grown for its yellow fruit (Figure 2).

3. *Hylocereus polyrhizus*: *Hylocereus polyrhizus*, popularly known as red pitaya, is native to Mexico. It consists of red skin with red flesh and is popular for its high antioxidant properties and has high market value. (Figure 3).

		
Figure 1	**Figure 2**	**Figure 3**

Nutritional Value of Dragon Fruit / Pitaya

Dragon fruits are rich in vital nutrients, low in calories, filled with essential vitamins, minerals and dietary fiber. Here are the nutrition facts for a serving of 3.5 ounces, or 100 grams: Calories: 60, Protein: 1.2 grams, Fat: 0 grams, Carbs: 13 grams, Fiber: 3 grams, Vitamin C: 3% of the RDI, Iron: 4% of the RDI and Magnesium: 10% of the RDI.

Storehouse of Antioxidants

Dragon fruit contains antioxidants that protect our cells from free radicals which are unstable molecules that are linked to chronic diseases and aging. The dragon fruit pulp contains some of the following antioxidants:

1. Hydroxycinnamates: This group of compounds has proven anticancer activity in test-tube and animal studies.

2. Flavonoids: These antioxidants are linked to reduced risk of heart disease and better brain health.

3. Betalains: These deep red pigments have been shown to protect "bad" LDL cholesterol from becoming oxidized or damaged which are found in the pulp of red dragon fruit.

Health Benefits of Eating Dragon Fruits

1. As mentioned above, it is rich in different types of antioxidants, it helps protect your body from free radicals that can lead to chronic illnesses and also fasten the process of ageing.
2. Dragon fruits are also known for its high fiber content, which plays an important role in maintaining digestive health and watching unhealthy weight gain.
3. It can strengthen our immunity as well due to its high nutritional value. The vitamin C and carotenoids prevents infections to enter your body and therefore can keep illnesses at bay.
4. Dragon fruit consumption can keep insulin level in check, reduce inflammation in the body and can reduce risks of heart diseases.

The Bottom Line

Dragon fruit is a low-calorie fruit that contains low sugar and fewer carbs than many other tropical fruits. It has potential health benefits, but human studies are needed to verify this. Overall, dragon fruit is unique, incredibly tasty, and can add variety to our diet.

Ohmic Heating of Pineapple- A Review

Article ID: 10773

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Abstract

Ohmic heating, also called electrical resistance heating, joule heating, or electro-conductive heating, is an advanced thermal food processing technique where heat is internally generated in a sample due to electrical resistance when electric current is passed through it. It is a novel technique which provides rapid and uniform heating, resulting in less thermal damage to the food product. According to the recent literature, plant products are most suitable and often used for ohmic heat processing. Beyond heating of fruits and vegetables, the applied electric field under ohmic heating causes various changes in quality and nutritional parameters which include inactivation of enzymes and micro-organisms, degradation of heat- sensitive compounds, changes in cell membranes, viscosity, pH, color, and rheology. Ohmic heating rate depends on the electrical field strength and electrical conductivity of product. This review focuses on various factors affecting the electrical conductivity of fruits and vegetables and the effect of ohmic heating on their quality and nutritional properties.

Keywords: ohmic heating; pineapple; quality; nutritional properties; electrical conductivity.

Introduction

Heat treatment is often used for the processing and preservation of food products. Conventional heating is the most common method in the heating of foodstuffs. During conventional thermal processing in cans or aseptic processing systems for particulate foods, significant product quality damage occurs due to slow conduction or convection heat transfer (Zell, Lyng, Cronin, & Morgan, 2009). Innovative technologies such as microwave heating, inductive heating, ohmic heating, and many more have evolved as alternatives to traditional thermal processing. The main difference between ohmic heating and other electrical methods is that electrical energy is directly dissipated into the product.

Ohmic heating, also called electrical resistance heating, joule heating, electro-conductive heating, is an advanced thermal food processing technique based on the passage of an alternating current through a sample which responds by generating heat internally due to its inherent resistance (Fryer, de Alwis, Koury, Stapley, & Zhang, 1993; Palaniappan & Sastry, 1991a). The energy generation is proportional to the square of the electric field strength and the electrical conductivity (EC) of the product (Goullieux & Pain, 2005; Ruan, Ye, Chen, & Doona, 2001). Since heat generation depends on EC, it is a key parameter to be quantified (Halden, De Alwis, & Fryer, 1990). The main advantage of ohmic heating is the rapid and uniform heating process.

Pineapple and Pomegranate

EC of pineapple was determined over 25–140°C temperature range. Viscosity and EC of pineapple juice was measured over temperature range (25–70°C) during ohmic heating. The effect of ohmic heating technique on EC, heating rate, system performance, and pH of pomegranate juice was investigated.

Quality and Nutritional Parameters Affected by Ohmic Heating

There has been limited research on the effect of ohmic heating on enzymes. PME is an enzyme that has been found in essentially every plant tissue, several fungi, and bacteria. PME has no prosthetic group and catalyzes deesterification of galactosyluronate methylesters of pectins, releasing protons and methanol into the media.

Peroxidases are known to be the most heat stable enzymes in vegetables, and their inactivation is usually used to indicate the adequacy of blanching.

Lipoxygenase and polyphenoloxidase inactivated at a faster rate due to electric fields, applied during ohmic heating than conventional heating. Similarly, the effects of voltage gradient, temperature, and holding time on the poly phenoloxidase activity were investigated for grape juice ohmic heating. There was an increase in ohmic heating rate with in- crease in voltage gradient. The critical deactivation temperature at higher voltage gradient was lower than at low voltage values because of the faster increase in EC at higher voltage gradients causing higher deactivation in polyphenol oxidase.

Changes in cell membranes/structures: The phenomenon of cell membrane electro permeabilization has been known for several decades and has recently received increasing attention because of its applicability to the manipulation of cells and tissues. Although the nature of the effects in plant tissues during ohmic heating is rather complex and is not completely understood, it was assumed that the electrical breakdown or electroporation mechanism is dominant.

Degradation of heat-sensitive compounds: The literature values for anthocyanin degradation in fruit products vary considerably. Studies demonstrated that its stability is influenced by the intrinsic properties of the product and the process characteristics causing these differences to occur. Anthocyanin degradation in blueberry pulp was evaluated after thermal treatment using ohmic and conventional heating. Degradation increased with both increasing voltage and solids content. The comparison between ohmic and conventional heating showed that when lower voltage levels were used, the percentage of degradation was lower to those obtained during conventional heating. The pulp processed during ohmic heating exhibited higher anthocyanin degradation with high electric fields. Also, a higher level of degradation of vitamin C during ohmic heating using high voltages relative to conventional heating was shown by Assiry, Sastry, and Samaranayake (2003). They concluded that during ohmic heating, in addition to the degradation caused by heat, there is also electrochemical degradation due to number of reactions, including electrode reactions and electrolysis of the solution; in addition, reactions between the electrode materials and the electrolysis products may influence the degradation reaction mechanisms and the kinetic parameters.

Viscosity and pH: Viscosity decreased with increase in temperature for four juices. This could be due to decrease in cohesive force between molecules at higher temperature. Processing and stabilization of a soup containing potato particles (cubes: 12–16 mm) by ohmic heating technology showed that this process resulted in a final product of pleasant texture and high viscosity, with a high content of particles >10 mm.

The effect of ohmic heating technique on EC, heating rate, system performance, and pH of pomegranate juice was investigated. The voltage gradient had significant effect on the pH change of pomegranate juice samples. As the voltage gradient increased, time and pH decreased.

Color changes: The highest values for activation energy were for ohmic heating which implies that a smaller temperature change is needed to degrade color more rapidly. Peroxidase.

Factors Affecting Ohmic Heating

The design of effective ohmic heaters depends on the EC of foods (Sarang et al., 2008). The ohmic heating rate is directly proportional to the square of the electric field strength and the EC (Sastry & Palaniappan, 1992). Since, heat generation depends on EC, it is a key parameter to be quantified.

It depends on temperature, applied voltage gradient, frequency, particle size, concentration, moisture content, and concentration of electrolytes (Icier & Ilicali, 2005b; Ye, Ruan, Chen, & Doona, 2004). Various factors affecting EC were analyzed.

EC increased with temperature presenting a linear or second-order relation, depending on the product. Halden et al. (1990) also noted the increase in EC of beetroot with temperature was sharper when processed electrically than the smoother increase seen when processed conventionally. The increase in field strength results in increasing fluid motion through the capillaries, which is directly proportional to EC (Halden et al., 1990).

Conclusion

Ohmic heating is an alternative heating process in which the food product is heated internally due to inherent resistance. Ohmic heating rate is dependent on the temperature, applied voltage gradient, frequency, particle size, concentration, and concentration of electrolytes. It linearly increases with increase in temperature, voltage gradient, and concentration of ionic constituents.

With in- crease in particle size and frequency, heating rate gets decreased. During study of ohmic heating behavior of two-phase food systems, it was found that as particle concentration increased, values of EC decreased uniformly. The effect of ohmic heating on quality and nutritional parameters of fruits and vegetables is also studied. Electrical fields applied during ohmic heating leads to faster deactivation of enzymes and micro-organisms.

The phenomenon of electroporation is dominant at low frequencies which lead to membrane rupture and ultimately a significant rise in tissue EC. The results showed that degradation of heat sensitive compounds (anthocyanins, ascorbic acid, and vita- min C) increases with both increasing voltage and solid contents. It has been observed that at low voltage levels, the percentage of degradation was lower to those obtained by conventional heating.

A higher level of degradation was seen at high voltages, whereas the use of low electric field frequency led to greater degradation due to occurrence of electrochemical reactions. Above 100 Hz, these reactions were minimized and both ohmic and conventional heating processes show similar degradation rates. The properties such as viscosity, pH, rheology, and color were also examined.With increase in temperature, viscosity decreases leading to increase in ohmic heating rate. pH de- creases with increase in voltage gradient. Similar effect was observed on rheological properties when juice was treated with both conventional and ohmic heating method. The studies reported that color degradation kinetics follow a first order reaction kinetics.

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Conservation Agriculture

Article ID: 10774

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Introduction

Conservation agriculture is described as a concept for resource saving agricultural crop production which is based on enhancing the natural and biological processes above and below the ground. ((FAO, 2012).

As per FAO Definition CA is to

1. Achieve acceptable profits.
2. High and sustained production levels.
3. Conserve the environment.

CA Goals Defined by FAO

1. It aims at reversing the process of degradation inherent to the conventional agricultural practices like intensive agriculture, burning/removal of crop residues.
2. It aims to conserve, improve and make more efficient use of natural resources through integrated management of available soil, water and biological resources combined with external inputs.
3. It can also be referred to as resource efficient or resource effective agriculture.

Principles of Conservation Agriculture

Conservation agriculture practices perused in many parts of the world are built on ecological principles making land use more sustainable (Wassmann, 2009; Behera et al. 2010; Lal, 2013).
1. Minimum mechanical soil disturbance (the minimum soil disturbance necessary to sow the seed).
2. Permanent organic soil cover (retention of adequate levels of crop residues on the soil surface).
3. Diversified crop rotation (to help moderate possible weed, disease and pest problems).

Conventional Vs. Conservation Agriculture

Conventional agriculture	Conservational agriculture
Cultivation land, using science and technology to dominate nature	Least interference with natural process
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(permanent covered)
Water infiltration is low	Infiltration rate of water is high
Use of ex-situ FYM/compost	Use of in-situ organic/compost
Kill establishment weeds but also stimulate more weed seeds to germinate	Weeds are a problem in the early stages of adoption but decrease with time
Mono cropping/culture, less efficient rotation	Diversified and more efficient rotation
Poor adaptation to stresses, yield losses greater under stress condition	More resilience to stresses, yield losses are less under stress condition
Productivity grains in long-run are in declining order	Productivity grain in long- run are in incremental order

Why does CA Represent A New Paradigm?

The principal indicators of non-sustainability of agricultural systems includes: soil erosion, soil organic matter decline, and salinization. These are caused mainly by:

1. Intensive tillage induced soil organic matter decline, soil structural degradation, water and wind erosion, reduced water infiltration rates, surface sealing and crusting, soil compaction.
2. Insufficient return of organic material.
3. Monocropping.

Therefore, a paradigm shift in farming practices through eliminating unsustainable parts of conventional agriculture (ploughing/tilling the soil, removing all organic material, monoculture) is crucial for future productivity gains while sustaining the natural resources.

Benefits of Conservation Agriculture

Agronomic benefits:

a. Improvement in soil productivity.
b. Advanced sowing date.
c. Increase in organic matter.
d. Soil water conservation.
f. Improvement in soil structure.

Economic benefits:

a. Time and labour requirement saving.
b. Reduction of costs.
c. Higher efficiency.

Environmental benefits:

a. Reduction in soil erosion.
b. Improvement in water quality.
c. Improvement in air quality (avoid crop residue burning).
d. Increase in biodiversity.
e. Carbon sequestration.

Constraints for Adoption of CA

1. Lack of appropriate seeders especially for small and medium scale farmers.
2. The wide spread use of crop residues for livestock feed and as fuel.
3. Burning of crop residues.
4. Lack of knowledge about the potential of CA to agricultural workers, extension agents and farmers.
5. Skilled and scientific manpower.
6. Mindset of farmer about tillage.

Challenges in Conservation Agriculture

1. Understanding the system (CA systems are much more complex).
2. Building a system and farming system perspective.
3. Technological challenges (relate to development and adoption of farm machinery for seeding with minimum soil disturbance).
4. Site specificity.
5. Long-term research perspective (Understanding the dynamics of changes and interactions among physical, chemical and biological processes is basic to developing improved soil-water and nutrient management strategies).

Prospects of CA

1. Reduction in cost of production.
2. Reduced incidence of weeds.
3. Saving in water and nutrients.
4. Increased yields.
5. Environmental benefits.
6. Crop diversification opportunities.
7. Resource improvement.

Policy Issues

1. The nature of cropping patterns and the extent of crop diversification are influenced by policy interventions. The government policies that directly or indirectly affect crop diversification are: pricing policy, tax and tariff policies, trade policies.

2. Policy support for capacity building by organizing training on CA is needed. Availability of trained human resources at ground level is one of the major limiting factors in adoption of CA. Efforts to adequately train all new and existing agricultural extension personnel on CA should be made in relevant departments.

3. Institutionalize CA: CA has to be mainstreamed in relevant ministries, departments or institutions and supported by adequate provision of material, human and financial resources to ensure that farmers receive effective and timely support from well trained and motivated extension staff.

4. Support the development of CA equipment and ensure its availability. The larger and more complex equipment is expensive and users may have to hire it. There is an opportunity to develop a local hire service industry by providing equipment, and training on machine maintenance and business skills.

5. Building partnership: partnership with farmers, participating with them in defining and solving problems rather than only expecting them to participate in implementing projects prepared from outside.

6. Credit and subsidy: The other important thing for successful adoption of CA is the need to provide credit to farmers to buy the equipment, machinery, and inputs through banks and credit agencies at reasonable interest rates. At the same time government need to provide a subsidy for the purchase of such equipment by farmers.

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Green Revolution

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Introduction

Green Revolution is characterized by the development and diffusion of high yielding varieties (HYVs) of crops, expansion of irrigation to assure the timely supply of water, multiple cropping in a year made possible by early maturing HYVs, and the use of agrochemicals. The widespread use of HYVs, primarily wheat and rice, by farmers during the early 1960s marks the beginning of the Green Revolution.

In the 1960s there were large-scale concerns about the world's ability to feed itself. However, widespread adoption of "green revolution" technology led to major increases in food-grain production. Between 1966 and 1990, the population of the densely populated low-income countries grew by 80%, but food production more than doubled. The technological advance that led to the dramatic achievements in world food production over the last 30 years was the development of high-yielding varieties of wheat and rice. These varieties are responsive to fertilizer inputs, are lodging resistant, and their yield potential is 2-3 times that of varieties available prior to the green revolution. In addition, these varieties have multiple resistance to diseases and insects and thus have yield stability. The development of irrigation facilities, the availability of inorganic fertilizers, and benign government policies have all facilitated the adoption of green-revolution technology.

Limitations of Green Revolution

1. The green revolution, howsoever impressive, but not a 100% success.
2. Only Punjab and Haryana states showed best results of green revolution.
3. In the areas where water is a limiting factor for agriculture, farmers have not been able to take the advantage of the Green Revolution technology for even rice and wheat. Scientists have tried and failed to develop high-yielding crop varieties for most marginal environments, where water, climate, and soil constraints cannot be overcome through varietal improvement.
4. Poor farmers could not afford HYV's, fertilizers and machinery.
5. HYV's need more water and fertiliser, which is expensive.

In the 1990s, the rate of growth in food-grain production has been lower than the rate of growth in population. If this trend is not reversed, serious food shortages will occur in the next century. Intensive cultivation of land with the heavy use of chemical fertilizer, as is the case with the Green Revolution, would gradually deteriorate the productive capacity of the land. Likewise, the indiscriminate use of agrochemicals such as pesticides would continue to have adverse impacts on agro biodiversity as well as on human health through the toxic residues presenting rains and other edible crop parts. Excessive mining of underground water to fulfill the irrigation needs of the Green Revolution agriculture would lead to exhaustion of groundwater resources. Replacement of locally adapted crop varieties with 1 or 2 high-yielding strains in large contiguous areas would result in the spread of serious diseases capable of wiping out the entire crop population.

At present, the issue is whether to continue with the chemical inputs-based intensive technologies or to go back to the traditional environment friendly farming practices like organic farming for sustainable production, income and socio-economic development of the farming community.

a. Due to intensification of agriculture, pollution from synthetic fertilizers.
b. Water depleted for irrigation; the excessive use of groundwater for irrigation depleted the water table in many parts of the country.

c. Problem with soil fertility (micronutrient issues), soil erosion

d. Increased dependence on external application of fertilizers; the overuse of chemical fertilizers to get high yield causes physical and chemical degradation of the soil by altering the natural micro flora and increasing the alkalinity and salinity of the soil.

e. Water quality issues.

f. Loss of diversity; the sole cultivation of monohybrid crops in the field by the farmers caused the removal of several indigenous species from cultivation.

g. Changed the nature of agriculture, from internal to external inputs.

h. Decreasing returns on investment.

Future Challenges

1. Increase in world population.
2. Food security in a sustainable way
3. Global warming – fluctuation in climate – crop failure
4. Limited availability of land and water (quantity and quality both) will pose a huge challenge to feeding our rising population.
5. Changing climatic patterns are the greatest worry. More than half of all cultivated land is still dependent on monsoons. But rainfall patterns are becoming more unpredictable.

Tackling of Problem According to Ecological Perspective

1. We are able to achieve food security in a sustainable way either by reducing the contribution of the agricultural sector to environmental degradation or by enabling the agricultural sector to adapt to those environmental changes

2. Plant architecture modification. By bi – directional sowing, narrow row spacing and also the orientation helps to utilise efficiently the resources (especially solar radiation, water etc.)

3. Conservation agriculture (zero tillage); Resource-conserving practices are helping to increase agricultural productivity.

4. Genetically diverse, suited to a range of agro- ecosystem and farming. Agro-biodiversity contributes to ecological stability, system resiliency, and overall productivity. It has also been argued that if agro biodiversity deteriorates, the farming system becomes more vulnerable to climatic perturbation, insects, pests, and diseases. Unfortunately, the Green Revolution has reduced agro biodiversity to two levels. First, it has replaced traditional cropping patterns encompassing combinations of cereals (e.g., rice, wheat, millet, maize), leguminous (e.g., lentil, peas, chickpea) and oilseed (e.g., mustard, linseed) crops, to monoculture of rice and wheat. Second, the introduction of rice and wheat HYVs came from a very narrow and alien genetic base. For example, when the PR-106 rice variety was introduced in India’s state of Punjab in 1976, it was considered resistant to white-backed plant hopper and stem rot. It has since become susceptible to both the diseases, in addition to succumbing to multiple other insects and pests.

The loss of genetic diversity is thus a “common threat to the sustainable use of plant genetic resources to meet the present needs and aspiration of the future generation”. In India, prior to the Green Revolution, some 30,000 landraces of rice were grown, while presently the bulk of the production comes from less than 50 modern varieties. Genetic diversity is essential to avoid vulnerability to pests and diseases that are expected to be more common in the future.

5. Adding organic fertilizers combined with suitable managing strategies, like incorporating plant residues or applying zero-tillage or minimum tillage rather than inorganic fertilizers, can improve soil quality, increase C sequestration, and reduce GHGs emissions while increasing grain yield.

6. Cropping pattern

7. Sowing time; by sowing of different varieties according to sowing time (early, mid and late) help in reducing epidemic of pest- diseases and play an important role for the long life of a variety. For the future, the sowing time altered due to the influence of climate change.

8. Water management: Exp. (SRI Technology, DSR,) collection of rain water in pond. Irrigation scheduling techniques are greatly diversified in terms of their utilization and performance. Scheduling is planned by exploiting multiple options taking into account the estimation and measurement of the water status in soils and their balance, symptoms of stresses in plants, climatic parameters, and sophisticated models.

9. Soil conservation and reclamation

10. Crop rotation – temporal diversity incorporated into cropping system provides crop nutrients and breaks the life cycles of several insect pests, diseases and weeds.

11. Agroforestry systems - An agricultural system where trees are grown together with annual crops and/or animals, results in enhanced complementary relations between components, increasing multiple use of the agro-ecosystem.

12. Cover crops - The use of pure or mixed stands of legumes or other annual plant species under fruit trees for the purpose of improving soil fertility, enhances biological control of pests, and modifies the orchard microclimate.

13. Crop/livestock mixtures - Animal integration in agro-ecosystems aids in achieving high biomass output and optimal recycling. Redesign of diversified farming systems with an optimal crop/ animal integration which encourages synergisms, so that the system can sponsor its own soil fertility, natural pest regulation and crop productivity.

14. The integration into cropping systems of pulses and legumes that help builds up and maintains soil nitrogen levels.

15. Proper planning and implementation of agricultural plan.

16. By altering land use more towards forestland and grassland, Land use change can also reduce the soil methane sink - the capacity of certain types of soil bacteria (methanotrophs), which use methane as an energy source, to negate methane emissions from other soil microbes and also break down atmospheric methane to carbon dioxide and water

17. Avoiding excess use of chemical fertilisers and pesticides. We should focus on precision farming i.e. right time, right amount, right method etc.

18. Proper irrigation systems so that water wastage can be controlled.

19. Frequent pollution control check of the soil should be done.

20. Practices like Intercropping, vegetative barriers and contour bunding play an important role in conserving soil and hence reducing erosion.

Conclusion

Green revolution has done a lot of positive things, saving the lives of million peoples and exponentially increasing the yield of food crops. But environmental degradation makes the green revolution an overall inefficient, short – term solution to the problem of food insecurity. So, more sustainable and environmentally friendly system of cultivation needs to be practiced. The world needs green revolution 2, which promises to feed a growing world population sustainably – without compromising the needs of future generations.

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Challenges and Opportunities in Sustainable Agriculture

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Introduction

The word sustain comes from the Latin 'sustinere' (sus-, from below and tenere- to hold), to keep in existence or maintain and implies long-term support or permanence. As it pertains to agriculture, sustainable describes farming systems that are "capable of maintaining their productivity and usefulness to the society indefinitely. Such systems must be resource conserving, socially supportive, commercially competitive, and environmentally sound."

Some terms defy definition. "Sustainable agriculture" is one of them. Let me quote a definition of "Sustainable agriculture" mentioned in the "Farm Bill" introduced in the US as early as in 1990. Under that law, "the term sustainable agriculture" means an integrated system of plant and animal production practices having a site-specific application that will, over the long term:

1. Satisfy human food and fiber needs.
2. Enhance environmental quality and the natural resource base upon which the agricultural economy depends
3. Make the most efficient use of non-renewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls.
4. Sustain the economic viability of farm operations.
5. Enhance the quality of life for farmers and society as a whole.

Goals for Sustainable Development

The goals for sustainable development are listed in the document titled "The Future We Want" presented in the United Nations Conference on Sustainable Development. The goals are as follows:

1. Eradication of poverty

2. Zero hunger
3. Good health and well being
4. Quality education
5. Gender equality
6. Clean water and sanitation
7. Affordable and clean energy
8. Decent work and economic growth
9. Innovation and infrastructure
10. Reduced inequalities
11. Sustainable cities and communities
12. Responsible consumption and production
13. Climate action
14. Life below water
15. Life on land
16. Peace, justice and strong institutions
17. Partnerships for achieving the goals.

Sustainability Issues & Challenges

The agriculture sector has the most challenging sector in respect of economically, environmentally and socially. As stated earlier, the studies reported a twofold increase in the food production during the first 20 years of the launch of green revolution in India. This radical growth was achieved by seven-fold and 375-fold increase in the consumption of chemical fertilizers and pesticides, respectively (Singh et al. 2016). This reckless development had some devastating effects (Bose and Mondal 2013). The external input-driven approach subdued the importance of internal regulation in the agro-ecosystem functioning, biological interactions, soil health and overall environmental sustainability (Srivastava et al. 2016). Thus, it resulted in a significant decline in soil quality and its multi-functionality (Singh 2000). Further, the positive effects of green revolution in the form of instant increase in food production at that time have gained a plateau as the yield is not rising now with the rates as observed during the period of 1965–1980 (Kumar and Mittal 2006; Singh and Sidhu 2006; Dhillon et al. 2010).

The Indian agriculture sector faced various traditional as well as new global challenges the key challenges addressed as follows:

1. Yield Gap
2. Low pace of technology adoption
3. Horizontal expansion, Climatic change
4. Transition towards high value crops
5. Provision and efficient use of quality inputs
6. Rehabilitation of degraded resources
7. Regional competitiveness
8. Obsolete/ unfair market mechanism
9. Surplus/shortage syndrome
10. Increasing production costs
11. Shrinking agriculture land
12. The conservation and enhancement of ecological foundations for sustainable agriculture, which included land, water, biodiversity, and marine resources. Urbanization and non-agricultural land uses to create tremendous challenge before agriculture.
13. The 80 percent farmers in India having small size of land. They are not economically sound and lack of market attachment.

14. The net income from agriculture of small and marginal farmer's quite low or some time it become negative. Because of large increase in production cost in agriculture sector.
15. The contribution of private sector in agriculture investment quite low and declined trend of public investment in agriculture after 2000.
16. The agriculture productivity is very low and hampers income of the farmers. The per unit area productivity also low in case of major crop producing in countries.
17. The fall in the ground water level generate more pressure on other irrigation facilities and create hurdles in the way of agriculture development in India.
18. Lack of competitiveness in Indian farmers is another hurdle rise in between improve agriculture development. The farmers are less risk bearing and unskilled which adversely impact on their income from agriculture.
19. Natural risk in agriculture is a common phenomenon but most of the farmers not get benefits of crop insurance scheme. The agricultural insurance schemes are inefficient to overcome various risk in agriculture sector.
20. Low profitability is a main cause behind the farmer's indebtedness and suicide problem existed in many states of India in the last few years.
21. The spending on agriculture subsidy has increased year by year but problem remains same and continuously grow-up.
22. Prevalence of rural poverty.
23. Rising internal food demand crisis.
24. Water scarcity, pollution of waterways, depletion of fresh water resources, lack of irrigation facilities.
25. Land degradation and soil erosion.
26. Inappropriate land management practices.
27. Loss of soil fertility.
28. Inappropriate use of fertilizers.
29. Negligence of traditional methods of farming and natural resource management.
30. Lack of rural credit.
31. Lack of research and development in agriculture and dearth of agricultural scientists.
32. Poor human resource in agricultural sector.
33. Illiteracy and ignorance of farmers prevent them from gaining knowledge about bio-fertilizers, new varieties of crops, credit etc.
34. No adoption of land reform measures particularly co-operative farming.
35. Small size of land holdings obstructs farmers from making huge investment in land and utilizing agricultural opportunities.
36. Lack of accessibility to farm credit from organized sector and institutional sources. Hence, small and marginal farmers depend on informal source which has huge drawbacks.

Opportunities for Sustainable Agriculture

The following key recommendations has given to ensure higher and inclusive growth in Indian agriculture sector:
1. Hard working farmers
2. Fertile land
3. Suitable climate for year-round cropping
4. Strong R&D system
5. Largest canal irrigation network with good quality aquifer
6. Proximity to international market
7. Increasing agricultural productivity is a key challenge for ensuring national food security. To increase production, exploiting the potential of existing yield gaps offers a tremendous opportunity

8. Rain fed areas has a huge potential to raise production and increase farm income. These grey areas can soon be made green to harness a second green revolution.
9. Linking farmers to markets is a pre-requisite for augmenting farm production and farmers' income. Role of innovative institutions would be critical in this context to reap the benefits of emerging opportunities
10. There is a dire need to significantly expand the capital investment in agriculture by both public and private institutions in the non-green revolution regions, particularly in the eastern and north-eastern India, where there is a great potential for agricultural growth.
11. Water will be the most critical natural resource for the future growth of agriculture. Currently, the water sector for irrigation is invariably neglected both at the central and state levels
12. Climate change has added a new dimension to future agricultural growth, which is a major concern. The worst affected would-be small farm holders located in the marginal and under-privileged areas.
13. There is an urgent need for agricultural diversification by identifying the key crops/ commodities which can help small farm holders to raise their income.
14. Food processing and distribution sector needs to be strengthened by evolving policies for larger private sector participation in the entire value chain.
15. Globalization of agriculture creates huge opportunities for enhanced agricultural production and export.

Conclusion

Global warming and climate change all adversely impact on overall agriculture productivity and production in India. The future demand for food grain and raw material will not be satisfied from agriculture sector. Less production from agriculture and expansion in demand create bourdon on agriculture production and food inflation in India. But another side is that the agriculture production, productivity, profitability of marginal farmers has declined. On that ground the sustainable agriculture development is only way to overcome this problem and further development.

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Green Manuring: An Option for Sustainable Soil Health and Crop Productivity

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Introduction

Green manuring is a part of organic farming. Green manuring is the practice of enriching the soil by ploughing under or soil incorporation of any green manure crops while they are green or soon after they start flowering. “The value of Green Manuring lies in the fact that organic matter is incorporated into the soil”. The organic matter in the soil is recognized as being one of its most valuable constituents for real soil fertility. The decay of this organic matter influences the availability of the soil nutrients. Crops that are grown for green manure are called green manure crops. Green manuring has recently been under practice by our farmers for decades. Estimates suggest that a 40-50 days old green manure crop can supply up to 80-100 kg. N/ha. Even if half of this N is crop utilizable, a green manure crop can be a substitute to 50-60 kg. fertilizer N/ ha (Sharma et al., 2013). Some of the potential green manuring legumes are dhanicha, sunhemp, cowpea, mung, bean, guar and berseem etc. Dhanicha, sunhemp, mung bean and guar grown during kharif season as green manure crops have been reported to contribute 8-21 tons of green matter and 42-95 kg. N/ha. Similarly, Khesari, cowpea and berseem grown during rabi season can contribute 12-29 tons of green matter and 67-68 kg of N/ ha (Mishra and Naik, 2004).

Broadly the practice of green manuring in India can be classified in two ways.

In Situ Green Manuring

In situ green manuring is also called as on–farm green manure or legume green manuring. In this system, the short duration legume crops are grown and buried in the same site when they attain the age of 60-80 days after sowing. This system of on-site nutrient resource generation is most prevalent in northern and southern parts of India, where rice is the major crop in the existing cropping systems. Almost any crop can be used for green manuring, but legumes are preferred because of their ability to fix nitrogen from the air. Green manuring with legumes (peas, clovers, lentils, etc.) is called legume green manuring. These crops should be turned into the soil before setting of seeds. Legume green manuring could be profitably used on lands where, it was not possible to add animal manures.

Table 1: Representing the content of green manure crops:

S. no.	Plant	Botanical name	Nutrient content (%) on air dry basis		
			N	P	K
1.	Sunhemp	*Crotolaria juncea*	2.30	0.50	1.80
2.	Dhaincha	*Sesbania aculata*	**3.50**	**0.60**	1.20
3.	Sesbania	*Sesbania speciosa*	2.71	0.53	**2.21**
4.	Cowpea	*Vigna sinensis*	1.70	0.28	1.25
5.	Mungbean	*Vigna radiata*	2.21	0.26	1.26

Green Leaf Manuring

Where the application of green leaves and twigs of trees, shrubs and herbs collected from plants grown in wastelands, field bunds, degraded lands and nearby forest. They are turned down or mixed into the soil 15-30 days before sowing of the crops depending on the tenderness of the foliage or plant parts is known as green leaf manuring.

Techniques of Green Manuring in the Field

The maximum benefit from the green manure crop cannot be obtained without knowing the:

1. Right time of growing.
2. Right time of incorporating in the soil.
3. Time required for decomposition.

Time of Sowing of the Green Manure Crop

Time of sowing of the green manure crop varies according to local conditions and resources available. Normally, green manure crop is sown immediately after monsoon rains. But, if irrigation facility is available, green manure crop can be grown as catch crop after harvesting of rabi crop during April and May. Sunnhemp and dhaincha are suitable for growing in April-May and can be buried in June-July before planting of main kharif crop. In rainfed areas intercropping of dhaincha with paddy in row ratio of 4:1 can be done. Also, sunnhemp and cowpea can be intercropped in widely spaced crop such as cotton, maize and sugarcane.

Green manures and undersowing: Undersowing involves growing a green manure at the same time as that of main crop. Sometimes they are sown with the crop or slightly later when the crops are already growing. This reduces competition between the green manure and the crop. No extra time is spent preparing the land and sowing the green manure.

Stage of Burying of Green Manure Crop

Burial of green manure crop at specific time provides maximum nitrogen and organic matter. This specific stage is when plant is immature and has started flowering, as the basic aim of green manuring is to provide maximum succulent green matter at burying. During early period of crop growth N content, protein, water soluble constituents are maximum, whereas fibre, hemicelluloses, cellulose, lignin and C:N ratio are less. Therefore, tissues of immature plants usually decompose more rapidly as compared to matured plants. Delay of even 15-20 days reduce nitrogen content and increase C:N ratio, fibre, hemicelluloses, cellulose, lignin making it difficult for soil microorganisms to act and decompose (Yadav et al., 2013).

Method and depth of burial of green manure crop: Before a crop is sown the green manure is dug back into the soil. Green manures should not be ploughed in as this buries the plants and the nutrients too deep. They should be turned in just under the soil surface. Here, it decomposes and the nutrients held inside green manure plants are released. Immature crop can decompose at any depth, but mature crop should be buried at less depth. If the weather is dry green manure crop should be buried at more depth compared to moist season. If moisture in soil is less water should be supplied externally. Green manure crop should be buried at higher depth in sandy soil and in heavy soils at less depth for proper decomposition.

Time Interval Between Burial of Green Manure Crop and the Sowing of the Next Crop

The time interval should be such that it allows complete decomposition of the turned in green manure crop before planting of the next crop. Time interval depends on the following factors: 1) weather conditions, 2) nature of buried green material. Crop should be sown after 35- 45 days of burial of green manure crop as green manure crop takes about 4-6 weeks for complete decomposition. If the green manure crop is succulent, then there is no harm in transplanting the paddy immediately after turning in the green manure crop. However, in case of woody, then sufficient time should be allowed for its decomposition. Green manure crop was intercropped in between the rows of the main crops like paddy, cotton, sugarcane etc. Then, it is buried in the succulent stage for its rapid decomposition.

Limitations of Legume Green Manuring

In spite of the wide range of literature which reveals associated benefits of legume LGM, its applicability still remains in the research farms. Their adaptation by farmers is still not a common practice due to lack of awareness and some limitations at farm levels. There are few cases to cite. Haryana Government promotes LGM in rice-wheat areas of state. They are listed below:

1. Establishment and incorporation of green manuring crops are relatively costly.
2. Narrow window period between the two crops for growing and incorporating green manure crops during most of the cropping season.
3. Green manure crop, if not incorporated at proper growth stage and time, may lead to immobilization of N on a temporary basis.
4. Being a high-water requiring crop, it may not be suitable for dryland agriculture.
5. Problems of decomposition of green manuring in the sowing of the following crop if proper moisture is not available, particularly in semiarid regions.
6. No visible economic benefits are seen during initial few seasons of green legume manuring.
7. Easy availability of fertilizers and their ease of application in comparison to green manuring.
8. Prices of mineral fertilizers are relatively low when compared to the high price of land and labor.

Future Perspectives

Future research for legume green manures is needed on following topics:

1. The studies across the globe have established the benefits of green manures on soil physicochemical and biological health. However, their application to the farm level is still at a limited stage because of lack of awareness and suitability under particular environments and cropping system.

2. There is need to develop a location-specific cropping system with compatible legume green manure crop either partly or in the window period between two crops.

3. Benefits of green legume manure need to be quantified regarding fertilizer saving, water saving, increase in crop productivity, and more importantly soil health improvement, so that the extra cost involved in raising the green manure crop may be justified to the ultimate adapter, the farmers.

4. Efforts are to be directed to find out alternative techniques like brown manuring of legume crops by growing them as intercropped, which can save time as well as need of incorporation. Such easily acceptable techniques are to be devised.

Conclusion

The ever-increasing human population poses a burden on soils to produce more food. The intensive use of agrochemicals is threatening the soil sustainability. Use of chemical fertilizers in intensive cropping systems may lead to degradation of natural resources, particularly soils. These degraded soils will not be fit for profitable agriculture. Therefore, incorporation of legume green manure crops into the soil is emphasized for crop production. In ancient times, also legumes were recognized as suitable crops for green manuring to improve soil health and crop productivity. In addition to fixing of atmospheric N, it helps in conservation of soil water and reduction of soil erosion. LGM is to be considered superior over the non-legume crops due to a higher N content and lower C/N ratio, helping in easy decomposition of OM and mineralization for nutrient release at a faster rate. Besides this, it also reduced the N immobilization risk for succeeding crops. Therefore, practices of LGM have a large scope for inclusion, to make the farming system more sustainable.

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Crop Growth Analysis

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Introduction

Growth is an irreversible increase in mass, weight or volume of a living organism, organ or cell. It is advancement towards maturity and attained mainly by photosynthesis less what is lost through respiration.

In Situ Green Manuring

In situ green manuring is also called as on–farm green manure or legume green manuring. In this system, the short duration legume crops are grown and buried in the same site when they attain the age of 60-80 days after sowing. This system of on-site nutrient resource generation is most prevalent in northern and southern parts of India, where rice is the major crop in the existing cropping systems. Almost any crop can be used for green manuring, but legumes are preferred because of their ability to fix nitrogen from the air. Green manuring with legumes (peas, clovers, lentils, etc.) is called legume green manuring. These crops should be turned into the soil before setting of seeds. Legume green manuring could be profitably used on lands where, it was not possible to add animal manures.

Stages of Cellular Growth

The growth of an organ or an organism occurs in three successive stages. They are:

1. Cell division: The number of cells increases due to mitosis.

2. Cell enlargement: The size of individual cell increases after cell division due to increase in the volume of its protoplasm.

3. Cell differentiation: In this stage, structure of the cells changes to perform specific functions. And similar type of cells having same functions form a group, which is known as tissue.

Types of Growth

1. Determinate Growth: Plant growth in which it grows to certain size and then stops growing due to presence of terminal inflorescence is called determinate growth. After their growth is completed, they eventually senesce and die.

2. Indeterminate Growth: Plant growth in which the main stem continues to elongate indefinitely without being limited by a terminal inflorescence or other reproductive structure.

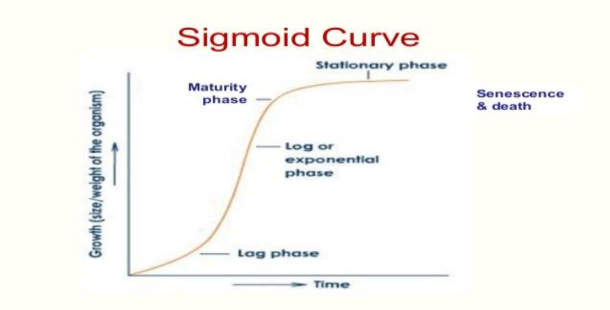
Growth Curve

This can be divided into three phases.

1. Lag period of growth: During this period the growth rate is quite slow because it is the initial stage of growth.

2. Log period of Growth: During this period, the growth rate is maximum and reaches the top because at this stage the cell division and cell division and physiological processes are quite fast.

3. Senescence period or steady state period: During this period the growth is almost complete and become static. Thus, the growth rate becomes zero.



Growth Analysis

Growth analysis is a mathematical expression of environmental effects on growth and development of crop plants. This is a useful tool in studying the complex interactions between the plant growth and the environment. This analysis depends mainly on primary values (Dry weights) and they can be easily obtained without great demand on modern laboratory equipment.

Objective of Growth Analysis

1. To identify spatial and temporal integration of all plant process.
2. To know the rate of dry matter accumulation varies across the life cycle of the crop.
3. To quantify the effects of environmental influence or to analyse the genotypic differences between crop cultivars.
4. To learn what are the most relevant methodologies to measure the daily performance of crop canopy.

To know why plant-to-plant variability does makes the measurement of plant productivity so difficult.

The growth parameters that are commonly used in agricultural research:

a. Leaf Area: This is the area of photosynthetic surface produced by the individual plant over a period of interval of time and expressed in cm^2 $plant^{-1}$.

b. Leaf Area Index (LAI): Williams (1946) proposed the term, Leaf Area Index (LAI). It is the ratio of the leaf of the crop to the ground area over a period of interval of time. The value of LAI should be optimum at the maximum ground cover area at which crop canopy receives maximum solar radiation and hence, the TDMA will be high.

$$LAI = \frac{\text{Total leaf area of a plant}}{\text{Ground area occupied by the plant}}$$

c. Leaf Area Ratio (LAR): The term, Leaf Area Ratio (LAR) was suggested by Radford (1967), expresses the ratio between the area of leaf lamina to the total plant biomass or the LAR reflects the leafiness of a plant or amount of leaf area formed per unit of biomass and expressed in cm^{-2} g^{-1} of plant dry weight.

$$LAR = \frac{\text{Leaf area per plant}}{\text{Plant dry weight}}$$

d. Leaf Weight Ratio (LWR): It was coined by (Kvet et al., 1971) Leaf weight ratio is expressed as the dry weight of leaves to whole plant dry weight and is expressed in g g^{-1}.

$$LWR = \frac{\text{Leaf dry weight}}{\text{Plant dry weight}}$$

e. Leaf Area Duration (LAD): To correlate dry matter yield with LAI, Power et al. (1967) integrated the LAI with time and called as Leaf Area Duration. LAD takes into account, both the duration and extent of photosynthetic tissue of the crop canopy. The LAD is expressed in days.

$$LAD = \frac{L1 + L2}{2} * (t2 - t1)$$

L1 = LAI at the first stage

L2 = LAI at the second stage, (t 2 - t 1) = Time interval in days

f. Specific Leaf Area (SLA): Specific leaf area is a measure of the leaf area of the plant to leaf dry weight and expressed in cm^2g^{-1} as proposed by Kvet et al. (1971).

$$SLA = \frac{\text{Leaf area}}{\text{Leaf weight}}$$

Hence, if the SLA is high, the photosynthesizing surface will be high. However, no relationship with yield could be expected.

g. Specific Leaf Weight (SLW): It is a measure of leaf weight per unit leaf area. Hence, it is a ratio expressed as g cm^{-2} and the term was suggested by Pearce et al. (1968). More SLW/unit leaf area indicates more biomass and a positive relationship with yield can be expected.

$$SLW = \frac{\text{Leaf weight}}{\text{Leaf area}}$$

h. Absolute Growth Rate (AGR): AGR is the function of amount of growing material present and is influenced by the environment. It gives Absolute values of biomass between two intervals. It is mainly used for a single plant or single plant organ e.g., Leaf growth, plant weight etc.

$$AGR = \frac{\text{h2} - \text{h1}}{\text{t2} - \text{t1}}\ cm/\ day$$

Where, h1 and h2 are the plant height at t1 and t2 times respectively.

i. Net Assimilation Rate (NAR): The term, NAR was used by Williams (1946). NAR is defined as dry matter increment per unit leaf area or per unit leaf dry weight per unit of time. The NAR is a measure of the average photosynthetic efficiency of leaves in a crop community.

$$NAR = \frac{W2 - W1}{t2 - t1} * \frac{\log_e l2 - \log_e l1}{l2 - l1}$$

Where, W1and W2 is dry weight of whole plant at time t1 and t2 respectively

L1 and L2 are leaf weights or leaf area at t1 and t2 respectively

t1 – t2 are time interval in days

NAR is expressed as the grams of dry weight increase per unit dry weight or area per unit time (g $g^{-1}day^{-1}$)

j. Relative Growth Rate (RGR): The term was coined by Williams (1946). Relative Growth Rate (RGR) expresses the total plant dry weight increase in a time interval in relation to the initial weight or Dry matter increment per unit biomass per unit time or grams of dry weight increase per gram of dry weight and expressed as unit dry weight / unit dry weight / unit time (g $g^{-1}day^{-1}$).

$$RGR = \frac{\log_e W2 - \log_e W1}{t2 - t1}$$

Where, W1 and W2 are whole plant dry weight at t1 and t2 respectively,

t1 and t2 are time interval in days

k. Crop Growth Rate (CGR): The method was suggested by Watson (1956). The CGR explains the dry matter accumulated per unit land area per unit time (g m^{-2} day^{-1}).

$$CGR = \frac{\text{W2} - \text{W1}}{\rho(\text{t2} - \text{t1})}$$

Where, W1 and W2 are whole plant dry weight at time t1 – t2 respectively

ρ is the ground area on which W1 and W2 are recorded.

CGR of a species are usually closely related to interception of solar radiation

l. Total dry matter production (TDMP) and its distribution: The TDMP is the biomass accumulated by the whole plant over a period of interval of time and its distribution (allocation) to different parts of the plant such as roots, stems, leaves and the economic parts which controls the sink potential.

m. Translocation percentage (TP): The term translocation percentage indicates the quantum of photosynthates translocated from source (straw) to the grain (panicle/grains) from flowering to harvest.

$$TP = \frac{\text{straw weight at flowering} - \text{straw weight at harvest}}{\text{panicle weight at flowering} - \text{panicle weight at harvest}}$$

n. Light extinction coefficient: It is the ratio of light intercepted by crop between the top and bottom of crop canopy to the LAI.

$$K = \frac{\log_e I/I0}{\text{LAI}}$$

Where, Io and I are the light intensity at top and bottom of a population with LAI

o. Light Transmission Ratio (LTR): It is expressed as the ratio of quantum of light intercepted by crop canopy at top to the bottom. Light intensity is expressed in K lux or W m^{-2}

LTR = I / Io

Where, I: light intercepted at the bottom of the crop canopy

Io: light intercepted at the top of the crop canopy

p. Dry Matter Efficiency (DME): It is defined as the percent of dry matter accumulated in the grain from the total dry matter produced over the crop growth period.

$$DME = \frac{grain\ yield}{TDMP} * \frac{100}{duration\ of\ crop}$$

q. Unit area efficiency (UAE): It is expressed as the quantum of grain yield produced over a unit land area for a specified crop growth period.

$$UAE = \frac{grain\ yield}{land\ area} * \frac{1}{duration\ of\ crop}$$

r. Harvest Index: The harvest index is expressed as the percent ratio between the economic yield and total biological yield and was suggested by Nichiporovich (1951).

$$HI = \frac{Economic\ yield}{total\ biological\ yield} * 100$$

Advantages of Growth Analysis

1. We can study the growth of the population or plant community in a precise way with the availability of raw data on different growth parameters.
2. These studies involve an assessment of the primary production of vegetation in the field i.e. at the ecosystem level (at crop level) of organization.
3. The primary production plays an important role in the energetics of the whole ecosystem.
4. The studies also provide precise information on the nature of the plant and environment interaction in a particular habitat.
5. It provides accurate measurements of whole plant growth performance in an integrated manner at different intervals of time.

Drawbacks of Growth Analysis

1. In classical growth analysis sampling for primary values consist of harvesting (destructively) representative sets of plants or plots.
2. It is impossible to follow the same plants or plots throughout whole experiment.

Carbon Farming: A Miracle for Climate Change

Article ID: 10779

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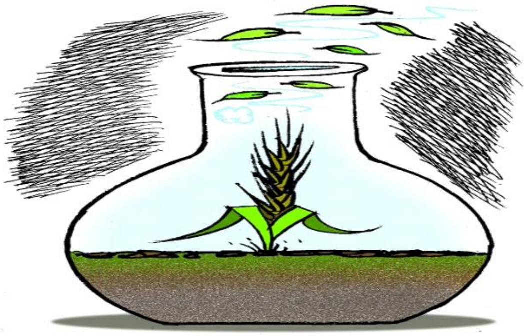
Introduction

Carbon farming includes implementation of practices which can enhance the rate of CO_2 removed from the atmosphere and get converted into plant material or soil organic matter. This practice is successful only when the carbon losses are minimized and there is increase in carbon gains through implementation of land management and conservation practices (IPCC, 2007).

In Situ Green Manuring

1. Landholders will get financial incentives for reducing carbon emissions.
2. It possess multiple economic and environmental benefits
3. It is aimed to maintain carbon balance, means proportion of emissions to sequestration. Emissions should be less than sequestration for maintaining carbon balance.

Carbon farming activities are mainly categorized in 2 types - Either it sequesters carbon or it reduces GHG emissions which include CO_2, N_2O and CH_4



Importance of Carbon Farming

The great irony is that agriculture can more being a larger contributor to GHG to being a carbon sink.
1. Carbon sink capacity of the world's agricultural and degraded soils is 50 to 66% of the historical carbon loss of 42 to 78 Gt of carbon. (Lal, 2004).
2. By adopting improved agricultural management practices, agricultural soils in the world are estimated to have the potential to sequester 0.4–0.8 Pg C per year (Lam et. al., 2013).

Sources of Farm Emissions

These are the sources of emissions from farm:
1. Methane from rice fields.
2. Agrochemical application.
3. While pumping water for irrigation.
4. Methane from cattle enteric fermentation.
5. Biomass burning.
6. Due to poorly managed manures.

7. Ploughing and subsoiling.
8. Use of farm machineries.
9. Manufacturing fertilizers.
10. Land clearing and deforestation.

Carbon Farming Technologies

These are some carbon farming practices that removes excess CO_2 from the atmosphere where it causes harm, and sink it into plants and soil, where it is a benefit.

Category	Practices and Impacts	Potential Global Mitigation Impact	Ease of Adoption by Farmers	Readiness of Practice
Managed grazing	Stocking densities, improved grazing management, fodder production and diversification	Low	Moderate to easy	Ready
Manure application	Application of manure to cropland for fertility; livestock– crop integration	High	Easy	Ready
Livestock feeding	Methane-reducing feed and forage	Medium	Moderate	5–10 years
Manure management	Modified bedding, changed feeds, bio-digestion, etc.	High	Moderate to easy	Ready
Agroforestry	Integration of trees with crops and/or livestock	Medium	Moderate	Ready
Mixed biomass production	Productive shelterbelts and riparian buffers, biomass crop integration	Medium	Easy	Ready
Afforestation of farmland	Monocultures or mixed species, including tree crops and multipurpose trees	Medium	Easy	Ready
Crop management	Rotations, cover crops, perennial crops, improved varieties	Medium	Easy	5-10 years
Tillage and residue management	Reduced tillage, crop residue retention	High	Easy	Ready
Water management	Rainwater harvesting and other strategies	Medium	Moderate	5–10 years
Rice paddy management	Straw retention, reduced flooding, nutrient management	Medium to high	Moderate to easy	Ready
Biochar application	Application of biochar for fertility and carbon sequestration	High	Moderate	Still under development
Pasture management	Improved pasture species, fodder banks, etc.	Low	Easy	Ready

Source: Adapted from IPCC, Climate Change 2014: Mitigation of Climate Change, 830– 32.

1. Among these practices' tillage-residue management; rice paddy management; biochar application; manure application and management have greater potential mitigation impact.

2. Most of the practices are easily or moderately adopted by the farmers.

3. Except crop management, water management all other activities can be readily practiced. But bio-char application is at developmental stage.

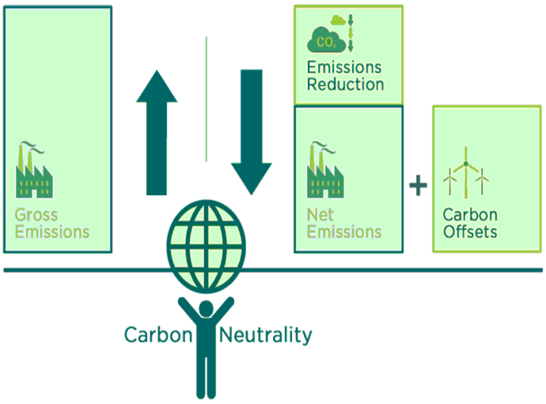
4. Overall tillage-residue management; rice paddy management; manure application and management activities can be easily adopted with their high mitigation impact and readiness to practice.

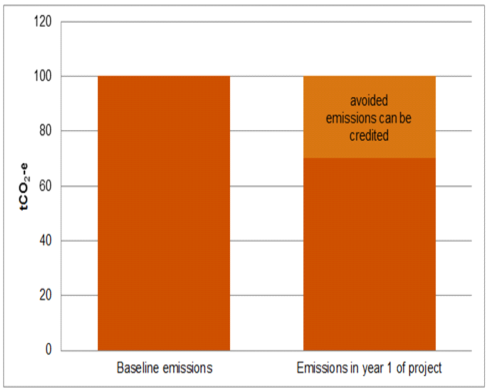
Benefits of Adopting Carbon Farming

1. Increased soil & water conservation.
2. Diversified Production.
3. Retention and transference of cultural knowledge.
4. Quality agri-products.
5. Income diversification.
6. Increased climate resilience.
7. Increased productivity.

Carbon Market and Carbon Credits

1. Carbon market is a place where a carbon can be sold for money. It is very similar to other markets where commodity is purchased and sold. So, carbon is traded like a commodity
2. Carbon credit is equal to one ton of carbon sequestered for every ton of emission, which is commonly called 1 ton of CO_2 equivalents
3. Carbon farming is introduced in Australia and carbon credits of Australia are called Australian Carbon Credit Units (ACCU).
4. Since 2015, the policy in Australia is called the 'Direct Action Plan' and Australian Carbon Credit Units can be sold to either The Australian Government (the primary market) or to Private organizations (the secondary market).
5. Credit generated in a project is dependent on the tonnes of CO_2e reduced in the project as compared to before the project started.
6. The emissions were also recorded before the project starts (when there was unmanaged land). This is called the baseline or baseline emissions.
7. The baseline represents what would happen (how much emissions would there) if we didn't do the project. It is also known as business as usual.





Future Pathway

1. The public sector will play a major role in determining how to engage agricultural sector in reduction of greenhouse gas emissions. The govt. can use its power to tax, subsidize or create a new market mechanism to do this.
2. Implementation of a soil C trading system by the government as a policy can be one of the best ideas. For creating potential soil C markets to provide incentives to landholders for accumulating SOC and delivering cost-effective mitigation option
3. There is need to develop tools like nutrient expert tool as it is easy to use and free cost. Adoption of this tool in pan India over traditional farmers fertilizer practice can serve as a best mitigation tool, as it reduces GHG emissions and also provide income to farmers by saving unusual fertilizer consumption and also increases yield.

"An investment is not an investment if it destroys our planet"

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Status of Vegetable Seed Market in India

Article ID: 10780

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Summary

Seeds being the primary and most critical input for sustainable agriculture, the demand for high-quality vegetables and fruits is expected to increase. Since 2011, the fruit & vegetable seeds market has witnessed an increase in demand, especially in countries such as the US, Canada, Spain, the UK, India, and China. The global fruit & vegetable seeds market is estimated to be valued at USD 8.77 billion in 2016 and is projected to reach USD 14.00 billion by 2022, at a CAGR of 8.10% from 2016 (Market and Market Analysis, 2016). Factors such as demand for nutritional food, innovative production practices, new product offerings, and the advent of modernization in agriculture are increasing the market for the seed industry globally. The seeds market is primarily driven by the consumption of its end products and is gaining awareness among the farmers. Broadly, seed marketing includes such activities as production processing, storage, quality control and marketing of seeds.

Introduction

India Seed market share 25 % of the present (2018) seed market, the total hybrid seed market value is about 30,000 million and the total open-pollinated seed market value is 15,000 million with an overall annual growth rate of 5–6%. Indian vegetable seed market contributes the share of 30% while 70% are the saved seeds which are used in production by the farmers.

Out of 30% market available seeds, 66% are hybrids and 34% are varieties, Indian vegetable seed market registered robust growth at a CAGR of 8.4%, in volume terms during 2012-16 and is projected to grow at a CAGR of 9.8% for the forecast period between 2020-2025 (Mordor Intelligence, 2019). Further, the hybrid seeds market in India is expected to grow at a CAGR of 12.65% during the period 2017-2021 (Research and Markets, 2017). The Indian seed industry is projected to surpass USD 4.3 Billion by the end of 2026 from the current value of about 3.0 Billion (TechSci Research, 2016).

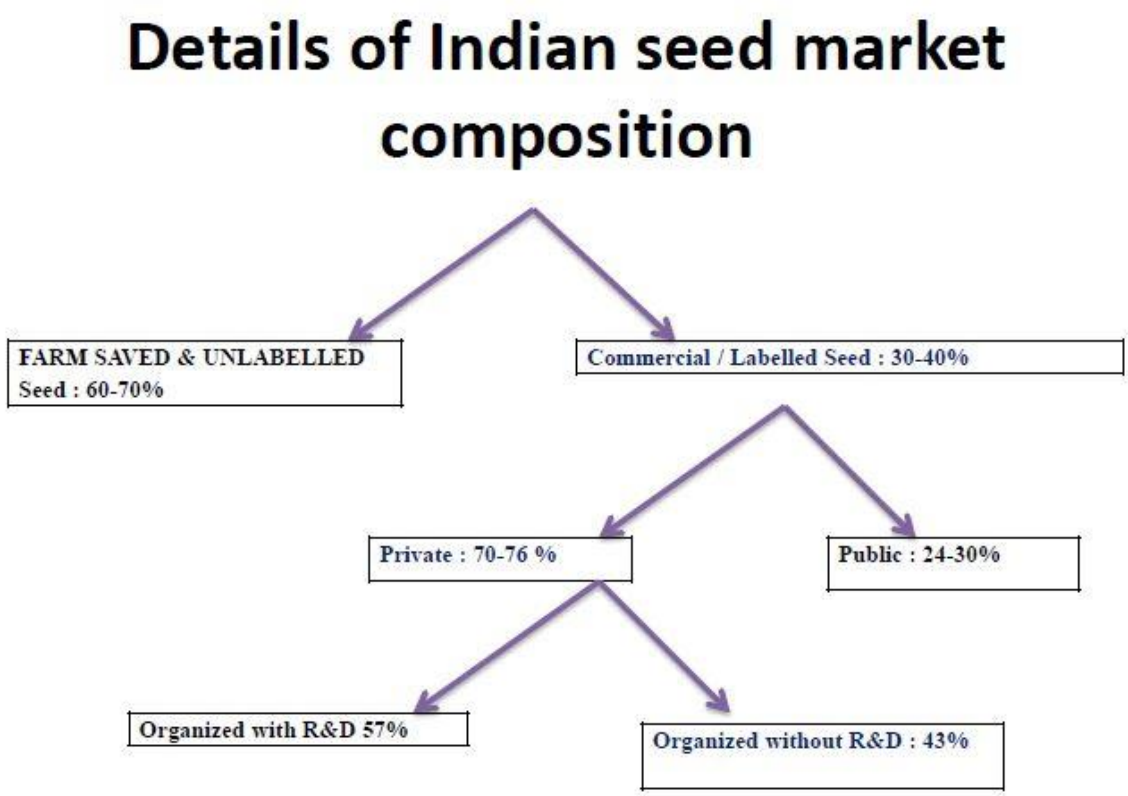
Owing to favourable policies and plans laid by Government of India such as National Policy for Farmers (NPF), National Food Security Mission, Paramparagat Krishi Vikas Yojana (PKVY), National Mission on Agricultural Extension and Technology (NMAET), the seed industry of the country would witness tremendous growth through 2026. The country recorded 3.8 million metric tons of quality seeds availability during 2016, which would escalate at a healthy rate over the next nine years on account of population explosion in India.

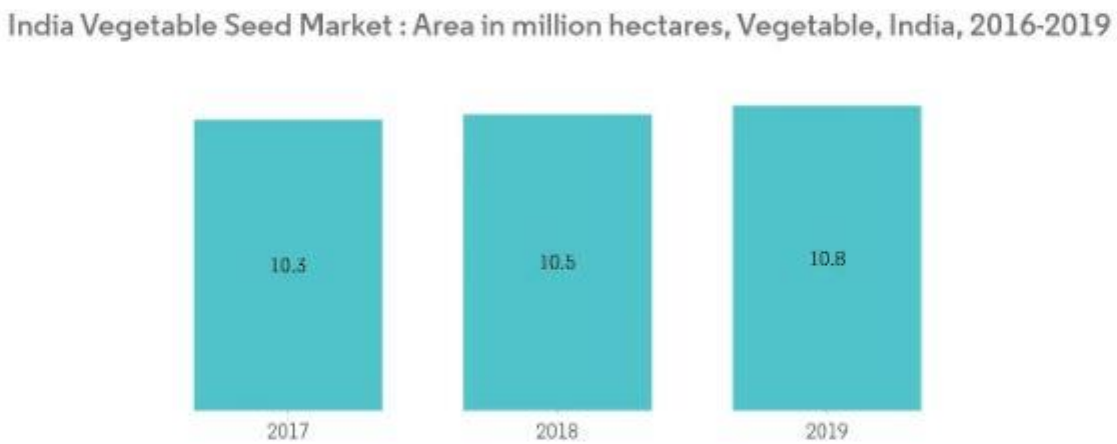
Moreover, the growing adoption of hybrid seeds would further hasten the growth of India seed market through 2026. Rating agency ICRA estimated that with the growth in volumes as well as value on the back of hybridization, the size of the vegetable seeds industry would double from the current levels to around Rs 8,000 crore in the next five years.

Most of the vegetable seeds companies in the country are focused on the production of tomato, cabbage, brinjal, chilli, okra, and cucumber seeds. Among all the vegetable seeds, cabbage and tomato hold the highest seed replacement rate. At present, only less than 15% of seeds used by the farmer are good quality seeds, and the rest of the seed demand is being satisfied by the saved seeds of farmers from the previous season.

Increasing Area Under Vegetable Production Driving the Market

According to ICRA, increasing awareness regarding consumption of vegetables to meet various dietary requirements and nutritional needs has raised the demand for vegetables, consequently leading to an increase in the area of vegetable production. On the supply side, farmers are growing a wide range of vegetables, because vegetables are short-duration crops that have multiple harvests, resulting in better cash flow for the farmers.

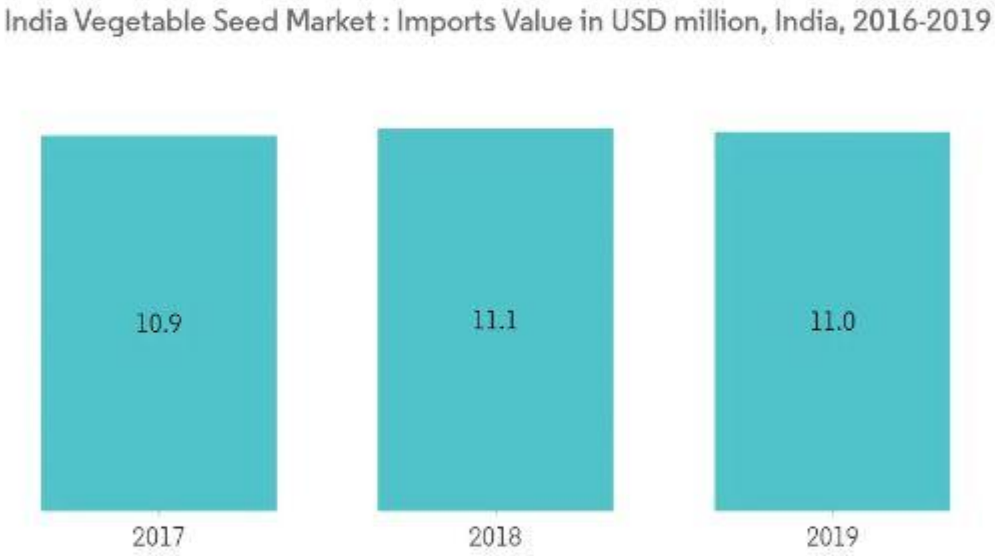




Source: FAOSTAT

India Emerging as One of the Major Importers of Vegetable Seeds

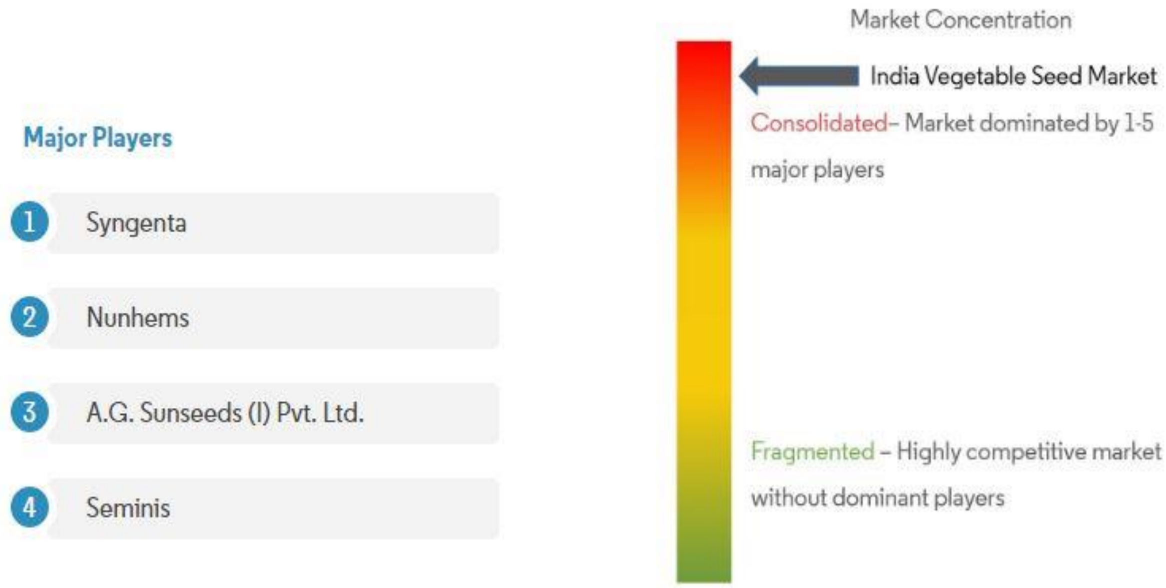
India is the tenth-largest importer of vegetable seeds by value and seventh-largest importer by volume, in the world. It accounted for about 1% of the total vegetable seed imports by volume during 2018. Chile, Thailand, Italy, China, New Zealand, South Korea, Philippines, Indonesia, and the Netherlands are the major countries exporting vegetable seeds to India. Chile, Thailand, and Italy are the largest exporters, which, collectively, account for more than 50% of the total import of vegetable seeds by India.



Source: ITC Trade Map

Competitive Landscape

The India Vegetable Seeds Market is consolidated with top players occupying the majority of the market. Syngenta, Nunhems, Namdhari, Bejo Sheetal, Mahyco, Seminis, Advanta (UPL), Vibha, US Agri, and Ankur seeds are the top ten vegetable seed companies in the nation, controlling more than 80% of the market. The private sector dominates the Indian vegetable seed industry, both by value and by volume.

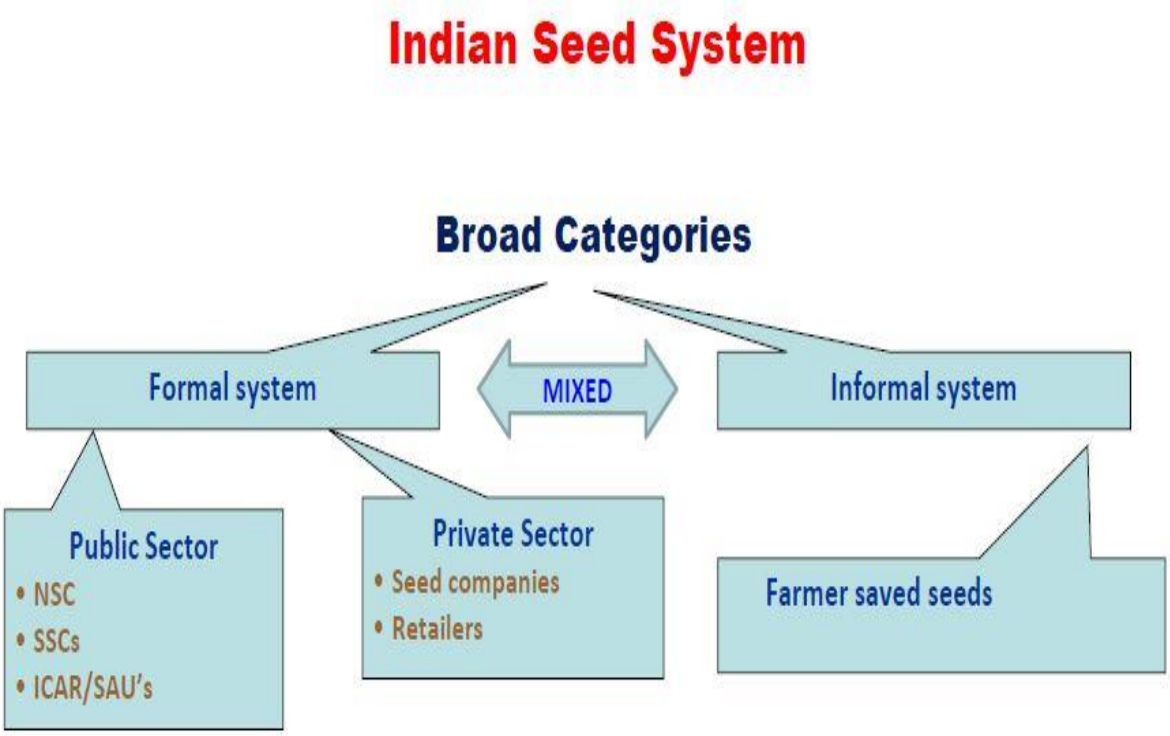


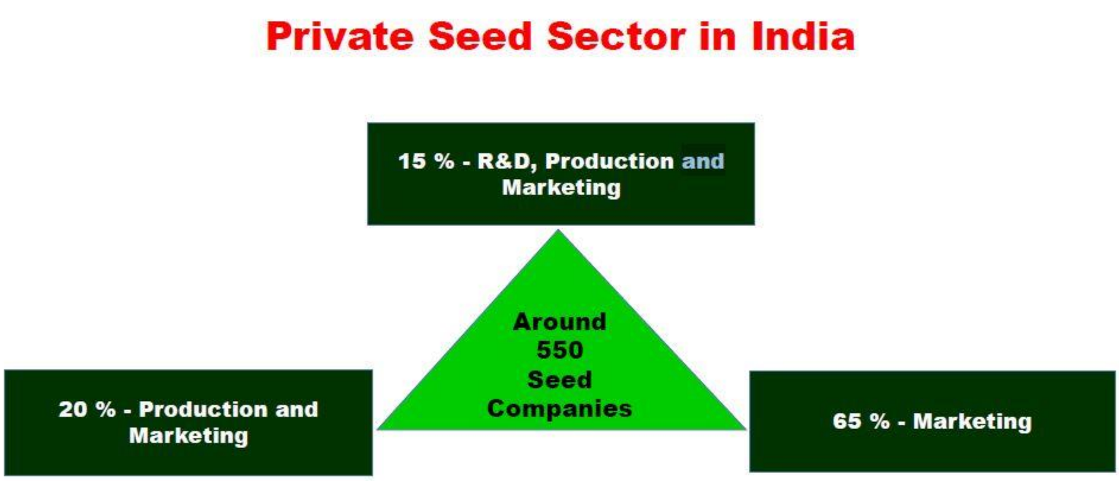
Source: Mordor Intelligence, 2019

Indian Seed System

The production and distribution of quality/certified seeds is primarily the responsibility of the State Governments. Certified seed production is organized through State Seed Corporation, Departmental Agricultural Farms, Cooperatives etc. The distribution of seeds is undertaken through several channels, i.e., Departmental outlets at block and village level, co-operatives, outlets of seed corporations, private dealers. The efforts of the state governments are being supplemented by NSC and SFCI which produce varieties of national importance. NSC markets its seeds through its marketing network and also through its dealer network. SFCI markets its seeds mainly through the State Departments of Agriculture and the State Seed Corporations. The production of certified seed by NSC and State Seed Corporations is mainly organized through contract growing arrangements with progressive farmers or with private firms. SFCI undertakes seed production on its farms. The private sector plays a vital role in the supply of quality seeds of vegetable crops. Further, the private sector dominates the vegetable seed market.

State Governments assess the requirement of certified/quality seeds based on the area sown under different crop varieties, an area covered by hybrid and self-pollinated varieties as well as the seed replacement rate achieved. The availability of seed is ascertained by the State Departments of Agriculture based on the production of seed in government farms and production of seeds by State Seeds Corporations and other agencies. The Government of India periodically assesses the requirement and availability of seeds through detailed interaction with State Governments and seed-producing agencies in the bi-annual Zonal Seed Review Meetings and the National Kharif and Rabi Conferences. The Department of Agriculture and Cooperation facilitates tie-up arrangements with seed-producing agencies to ensure that the requirement of seeds is met to the maximum extent possible.





Seed Marketing Comprises the Following

1. Demand forecasts.
2. Marketing structure.
3. Arrangements for storage of seeds.
4. Sales promotional activities.
5. Post-sales service.
6. Economics for seed production and seed pricing.

Present Status of Seed Distribution

The types of seed distribution systems in India are:

1. Farmer to farmer distribution: This is the traditional method, whereby farmers obtain their requirements from neighbours either on cash payment or on an exchange basis. No formal marketing organization is required for this type of distribution.

2. Distribution by co-operatives: This involves the procurement of seeds by co-operatives and its subsequent distribution. The distribution of seeds through co-operatives has often been encouraged by the government through subsidies and guarantees.

3. Distribution by departments of Agriculture: Seeds are purchased by the governments, out of the government funds, and are distributed district Agricultural Officers and Block Development officers.

4. Distribution of seeds by non-government or quasi-government agencies: In this system, the seeds are distributed through a network of seed distributors and seed dealers.

Some Seed Distribution Channels in India

SEED COMPANY=> DISTRIBUTOR=> DEALER => RETAILER => FARMER
SEED COMPANY=> DEALER => RETAILER => FARMER
SEED COMPANY=> RETAILER => FARMER
SEED COMPANY=> FARMER

Major Growth Drivers for the Indian Seed Market

1. Increase in area under Hybrids: (Cotton 95%, Vegetables 70%, Corn 50%, Rice 5%)
2. Scope exists to increase the seed replacement rate under new varieties/hybrids
3. The interest of private seed players in the seed industry
4. Increasing demand for selected crops
5. Increase in the penetration rate of hybrid seeds, research & development and
6. Favourable government policies
7. Institution and human resource sync
8. Global partnership (ICAR with other organizations and PPP model)
9. Extension system linkage with progressive farmers for seed production programmes
10. Considerable scope for global seed market (almost five times in next decade)

Constraints in Vegetable Seed Marketing

1. Operational inefficiencies in a vegetable seed marketing system can lead to reduced marketing margins and profitability.
2. Regulations in the cultivation of GM crops and the change in cropping pattern to industrial crops are restraining the growth of the fruit & vegetable seeds market.
3. Regional preference for vegetables
4. Policy on GM seeds, long-awaited approvals
5. Pricing control on seeds
6. Incentives on sale of bio-fortified seeds (bio-fortified cauliflower)

7. Perishable nature of seeds
8. Testing protocols & standards for organic seeds
9. Fear of mergers and acquisition of small companies
10. Problems in contract farming
11. Diminishing product life cycle
12. Barriers to entry
13. Long production period
14. Climate change
15. Pest & disease-related problems and their impact on seed production and quality.

Alternate Approach in Vegetable Seed Marketing

Marketing Structure: (Establishment of Effective Channel for Seed Distribution):

1. The key to success in seed marketing is the establishment of an effective channel of distribution.
2. The various channels through which seed can be marketed vary significantly according to the needs of the seed company.

Marketing Organization

There are many possible ways a marketing network could be organized. The simple and most efficient systems are to establish a central marketing cell and regional offices in end-use areas. The retail sale could be organized either by appointing distributors/dealers such as private dealers, co-operatives, agro-sales service centres, or by opening seed company/corporation owned sales points, or both.

Central Marketing Cell

1. Regional Offices.
    a. Sole distributors.
    b. Dealers (Private).
    c. Dealers (Coops).
    d. Dealers (Agro-Sales Services).
    e. Company sale depots.

SWOT

Interacting with different functionaries in the seed market the critical gap should be analyzed within this section with the help of Strengths, Weakness, Opportunities and Threats (SWOT) tools which are extremely useful for market development.

Conclusion

Increasing population awareness to consume more vegetables to meet diverse dietary requirements and nutritional needs, has raised the demand for vegetables significantly. As of now, per-capita availability of vegetables in India is around 140 kg per annum which is at par with the recommendation of average per capita consumption of 110 kg of vegetables per annum. Despite that, there is still a relative shortfall of vegetables in meeting the required nutritional needs of the population due to mismanagement at various levels. India would require around a 35% increase in production of vegetables over the next five years. However, given the constraints on increasing the area under cultivation, the growth would come through productivity augmentation of which a significant part has to be driven by greater adoption of hybrid seeds in the cultivation of vegetable crops. The key to improving adoption of hybrid seeds in the production of vegetable lies in ensuring the availability of quality seeds, bridging the awareness gap in farmers regarding better techniques, and developing supportive infrastructure facilities. New location-specific high yielding hybrid varieties should be developed given the diverse agro-climatic conditions in the country.

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Blanching of Fruits and Vegetables to Neutralize the Effect of the Pesticide and Insecticide

Article ID: 10781

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What is Blanching?

Blanching is a mild heat treatment applied to freshly harvested fruits and vegetables to maintain their physical and physiological properties of the produce. Blanching is used to deactivate enzymatic activity in vegetable and some fruits prior to other processing as well as freezing or dehydration or canning or thermal processing. The blanching pre-treatment is applied by means of heat for a specific time followed by rapid cooling or passing immediately to the next processing stage. The time and temperature combination are directly dependent from product to product, the condition and size of harvested produce. Generally, the blanching temperature is kept below 100 ^{0}C temperature. Mostly the temperature varies from 88 to 99 ^{0}C.

Purpose and Objective of Blanching

1. To soften the tissue to facilitate packaging.
2. To avoid damage to the product.
3. To eliminate air form the product.
4. To preserve the natural cooler.
5. To destroy or retard certain undesirable enzymes.
6. To help preserve natural flavor.

How Blanching is Effective as a Pre-Treatment for the Fruits and Vegetables

In some of the fruits and vegetables poly phenol oxydase enzyme is responsible for discoloration in presence of oxygen. When cut fruits or vegetables are exposed to open environment, then the cut surface exposed to atmosphere darken and discoloured very soon. The blanching pre-treatments deactivate the enzymes responsible for discolouration and helps to maintains its original colour after processing.

Factor Affecting the Blanching of Fruits and Vegetables

1. Type of fruit or vegetable.
2. Size of the pieces of food.
3. Blanching temperature.
4. Method of heating.

Factor Controlling the Rate of Blanching

1. The temperature of the heating medium.
2. The convective heat transfer coefficient.
3. The size and shape of the pieces of food.
4. The thermal conductivity of the food.

General Method of Blanching

Basically, blanching is carried by two methods:

1. Steam blanchers.
2. Water blanchers.

Steam Blanchers

This blanching method is the more suitable for foods with a larger area of cut surfaces are exposed to steam as leaching lossesare much smaller in comparison to using hot-water blanchers.The steam blancher consists of a mesh conveyor belt that carries food through a steam atmosphere in a tunnel. The residence time of the food is controlled by the speed of the conveyor and the length of the tunnel.

Figure 1: View of steam blancher

Typically, a tunnel is 15m long and1–1.5m wide. The efficiency of energy consumption is 19% when water sprays are used at the inlet and outlet to condense escaping steam.

Advantages of steam blancher: Faster, more uniform heating. Good mixing of the product. A substantial reduction in the volume of effluent. Shorter processing times and hence smaller losses of vitamins and other soluble heat sensitive components of food.

Hot-Water Blanchers

The hot water blanchers are available in number of different designs. The hot water blancher holds the food and dip in hot water at 70–100 ^{0}C for a specified time. Then removes the blanched product for dewatering and cooling.

Figure 2: Hot water blancher machine.

The produce fed into the blanching machine is moved through the drum by internal flights. The heating time for the blancher is dependent on the speed of rotation and blancher length. Hot water is re-circulated again and again, food is metered inside the blancher drum.

Blanching of fruits and vegetables at home: In modern agriculture practices, to increase the production of the fruit and vegetables various kind of the fertilizers, pesticides and insecticides are used in higher proportion. The effect of the pesticide and insecticide is long persistent in fruits and vegetables. To reduce the impact of the applied pesticide and insecticide the harvested produce is blanched before the consuming or processing.

Figure 3: Blanching of the freshly cut potato chips, fruits and vegetables at home

The blanching of fruits and vegetables can be performed at the domestic level. To perform the blanching process, the fruits or vegetables are collected into a container and dipped into the water. Then the container, containing the water, is allowed to raise the temperature 70-90 ^{0}C. The produce is dipped into the hot water for a pre determine period of 3 to 10 minutes. After that, the product is taken out and allowed to cool at the room temperature.

Advantage of hot water blanching: Having large holding capacity. Require a small floor area to operate. Transportation of raw material and finished produce is easy. Hot water blancher is suitable for batch processing. Minimize the wastage of water. Product quality is maintained. Loss of heat from water is reduced thus acts as energy saving processing.

Table 1: Time temperature combination for blanching of some vegetables:

Vegetables	Temperature, ^{0}C	Time, min
Peas	85-90	2-7
Green beans	90-95	2-5
Cauliflower	Boiling (100)	2
Peppers	90	3-5
Carrots	90	3

Effect of Blanching on Food

Changes in nutrients: Some minerals, water-soluble vitamins and other water-soluble components are lost during blanching. Losses of vitamins are mostly due to leaching, thermal destruction and, to a lesser.

Changes in colour and flavour: Blanching improves the colour of some foods by removing air and dust on the surface. Enzymatic browning of cut apples and potatoes is prevented by holding the food in dilute (2% w/w) brine prior to blanching.

Changes in texture: The blanching process soften the texture of vegetables. The softening of texture facilitate them filling into containers prior to canning. A solution of calcium chloride (1–2%) is therefore added to blancher water to form insoluble calcium pectate complexes and thus to maintain firmness in the tissues.

Conclusion

The blanching pre-treatments deactivate the enzymes responsible for discoloration, deactivate the harmful impact of insecticide, pesticide on the produce and helps to maintain its original colour after processing. The blanching also enhances the self-life, overall acceptability and storage life of the treated produce. So overall we can say that, the blanching helps us to maintain and improve the life of the edible food products.

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Pre-Cooling: An Innovative Approach to Increase the Self-Life and Marketability of Harvested Fruits and Vegetables at Farm Level

Article ID: 10782

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Pre-cooling refers to the rapid removal of field heat shortly after the harvest of a crop. In general, the temperature should be cooled down till it reaches 88% of the existing difference in temperature and its optimal storage temperature. The entire products must be pre-cooled as early as possible to the recommended storage temperature and relative humidity. Pre-cooling is done just above chilling and freezing temperature.

Why Need of Pre-Cooling?

Agricultural produce when harvested at the field condition, they contained field heat. If the harvested produce is directly fills in packets/jute bags/cartons, that field heat reduces the freshness and overall quality of that produce. So that the market quality of the harvested produce is decreased rapidly and the farmer's incomes get affected. So to prevent above mentioned losses and to increase the farmer income, it needs to pre cool.

How Pre-Cooling is Advantageous

It removes the field heat after harvest the fruits and vegetables. The freshness of the produce maintained after the harvesting. Reduces the rate of respiration and ripening of fruits and vegetables. Reduces the production of ethylene that delays the ripening of fruits and vegetables. Reduces /inhibits the growth of spoilage organisms. Eliminate the attack of the dryness factor.

Choice of Pre-Cooling Method Depends

The pre cooling method basically depends upon the nature of the produce and the economics of the process. We can also choose the methodology that is easily available at near the farm location.

Kinds/Type of Pre-Cooling Method Used for Farm Produce

S. No.	Pre cooling method	Produce to be pre cooled
1.	Room cooling	All fruits and vegetables.
2.	Forced air cooling	Fruits and fruits type vegetables, tubers and cauliflowers.
3.	Hydro cooling	Stems, green leafy vegetables, fruits and fruit type
4.	Package icing	Roots, stems, cauliflowers, green onion, brussel sprouts.
5.	Vacuum cooling	Stems, Leafy and flowers type vegetables.
6.	Transit's cooling -Mechanical -Top icing& channel icing	All fruits and vegetables root, stems green leafy vegetables and cantaloupes.

Types of Pre-Cooling Methods

1. Shade.
2. Air Cooling.
3. Water Cooling.
4. Ice Cooling.

5. Vacuum Cooling.

Pre-Cooling in Shade

This is the very simple, low cost and low technology to reduce field heat after harvesting the produce. The produce is move to a deeply shaded area directly after harvest. The temperature is reducing and maintained in shade houses, having roofs that are light coloured or reflective, can reduce temperatures as much as 20°C. The produce harvested in summer or sunny days require immediate to store under the shade to minimize the losses due to field heat.

Fig.1 Picture of shade drying at farm level

Suitable for

This method is suitable for the produce like pea, egg plant, potato, tomato, French bean, capsicum, carrot, beat root, cauliflower, green onion, green garlic, cabbage, guava, raw mango, lemon, raw jackfruit etc.

Pre-Cooling Using Air Cooling

Under this technique the cooling of the produce is performed by use of refrigerated air in a conventional cold storage room. A special pre-cooling room, a funnel cooler, or a forced air cooler mechanism is used to cool the produce. Air cooling can be subdivided in the methods of room cooling and forced-air cooling.

Fig.2 Picture of air cooling

Room Cooling

Fig.3 Picture of room cooling

The harvested produce is put into a cold (refrigerated) room below the atmospheric temperature. The product is stored for a definite period of time depending upon the nature of the produce and marketing demand. The produce is stored in either packed in cartons, crates or sacks or in bulk. As shown in figure below.

Advantage

This method of pre cooling saves more of the energy if designed properly. It can be used at the farm level or in the rural area without need of any skilled person or technician.

Water Cooling

Under this techniques water is used to release the heat from harvested produce. Cold or chilled water is sprayed at uniform rate on produce or the produce is dipped into the cold water for a definite period of time. we can dip the produce in a water tank for a definite period of time. After that the water is drained off from the tank.

Fig.5 Picture related to water cooling

Suitable for

This method is useful for the commodities/produces that can tolerate moisture becoming wet. Example-celery, peas, asparagus, Chinese cabbage pomegranate etc.

Advantages

Water pre cooling can be done with a refrigerated $CaCl_2$ solution to prevent storage disorders in fruits and fruit like vegetables.

Ice Cooling

Ice cubes or crushed ice is used to remove field heat from fresh produce. The ice cubes easily remove the latent heat from the produce, when the produce directly comes in contact.

Advantages

Ice is easily available in the market, homemade and local area where the produce is grown. Ice removes heat rapidly from the produce.

Fig.6 Picture related to ice cooling

Suitable for

The produce with high respiration rates.

Conclusion

Generally, quality grading includes outer parameters (size, color intensity, color homogeneity, bruises, shape, stem identification surface texture, and mass), inner parameters (sweetness, acidity, or inner diseases) and freshness. All horticultural crops are high in water content and are subjected to desiccation and to mechanical injury. Thus, we can say that, Pre-cooling is the key component in the preservation of quality for perishable fresh produce in post-harvest systems.

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Agricultural Sustainability in Relation to Environment, Animal and Human Health

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Sustainable agriculture is part of a larger movement toward sustainable development, which recognizes that natural resources are finite, acknowledges limits on economic growth, and encourages equity in resource allocation. It gives due consideration to long-term interests (e.g., preserving topsoil, biodiversity, and rural communities) rather than only short-term interests. Prime goal of sustainable agriculture movement is to create farming systems that mitigate or eliminate environmental harms associated with industrial agriculture. Sustainable agriculture is holistic in that it takes a system wide approach for solving farm management problems. It also recognizes that farm management problems (weeds, insects, etc.) cannot be dealt with in isolation but must be seen as part of a whole ecosystem whose balance must be maintained. There is increased societal concern regarding the crucial harmonic balance between feeding an ever-growing human population and minimizing environmental damage for the planet's future inhabitants.

Therefore, long-term stewardship of both natural and human resources is of equal importance to short-term economic gain. Stewardship of these resources includes:

1. Consideration of social responsibilities such as working and living conditions of laborers, the needs of rural communities, and consumer health and safety both in the present and the future.
2. Maintaining or enhancing the quality of these resources and using them in ways that allow them to be regenerated for the future and addressing concerns about.
3. Animal welfare in farm enterprises.

Scientific understanding about what constitutes sustainability in environmental, social, and economic terms is continuously evolving and is influenced by contemporary issues, perspectives, and values. For example, agriculture's ability to adapt to climate change was not considered a critical issue 20 years ago, but is now receiving increasing attention.

Therefore, it is more useful and pertinent to think of agricultural systems as ranging along a continuum from unsustainable to very sustainable, rather than placed in a sustainable/unsustainable dichotomy. The health of both the environment and humans would be enhanced if more of our farms made the transition to sustainable systems of production.

Sustainable agriculture is not merely a package of prescribed methods. More important, it is a change in mind set whereby agriculture acknowledges its dependence on a finite natural resource base—including the finite quality of fossil fuel energy that is now a critical component of conventional farming systems.

Goals of Sustainable Agriculture

Sustainable agriculture integrates three main goals – environmental health, economic profitability, and social equity that are closely intertwined and are necessary components for a truly sustainable agriculture. Sustainable agriculture is not a single, well-defined end goal.

Sustainable Agriculture Practices

Precision chemical application, Precision nutrient management, crop rotation, conservation tillage, Soil testing and analysis and soil sampling technique are very important in terms of fertilizer usage efficiency thus promoting farming practices that sustain local ecosystems and topsoil.

1. Because of agriculture's importance to global social and environmental systems, the international community has committed to increase sustainability of food production as part of Sustainable Development Goal 2 which states "End hunger, achieve food security and improved nutrition and promote sustainable agriculture".
2. The United Nations Environment Programme's 2021 "Making Peace with Nature" report highlighted agriculture as both a driver and an industry under threat from environmental degradation.

Livestock Production

Sustainable livestock systems contribute to food security, economic and environmental stewardship, and sociocultural needs and are vital for achieving most of the United Nation's Sustainable Development Goals. In order to keep animal agriculture sustainable, changes must be implemented to allow animal production to continue in an efficient and environmentally conscious manner. The overall sustainability of animal production reflects the collective viability of a variety of agricultural aspects including animal welfare, food quality, the environment, and human health. A scientifically established correlation between the consumption of certain animal products and public health has garnered more attention as chronic metabolic problems, such as diabetes or cardiovascular disease, threaten the public ideal of reaching old age in a healthy state. Sustainable animal agriculture must address important issues in the production, marketing, and consumption of livestock, poultry, and fish.

A system becomes unsustainable once it begins to use methods that are environmentally, economically, socially, or ethically unviable. Excessive use of fertilizers and management of manure associated with large-scale production have led to exacerbated nitrogen and phosphorus contamination of the environment in certain parts of the world. Each animal species has its own biological limitations and needs. If pushed beyond certain physiological limits, animals will start to suffer. Dairy cows, selected for high milk yields -decreased immune function and increased presence of health problems such as mastitis, lameness, and infertility. Population expansion brings with it an increased demand for food and water. A rise in meat consumption occurs in areas of sustained economic growth. The shift from plant to animal protein that occurs as countries develop is referred to as a nutrition transition. This transition does not come without consequences, as human health is affected by excess consumption of saturated fats of animal origin. The long-term sustainability of animal agriculture relies on the industry's ability to respond to consumer concerns and maintain practices that are socially, economically, and environmentally sound.

Human Health

The idea of connecting sustainable agriculture with the promotion of human nutrition and health is a concept that was introduced to the nutrition profession more than 20 years ago. Organic farming systems offer potential benefits to human health through reducing farmers' exposure to pesticides. Four Dimensions of Healthy, Liveable Communities- health, economics, farming and environment. Hunger and food insecurity are currently problems not of resource scarcity but of insufficient political will or moral imperative to change the way food is allocated. Large civilizations have risen on the strength of their agriculture and subsequently collapsed because their farming methods had eroded the natural resource base.

Sustainable Agriculture in Relation to Soil

Soil has been identified as an underutilized carbon sink, with a great potential to alleviate climate pressure. The conservation of soil quality is fundamental to agricultural sustainability. The soil, a substrate for plant anchorage, a buffered supply of essential mineral elements and water, a repository for carbon, a reservoir of functional biodiversity, and a filter for reducing the pollution of air and water by agrochemicals. Soil microbes influence crop production and agricultural sustainability both through their direct and indirect interactions with plant roots and their effects on the biogeochemistry of carbon compounds and mineral elements in the soil.

The authors suggest fertiliser management strategies to exploit these phenomena to control the abundance of these weeds. B. Kone et al. investigated whether the management of soil chemistry might be used to control problematical weeds in rice producing areas and observed that the abundance of speargrass (*Imperata cylindrica* L.) was positively correlated with soil potassium concentration and negatively correlated with soil calcium and iron concentrations, whereas the abundance of Cyperus spp. was positively correlated with both potassium: magnesium and calcium: magnesium ratios in the soil. Nutrient management is a key challenge for global food production: there is an urgent need to increase nutrient availability to crops grown by smallholder farmers in developing countries. Improving fertilizer efficiency through practices like precision farming using GPS tracking can reduce nitrous oxide emissions. SSNM- improve yield and NUE indicative of soil health.

The theme for World Soil Day 2020 is "Keep soil alive, protect soil biodiversity"

Conclusion

One way to both increase crop yields and mitigate greenhouse gas emissions would be through soil carbon sequestration, which is the process by which atmospheric carbon is pulled into and stored in soil. Generally, high soil diversity and reduced disturbance can help maximize soil carbon sequestration. Soils are the largest terrestrial sink for carbon on the planet. It is reasonable to argue that achieving either national public health goals or preservation of our natural resources is increasingly difficult as isolated goals. There is, however, ample evidence to indicate the potential for synergistic benefits through linkage of these goals. In other words, shifting from a focus on the food supply to a focus on enhancing sustainability of the food system with greater localization of the food source provides a myriad of opportunities linking the realms of public health, sustainable agriculture, environmental stewardship, and economic development.

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Extrusion: Value Addition of the Agricultural Produce through the Extrusion Process

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What is Extrusion Process?

Extrusion is a process which combines several unit operations including mixing, cooking, kneading, shearing, shaping and forming. Extrusion is a high temperature and short time process (HTST). The feed raw material is exposed to a temperature of near about 100 ^{0}C. Extrusion cooking is a high-temperature short-time (HTST) process which reduces microbial contamination and inactivates enzymes. However, the main method of preservation of both hot- and cold-extruded foods is by the low water activity of the product (0.1–0.4).

Theory of Extrusion

The process of extrusion involves simultaneous mixing, kneading and cooking, it causes a large number of complex changes to a food, including hydration of starches and proteins, homogenisation, gelation, shearing, melting of fats, denaturation or re-orientation of proteins, plastification and expansion of the food structure.

Why the Extrusion Process is Suitable for Value Addition?

1. Operational versatility: In extrusion process a very wide variety of products are possible to produce, by changing the concentration of ingredients, the operating conditions of the extruder and the shape of the dies for the particular product.

2. Reduced production costs: Extrusion process has lower production costs and higher productivity than other cooking or forming processes.

3. High production rates with automated production: The extruder produces the final product at a very high rate. The extrusion process is fully automatic, so there is no need of more skilled person.

4. Superior product quality: Extrusion cooking involves high temperatures applied for a short time and the limited heat treatment, therefore in extrusion process loss of heat sensitive vitamins and mineral in the final product is preserved.

5. No process effluents: Extrusion operation is performing the raw material having very low moisture content, so there is no production of any kind of wastage material in all the process.

Extrusion Process

Extruders are classified according to the method of operation (cold extruders or extruder-cookers) and the method of construction (single- or twin-screw extruders). The principles of operation are similar in all types: raw materials are fed into the extruder barrel and the screw(s) then convey the food along it:

1. Hot Extrusion.
2. Cold extrusion.

Hot Extrusion Process

If the food is heated above 100ºC the process is known as extrusion cooking (or hot extrusion). In this process, frictional heat and any additional heating that is used cause the temperature to rise rapidly. The food is then passed to the section of the barrel having the smallest flights, where pressure and shearing is further increased. Finally, it is forced through one or more restricted openings (dies) at the discharge end of the barrel as the food emerges under pressure from the die, it expands to the final shape and cools rapidly as moisture is flashed off as steam.

Suitability of the hot extrusion process: The hot extrusion process is suitable for producing a variety of shapes of the product. The various shapes like rods, spheres, doughnuts, tubes, strips, squirls or shells can be formed. Typical products include a wide variety of low density, expanded snack foods and ready-to-eat (RTE) puffed cereals.

Cold Extrusion

Cold extrusion, in which the temperature of the food remains at ambient condition. This process is used to mix and shape foods such as pasta and meat products. Low pressure extrusion process is performed at temperatures below 100ºC.

Suitability of the cold extrusion process: The cold extrusion process is used to produce liquorice, fish pastes, surimi and pet foods.

Factor affecting the extrusion of the product: The type of feed material and their moisture content. The physical state of the materials and their chemical composition, particularly the amounts and types of starches, proteins, fats and sugars. The pH of the moistened material.

Factor Affecting the Extrusion Process

1. Temperature.
2. Pressure.
3. Diameter of the die apertures.
4. Shear rate.

Applications of Extruder

Confectionery based products: HTST extrusion cooking is used to produce a gelatinised, chewy product such as fruit gums and liquorice, from a mixture of sugar, glucose and starch. Colourings and flavours are added to the plasticised material and, after mixing, it is cooled and extruded. These different combinations permit a very large range of potential products, including liquorice, toffee, fudge, boiled sweets, creams, and chocolate, each produced by the same equipment.

Cereal Products

1. Crisp bread: Wheat flour, milk powder, corn starch, sugar and water are mixed and the product is extruded at a high temperature and pressure. The crisp bread is then toasted to reduce the moisture content further and to brown the surface.

2. Breakfast cereals: In traditional cornflake manufacture, large maize kernels (grits) were needed, as the size of the individual grit determined the size of the final cornflake. Grits were then pressure cooked, dried, tempered to ensure a uniform moisture distribution, flaked, toasted and sprayed with a vitamin solution.

Protein-Based Foods

1. Texturised vegetable protein (TVP): Extrusion cooking destroys the enzymes present in soybeans, including a urease which reduces the shelf life, a lipoxidase which causes off flavours by oxidation of soya oil and also a trypsin inhibitor which reduces protein digestibility. This improves the acceptability, digestibility and shelf life of the product.

2. Meat and fish products: The extruders are used in production of extruded snacks or shelf-stable starch pellets that incorporate previously under-utilised by-products from meat, fish or prawns. Also used in the manufacture of shiozuri surimi from ground, minced fish

The Advantages of Extrusion Cooking are

1. A reduction in raw material.
2. Rapid processing to produce cornflakes within minutes of start-up.
3. Close control over the size and quality of the final product.
4. Flexibility to change the product specification easily.

Effect of Extrusion on Food

Sensory characteristics: The HTST conditions in extrusion cooking have only minor effects on the natural colour and flavour of foods. Flavours are therefore more often applied to the surface of extruded foods in the form of sprayed emulsions or viscous slurries.

Nutritional value: High temperatures and the presence of sugars cause Maillard browning and a reduction in protein quality. Lower temperatures and low concentrations of sugars result in an increase in protein digestibility, owing to rearrangement of the protein structure. Destruction of anti-nutritional components in soya products improves the nutritive value of texturised vegetable proteins.

Conclusion

Extrusion technique is a process in food processing technology which combines several unit operations including mixing, cooking, kneading, shearing, shaping and forming. Food extrusion is a form of extrusion used in food processing. It is a process by which a set of mixed ingredients are forced through an opening in a perforated plate or die with a design specific to the food, and is then cut to a specified size by blades. By the extrusion process various shapes like rods, spheres, doughnuts, tubes, strips, squirls or shells can be formed. Thus, the extrusion plays an important role in value addition of the raw milled flours of various agricultural produce.

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Fertigation

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Abstract
Numerous problems arising due to the intensification of agricultural production systems have led to the development of technologies for the efficient use of resources, such as fertigation. Fertigation is a method of fertilizer application in which fertilizers, soil and water amendments and other water-soluble products are incorporated in the irrigation water and applied by the micro-irrigation system. Fertilizer use efficiency can be increased up to 80-90 per cent with fertigation against 10-40 per cent in the soil application. The commercially available water-soluble fertilizers used for fertigation are, 19:19:19, 18:18:18, 12:61:0, 17:44:0, 0:0:50, 13:0:45 etc. Sub-surface fertigation is practised to avoid problems such as damage to drip lines by the movement of heavy machinery and animals, heavy cost incurred in installation and disassembling of laterals in drip fertigation every season.

Introduction
Growing demand for food has led to the intensification of agricultural production systems. But numerous problems arising due to intensification have driven the researchers to develop sustainable agricultural production systems which use limited water and energy sources efficiently for higher production. One of the key features of these systems is the efficient use of water and fertilizers, i.e., fertigation. Fertigation is a method of fertilizer application in which fertilizer is incorporated in the irrigation water and applied by the micro-irrigation system (sprinkler, drip) (Mattos et al. 2020). In this system, fertilizer solution is distributed evenly in irrigation water. Fertigation in various trickle-irrigation technologies involves the injection of fertilizer solutions into irrigation systems via calibrated irrigation pumps. Fertigation is also used for soil and water amendments as well as other water-soluble products into an irrigation system. The availability of nutrients is very high; therefore, the efficiency is also more (Hagin and Lowengart 1995). In this method, liquid fertilizers, as well as water-soluble fertilizers, are used. By this method, fertilizer use efficiency can be increased up to 80-90 per cent, while only 10-40 per cent of applied nutrients are absorbed through soil application (Table 1).

Fertilizers Used in Fertigation
Urea, potash and highly water-soluble fertilizers are available for applying through fertigation. Application of superphosphate through fertigation must be avoided as it makes precipitation of phosphate salts. Thus, phosphoric acid is more suitable for fertigation as it is available in liquid form. Special fertilisers like mono ammonium phosphate (N and P), poly feed (N, P and K), multi-K (N and K), potassium sulphate (P and S), are highly soluble for fertigation as they are highly soluble in water. Micronutrients like Fe, Mn, Zn, Cu, B, Mo etc. are also supplied along with special fertilisers. The commercially available water-soluble fertilizers used for fertigation are, 19:19:19, 18:18:18, 12:61:0, 17:44:0, 0:0:50, 13:0:45 etc.

Nitrogen fertigation: Urea is well suited for injection in a micro-irrigation system. It is highly soluble and dissolves in non-ionic form, so it doesn't react with other substances in the water. Also, urea doesn't cause the precipitation problem. Urea, ammonium nitrate, ammonium sulphate, calcium ammonium sulphate and calcium ammonium nitrate are commonly used as nitrogenous fertilizers in drip fertigation.

Phosphorus fertigation: Application of P superphosphate to irrigation water may cause precipitation of phosphatic salts. Phosphoric acid and mono ammonium phosphate appear to be more suitable for fertigation.

Potassium fertigation: The application of K fertilizers doesn't cause any precipitation of salts. Potassium nitrate, potassium chloride, potassium sulphate and monopotassium phosphate are used in drip fertigation.

Micronutrients: Micronutrients (Fe, Mn, Zn, Cu, B, Mo etc.) can be applied through drip fertigation. However, it is problematic because of the precipitation of micronutrients (Fe, Mn etc.) at high pH. Hence, iron chelated (Sequestrene-138) is applied which prevents Fe from precipitation. Also, Zn chelates are good to prevent Zn precipitation.

Table 1. Fertilizer use efficiencies of various application methods (Biswas, 2010):

Nutrient	Soil application	Drip + soil application	Drip + fertigation
N	30-50	65	95
P_2O_5	20	30	45
K_2O	60	60	80

Fertigation Equipment

Fertigation is done with the help of special fertilizer apparatus (injectors) installed at the head control unit of the system, before the filter. Three main groups of equipment used in a drip system are:

1. Ventury system: Constriction in the main water flow pipe causes a pressure difference (vacuum) which is sufficient to suck fertilizer solution from an open container into the water flow. It discharges 750 to 1000 ml water per minute and is attached to the pressurized irrigation system.

2. Fertilizer tank system: A tank of 20-30 l capacity, containing fertilizer solution is attached to the irrigation pipe at the supply point. Part of the irrigation water is diverted through the tank diluting the nutrient solution and returning to the main supply pipe. The concentration of fertilizer in the tank thus becomes gradually reduced.

3. Fertilizer injection pump: The fertilizer injection pump is a standard component of the control head. The fertilizer solution is held in a non-pressurised tank and can be injected into the irrigation water at any desired ratio. Therefore, the fertilizer availability for each plant is maintained properly.

Sub-Surface Fertigation

Installation and disassembling of laterals in drip fertigation every season require extra labour and energy (Kafkafi and Kant, 2005). Damage to drip lines by the movement of heavy machinery and animals restricts the use of surface drip irrigation, although the placement of trickle lines at appropriate soil depths can solve such problems. Recent improvements in liquid, soluble and compatible fertilizers, filtration devices, and reduced clogging problems have opened the way for the development of sub-surface fertigation. Special slow-release chemicals embedded in the plastic of the filters prevent root entry into the trickle. In addition to cost-effectiveness and energy-saving, subsurface drip fertigation has added agronomic advantages over surface drip fertigation:

1. Placement of nutrients in the region where root activity is maximal and the daily and seasonal temperate fluctuations are minimal. Distribution of nutrients in the sub-surface application is more uniform and spherical around emitters than surface fertigation, where movement is hemispheric below the point source and evaporation causes accumulation of soluble salts at the wet zone periphery.

2. Roots can explore a greater soil volume for water and nutrients since roots grow deeper in a sub-surface system.

3. The top 4-5 cm of soil remains dry in sub-surface fertigation, thereby reducing evaporation losses and weed germination. Fertigation gives the plant grower a tool to control the daily supply of water and nutrients in tandem with plant growth rate and nutrient demand. When properly employed, plant potential growth can be achieved that is only limited by radiation and temperature. To reach maximum plant performances, the accurate design of the fertigation system, efficient utilization of equipment, combined with the timely application and selection of compatible fertilizers, are essential criteria. More detailed research on the surface

and sub-surface fertigation is needed for different commercial crops. Fertigation in protected agriculture must take into consideration the root zone temperature when choosing N fertilizer. Further study on the availability and movement of dissolved nutrients in different soil types to meet the nutrient requirements of important crops as a function of time is needed for open-field grown crops.

Advantages of Fertigation

1. Water and nutrients are supplied near the active root zone through fertigation which results in greater absorption by the crops.
2. As water and fertilizer are supplied evenly to all the crops through fertigation there is a possibility for getting a 25-50 per cent higher yield.
3. Fertilizer use efficiency through fertigation range between 80-90 per cent in case of N and K, which helps to save a minimum of 25 per cent of nutrients.
4. Saving of water, fertilizer, time, labour and energy is there through fertigation.

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Biochar in Climate Change Mitigation

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Summary

Interest in the use of biochar in agriculture has increased exponentially during the past decade. Biochar, when applied to soils is reported to enhance soil carbon sequestration and provide other soil productivity benefits such as reduction of bulk density, enhancement of water-holding capacity and nutrient retention, stabilization of soil organic matter, improvement of microbial activities, and heavy-metal sequestration. Converting the locally available feedstocks and farm wastes to biochar could be important under smallholder farming systems as well, and biochar use may have applications in tree nursery production and specialty-crop management. Thus, biochar can contribute substantially to sustainable agriculture. While these benefits and opportunities look attractive, several problems, and bottlenecks remain to be addressed before widespread production and use of biochar becomes popular. Nevertheless, available indications suggest that biochar could play a significant role in facing the challenges posed by climate change and threats to agroecosystem sustainability.

Agroecosystems the world over are under severe stress. Faced with the challenge of feeding the burgeoning population and meeting the ever-growing demands for fiber and other natural products, agricultural and forestry production systems have become highly dependent on chemical products and technological inputs (Mueller et al., 2012). While the resultant production increases have helped eradicate hunger in many parts of the world, the accompanying ecosystem degradation on a massive scale has raised major concerns (Nair P. K. R., 2014). Consequently, farming practices and technologies that can increase and sustain production without ruining the ecosystem were promoted as an approach to addressing these concerns. Thus, numerous terms and rallying themes became prominent in the global land-use arena during the past few decades, such as (in alphabetical order), agroecology, agroforestry, climate-smart agriculture, conservation agriculture, organic agriculture, permaculture, sustainable intensification, and so on. Almost all of them share the objective of minimizing external inputs by building on the efficient use of locally available resources. This has led to focusing attention on some naturally occurring materials as well as products that can be relatively easily assembled from natural resources to substitute or complement the use of synthetic products. Biochar is one such product that has become quite prominent in the recent past. This paper presents a synthesis and evaluation of the current level of knowledge on biochar and its potential role in agroecosystem management in the climate–change–sustainability context.

Based on the management practice of the ancient civilizations, the idea of sequestering carbon via biochar addition to soil has been of interest to scientists as a means of mitigating global warming through soil C sequestration. So much so, biochar application to agricultural soils is now considered as a soil-based greenhouse mitigation strategy for sustainable environmental management (Paustian et al., 2016). Management practices that could potentially increase C sequestration in biomass and in the soil by using biochar as a nutrient source also have received some research attention. Following an evaluation of the characteristics of 76 biochars from 40 studies, Brassard et al. (2016) reported that biochars with lower N content (C/N ratio >30) were found to be more suitable for mitigation of N_2O emissions from soil, and those produced at higher pyrolysis temperature might have high C sequestration potential. Increasing biomass production, whether for increasing food production, energy generation or for reclaiming degraded land, will remove atmospheric CO_2 and could thus be a mitigating strategy for reducing global warming. Moreover, conversion of agriculture and forestry byproducts into biochar could reduce CO_2 and methane emissions from feedstocks during the natural decomposition or burning of the waste material. Overall, it seems reasonable to conclude that biochar's effect on climate change mitigation cannot be established as a cause—effect relationship; but there could be advantages in the longer term.

Based on available data, Mukherjee and Lal (2014) identified several negative aspects of biochar application to soil. These included leaching losses of C and N, contaminant mobility, and several unfavourable physical changes and changes to soil biota. The authors also identified some negative impacts on agronomic yields, and pointed out those effects of biochar applications on gaseous emissions were contradictory. Some of the relatively recent literature on the effect of biochar application on plant nutrition and soil nutrient dynamics shows, the majority of the studies reported positive responses, while a few indicated negative ones. It is also likely that some authors may be reluctant to report negative results.

Conclusions

Available evidence and indications strongly justify continued research and development efforts in understanding more about the benefits and potentials as well as limitations of biochar and expanding its use in land management. The beneficial role of biochar application on the broader issues of climate-change mitigation and sustainable agriculture can reasonably be assumed based on the available body of knowledge, but it is abysmally weak—almost non-existent—on socioeconomic issues (the "other hand" of sustainability). In order to accomplish the goal of agroecosystem sustainability, it is essential that the two sectors are strengthened and are then properly integrated. Rather than presenting a long "wish list" of "things to do," suffice it to say emphatically that while biochar use is not a panacea for solving all the problems of land management, it certainly is an aspect that deserves serious attention in agroecosystem management in the future.

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De-Topping in Maize: A Boon for Sustainability

Article ID: 10787

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Summary

The dairy production is an integral and hugely important branch for Indian agriculture. The feed supply for the farm cattle is never adequately met and the chance of increasing the horizontal land area is far down the line because global population is increasing at a mushrooming rate. De-topping in maize, the highest fodder producing crop, can majorly help to meet the feed demand. This introduced practice can produce more and quality green fodder which can be used as feed for cattle/farm animals without compromising the crop's grain yield.

Introduction

DE topping in maize can majorly help to meet the feed demand. The practice of de-topping refers to nipping or the removal of terminal portion from the uppermost node. The objective is to improve the yield through greater functioning of remaining leaves by arresting unnecessary growth, decreasing mutual shading of leaves, enhancing light interception, increasing nutrient uptake, decreasing competition between the tassel and cob for available plant nutrients, diverting plant nutrients to the reproductive part which aids in better source-sink relationship and better cob development.

It is generally accepted that the yielding capacity of the forage crop or type is genetic character; however, yield per unit area is modified through management practices under given agro-climatic conditions. The yield of forage crop, therefore, is basically a function of management practices in relation to agro-climatic conditions. Maize is an important crop to develop standard agronomic practices to get maximum yield. Among the several agronomic practices, de-topping is one of the practices practiced by maize growers.

History and Concepts

A lot of information available on forage maize cultivation but information on de-topping practices is meagre. It is a relatively modern innovation to back both the system of grain and fodder production. Apparently, greater interest in corn de-topping began in the last decades of the nineteenth century when the first attempts were initiated to produce hybrid corn cultivars. The interest in studying the influence of de-topping on corn performance persists to for almost 120 years during which corn de-topping studies have been conducted, most of those studies aimed to evaluate the effects of this practice on mature grain yield. Such studies have shown that de-topping may influence grain yield variedly but the pace in the field in noticeable since the since the start of the 21st century.

Maize tassel removal may affect light penetration in the canopy, especially as the crop is a C4 plant, needs high light requirement. In any crop, the degree of yield reduction is directly proportional to the percentage of leaf area destroyed. The loss of functional leaf area results in loss of photosynthetic area of plant and reduce the assimilate availability. The superior effect of top leaves on the yield depends on their extent of sunlight absorption. Tassel (the male flower) removal may increase the seed yield and seed quality. Interaction of defoliation and tassel removal may also affect assimilate distribution between reproductive and vegetative organs. And also, up to 75% of the plant could be de-tasseled randomly before pollen shedding for fodder use farmer's practice of de-topping after brown husk did not affect the grain yield. Proper time of de-topping seems to be very important for controlling lodging and obtaining enough forage without sacrificing grain yield.

Figure: (1) Maize crop de-topped at 40 days after taselling (2) Maize cob (Source: https://iimr.icar.gov.in/karimnagar-telangana)

In soils with low fertility under drought condition, the corn yield can be increased by maintaining above optimum plant populations and defoliation. And, in the ear of corn, 50 per cent of the total dry matter accumulation was contributed by above two leaves and two leaves below the ear. The removal of the tassel can increase yield in corn due to proper light interception by underlying photo-synthetically active tissue and more favorable translocation of photosynthetic to the seed. However, number of leaves removed along with tassel was dependent on plant morphology in maize.

Table 1. Grain yield, stover yield and green fodder yield of maize influenced by different stages and heights of de-topping in rabi maize:

Treatments	Grain yield (Kg ha^{-1})	Stover yield (Kg ha^{-1})	Green fodder yield (t ha^{-1})
Different stages of de-topping			
D1	4898	6256	8.33
D2	7088	6107	8.08
D3	7204	5899	7.92
Different heights of de-topping			
L1	6568	6631	3.16
L2	6544	6204	7.32
L3	6078	5426	13.85
D1- 10 days after silking, D2- 20 days after silking and D3- 30 days after silking. L1- De-topping up to 2 top leaves, L2 – De-topping up to 4 top leaves, L3- De-topping up to 6 top leaves and Control- No de-topping.			

(Source: Bhargavi et al., 2016)

This gifted crop is grown round the year in all season (kharif, rabi and summer). De-topping can be performed in maize irrespective of the type of the varieties or season it is grown in. Comparatively, the fodder type varieties produce more green forage yield (GFY) when de-topping is carried out but grain producing varieties yields grain (Seed Yield) which is at par with the conventionally grown while producing evidently greater amount of green fodder yield and stover yield as well which aids to the better farm income.

Table 2. Grain yield, fodder yield, biological yield and harvest index of maize influenced by de-topping practice, different type of varieties and varying nitrogen levels in maize:

Main plot	Grain yield (Kg ha-1)	Fodder yield (Kg ha-1)	Biological Yield (Kg ha-1)	Harvest index (%)
A. De-topping				
D1: No de-topping	3923	6096	10000	39.31
D2: De-topping	3123	7339	10462	29.39
B. Varieties				
V1: African tall	2567	7518	10086	25.75

V2: Pioneer-3396	4459	5917	10376	42.95
Sub plot **C. Nitrogen levels**				
N0: 0 Kg ha-1	2510	5021	7531	33.48
N1: 50 Kg ha-1	3537	6588	10126	34.89
N2: 100 Kg ha-1	3931	7455	11387	34.65
N4: 150 Kg ha-1	4074	7805	11880	34.37

D1: No De-topping, D2: De-topping at 15 days after tasseling;
V1: African tall (Fodder type), V2: Pioneer-3396 (Grain type);
N0: 0 Kg N ha-1
N1: 50 Kg N ha-1– 50% basal and 50% top dressing at 30 DAS
N3: 100 Kg N ha-1– 50% basal and 50% top dressing at 30 DAS
N4: 150 Kg N ha-1 – 50% basal and 50% top dressing at 30 DAS.
(Source: Samadhan Vishnu Sapkal, thesis, 2019)

Conclusions

The superiority of the magical crop maize can be utilized by encouraging de-topping. This practice can avail more quality maize green fodder to the dairy farm without hampering the grain yield. The dairy farms will be hugely benefited in particular and the farm income will be improved as a whole.

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Fall Armyworm *(Spodoptera frugiperda)* and their Management

Article ID: 10788

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Abstract

This is the insect pest in United State since long and this pest is reported the host range of more than 300 plant species, among them the corn is most preferred host reported from many places. Due to any mistake this pest is introduced to many countries accidently and it was first reported in Africa in 2016 other than US, where it is causing significant damage to maize crop and has great potential for further spread and economic damage thereafter reported from many countries. Fall Armyworm has infested crops in over 50 countries, across two continents in just over two years. In May 2018 it began to spread widely in India. In January 2019 a heavy infestation of fall armyworm was recorded in corn fields in Shivmoga district of Karnataka. In Bihar it is reported in 2019 in different month and districts and created havoc among the farmers and Govt was compelled to make a task force to manage this dreaded pest.

Introduction

The fall armyworm *(Spodoptera frugiperda)* is a pest belonging to Family - Noctuidae in the order - Lepidoptera, and is the larval stage of a fall armyworm moth is destructive stage of pest. The term "Armyworm" can refer to several species, often describing the large-scale invasive behaviour of the species' larval stage. It is regarded as a pest and can damage and destroy a wide variety of crops plants, which cause major economic damage. Another remarkable character of the larva is that they exhibit cannibalism.

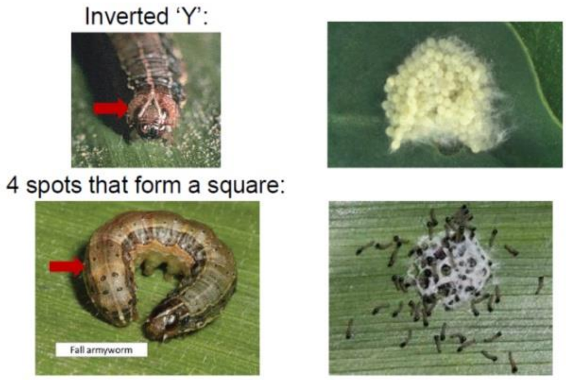
Life cycle: Fall army worm has four life stages: Egg, larva, pupa and adult.

Egg: Army worms adult flies' mate at night, after which the female lay up to 1000 eggs in masses on suitable host plants or indiscriminate surfaces including the underside of leaves or on structures near turf grasses. Egg is dome shaped and measures around 0.4 millimetres in diameter and 0.3 millimetres in height and covers with hairs. The eggs will hatch within a few days.

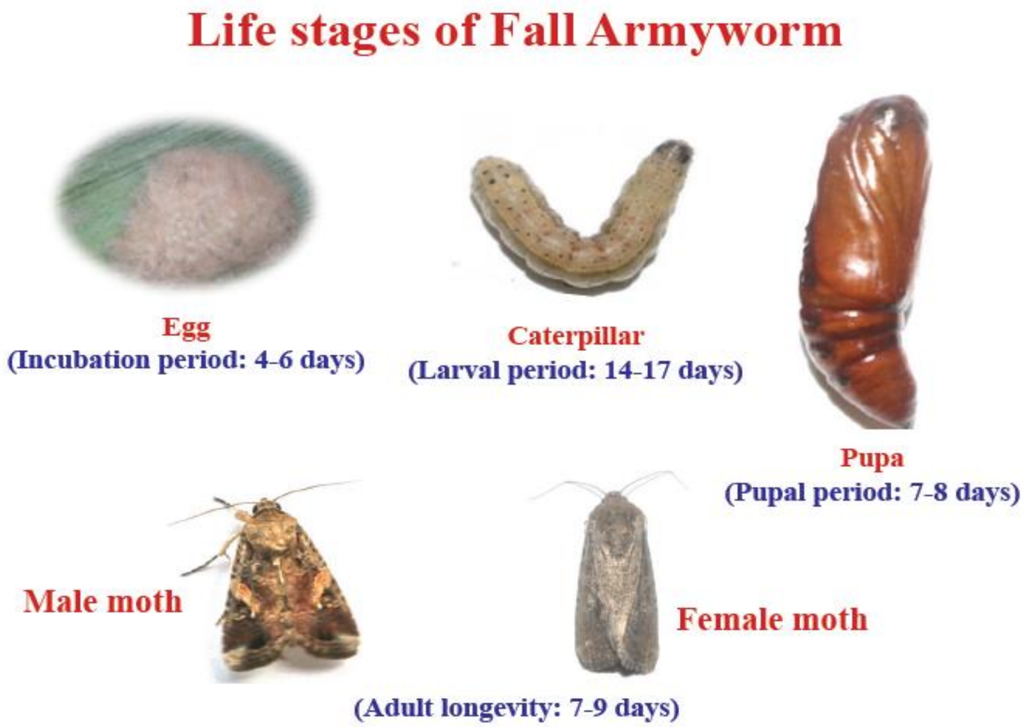
Larva: After hatching newly emerged larvae may spin a silken thread to lower themselves to the turf to feed. The earliest (1-4) instars eat relatively little leaf material, while the 5th and 6th larvae stages eat over 93 per cent of the total foliage consumed over its life span.

Caterpillars feed throughout the day but are typically most active in the early morning and late evening hours where they can often be easily observed.

Fall army worm caterpillars' range in colour from shades of brown to gray, green or yellow- green. Their most distinguishing characteristic is a whitish Inverted Y shaped mark between the eyes and three whitish stripes on the prenatal shield behind the head.



The larval process lasts from 14-30 days and again depending on climatic conditions and food availability.



Pupa

Pupation normally takes place in the soil, at a depth of 2-8 cm. The larva constructs a loose cocoon, oval in shape and 20-30 mm in length, by tying together particles of soil with silk. If the soil is too hard, larvae may web together leaf debris and other material to form a cocoon on the soil surface. The pupa is reddish brown in colour, and measures 14 to 18 mm in length and about 4.5 mm in width. Duration and survival of the pupal stage depend on the temperature of the environment.

Adult

Once emerged, the adults live for about 8 to 10 days with a range of about 7- 21 days. Adults are nocturnal, and are most active during warm, humid evenings. After a preoviposition period of three to four days, the female normally deposits most of her eggs during the first four to five days of life, but some oviposition occurs for up to three weeks. Adult moths are generally gray in colour, with a 36-40 mm wingspan and white hind wings. Forewings are mottled with flecks of white, and males may have a triangular white spot near the wing tip and another spot in the middle of the wing.

Damaging Symptoms

Damage caused by fall armyworm caterpillars feeding on all plant parts. Young larvae initially eat one side of the surface of the leaf tissue, leaving the opposite layer intact (window feeding).

Seedlings can be fed upon up to the destruction of buds and growing points. Larger larvae show characteristic row of perforations and ragged margins on leaves. They can also cut the base of the plant or attack the reproductive parts and young fruit. In the case of heavy infestation, fall armyworm larvae can cause extensive loss to the crops.

Management practices:

1. Integrated pest management strategies including the followings:

a. Monitoring.
b. Cultural control.
c. Mechanical control.
d. Biological control.
e. Stage wise options including chemical control.

2. Monitoring:

a. Installation of traps @ 5/acre in the current and potential area of spread in crop season and off-season.
b. Daily observation at initial growth stage of plant.

2. Cultural control:

a. Deep ploughing is recommended before sowing. This will expose FAW pupae to predators.
b. Timely sowing is advised. Avoid staggered sowings.
c. Intercropping like maize with suitable pulse crops of particular region. (eg. Maize + pigeon pea/black gram /green gram).
d. Erection of bird perches @ 10 /acre during early stage of the crop (up to 30 days)
e. Sowing of 3-4 rows of trap crops (eg. Napier) around maize field and spray with 5% NSKE or azadirachtin 1500 ppm as soon as the trap crop shows infestation of FAW/ damage.
f. Clean cultivation and balanced use of fertilizers practised.
g. Resistant varieties of crop select for cultivation if any.

3. Mechanical control:

a. Hand picking and destruction of egg masses and neonate larvae in mass by crushing or immersing in kerosinised water.
b. Mass trapping and destruction of moths using light traps @15/acre.

4. Biological control:

a. In Situ protection of natural enemies by habitat management. Increase the plant diversity and intercropping with pulses and ornamental flowering plants which help in build-up of natural enemies' population.

b. Augmentative release egg parasitoids *Trichogramma pretiosum* Or *Telenomus remus* @ 50,000 per acre at weekly interval or based on monitoring trap catch of 3 moths/trap.

c. Application of Bacillus thuringiensis var. kurstaki formulations @2g/lit (or) 600g/acre.

5. Stage wise options including chemical control:

a. First Window (seedling to early whorl stage): To control FAW larvae, at 5% damage to reduce hatchability of freshly laid eggs; spray 5% NSKE OR Azadirachtin 1500 ppm @ 5ml/l or Profenophos 1.5ml/litre of water.

b. Second window (mid whorl to late whorl stage): To manage 2nd and 3rd instars larvae at 10-20% damage spray Spinetoram 11.7% SC @ 0.5 ml/litre of water OR Thiamethoxam 12.6% + lambda cyhalothrin 9.5% @ 0.4 ml/l of water OR Chlorantraniliprole18.5% SC @ 0.4 ml/litre of water.

Important Considerations

1. All the sprays should be directed towards whorl and either in the early hours of the day or in the evening time.
2. Capacity building and mass awareness should be done for to management synchronisation.
3. Application of timely plant protection measures to avoid large scale spread of the insect from the abandoned crop.
4. Creation of awareness among stake holders through trainings /group discussions.
5. Community based and area-wide approach for implementing management strategies to get desired success.

Engineering of Food Crops for Quality Improvement

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Genetic Engineering for Quality Improvement

1. Genetic engineering for longer shelf life: There are many fruits which ripen after picking. After they reach optimum ripeness, they begin to deteriorate. This is necessary for the life cycle of the plant, which relies on the sweet and pulpy parts to nourish the seeds. The fruit cannot be enjoyed out of season, or far from its growing area

Transgenic tomato – Flavr Savr, Delayed ripening, Calgene, USA, 1994, Improved storage or long shelf life, Suitable for processing

a. Antisense RNA technology in tomato: Polygalacturonase (PG) degrades pectin – softening of fruit and deterioration of fruit quality an antisense PG gene was constructed and tomato plants were transformed. Transgenic tomato produces both antisense and sense strand mRNA for the PG gene – RNA-RNA pairing. Non production of PG gene product- preventing fruit softening.

b. Inhibiting ACC oxidase gene: If the ripening-related ACC oxidase gene cloned in tomato, the ethylene expression inhibited by 95% .This level of inhibition did not block ripening in the transgenic plants allowing normal development of the fruits but delaying the onset of senescence, over ripening and cracking of fruits.

2. Enhancement the level of nutritionally occurring nutrients as vitamin: Golden rice is a variety of rice (Oryza sativa) produced through genetic engineering to biosynthesize beta-carotene, a precursor of pro-vitamin A in the endosperm of rice. The colour is due to ß-carotene, which makes this the Golden Rice.

a. Golden rice cannot be created using classical plant breeding techniques because vitamin A compounds are found naturally in the vegetative parts of rice, not in the seed.

b. In order to create a rice seed containing vitamin A compounds, scientists had to use genetic modification, integration of two daffodil genes and a bacterial gene into the rice genome.

3. Expression of modified storage protein genes: Protein provided main source of energy and structural gene coding for specific polypeptide have been transgenically expressed in cereals, to improve nutritive and processing value of their grain.

Example on GE plants for quality improvement:

Crops	Characteristics	Impacts
Wheat	Increased visco elasticity by introducing glutanin gene from Bob white variety of wheat	Improved bread quality
Maize Rice	Increased level of specific a. a. lysine 1. Expression of B phaseolin of common bean 2. Relative proportion of amylose and amylopectin	Enhance nutritional quality
Potato	Insertion of glgc 16 gene (unregulated ADP glucophosphorylase) of E. Coli, leads to accumulation of glycogen	Better cold tolerance Higher level of dry matter content (24%)
Rice	Ferritin gene from soybean	Improve iron content of rice

Three approaches in cereal:

a. Altering the composition of storage protein fraction by manipulating the expression level of gene for nutritionally superior and inferior polypeptide.

b. Transgene coding for heterologous protein.

c. Modifying the gene sequence by insertion of codon for limiting essential a. a. for polypeptide have a lower content.

4. Genetic engineering for Production of novel starch: The genes encoding the main enzymes of starch biosynthesis have been cloned and used to produce transgenic lines:

In potato, GBSS I- main enzyme of amylose biosynthesis, SSS- amylopectin biosynthesis, it has 2 isoform SSS-I and SSS-II. While suppression of GBSS I by antisense RNA technology, should enhance the amylopectin content of potato (waxy starch in potato)- reported in 1991

The bacterial gene encoding CGT was transferred into potato and expressed in tuber. The gene constuct consist of:

a. Petatin gene promoter- tuber specific.

b. Sequence encoding the transit peptide- ribulose bis-phosphate carboxylase.

c. CGT gene.

d. 3' sequence of nopaline synthase gene of Agrobacterim.

The expression of this construct resulted in production of cyclodextrins up to 0.001 to 0.01% of total starch content of the tuber. It improves prehybridization of starch.

5. Engineering plant gene for modification of fatty acid composition: Vegetable oil and fats constitute an important component in human diet. They are rich source of energy- vitamins and harmones .Oil quality defined as the type and proportion of different fatty acids present in oil.

So, modify fatty acids by enzymes-
Introducing acyl transferase (acyl ACP thioesterase), acyl-ACP desaturase
Suppression of alfa acyl ACP desaturase

Example- Brassica
A. laurical as transgenic line-
Gene encoding lauroyl- ACP thioesterase was isolated from *Umbellularia california* (laurate 12: 0) and transferred into Brassica napus.

Transgenic line increased 60% lauric acid content of *Brassica napus* oil, released as laurical.

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Unveiling the Truth Behind the Low Efficiency of Micronutrient Fertilizers - The Hysteresis Effect

Article ID: 10790

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Introduction

When we apply a micronutrient fertilizer to soil, its concentration in soil solution increases, and the nutrient ions become adsorbed to soil solids. But, in most cases, when solution concentration decrease, soil desorb very little portion of the adsorbed ions. This lagging of a desorption process over the adsorption is called hysteresis which is derived from an ancient Greek word husterésis, meaning "deficiency" or "lagging behind”. The very low efficiency of micronutrient fertilizers is often associated with a large hysteresis property of soil.

Reasons of Hysteresis

1. Specific adsorption/Inner-sphere complex: This type of adsorption is due to adsorption of micronutrient cations (M^{n+}) or anions (A^{n-}) in charged surface of clay/organic matter particles owing to protonation / deprotonation of the surface (S) $OH^{-1/2}$ *or* OH_2^+ groups.

$$>SOH]^{-1/2} + M(H_2O)_6^{n+} = >S\text{-}O\text{-}M(H_2O)_5]^{(N-3/2)+} + H_3O^+ \text{ (hydrated cation)}$$

$$>S\text{-}OH_2^{+1/2} + A^{n-} = >S\text{-}A^{(n-1/2)-} + H_2O \text{ (anion)}$$

Specific adsorption can be broadly categorized in two groups- adsorption on inorganic surfaces (Fe, Al and Mn oxides, carbonates etc.) and adsorption on organic surface i.e., carboxyl (-COOH) and phenolic ($-C_6H_xOH$) groups. Cu has a very high specificity on organic colloids due to high electronegativity. Similarly, borate anion is adsorbed on organic surface by forming cis-diol structure.

2. Solid-state diffusion to internal binding sites: After adsorption on inorganic surface, the ions could migrate inside the crystal structure and fixed with greater tenacity. But, the diffusion of substances from solutions into solids is often hindered by energy barriers. This is called activation energy and we can calculate this with Arrhenius equation.

Measures of Hysteresis

1. Desorption index (DI), (Datta and Bhadoria, 1999)

$$DI= \frac{\frac{1}{n_{ads}}}{\frac{1}{n_{des}}}$$

1/n is the slope of linearized Freundlich equation, DI>1 indicate hysteresis.

2. Hysteresis coefficient (λ), (Chen et al., 2009)

$$\lambda= [\frac{a_{des}(\frac{1}{n_{ads}}+1)}{a_{ads}(\frac{1}{n_{des}}+1)} C^{(\frac{1}{n_{des}}-\frac{1}{n_{ads}})} - 1] \times 100$$

Different equilibrium and kinetic models have been used for micronutrient retention in soil by several authors. But, among these equations, two most widely used are:

a. Freundlich equation:

$$\text{Log } x=\log a+ 1/n \log c$$

b. Langmuir equation:

$$\frac{c}{x} = \frac{c}{b} + \frac{1}{k.b}$$

Hysteresis of Cationic Micronutrients

Copper (Cu): Elbana and Selim (2011) found acidic Windsor soil adsorbed far lesser Cu than calcareous Bustan soil. Based on the results, authors concluded that a fraction of Cu was specifically or irreversibly sorbed on the $CaCO_3$ fraction. Also, with low soil pH, a marked decrease in the number of sites available for Cu sorption was observed. The Windsor soil exhibited relatively low affinity for Cu compared to Bustan soils. In another study, 1*M* ammonium acetate (NH_4Ac), pH 5.0 was used for desorption of the previously adsorbed Cu (Yu et al., 2002), as acetate anion has a strong affinity for Cu and it was assumed that Cu desorbed in the NH_4Ac could mimic Cu uptake by plants. But, after five successive extractions, only 61 to 95% of the total adsorbed Cu was desorbed.

Zinc (Zn): Mandal et al. (2000) found higher desorption of adsorbed Zn by DTPA in Alfisols than in Inceptisols as Alfisol contains kaolinite clay, which has a lower fixing capacity of Zn. Also, the flooded-dried treatment desorbed more Zn than control because of the transformation of reactive amorphous Fe and Mn oxides to crystalline Fe- and Mn-oxides during the drying phase. Reyhani et al. (2010) also indicated a clear hysteresis between the adsorption and desorption processes. The authors have also observed good corelation of Freundlich parameters with different soil properties e.g., calcium carbonate equivalent (CCE), CEC, % silt, DTPA extractable Zn and specific surface area

Nickel (Ni): Davari et al. (2015) set up an experiment to evaluate the effect of three ionic strengths (0.001, 0.01, and 0.1M $CaCl_2$) and three different concentration (89, 178, and 267 µM) of competitive Cd^{+2} ion on Ni^{+2} adsorption. The observed effect expresses the strong competition between calcium with Ni ion for the negatively charged surface sites. Ni adsorption is decreased by an increase in Cd concentration. After four successive desorption steps, only 0.3% the initially adsorbed Ni was desorbed. The observed desorption behaviour suggest that most adsorbed Ni ions are bounded tightly to specific adsorption sites such that a relatively weak competitor ion such as Ca cannot release them. While, at the same initial Ni concentration and in the presence of 89, 178, and 267 µM Cd concentrations, 14.68, 19.76, and 23% were released. In the investigation by Barman et al (2013), sorption of Ni was maximum for clayey and minimum for sandy soils. It was observed that as high as 83% variability in Langmuir 'b' parameter could be attributed to pH, CEC, clay and free Fe_2O_3 content.

Hysteresis of Anionic Micronutrients

Boron (B): Datta and Bhadoria (1999) have found in sandy soil, the adsorption and desorption of B followed almost the same path which can also be predicted from the desorption index (DI) value which is less than 1. On the other hand, in clay loam soil, large hysteresis was observed with a DI value of 2.12. Also, in different soils, about 9-90 per cent variation in Freundlich 'a' parameter was due to CEC, Fe_2O_3 and clay content of the soils. Chen et al. (2009) studied effect of pH on hysteresis of B and found both are inversely related. The hysteresis coefficients at original pH of 4.6 (DI= 2.23 and λ= 28.4) gradually decreased as pH increased to 7.8 (DI= 1.12 and λ = 4.2), suggesting that adsorption-desorption was nearly reversible at higher pH.

Molybdenum (Mo): San and Selim (2018) conducted an adsorption-desorption kinetic study on Mo desorption in a loam soil (Webster) and a sandy soil (Windsor), where distinct discrepancies between adsorption and desorption isotherms were noticed. The amount of Mo desorbed was14.8-25.4% (Webster loam) and 14.1-23.0% (Windsor sand).

Conclusions

The extent of hysteresis depends on many factors of which soil texture, pH, redox, organic matter, oxides, carbonates, competing ions and selectivity between adsorbing surface and adsorbate are the prime factors. The availability of micronutrient to plants is dependent on desorption capacity of soil and it is negatively correlated with the Freundlich and adsorption parameters and can suitably be used to predict availability.

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Tractor Mounted Rotavator

(An Operational Manual for Farmers)

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List of Contents

AGRICULTURE & FOOD: e-Newsletter Volume 3 – Issue 4 – April 2021
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1. INTRODUCTION

Mechanization is the process of changing from working largely or exclusively by hand or with animals to doing that work with advance machinery. It may be either partial or complete. It is partial when only a part of the farm work is done by machine, its term as partially. When animal or human labor is completely dispensed with by power supplying machines, it is termed as completely. It is the application of machineries, equipment and implements in the day to day farm activities to increase marginal output in food production and poverty eradication.

Land preparation is one of the most important farm operations. The objectives of proper land preparation or pulverization are to provide a suitable environment for seed germination, weed control, excess moisture removed and reduction of surface runoff by increasing infiltration (Khan Kalay *et. al.* 2015).

Tractor mounted rotavator is a tillage machine designed for preparing land by breaking the soil with the help of rotating hatch (L-blades) type blades which give better soil tilth which are suitable for sowing seeds. It also plays a vital role in eradicating weeds, mixing manure or fertilizer into soil, to break up and renovate pastures for crushing clods etc. It offers an advantage of rapid seedbed preparation and reduced draft compared to conventional tillage. The first rotavator was introduced in US by a Swiss manufacturer in 1930s. Rotavator action involves the direct application of tractor engine power through a rotor and blades of a special design to soil preparation in establishing the ideal growth conditions for seedlings and seeds.

Tractor mounted rotavator take the power from PTO shaft of the tractor and transferred to rotavator shaft with the help of propeller shaft. Therefore, there is less wheel slippage and produce negative draft.

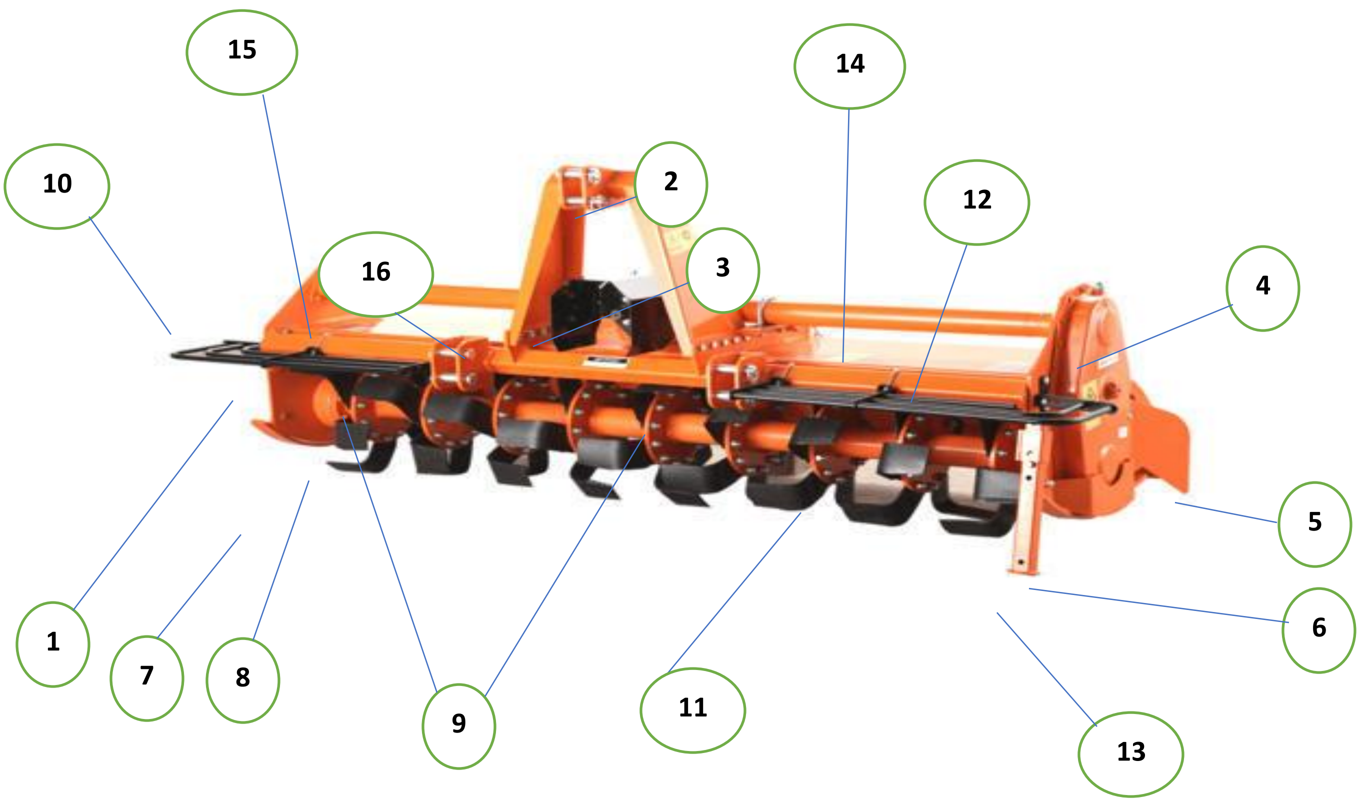
Rotavator play a vital role in wet land operation i.e. in puddling (puddling is the tillage of paddy field while flooded, an ancient practice that is used to prepare for rice cultivation which reduces the percolation rates of water by churning the clay particles and making them close many of the soil pores) before transplanting of paddy seedling.

This manual contains valuable information about tractor mounted rotavator. It has been carefully prepared to give you helpful suggestions for operating and adjusting of rotavator parts.

Proper use of equipment and application of all reasonable practices to avoid any risks, prevents accidents or injury, allows the machine working better and longer, and minimize the failures.

Before using the rotavator, operator has to carefully read all the adjustment and safety instructions. Before starting the work, the operator must be familiar with all machine controls, handling devices and their functions and also never let anyone operate the machine who is not trained.

2. Constructional Detail of Tractor Mounted Rotavator



1. Main frame
2. Mast
3. Central gear box (Primary gear box)
4. Secondary gear box
5. Trailing board
6. Skid (For supporting and adjusting the depth of cut)
7. Rotor blade
8. Flange
9. Lower hitch
10. Side support
11. Rotor shaft
12. Top cover
13. Rotavator stand
14. Gear box shaft
15. Supporting rod
16. P.T.O. shaft of rotavator

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3. Major parts of Tractor Mounted Rotavator

3.1 Frame

The frame of the rotavator is made of mild steel square pipe & mild steel plate. Mostly all the components of the rotavator are attached to it. The frame of the rotavator is welded with the side supporting flat.

3.2 Side support

The side support (both side) of the rotavator is made of MS plate which is fixed to the main frame with the help of four nuts & bolt on RHS and four bolts & nuts on LHS. Rotor shaft is fixed in side support with the help of bearing.

3.3 Shield (Top cover)

The shield of the rotavator is made of M.S. sheet and welded to supporting flats of main frame chassis of rotavator.

3.4 Trailing board (Rear hood)

It is the rear part of the rotavator which is made of MS sheet. It fixed in the rear of rotavator with one lengthy rod. The board is held in position by locking on the fixing bracket on plate section through spring loaded rod. Two number hinges are provided on trailing board which bolted to main frame chassis. The main work of the trailing board is breaking the soil clods and top finishing of field at the time of operation. It can raise or lower (according to requirement) with the help of nut and bolts of hinges.

3.5 Rotor

3.5.1 Axle

Axle of rotavator made is made of MS pipe. Axle in tubular section with flanges for mounting of blades, flanges (circular disc) are made of MS plate. 5 or 6 blades are mounted on each flange on rotor shaft with the help of two nut and bolts. Rotor shaft is bolted with hubs on both ends. This shaft is fixed in a hub through a ball bearing on gear side and through a ball bearing on other side.

3.5.2 Rotor blades

Rotor blades are most popular rotary tillage tool in rotavator. Hatchet ‘L’ Type or “C” Type blades are used which is made of boron steel. The strength of blades depends on hardness and chemical composition. ‘L’ type blades good for trashy lands and “C” type blades well for working in heavy and puggy clay soils. This allows the greater clearance between the blade and rotor, due to this reason it provide a greater depth of cultivation.

3.6 Depth control mechanism

3.6.1 Skid

Skid is the main component of rotavator which is made of MS flat double plate (Curved shape) is fixed with the help of two bolts & nuts. Two skids are provided in both side of rotavator.

3.6.2 Adjusting rack

It is the depth control mechanism of rotavator which is made of MS flat with 4 holes for depth adjustment (increase or decrease). MS flat is fixed at end of the skid & lower side support with the help of nuts & bolts.

3.6.3 Side disc

Two side discs are provided in rotavator which is made of MS plate. Side Disc is an essential alignment and depth adjustment tool. With side disc assy you get better yields and better field pulverization and puddling.

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Volume 3 – Issue 4 – April 2021

3.7 Mast & Three-point linkage

Mast is made of MS sheet usually in pyramid shape or rectangle. One upper hitch and two lower hitches are provided in tractor drawn rotavator which widely used for attaching the implements to the tractor. Three-point attachment is the simplest and the only statically determinate way of joining two bodies in engineering. The primary benefit of the three-point hitch system is to transfer the weight and resistance of an implement to the drive wheels of the tractor which gives to the tractor more usable traction.

3.8 Power transmission system

3.8.1 Method of transmission

3.8.1.1 Primary gear reduction

Propeller shaft (universal joint) takes drive from PTO shaft of the tractor and transmits power to rotor shaft through one gear box (primary) and gear drive (secondary reduction). The power received from the PTO propeller shaft is transmitted through a set of gear.

3.8.1.2 Secondary gear reduction

In secondary reduction gear drive, two spur gear and one idler gear provided or chain & sprockets mechanism provided in some rotavator.

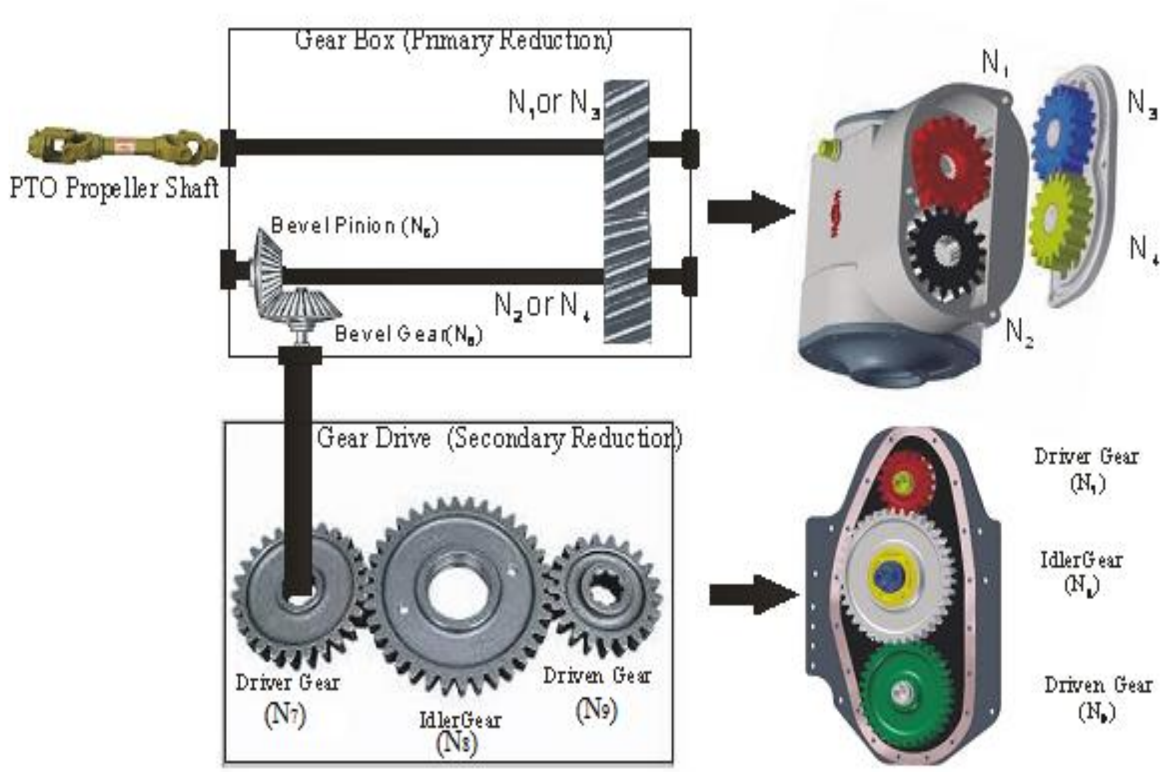

Fig.1: Line diagram of gear box assembly of Tractor Mounted Rotavator

Table: 1. Information of gear box assembly

Tame of Gear	To. of teeth
	For 540 PTO RPM
T_1	18
T_2	17
T_3 (Bevel)	14
T_4 (Bevel Gear)	22
T_5 (Driver Gear)	18
T_6 (Idler Gear)	38
T_7 (Drive Gear)	30

Note: Every manufacturer of rotavator has separate gear assembly

3.9 Calculation for obtains final RPM of tractor mounted rotavator

Solution: (See fig.1. Line diagram of gear box assembly).

RPM of tractor PTO = 540 rpm

$T_1 = 18$

$N_1 = 540$

$T_2 = 17$

$T_1/T_2 = 18/17 = 1.058$ [1:0.58]

$T_1/T_2 = N_2/N_1$

$N_2 = N_1 \times 1.058 = 571.32$ rpm

Note: The power received from the PTO propeller shaft is transmitted through a set of gear i.e. T_1=18 & T_2= 17 to bevel pinion and bevel gear and thus achieving a reduction ratio of 1:0.58.

Then RPM at N_2 = 571.32 RPM

Now,

$N_2 = N_3$ (because shaft is same)

$T_3 N_3 = T_4 N_4$

$T_3 = 14$

$T_4 = 22$

$N_4 = T_3 N_3 / T_4$

$= 14 \times 571.32/22$

$= 363.56$ rpm

$N_4 = N_5$ (because shaft is same)

$T_5 N_5 = T_6 N_6$

$T_5 = 18$

$T_6 = 38$

$N_5 = 363.56$ rpm

$N_6 = T_5 N_5 / T_6$

$= 18 \times 363.56/38$

$= 171.94$ rpm

$T_6 N_6 = T_7 N_7$

$T_7 = 30$

$N_7 = T_6 N_6 / T_7$

$= 38 \times 171.94/30$

$= 218$ rpm (Final rpm of Rotavator)

Note: RPM of Rotavator can be increase or decrease by replacement of gear

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Table: 2. Work sheet for performance of tractor mounted rotavator

Sl. No.	Parameters	For dry land operation	For wet land operation (Puddling)
1.	Tractor used		
2.	Type of soil		
3.	Av. Soil moisture (%)		
4.	Depth of standing water (cm)	--	
5.	Slip, %		
6.	Field efficiency %		
7.	Puddling index (%)	--	
8.	Av. Speed of operation (kmph)		
9.	Av. depth of cut, cm – Single pass		
	Av. depth of cut, cm – Double pass		
10.	Depth of puddle (cm)	--	
11.	Av. working width (m)		
12.	Area covered (ha/h)		
13.	Time required for one hectare (hour)		
14.	Fuel consumption (Litre)		
	- L/h		
	- L/ha		

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4. Saftey Precuations in Hitching of Tractor Mounted Rotavator

The Occupational Health and Safety Act (OHS Act.) applies to all workplaces, including farms. As a farmer, you may be an employer, a self-employed person or a person who manages and controls the farm. The rotavator has three point of i.e. two lower and one top link. The rotavator is attached to tractor with the help of three points hitch. The top link hitch point also helps in leveling the rotavator. The three-point hitch adjustments where the rotavator fixes to the tractor should be adjusted. The rotavator should level from side to side and have just enough forward and backward adjustment to enter the soil at the proper angle. There are some points keep in the mind at the time of hitching of rotavator.

i. Tractor power and rotavator power requirement
ii. The rotary tiller is coupled to the tractor when the tiller is on the ground. The ground area should be flat.
iii. Ensure hitch attachments match the tractor hitch category.
iv. Use only approved hitch pins. If hitch pins are damaged or bent, take them out of service.
v. Make sure the hitch pin locked in place or secured with a retainer clip.
vi. Check the implement raising or lowering by the hydraulic system of tractor.

5. Equipment safety guidelines

i. Read safety instructions for both the tractor and this tiller before use.
ii. Never exceed the advised limits of the tractor or the tiller.
iii. This equipment is dangerous to children and those unfamiliar with its operation. DO NOT ALLOW children to operate or play around equipment.
iv. Operator should be an adult who is familiar with operating the tractor and the tiller. Operator should be physically and mentally fit before operating machinery. Fatigue, stress, alcohol and drugs may impair the ability for safe farm machinery operation.

6. Before Use of Rotavator

i. The machine is perfectly in order that the lubricants are at the correct levels.
ii. Check the rotary tiller is correctly fitted & positioned to obtain the right working depth.
iii. Check air breather valve is fitted on gear box and side gear cover.

7. How to adjust working depth

Rotavator working depth is regulated on the basis of skids. To adjust working depth on this type of machine you must loosen the adjustment pin and raise or lower the skid to the desired extent. Then reposition the pin. Both skids should be subjected to this operation, which will vary according to the type of soil.

8. Troubleshooting hints for the Tractor operator

a. If working depth is insufficient

- Check the positioning of the two depth skids.
- Move forward slower as the power of the tractor may be insufficient.
- If the soil is too hard a second or third hoeing may be required.
- If the hoe blades are rotating on top of the soil instead of cutting into it proceed more slowly.

b. If the soil too finely broken up by the Rotavator

- Raise the leveling blade.
- Increase the forward moving speed of the tractor.

c. If the soil not broken up finely enough

- Lower the leveling blade.
- Reduce the tractor speed.
- Don't work soil that is too wet.
- In the rotary hoes fitted with a leveling bar, raise or lower this so as to keep the sods closer to the hoe blades.

d. Clogging up the rotor

- The soil is too wet for hoeing.
- Raise the leveling blade.
- Reduce the tractor speed.
- Reduce the number of the hoe blades per flange from six to four.
- Avoid hoeing where there is long grass.

e. The rotary hoe bounces over the soil or vibrates

- There are foreign bodies caught between the hoe blades.
- The hoe blades have been incorrectly assembled thereby not forming.
- The helix shape or with the blunt edge placed to cut into the soil first instead of the cutting edge.
- Worn or broken hoe blades.
- The rotor is deformed because of blows to the central part caused by foreign bodies present during hoeing.

9. Working on hill/slope

Where possible always try to 'work up' the slope. If this is not possible avoid hoeing along the contours of the hill and hoe up and down the slope to avoid a terracing effect.

10. Familiarization with 8, 50 and 200-hours service schedule

10.1 Every 8 working hours

Grease the cardan shaft cross journals. Check that the bolts fixing the hoe blades are well tightened.

10.2 Every 50 working hours

Check the level of the oil in the gearbox or in the reduction unit and top up to the level mark on the rod as necessary.

10.3 Every 200 working hours

Change the oil in the gearbox or in the reduction unit and transmission casing by completely draining of the old oil through the drain plug, under the reduction unit and through the transmission drain plug.

Note: It is advisable to use SAE 140 EP Grade oil or equivalent for the gear box unit and side transmission.

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List of Contents

1. INTRODUCTION

Sowing is one of the most important agricultural operations for raising crops. Proper application of fertilizer at proper location has also a good effect on crop growth and yield. Proper placement of seed at proper depth row also necessary. The main reason for increase in yield is the uniform and controlled application of fertilizer with respect to seed in a concentrated bond at about 50 mm below and 50 mm away from the seed. Water and labor scarcity and timeliness of farming operations specially planting under the emerging uncertainties are becoming major concerns of farming all across farmer typology, production systems and ecologies in the region (Chauhan et al., 2012). Potential solutions to address these issues include a shift from intensive tillage-based practices to conservation agriculture (reduced or no tillage) based crop establishment techniques (Saharawat et al., 2010; Jat et al., 2012; Gathala et al., 2011). Direct drilling (seeding/planting with zero tillage technology) is one such practice that potentialy addresses the issues of labor, energy, water, soil health etc (Malik et al., 2005; Gupta and Sayre, 2007; Jat et al., 2009; Ladha et al., 2009; Gathala et al., 2011). As our population continues to increase, it is necessary that we must produce more food, but this can only be achieved through some level of mechanization. Manual method of seed planting, results in low seed placement, spacing efficiencies and serious back ache for the farmer which limits the size of field that can be planted. However, planting machine or planter that is normally required to produce more food is beyond the buying capacity of small holder farmers (Khan at al., 2015).

However, in Kashmir mostly farmers belong to marginal and small land holdings. Due to these conditions of farmers not affordable to purchase many machines for the sowing of different crops. Therefore, multi-crop planter has been invented and are being used by many farmers across South Asia. The same multi-crop planter available in the Jammu & Kashmir region can be used for sowing of several crops including maize, pea, okra, wheat etc. after applying of tillage. One of the major constraints in Jammu & Kashmir region for adoption of this technology is the lack of skills/knowledge on operation and calibration of the machinery for multiple uses. On farm there are many field/ crop/situation specific adjustments needed before the use and at the time of use of the machine in the field. These adjustments include calibration, proper spacing between row to row and plant to plant, depth of sowing, fertilizer placement and its quantity as per the crop and field conditions to realize the potential benefits of the technology. There is no any agricultural machinery manufacturers & neither operational manuals are not available for above adjustment of multi-crop planter in Jammu & Kashmir region. In absence of the manual guidelines/protocols for efficient use of these planters by the farmers, service providers, extension agents for different purposes and variable field conditions, many times the desirable results are not achieved by the farmers and even contradictory results are observed. In this manual, we attempted to provide simple guidelines for the farmers/users/students/stakeholders/researchers for calibration, operation, knowledge of seed metering device, maintenance, adjustment, problems and their solutions on farm for efficient use of multi-crop planter. All implements with moving parts are potentially hazardous. There is no substitute for cautions safe minded operator who not recognized the potential hazards and follow reasonable safety practices. The manufacturer has designed this implement to be used with all safety equipment properly attached to minimize the chances of accidents.

2. Importance of Multi-crop Planter

Sowing is a critical field operation that makes the prospects of a crop. Farmers in the region still follow traditional methods of manually sowing as broadcasting or dibbling. These methods result in lower yield due to uneven distribution of seed, low germination and excessive weed growth. Largely, agricultural operations are labor intensive and performed manually. Existing locally evolved tools give low output and involve excessive drudgery. Although a number of planters have been developed in the country, these could not be adopted by the farmers of the hill areas due to their lack of operational knowledge and heavy weight. Due to fragmented and small land holdings and variable farmer typology, it is neither affordable not advisable to purchase many machines for the planting of different crops by the same farmer. The multi-crop planter can plant different crops with variable seed size, seed rate, depth, spacing etc. In addition to adjustments for row spacing, depth, gears for power transition to seed and fertilizer metering systems, the multi-crop planters have precise seed metering system using inclined rotary plates with variable grove number and size for different seed size and spacing for various crops (Kapil et al 2012).

3. Major Parts of Multi-Crop Planter

3.1. Frame

The frame of the multicrop planter is made of mild steel and welded together to provide the desired strength and rigidity to the machine. Mostly all the components of planter are attached to it. The frame of the planter consists with 5 or 7 or 9- tynes.

3.2. Seed and fertilizer hopper

It is used to store the seed/fertilizer in the machine. The hopper of planter is in trapezoidal shaped which made of mild steel sheet. Hopper are mounted side by side (fertilizer hopper in front and seed hopper in the rear) on the frame of the planter. The dimensions of seed hopper depend on working width of planter and will increase with the increase in the number of furrow opener in the planter. Capacity of seed and fertilizer hoper depend on bulk density of seeds.

3.3. Ground wheel

Ground wheel of planter is attached in the middle of the front bar of the frame. Ground wheel rotate on field surface and is to transmit power to the seed and fertilizer metering gears through chain and sprocket. The trapezoidal lugs are provided on circumference of ground wheel to avoid or minimize slippage.

3.4. Depth control wheel

Two depth control wheels are attached in each side of frame for proper placement of seed and fertilizer at required depth i.e. according to recommended sowing depth. The depth of seed and fertilizer placement can be increased or decreased with the help of depth adjusting nut and bolt mechanism attached to the frame. Before the adjustment of depth, you should be aware that, what is the recommended depth of sowing of particular seeds crop. The adjustment of depth of sowing of seed should be done on farm.

3.5. Power Transmission

It is one of the main mechanisms of planter. The function of power transmission unit is to transmit the power from ground wheel to seed and fertilizer metering device through the chain and sprocket for dropping the seed in opened furrow with the help of seed tube. A sprocket is attached to main shaft of ground wheel and second sprocket is attached the first end of shaft which is mounted on front bar of frame. One sprocket is attached to second end of shaft which is mounted on front bar of frame. Seed and fertilizer metering shaft have one sprocket at end of shaft. Now through chain, ground wheel transmits the power to the shaft which is mounted on front bar of frame, this shaft transmits the power through chain and sprocket to seed and fertilizer metering shaft.

3.6. Seed Metering System

Seed metering mechanism is the heart of planting machine which distribute seed uniformly. As the shaft rotates, the seed metering device also rotates and delivered the seed in opened furrow with the help of seed tube. Seed rate can be adjusted by adjusting lever which is attached to the seed box for increasing or decreasing the rate of seed into the seed metering device. The distance between dropped seed in furrow can be control increasing or decreasing the number of slot/hole/cells in seed metering device.

3.7. Fertilizer Metering System

Proper application of fertilizer at the time of sowing is very necessary. This system controls the rate of fertilizer for specific crop. As the shaft of fertilizer metering system rotates, the fertilizer metering device also rotates and picks the fertilizer from the fertilizer hopper and delivered in soil with the help of fertilizer tube. Fertilizer rate can be adjusted by adjusting lever which is attached to the fertilizer box for increasing or decreasing the rate of fertilizer into the fertilizer metering device.

3.8. Furrow openers

Furrow openers is the main component of planter which opened the furrow and place the seed and fertilizer at desired depth. As the furrow openers drill the soil, the seeds and fertilizers dropped in the delivery pipes and passed through the seed and fertilizer boots through the action of drive wheal and finally placed into the slits opened by the furrow opener. The spacing between furrow openers can be adjusted by adjustment of tyne. The spacing between furrow openers is generally kept on the basis of row to row spacing of specific crop. The point of share is made of 8 mm thick high carbon bit welded to a mild steel plate.

3.9. Seed and fertilizer tube

See/fertilizers tube convey the seed/fertilizer from the seed/fertilizer metering device to opened furrow. Seed/fertilizer tube are attached to the seed and fertilizer hopper through the seed and fertilizer cups and to seed/fertilizer boot. Seed/fertilizer tubes should be connected firmly so that these may not come out during field operation. The seed/fertilizer tube should be protected from bending and breakage and excessive bend in the tubes should be avoided otherwise the bend will cause obstruction in free flow of seed/fertilizer.

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Fig. 1: Components of Tractor Drawn Multi-Crop Planter

Fig. 2: Power Transmission System of Multi-Crop Planter

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4. Calibration of Planter for accurate Seed and Fertilizer Rates

4.1. Calibration in Laboratory

The procedure of testing the planter for correct seed/fertilizer rate is called calibration of planter. It is necessary to calibrate the planter before putting it in actual use to find the desired seed/fertilizer rate. Calibration is done to get predetermined seed rate of the planter. The following steps are followed for calibration of planter:

- Measure circumference of drive wheel (CD):
  $C_d = \pi D$
- Measure effective width of the planter (WD):
  WD = No of furrow opener × distance between opener to opener
- Put seed in seed box and fertilizer in fertilizer box.
- Now rotate ground wheel manually to ten full rotations and collect seed delivered from each seed/fertilizer seed tube separately in polythene bags.
- Weigh the seeds (SW) and fertilizer (FW) in each bag and also determine the total seed weight and fertilizer weight. The difference in seed/ fertilizer weight between individual delivery tubes should not more than 10%.
- Calculate seed and fertilizer application rate per hectare using the following formula:
  Seed rate (kg/ha) = $\frac{\mathrm{SW}}{\mathrm{CD} \times \mathrm{WD}}$

Note: Calculated seed and fertilizer rates can differ from the actual rates due to drag and slippage of the drive wheel depending upon available soil moisture, crop residue and field topography.

4.2. Calibration in Field

Firstly, select a well-prepared field at least 20 m in length and fill seeds in seed box and fertilizers in fertilizer box and set the indicator at desired seed rate and fertilizer rate. Now start to run the planter at a distance of 20 meters in the field. Collect the seed and fertilizer from the seed tubes in polythene bags from each pipe. The amount of seed and fertilizer collected in each pipe in 20-meter run is then weighed (g). Then we calculate the seed rate and fertilizer rate by using this formula as under:

One hectare = 10000 m^2

WD = Effective width of the planter
= No of furrow opener × distance between opener to opener

Let number of furrow opener = 9
Let distance between opener to opener = 20 cm
Effective width of the planter = 1.80 m
Let diameter of ground wheel = 50 cm or 0.50 m
Let weight of seed or fertilizer dropped from tubes = 200 g. or 0.2 kg.

So, area covered in one revolution = πDW
= 3.14×0.50×1.80
= 2.286 m^2

Now, area covered in 10 revolutions of ground wheel = πDW×10
= 3.14×0.50×1.80×10
= 22. 86 m^2

Seed or fertilizer dropped/h =

$$\frac{10000 \times \text{Seed dropped in 10 revolutions (kg)}}{\text{Area covered in 10 revolutions in square m}}$$

$$= \frac{10000 \times 0.2}{22.86} = 87.48 \text{kg/ha}$$

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Note: If the seed or fertilizer rate is not equal to recommended rate then accordingly set the indicator at higher or lower rate and again start the procedure of calibration of planter in field.

5. Saftey Precuations in Hitching

The Occupational Health and Safety Act (OHS Act) applies to all workplaces, including farms. As a farmer, you may be an employer, a self-employed person or a person who manages and controls the farm. The planter has three point of i.e. two lower and one top links. The planter is attached to tractor with the help of three points hitch. The top link hitch point also helps in leveling the planter. The three-point hitch adjustments where the planter fixes to the tractor should be adjusted. The planter should level from side to side and have just enough forward and backward adjustment to enter the soil at the proper angle There is some point keep in the mind at the time of hitching of planter.

- **i.** Tractor power and planter power requirement
- **ii.** Ensure hitch attachments match the tractor hitch category.
- **iii.** Use only approved hitch pins. If hitch pins are damaged or bent, take them out of service.
- **iv.** Make sure the hitch pin locked in place or secured with a retainer clip.
- **v.** Check the implement raising or lowering by the hydraulic system of tractor.

6. Precuation Before planting Opeartion

- Seed should be of good quality and free from dirt and dust.
- Before sowing, note the size of clods remaining after cultivation. If they are dense and greater than 5 cm in diameter, they could cause variations in seeding depth or physically prevent seedlings from emerging. Fix the problem now.
- Fertilizer should not have clods. Clods should be properly broken to uniform size for free flow of fertilizer.
- All the nuts and bolts, and springs should be thoroughly checked, defective parts should be replaced and nuts/bolts properly tightened.
- Seed and fertilizer boxes should be thoroughly cleaned.
- Seed metering device should be thoroughly cleaned and blocked if any, must be removed.
- Ensure that seed tube do not have excessive bend. This will block the free flow of seed and fertilizer in tubes.
- Chain sprocket of metering mechanism should be properly aligned. Appropriate tension in the chain may be kept for free movements of seed and fertilizer metering shafts. If there is any noise during operation, stop the machine and check it.
- Furrow openers should be fitted on the frame according to the requirement (row to row distance) of the crop. There should be no crossing or twisting of furrow openers.
- Fill the seed and fertilizer boxes and calibrates the machine. Ensure that the seed drill is set at desired seed and fertilizer rates. This will ensure proper metering of seed and fertilizers and result in excellent germination, good crop stand and higher yield.

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7. Operation of Planter in Field

- Field should be properly levelled and well prepared before operation.
- Do not allow drying up of the upper soil layer before sowing, otherwise, seed will have to be placed deep and it will affect germination.
- Field should not be neither too wet nor too dry i.e. soil moisture should be optimum both for the operation of planter as well as germination of the seeds.
- Firstly, planter is attached to the tractor with the help of three-point linkage.
- Operational speed of planter should not be more than 5-7 km/h for smooth operation.
- Depth of sowing should be properly adjusted by depth control wheel.
- As the tractor moves the planter, the ground wheel rotates which in-turn rotates the chain-set attached to it on one end and to the drive shaft at another end. The drive shaft then provides the drive to the seed box shaft and fertilizer box shaft as all of these shafts are attached with a chain and gear drive.
- Seed/fertilizer metering shaft rotates seed/fertilizer metering device.
- Seed/fertilizer metering device takes the seed from the hopper and delivered in opened furrow with the help of seed/fertilizer tube which is attached to the seed boot.

Note: Seed rate will be increased or decreased by changing the sprocket sets or number of slot/hole/cells in metering device.

8. Maintenance and Repair of Planter

Every planter should be cleaned in preparation to head back to the field each season. However, getting a planter ready for optimum seeding is more than cleaning. Final yield can vary dramatically on the basis of plant populations in the field, so it is best to plant adequate seeds to ensure that the final plant stand is optimum for the desired yield. Obtaining optimum yield depends on how you prepare and set your planter. Adjusting planters to plant a specified number of seeds per foot of row is important in obtaining a proper stand.

- Raise the machine above ground so that the drive wheels move freely.
- Remove seed and fertilizer from boxes.
- Wash the machine rollers/seed/fertilizer boxes with diesel to avoid rusting.
- Apply lubricating oil at appropriate places.
- Drive wheel should move freely. If it is jammed, then apply grease
- Drive wheel should be round, if it is bent then repair it.
- All sprockets should be properly tightened on their shafts
- Belt drive shafts should be repaired or replaced.
- Chain and idler sprocket should be properly tightened so that proper chain tension is maintained.
- Worn out parts, loose, broken and worn out bushes should be replaced.
- All the plastic tubes/ pipes should be properly open.
- Tighten all nuts and bolts of the mechanism.
- Old/bent tubes should be replaced.

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- If furrow openers wear out or twist very fast. Therefore, these should be repaired frequently.
- All the components of the machine should be painted.
- Machine should be protected from rain, dirt and dust etc. during its storage.
- Moving parts should be greased / oiled at regular intervals so that the machine gives a trouble-free service for a long time.
- Users training will lead to improvement in the performance of the machines.
- Check the shaft bearings and sprocket bearings for their shape and condition. They should be well lubricated

9. Planter Storage

Before storing the planter, firstly clean all the components of the planter, painted and apply lubricants I,e. grease/oil to the transmission chain and moving parts at regular intervals so that the machine gives a trouble-free service for a long time. Store the machine in a dry, well-ventilated store. Planter should be protected from rain, dirt and dust etc. during its storage.

10. Troubleshooting in planter and their remedies

Sl. no.	Problems	Causes	Remedies
1	If ground wheel is not rotating	• Weed is trapped in ground wheel i.e. more weeds are available in the field.	• Remove trapped weeds from the ground wheel
2	Seed metering device is not delivered the seed in furrow	• May be seed tube blocked. • Detached of seed tube from seed boot • Seed metering shaft is not rotating, may be chain is breaked. • Seed is not clean. • Excessive band in seed tube	• Check seed tube properly • If seed tube is detached from seed boot, fit properly in seed boot. • If chain is worm out, use nw one for smooth operation. • Seed should be of good quality and free from dirt and dust. • Check seed tube if banded
3	Seed not placed at desired depth	• Adjustment of depth control wheel is not proper	• Properly adjust the depth of furrow openers with the help of depth control wheel.
4	Unequal depth of seeding among different rows/ furrow openers	• Improper three-point linkage balancing	• Put the machine on a fairly level ground and then level all the furrow openers with the help of top link/ right lower link of the tractor.

5	Seed to seed spacing not maintained	• May be slot/cell of seed metering device closed. • Excessive speed	• Check slot/cell, if closed open of slot and clean it. • Do work slowly i.e. speed not more than 5-7 km/h
6	Not opened proper furrow	• May be shoe of planter bent due to more stony soil.	• Open and repair it.
7	Row to spacing not maintained	• Tynes of planter is loosed. • Furrow openers is not fitted on the frame according to the requirement.	• Nut and bolt properly tightened and defective parts should be properly replaced. • Furrow openers should be fitted on the frame according to the requirement
8	Excess slippage	• More soil moisture i.e. moist soil condition	• Soil moisture must be optimum.
9	Excessive noise, during operation	• More friction due to improper lubricants	• Apply lubricating oil at appropriate places.
10	Not equal balancing of planter	• Improper balancing of three-point linkage	• Put the machine on a fairly level ground and then level all the furrow openers with the help of top link/ right lower link of the tractor

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Flowers – God gift to mankind

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Winter season is the garden's youth age. At this time, the growth of flowers has taken place. In winter, more than 100 varieties of flowers are planted, which are called seasonal flowers. These seasonal flowers develop vegetative growth in one season and ends its life by completing its sexual development in the same season. The month of October is the perfect time to prepare plants. By this time monsoon is finished. The ground should be prepared well and mixed with plenty of compost, fine sand and soil in the ratio of 2: 1: 3. Also, DAP should be prepared 10 square feet per 50 grams of mixed well in the beds. Now we have come to the location of sowing seeds. Now take seeds of good quality and spread the seeds and pour compost and then press it with your hands and spray the water with water cans. The spray of water should be kept in the morning and evening. In two weeks, the seeds sprout and grow upwards. Plants are ready to be planted in 40 to 45 days. We can also sprout these plants by putting them in a seed tray and putting coco pit. Remove the seed from the tray and sample them wherever you want it. Have beds or utensil or polythene bags. The root of the plants will be in perfect health in the seed tray. We have clay pot which is 6 "to 8" inch deep. Want to make a hole in the bottom of the pot, put 5" deep soil in the pod and then plant the saplings into the pod. Remember, the soil should be filled at least 5 inch deep into the pot.

The pot should be filled with soil, sand and compost in the ratio 2: 1: 1. In this season, there are some most beautiful looking plants to grow, which are mentioned below:

- **Alyssum _** This one looks like coloured umbrella under the umbrella with a little sweet fragrance.
- **Antirrhinum_**, which is also called Snapdragon or dog Flower. Its flowers looks like the mouth of the dog.
- **Calendula_** Yellow Colour Single and Double with Hot Vow. She gets the summons of the leaf eyelid.
- **Dianthus_** is of many colours and shapes. They can be planted in pots, beds or rock gardens.
- **Pansy_** are small trees with beautiful flowers like butterflies which are good for hanging.
- **Hollyhock_** They are as tall as ladyfingers.
- **Larkspur_** They grow in colours of white, blue, pink etc. Potts are useful for Larkspur.

They are the flowers of design, the colours of petunia_. The hybrid variety has blue, white and pink colours in different colours and indigenous varieties which bloom most of the year. They mostly use jute for hanging.

- **Phlox_** They also look fun out of the house, they become usable for hanging, beds and pots.
- **Statice_** Pink has more beautiful legs. It is useful in decorating with dry flowers.
- **Verbena_** bunch has flowers, which are white, pink, blue red etc. colours.
- **Nastrissium_** It is a pea-like creeper which is mostly yellow coloured.
- **Poppy_** They look beautiful in many colours like opium.

There are also flowers of moss types like Carnation, Gazenia, Dahlia, Chrysanthemum etc. They also come now January toi February is the month of adulthood, this is the time for flowers. Enjoy the seasonality. After Holi, the garden's old age starts, it is the last time of flowering.

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Application of bio-fertilizer in vegetable crops

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INTRODUCTION

Biofertilizers: latent form of microbes capable of fixation, solubilizing and mobilizing essential plant nutrients from insoluble form to soluble form through biological process. They helps in maintaining soil fertility, sustainable crop production, improve crop growth and quality by producing plant growth hormones. Microorganisms also control many plant pathogens and can be used as potential bio-control agents in vegetable production. Biofertilizers are live formulation of beneficial microorganism which can be applied on seed, seedling, cutting, root or soil mobilize the availability of nutrients through their biological activity, helps in building up of lost micro-flora and improve the soil health. Hence, with the increase in price and use of chemical fertilizer and their ill effect on soil health use of biofertilizers is increasing day by day, they cause beneficial effect on soil health and increases productivity of crops. Microorganisms as biofertilizers increases growth of plants by different activities i.e., enhancing availability of essential nutrients, releasing plant growth-stimulating hormones, reducing the damage caused by pathogens and improving resistance to environmental stress conditions. Vegetables being one of the integrated components of agricultural production system are key contributors in economic development of the country and doubling farmer income. The demand of vegetables both for culinary and industry is growing at a very fast pace with India being the second largest producer of vegetable in the world. They are cheap source of nutrients both for humans and animals. Vegetable crops need ecofriendly technology for quality production and ensuring nutritional food security for sustainable agriculture production system. The application of biofertilizers offer an economically attractive and sustainable means of reducing external inputs of chemical fertilizers and for improving the quality of vegetable crops.

Biofertilizers in vegetable crops

The beneficial rhizosphere microbes: *Azotobacter*, *Azospirillum*, *Bacillus*, *Enterobacter*, *Pseudomonas*, *Rhizobium, Serratia* and mycorrhizal fungi. These rhizospheric microbes interact with each other and host plant through different mechanisms i.e. symbiosis, association, neutralism or antagonism. Through intensive selection and screening procedures, specific strains of microbes are recognized for their specific role in plant nutrient management and promotion of plant growth. Thus, biofertilizers are microbial inoculants possessing nitrogen-fixing, phosphate-solubilizing and plant growth-promoting ability that can be used to inoculate the seed, cut-piece/set, seedlings and soil treatment:

- Nitrogen fixing (*Azospirillum*, *Azotobacter*, blue-green algae, *Rhizobium*)
- Phosphate solubilizing (*Aspergillus*, *Bacillus*, mycorrhizal fungi, *Pseudomonas*)
- Potash mobilizer (*Bacillus* sp., *Pseudomonas* sp.)
- Sulphur uptake (*Thiobacillus*)
- Zinc solubilizer (*Bacillus subtilis*, *Saccharomyces* sp. and *Thiobacillus thiooxidans)*
- Iron uptake (*Pseudomonas fluorescens*)
- Plant growth promoters (*Bacillus*, *Pseudomonas*, *Serratia*)

Methods of application of biofertilizers on vegetable crops

Azotobacter and phosphate solubilizes are commonly used as biofertilizers in vegetables crops, they can be applied by following methods:

1. Seed treatment or seed inoculation
2. Cut-piece/set treatment/Self-inoculation or tuber inoculation
3. Seedling root treatment
4. Soil or main field treatment

Seed Treatment or seed inoculation

1. Most common method of applying biofertilizers on seeds.
2. For treating 10–14 kg of seeds about 200 g of biofertilizer is required.
3. Prepare 10% jaggery solution and mix it with biofertilizer or mix 200 g of biofertilizer in 400 ml of water and mix thoroughly.
4. Spread the seeds on clean polythene sheet or cemented floor now pour the mixture on seeds and mix properly with hands so that a uniform thin coating is formed on each and every seed.
5. Spread the treated seeds in shade for drying for 10–15 minutes before sowing them.

Cut-piece/Set treatment/Self-inoculation or tuber inoculation

1) This method is used to treat cuttings or sets and exclusively suitable for application of *Azotobacter* biofertilizer.
2) Mix four five kilograms of *Azotobacter* biofertilizer in 50-60 liters of water to make culture suspension.
3) Cut pieces or sets required for planting one acre are immersed in the culture suspension for 10–15 minutes.
4) Cut pieces or sets are allowed to dry for some time in shade before planting in the main field.
5) This method is generally used in crops like potato.

Seedling root treatment

1. Seedling root treatment is recommended for crops like; tomato, chilli, pepper, cole crops onion etc.
2. Culture suspension is prepared by mixing 2-2.5 kg of culture in bucket having 10–15 litres of water.
3. Make small bundle of freshly uprooted seedlings required for planting in one acre.
4. Dip the small bundle seedlings in the culture suspension for 15–20 minutes to enable the roots to get inoculum.
5. The treated seedlings are transplanted immediately.
6. Generally, the ratio of inoculants and water should be 1:10 approximately, i.e., a 1 kg packet in 10 litres of water.

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Soil or main field treatment

1. This method is used in crops where localized application is needed.
2. Prepare biofertilizer-compost mix by mixing 2–3 kg of culture in 40–60 kg of well decomposed granulated compost.
3. Incubate biofertilizer-compost mix for 24 hrs. Compost acts as nutrition medium and carrier for biofertilizer.
4. Broadcast the well-prepared mixture in one acre at sowing time or 24 hrs. before sowing. This method is generally used for the application of PSB biofertilizers.

Table no. 1: Bio-fertilizer inoculants for different vegetable crops

<table>
<tr><th>Bio-fertilizer</th><th>Crop</th><th>Bio-fertilizer</th><th>Crop</th></tr>
<tr><td rowspan="2">Rhizobium</td><td>Cowpea</td><td rowspan="9">Azospirillum</td><td>Cabbage</td></tr>
<tr><td>Pea</td><td>Capsicum</td></tr>
<tr><td rowspan="5">Azotobacter</td><td>Cabbage</td><td>Chilli</td></tr>
<tr><td>Garlic</td><td>Knolkhol</td></tr>
<tr><td>Knol khol</td><td>Onion</td></tr>
<tr><td>Onion</td><td>Garlic</td></tr>
<tr><td>Tomato</td><td>Okra</td></tr>
<tr><td rowspan="5">PSM</td><td>Garlic</td><td>Radish</td></tr>
<tr><td>Onion</td><td>Sweet potato</td></tr>
<tr><td>Potato</td><td rowspan="3">VAM</td><td>Chilli</td></tr>
<tr><td rowspan="2">Pumpkin</td><td>Onion</td></tr>
<tr><td>Potato</td></tr>
</table>

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Internet of things (IoT) project based on microcontroller and sensors for the complete automation of poly/green house

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INTRODUCTION

World is moving towards smart farming techniques, where automation as well as data bank is the future. Automation reduces the human interference and the data bank provides the basis for the design of artificial intelligence (AI) systems and will be useful for the development of many farming models and robots, etc. The automation setup for a poly house is shown in figure 1.

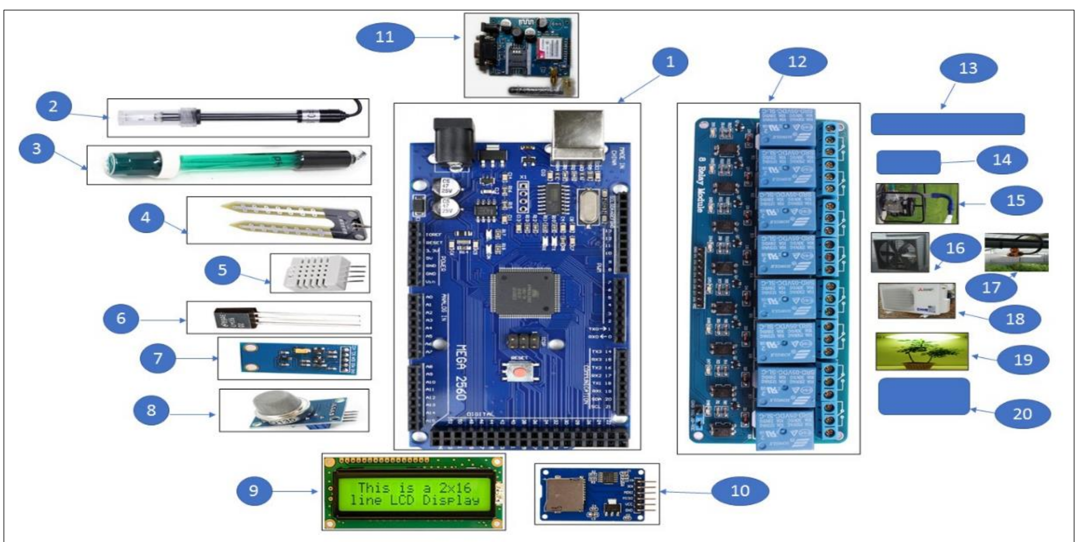

Fig 1: Pictorial view of Internet of Things (IoT) based agricultural data bank and automated farming module
1- microcontroller; 2- electrical conductivity sensor; 3- acidity and basicity sensor; 4- soil moisture sensor; 5- relative humidity sensor; 6- temperature sensor; 7-light intensity sensor; 8-air quality sensor; 9-screen; 10-data logger; 11-internet provider module; 12-relay switches; 13-electrical conductivity controller; 14-acidity or basicity controller; 15-water supplying device; 16-air supplying device; 17-spraying device; 18-temperature controller; 19-photosynthesis active radiation lamps; 20-air quality controller;

Figure 1: Set up for internet of things (IoT) based automated poly house

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The earlier existing technologies either do not have all the parameter reading sensors integrated at one place or are of very high cost. This technology would help our country to automate the farming systems and also collect large amount of data for the future farming.

Solution concept

The system aims to collect various kinds of farming data such as soil pH, Electrical conductivity of soil, Soil moisture, Light Intensity, Air Quality, Relative Humidity and Temperature. All the above-mentioned variables or parameters will be recorded approximately every minute and would be displayed on a LCD screen for offline real time readings as well as be recorded on the cloud server every minute, which can be accessed, viewed and downloaded in an Excel sheet automatically and also can be seen from any place in the world.

Along with the data, the farming will be automated and automatic irrigation according to the real time moisture content and electrical conductivity levels, can be performed. The varying real time pH of soil will be recorded automatically and can be used to apply treatments to the soil according to the acidity or basicity levels. The real time light sensor will be used to automatically control the Photosynthesis active radiation (PAR) lamps for such specific plants, according to the natural light availability. Also, the effect of real time air quality, relative humidity and temperature can be observed very easily for providing further possible treatments on the farm.

Figure 2: A view of the automated poly house

Advantages of the developed system

1. The system would be beneficial for the farmers for real time monitoring of data, for automating their farming system as well as would collect valuable data for the researchers and the government system for various future prospects such as AI, farming system monitoring, data bank, etc.

2. The cloud server has free storage for reasonably good amount of data and records date, time and location corresponding to each of the sensor data's recorded, automatically.

3. The sensors and other components used are accurate, very cheap and is readily available, which can be integrated in a small shoe box size.

4. All the 6 sensors such as pH sensor, EC sensor, soil moisture sensor, light intensity sensor, air

quality sensor and RH&T sensor, all are installed and mounted on the same microcontroller.

5. The setup can be prepared for plug and play type and therefore no special skills are required.

6. The system is flexible to add or remove the sensors as per our requirement and therefore the same system can be used to add more sensors, by making very minor changes in the system.

7. The cost in prototyping is estimated around 15,000 Rs INR and can be replicated very easily, so no delay to reach and is economic to the users or farmers.

8. The system can be used in rural areas as it uses 2G internet data bandwidth only.

9. Running charges for the system is limited to a 2G internet data plan and very low electricity consumption for the developed circuit, uses less than 10 V DC and a few mA of current, only.

10. The system can be powered through either DC/AC/Solar panel/Mini inverters, therefore provides flexibility of power supply.

11. Installation of the system and replication takes very less time and resources, therefore has a potential of industrial manufacturing.

12. The developed system can be replicated by any person, who has a sound knowledge of computer programming, basic physics and electronics.

Way Forward

1. The developed system has great manufacturing and industrial potential round the globe.

2. The huge soil and environmental parameters data bank has many advantages and is required for the artificial intelligence (AI) data bank, future crop predictions, etc along with the automated farming benefits.

3. The developed system can also be used by the researchers for recording different types of data automatically in their experiments, thus saving their time and energy, which can be diverted for improved research works.

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Proposed layout, design and benefit-cost ratio of a small-scale mushroom production unit

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Mushroom is a fleshy spore bearing fruiting fungus that are edible after proper cooking. The main component of mushroom is stem (stipe), cap (pileus), and gills (lamellae, sing. lamella). Mushroom is a ideal source of healthy protein. It is rich in vitamins like niacin, pantothenic acid, riboflavin, copper and selenium. At the beginning of 21st century common people of India were not much aware of the health benefits of mushroom. There were also myths all around regarding long term fatal effect of mushroom. But with increase in emphasis on 'Digital India' and wide spread of internet availability, people are getting correct information about mushroom. In India mushroom has gained a huge importance in terms of popularity. Public demand is increasing enormously. With that is also increasing the need to set up mushroom production unit. There are ample materials available in internet related to production technology of mushroom. But there is a scanty availability of proposed layout, design and benefit-cost ratio of a small-scale mushroom production unit. This short article will emphasis on these points in brief manner.

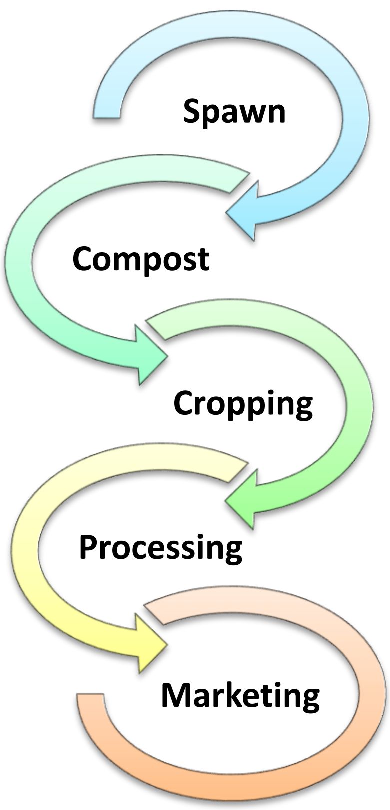

Fig. 1: Five basic steps in cultivation of white button mushroom

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Represented below in fig. 2 is the layout and dimension of a small scale mushroom production unit. Since it is in small scale, hence only the basic requirement room without which the production is not possible is only kept. This includes spawning room, pasteurization room and store room. The mushroom production room in case of small scale production is 20 feet x 16 feet.

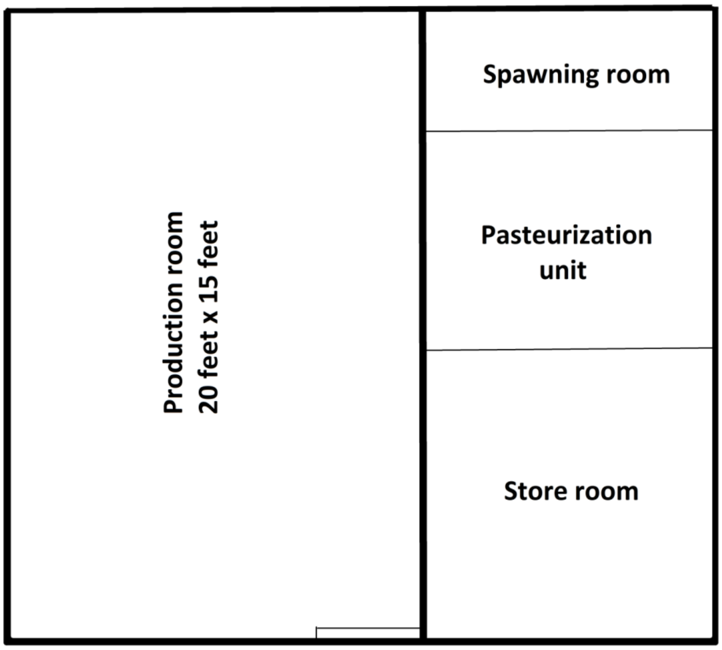

Fig. 2: Building layout of small mushroom production unit

Fig. 3 represents the dimension of mushroom production unit. Each unit is of dimension of 4 feet to 4 feet. Total 12 units can be accomodated in the production room. The gap between 2 units sidewise is kept 1 feet.

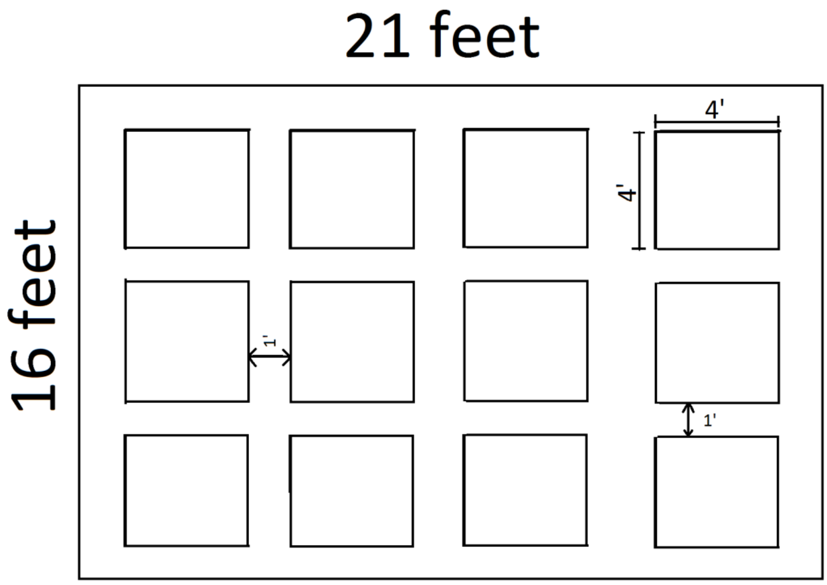

Fig. 3: Layout and Dimension of mushroom production unit

Table 1 showcases the benefit-cost ratio of a small-scale mushroom production unit. Building foundation, air conditioner, racks are a onetime investment. This cost is high for year 1 but for 2nd year onwards, the infrastructure cost is lower. After considering a production of 2000 kg mushroom every year and sale at a rate of Rs. 100 per kg, the total profit for 1st year and 2nd year is Rs 85000 and Rs. 152000 respectively.

Table 1: Estimated benefit-cost ratio of a small-scale mushroom production unit

Material	Cost
Cost of infrastructure (year one):	
Building foundation	Rs 30000
2 AC	Rs 40000
Racks	Rs 15000
Cost of infrastructure (year two):	Rs 8000
Cost of input for 1st year	**Rs 30000**
• Spawn	2000
• Water	2000
• Straw	3000
• Electricity & Labour	23000
Cost of input for 2nd year	**Rs 40000** (considering inflation, electric cost & increase in salary of labours)
• Spawn	3000
• Water	3000
• Straw	4000
• Electricity & Labour	30000
Mushroom Production per year = 2000 kg	
Expected Sale @ Rs 100/kg	2000*100 = Rs 200000
Benefit (1st year)	= Rs [200000 - (30000+40000+15000+30000)] = Rs 200000 – 115000 = Rs. 85000
Benefit (2nd year)	= Rs [200000 – (8000+40000] = Rs. 200000 – 48000 = Rs 152000

CONCLUSION: Benefit (1st year) and Benefit (2nd year) are Rs. 85000 and Rs 152000 respectively. The benefit cost ration for year one and year two is 200:115 and 200:48 respectively.

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A study on women empowerment through self-help groups in Anantapur district of Andhra Pradesh

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SUMMARY

Self Help Groups helps the women in uplifting their living conditions and also encompass the social, economic, educational level to improve their empowerment level. Women participation in Self Help Groups have obviously created tremendous impact upon the life pattern and style of poor women and have empowered them at various levels not only as individuals but also as members of the family members of the community and the society as whole. They come together for the purpose of solving their common problems through self-help and mutual help. The more attractive scheme with less effort is Self Help Group (SHGs). It is a tool to remove poverty and improve the women entrepreneurship and financial support in India. The present paper confines itself to study of Women Empowerment through the Self-Help Groups in Anantapur district of Andhra Pradesh. At present there are 18909 SHG functioning in total of Anantapur district. The main objective of this paper is to assess the benefits and socio-economic empowerment gained by rural women in Anantapur district. Based on the analysis of women empowerment through self help groups in Anantapur district, the major findings of this study reveals that there is a positive impact of Self-Help Groups on Women empowerment in Anantapur district of Andhra Pradesh.

INTRODUCTION:

Empowerment may be described as a process which helps people to assert their control over the factors which affect their lives. Empowerment of women means developing them as more aware individuals, who are politically active, economically productive and independent and are able to make intelligent discussion in matters that affect them(KOKO,1992). Women empowerment as a concept was introduced at the International women Conference in 1985 at Nairobi, which defined it as redistribution of social power and control of resources in favour of women (Panucha and Khatik 2005). Women's empowerment in India is heavily dependent on many different variables that include geographical location (urban/rural), educational status, social status (caste and class), and age. Policies on women's empowerment exist at the national, state, and local (Panchayat) levels in many sectors, including health, education, economic opportunities, gender-based violence, and political participation. However, there are significant gaps between policy advancements and actual practice at the community level. Empowerment for women in India requires a crosscutting approach and one which addresses the diversity of social structures that govern women's lives. Women's security, decision-making power, and mobility are three indicators for women's empowerment. In India, and more so for rural and less educated women, these three indicators are significantly low.

Data from the NFHS-3 survey on women's decision-making power shows that only about one third of the women interviewed took decisions on their own regarding household issues and their health. Decision-making power among employed urban women was higher than among rural and less educated women. The survey also found that older married women had more decision-making power than the younger married women. Younger women and girls experience an additional layer of discrimination as a result of their age. Many efforts were made by government for empowerment of women. One initiative which gained popularity is of Self help groups.

SELF HELP GROUPS:

SHGs are novel and innovative organizational setup in India for the women upliftment and welfare. All women in India are given chance to join any one of SHGs for training and development, so as to be prospective entrepreneur and skilled worker. The SHGs are promoted by the Government as if women in India may not be resourceful enough to be entrepreneurs. When the SHGs arrange training facilities to carry out certain kind of work which are suitable for women in India, bank must arrange financial assistance to carry out manufacturing and trading activities, arranging marketing facilities while the Governments will procure the product of SHGs, arrange for enhancing the capacity of women in terms of leadership quality and arranging for the management of SHGs by themselves so as to have administrative capacity. As a social movement with government support. SHGs become more or less a part and parcel of the society. SHGs Comprises very poor people who do not have access to formal financial institutions. It enables its members to learn to cooperate and work in a group environment. Today, in India, Self Help Groups (SHGs) represent a unique approach to financial intermediation. This combines access to low-cost financial services with a process of self management and development for the women who are SHG members. SHGs are formed and supported usually by Non- Governmental Organizations by Government agencies. SHG are seen to confer many benefits, both economic and social. SHGs are enable women to grow their savings and access the credit which banks are increasingly willing to lend. SHGs can also be community platform from which women become active in village affairs, stand for local election to take action to address social. In India before introduce this scheme for rural women were largely negligible. But in recent years the most significant emerging system called Self Help Group is a major breakthrough in improving lives of womenfolk and alleviating rural poverty.

Women participation in Self Help Groups have obviously created tremendous impact upon the life pattern and style of poor women and have empowered them at various levels not only as individuals but also as members of the family members of the community and the society as whole. They come together for the purpose of solving their common problems through self-help and mutual help. The more attractive scheme with less effort is Self Help Group (SHGs The empowerment of women through SHGs would lead to benefits not only to the families and community as a whole through the collective action for development in general, and women groups in particular. The main objective of this paper is to analyze the economic gains and social benefits derived by the members after joining the SHGs.

METHODOLOGY:

The present study was conducted in Anantapur district of Andhra pradesh. At present there are 18909 SHG functioning in total of Anantapur district. Five municipalities were purposively selected from total 12 municipalities based on highest number of SHG present viz. Anantapur (3839), Hindupur (2441), Guntakal (2353), Dharmavaram (2278) and Tadipatri (1616) respectively. Two villages with highest number of functioning SHG from each municipality were selected. From each selected village 20 members of SHG were selected as sample for study thus comprising total of 200 units in the sample.

RESULTS

1. Age:

Sl. No	Age	No of Members	Percentage
1	18-30	20	10
2	31-40	105	**52.5**
3	41-50	60	30
4	Above 50 years	15	7.5
Total		**200**	**100**

2. Education:

Sl. No	Literacy Level	No of Members	Percentage
1	Illiterate	37	18.50
2	Primary education	95	**47.50**
3	Secondary level	35	17.50
4	Intermediate	20	10.00
5	Graduation	13	06.50
Total		**200**	**100**

3. Family type:

Sl. No	Type of Family	No of Members	Percentage
1	Joint Family	38	22
2	Nuclear Family	162	**80**
Total		200	100

4. Reason for joining SHG:

Sl. No	Reason	No of Members	Percentage
1	Family support	48	**24.00**
2	To start business	18	9.00
3	To promote savings	21	10.50
4	To get credit	32	16.00
5	To meet household expenses	35	17.50
6	Financial support	20	10.00
7	Compulsion from other members	16	08.00
8	For other reasons	10	05.00
Total		**200**	**100**

5. Income level:

S.No	Monthly income	Before joining		After joining	
		Frequency	Percentage	Frequency	percentage
1	<1500	125	62.5	7	3.5
2	1501-3000	28	14	20	10
3	3001-5000	19	9.5	45	22.5
4	5001-7000	8	4	110	55
5	7001-9000	2	1	16	8
6	>9000	0	0	2	1
7	Non earning	18	9	0	0
	Total	200		200	

6. Repayment schedule:

S. No	Repayment Schedule	Frequency	Percentage
1	In Advance	16	8
2	On Time	152	76
3	Late	32	16
Total		200	100

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7. Type of Economic Activity:

S.No	Type of Economic Activity	Frequency	Percentage
1	Sheep/Goat nurture	22	11
2	Milk Animals	64	32
3	Agriculture investment	32	16
4	Fruits/Flower/Vegetables retailing	18	9
5	Weaving	5	2.5
6	Tailoring	16	8
7	Petty Shop	8	4
8	Tea Shop	15	7.5
9	Hotel/Tiffin Centre	8	4
10	Other activity	12	6
Total		200	100

8. Social changes:

S.No	*Items*	*Frequency*	*%*	*Rank*
1	Increase in the enrollment in schools	175	87.5	1
2	Decrease in the rate of migration	180	90	2
3	Improved sanitation and health	135	67.5	3
4	Increase in literacy rate	123	61.5	4
5	Increase in leadership qualities	110	55	6
6	Increase in the visiting general hospitals and veterinary hospitals	115	57.5	7

9. Political empowerment:

S.No.	Items	Before joining	%	After joining	%
1	Membership in political parties	48	24	135	67.5
2	Voting in state legislative election and local bodies	132	66	170	85
3	Contesting in the village *panchayat* election, ZPTC etc.,	28	14	60	30
4	Participation in *grama sabhas*	80	40	120	60
5	Participation in entrepreneurship programmes	45	22.5	70	35
6	Involvement decision making in family	34	17	132	66
7	Participation in awareness programmes like AIDS, sanitation etc.	72	36	160	80
8	Interaction with government officials(*mandal* and district level)	28	14	85	42.5
9	Saving–opening of bank account	95	47.5	185	92.5
10	Ownership of radio, television etc.,	130	65	189	94.5
11	Readers of newspapers	95	47.5	162	81

CONCLUSION:

A bird's eye view of the above tables revealed that majority (52.5%) of SHG members are of age group 31-40years, nearly half (47.50%) of respondents had primary education, (80.00%) belong to nuclear family ,(24.00%) of SHG members reported family support as main reason for joining to SHG. The income levels have been changed after joining to SHG, there exists political and social empowerment after joining to SHG. Government authorities and NGOs need to take substantially more enthusiasm for persuading and sorting out poor people and SHGs particularly among more fragile areas of the general public. Increasingly more essential SHGs must be unified and town associations must be shaped. This helps the administration in the executives of the SHGs and usage of the neediness easing programs in a successful way in the locale. Based on the above recommendations, it very well may be said that the administration, NGOs, electronic and print media need to give for advancing neediness easing through smaller scale money and SHGs and should release their social obligation.

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Access and usage of ICT's for agriculture and rural development – A critical analysis

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SUMMARY

ICT in agriculture is a promising field focusing on the enrichment of agricultural and rural development in India. It involves appliance of novel ways to use ICT in the rural domain. ICT is capable of providing accurate technical knowhow necessary for the farmers which facilitates better agricultural output. Though farmers still follow traditional approaches in agriculture, they have numerous challenges in terms of production, marketing, profit etc. which are being addressed significantly by using Information and Communication Technologies. It also helps in empowering the rural people by providing better access to natural resources, improved agricultural technologies, effective production strategies, markets, banking and financial services etc. A study was undertaken to identify the access and usage of ICTs among farmers of Prakasam district of Andhra pradesh. A total of 160 farmers were randomly chosen for the study during November 2019 to January 2020. The results showed that majority of the farmers owned mobile phones as well as television. The most frequently used ICT was mobile phone. Farmers also reported that mobile phones were widely used by the farmers for many purposes and few among them were social communication, contacting middle men for the marketing of produce and contacting experts on real time basis for getting agricultural advisories. Information services on availability of inputs, quality of inputs, and pest and disease management of crops were also used by the farmers through ICTs. Major problems in the use of ICTs by the farmers were lack of confidence in operating ICTs, erratic power supply, low network connectivity and lack of awareness of the benefits of ICTs. Many of farmer's suggested proper training and education to be given for effective utilisation of ICT's.

INTRODUCTION:

The desire to promote better information access to improve the socio-economic condition of the farmers has always been the top priority of agricultural extensionists and rural advisory service providers. According to FAO (2011), exchanging information is critical for the stakeholders in agriculture value chain in order to reduce the asymmetries in information and communication as well as to reduce the vicious circle of poverty. However, one component which can boost agricultural production is the contribution of information and knowledge. Since agricultural extension depends to a large extent on information exchange on the one hand and a broad range of other actors on the other (Mabe and Oladele, 2012), ICTs therefore can be used as a medium in bridging the information gap. There is also a growing recognition of farmers and members of rural communities realising the importance of knowledge, information and appropriate learning methods (Greenridge 2003, Lightfoot 2003) in order to move towards development. Therefore, in order to benefit the rural people, extensionists are grappling with the question of how to harness ICTs to improve rural livelihoods in order to contribute towards better information exchange and access. In this regard, extension practitioners are also interested in experimenting with innovative e-extension initiatives (Saravanan, 2010).

With regard to agriculture and rural development occupying an important place in the economy of Andhra Pradesh. The researcher has attempted to study the level of accessibility, availability, usage of ICTs and also the problems faced by the farmers in accessing ICTs. In fact, there is a need to realize that in order to reach the farming and rural development community in an efficient manner, it is important to study the type of communication media and ICTs owned and accessed by the farmers, their frequency of usage as well as the degree of usefulness of various ICTs as knowledge of the use of different ICTs will be helpful in drawing a suitable extension strategy as well as to provide improved ICT extension services to uplift the socio-economic status of the farmers and the rural people.

METHODOLOGY

A study was undertaken to identify the access and usage of ICTs among farmers of Prakasam district of Andhra pradesh. A total of 4 mandals namely Kandukur, Gudluru, Singarayakonda and Ulavapadu were selected for study. A total of 160 farmers were randomly chosen from 4 selected mandals. The study was conducted during November 2019 to January 2020.

RESULTS

1. Accessibility and availability (n=160)

S.no	Category	Availability		Accessibility	
		Frequency	Percentage	Frequency	Percentage
1	Mobile	160	**100.00**	160	**100.00**
2	Television	126	**78.75**	126	78.75
3	F.M Radio	82	**51.25**	82	51.25
4	Radio	60	37.50	60	37.50
5	KCC	145	**90.63**	120	75.00
6	ATM	142	**88.75**	72	45.00
7	Internet	92	**57.50**	72	45.00
8	Facebook	71	**44.38**	62	38.75
9	Camera	22	13.75	22	13.75
10	e-Mail	38	23.75	38	23.75
11	Computer	6	3.75	6	3.75
12	Whatsapp	110	**68.75**	86	53.75
13	CD/DVD	8	5.00	4	2.50
14	Youtube	45	28.13	45	28.13

2. Frequency of usage (n=160)

S.no	Category	Frequency of usage					
		Always		Some time		Never	
		F	%	F	%	F	%
1	Mobile	**145.00**	**90.63**	15.00	9.38	0.00	0.00
2	Television	**142.00**	**88.75**	18.00	11.25	0.00	0.00
3	F.M Radio	32.00	20.00	43.00	26.88	85.00	53.13
4	Radio	23.00	14.38	36.00	22.50	101.00	63.13
5	KCC	**111.00**	**69.38**	26.00	16.25	23.00	14.38
6	ATM	12.00	7.50	103.00	64.38	45.00	28.13
7	Internet	52.00	32.50	75.00	46.88	33.00	20.63
8	Facebook	32.00	20.00	85.00	53.13	43.00	26.88
9	Camera	10.00	6.25	12.00	7.50	138.00	86.25
10	e-Mail	12.00	7.50	26.00	16.25	122.00	76.25
11	Computer	2.00	1.25	4.00	2.50	154.00	96.25
12	Whatsapp	32.00	20.00	43.00	26.88	85.00	53.13
13	CD/DVD	3.00	1.88	5.00	3.13	152.00	95.00
14	Youtube	38.00	23.75	25.00	15.63	97.00	60.63

3. Purpose of usage: (n=160)

S.No	Purpose of usage	Frequency	Percentage
1	Availability of inputs	145	90.63
2	Quality of inputs	123	76.88
3	Market price of inputs and comparison	112	70.00
4	Marketing of produce	93	58.13
5	Pest and disease management of cultivated crops	83	51.88
6	Allied sectors information	72	45.00
7	Growing high value crops	62	38.75
8	Post harvest management of different crops	52	32.50
9	Knowledge on Water harvesting techniques	43	26.88
10	Knowledge on different Govt Schemes	41	25.63

4. Constraints in the use of ICTs among farmers: (n=160)

Sl. No	Item	Mean score	Rank
1.	Lack of confidence in operating ICTs	62.66	I
2.	Erratic power supply	59.03	II
3.	Low Network connectivity	57.63	III
4.	Lack of awareness of benefits of ICTs	56.22	IV
5.	Lack of skill in handling ICTs	54.12	V
6.	Low ICT literacy	49.18	VI
7.	Lack of repairing facilities and centres in villages	47.36	VII
8.	Negative attitude towards ICTs	46.07	VIII
9.	Poor Finance	38.99	IX
10.	Lack of training and practical exposure towards ICTs	37.35	X
11.	High cost of repairing ICTs	32.75	XI
12.	Insufficient regional specific language	31.69	XII

CONCLUSION:

The results of the study revealed that the level of availability and accessibility of ICTs was the highest for mobile phones followed by television, KCC, ATM, What's app respectively. The Frequency of usage is highest in KCC, Mobile and Television. The reason mobile phones was highly accessed and most frequently used by majority of the respondents is that it is easily affordable and could be easily used by even illiterate farmers. The areas where ICTs are widely used in agriculture is information services on availability of inputs, quality of inputs, contacting middlemen for marketing of produce, pest and disease management of ginger, pest and disease management of cole crops, pest and disease management of potato and market price of inputs. However, the study has found that lack of confidence in operating ICTs, erratic power supply, low network connectivity, lack of awareness of benefits of ICTs, lack of skill in handling ICTs, low ICT literacy, lack of repairing facilities, attitudinal barriers towards ICTs, poor finance, lack of training and practical exposure, high cost of repairing ICTs and insufficient regional language were the major constraints faced by the farmers in the effective use of ICTs.

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HERBICIDE RESIDUE MANAGEMENT

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The herbicide demand in India is rising sharply and could double in the next three years as an acute labour shortage makes them a cheaper option to farmers to grow crops with extra care. Usage of herbicides occupy 44 % of the total agrochemicals globally and 30 % in India. As herbicides are chemical in nature and excessive and repeated use may pose residue problems, phytotoxicity to crop plants, residual effect on susceptible inter-crops and health hazards due to accumulation of herbicide residues in the soil, crop produce and ground water. As soon as an herbicide is applied, a number of processes immediately begin to remove the compound from the original site of application. IWM involves the application of a variety of management practices to control weeds. Nonchemical weed control methods, such as crop rotation, cultivation, and competitive hybrids, rotary hoeing and altered planting dates, are can reduce the need for herbicides.

INTRODUCTION

The herbicide demand in India is rising sharply and could double in the next three years as an acute labour shortage makes them a cheaper option to farmers to grow crops with extra care. Usage of herbicides occupy 44 % of the total agrochemicals globally and 30 % in India. As herbicides are chemical in nature and excessive and repeated use may pose residue problems, phytotoxicity to crop plants, residual effect on susceptible inter-crops and health hazards due to accumulation of herbicide residues in the soil, crop produce and ground water. Herbicide application is more common in wheat crop (44%), followed by rice (31%), plantation crop (10%), soybean (4%), and other crops (11%). Residue is defined as "any substance or mixture of substances in food for man or animals resulting from the use of a pesticide and includes any specified derivatives, such as degradation and conversion products, metabolites, reaction products, and impurities that are considered to be of toxicological significance" are defined as herbicide/ pesticide residues (WHO). There is a need to monitor herbicide residues in various commodities to assess build up, bioma-gnifications and bioaccumulation of residues and adverse effects if any.

Fate and persistence of herbicide: As soon as an herbicide is applied, a number of processes immediately begin to remove the compound from the original site of application. 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 and the quantity that exists is referred to as residue. Herbicides persistence in the soil is expressed as half-life or time required to degrade fifty percent of the original molecule. Herbicides vary in their potential to persist in soil. Herbicide families

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which have high persistent in soil are triazines, uracils, phenylureas, sulfonylureas, dinitroanilines, isoxazolidinones, imidazolinones.

Management of herbicide residues in soil

1. Cultural and mechanical management practices

A. Integrated weed management: IWM involves the application of a variety of management practices to control weeds. Nonchemical weed control methods, such as crop rotation, cultivation, and competitive hybrids, rotary hoeing and altered planting dates, are can reduce the need for herbicides.

B. Ploughing or cultivating the land: Tillage operations help in bringing deep present herbicide residues to soil surface which would aid in decontamination by volatilization. Ploughing with disc plough or intercultivators reduce the applied herbicide is mixed to a large volume of soil and get diluted.

C. Incorporation of herbicides: Mechanical incorporation of herbicide by placing it below the mixing zone (eg, atrazine) helps to reduce runoff loss. Application of pre-emergent herbicides are incorporating them into the seed bed during the sowing process will often increase safety to crops because the sowing operation removes a certain amount of herbicide away from the seed row

D. Growing herbicide tolerant crops: Certain herbicide tolerant crops can reduce herbicide residues in a soil by absorbing and deactivating these in their tissues. Maize and millets, are very good consumers of triazine herbicides.

E. Light irrigation after application: Continuous moist soils often result in a more rapid breakdown of herbicides due to creation of favourable conditions for microbial activity. While controlled irrigations enhance all modes of deactivation, heavy irrigations leach herbicides out of the root zone of the crop.

F. Site specific application using variable rate applicator: The combination of automatic tractor steering and variable rate technology is well suited for site-specific application of pre-emergence herbicides can increase the efficiency of chemical application by applying optimum rates based on soil texture

2. Enhancing the herbicide degradation

A. Biostimulation: The concept of biostimulation i.e. enhancing the intrinsic degradation potential of a polluted matrix via the addition of amendments, nutrients, or other limiting factors has been used for a wide variety of xenobiotics. Organic amendments acts in two ways. Primarily, the application of FYM adsorbs the herbicide molecules in their colloidal fraction and makes them unavailable for crops, microbial population thriving on organic matter starts decomposing the herbicide residues at a faster rate due to high moisture holding capacity of organic matter in soils.

B. Bioaugmentation: The process of bioaugmentation is the introduction of specific microorganisms (indigenous or non-indigenous) aiming to enhance the biodegradation of target compound or serving as donors of the catabolic genes. *Rhizopus oryzea* is a potential fungal isolate and used for the bioremediation of alachlor from soil.

3. Reducing the availability of herbicides in soil

A. Use of optimum and reduced dose of herbicide: Hence, the hazards of herbicide residues can be minimized by the application of chemicals at optimum dosage by which the desired weed control is achieved. The indiscriminate use of herbicides leaves behind residues in food and produce.

B. Use of herbicides in combination and split doses: The use of herbicides in combinations can reduce the rates of application of highly persistence molecules in soil and in turn reduced their concentration.

C. Alternative use of herbicides: Avoid repeated use of herbicides with similar modes of action to reduce the potential development of herbicide resistance.

D. Phytoremediation: The in-situ use of vegetation in bioremediation schemes is termed as phytoremediation which is an emerging technology for the cleanup of contaminated environments such as soil, water and sediments. Poplar trees seemed to be effective in the rapid assimilation of atrazine.

Herbicides have been identified as an indispensable part of the crop production programme. However, to sustain the soil environment, the indiscriminate use of them should be avoided. Hence, integrating the mechanical and cultural management practices with herbicides for managing weeds is a viable option. The combination of bioaugmentation and biostimulation along with organic matter addition might be a promising technology to accelerate the biodegradation.

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SMALL SCALE MILKY MUSHROOM CULTIVATION AND ITS ECONOMICS

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Milky mushroom (*Calocybe indica*) like paddy straw mushroom is suitable for cultivation in tropical and subtropical regions of the country. This variety is new introduction to world mushroom family from India. During last decade it has become a major variety for cultivation in South India and during last 2-3 years its cultivation has become popular in North as well, particularly in Haryana. Most of the individuals don't have an idea about cultivation of mushrooms and economics even though they have interest to cultivation of mushrooms. Mlky mushroom cultivation is more suitable for south India where environmental conditions are more congenial for production. Its high biological efficiency, better keeping quality, simple cultivation technique and white attractive colour are major factors for its popularity.

INTRODUCTION:

The global food and nutritional security of growing population is a great challenge, which looks for new crop as source of food and nutrition. In this context, mushrooms find a favour which can be grown even by landless people, that too on waste material and could be a source for proteineous food. Use of mushrooms as food and neutraceutical have been known since time immemorial, as is evident from the description in old epics Vedas and Bible. Earlier civilizations had also valued mushrooms for delicacy and therapeutic value. In the present time, it is well recognized that mushroom is not only rich in protein, but also contains vitamins and minerals, whereas, it lacks cholesterol and has low calories. Furthermore, it also has high medicinal attributes like immunomodulating, antiviral, antitumour, antioxidants and hepatoprotective properties.

Steps in milky mushroom cultivation:

1. **Substrate and its preparation:**

The mushroom can be grown on a wide range of substrates. Substrates exposed to rain or harvested prematurely (green colour) are prone to various weed moulds, which may result in crop failure. It can be grown on straw of paddy/wheat/ragi/maize/bajra, cotton stalks and leaves, sugarcane bagasse, cotton and jute wastes, dehulled maize cobs, tea/coffee waste, etc., However, cereal straw (paddy/wheat), which are easily available in abundance are favoured.

Straw is chopped in small pieces (2-4 cm size) and soaked in fresh water for 8-16 hours. This period can be reduced when pasteurization is to be done by steam. Main purpose of soaking is to saturate the substrate with water. It is easier to soak if straw is first filled in gunny bag and dipped in water.

2. Pasteurization/sterilization:

Pasteurization/sterilization can be achieved by hot water treatment. Water is boiled in wide mouth container and chopped wet straw filled in gunny bag is submersed in hot water for 40 minutes at 80-90°C to achieve pasteurization. This is very popular method particularly with small growers.

3. Spawning and spawn running:

Spawning methods are similar to that mentioned for oyster mushroom. However, layer spawning is most commonly used in milky mushroom. Higher spawn dose of 4-5% (wet wt. basis) is used. After spawning bags are shifted to spawn running room and kept in dark where temperature between 25-35°C with 80% RH is maintained. It takes about 20 days for substrate to get colonised and after that bags are ready for casing.

3. Casing:

Casing means covering the top surface of fully colonised bags, with pasteurized casing material. Pond soil/soil (75%) + sand (25%), Coir pith + soil, FYM + soil can be used as casing material. However, soil (75%) + sand (25%) is generally preferred as casing material. Casing thickness is between 3-4 cm. Casing provides physical support, moisture and allows gases to escape from the substrate. Casing material, pH adjusted to 7.8-7.9 with chalk powder, is sterilized in autoclave at 15 p.s.i. for one hour or chemically treated with formaldehyde solution (2%) about a week in advance of casing. Treated casing is covered with polythene sheet to facilitate the action of formaldehyde and also to avoid its escape in the atmosphere. Soil is turned at an interval of 2 days so that at the time of casing, it is free from formalin fumes. For casing, bag's top is made uniform by ruffling top surface and spraying with carbendazim (0.1%) + formaldehyde (0.5%) solution. Casing material is sprayed with above chemicals to saturation level. Temperature 30-35°C and RH 80-90% are maintained thereafter for entire cropping cycle.

4. Cropping:

It takes about 10 days for mycelium to reach to top of the casing layer, thereafter fresh air is introduced and minimum 3-4 air changes per hour are required. Light should be provided for maximum duration during entire cropping period. These changes in environment result in the initiation of fruiting bodies within 3-5 days. Mushrooms with 7- 8 cm dia. are harvested by twisting, cleaned and packed in perforated polythene/polypropylene bags for marketing.

5. Economics of milky mushroom production (50kg/day) :

The cost of production depends upon the cost of raw material, yield/unit, production level and the wholesale price. At present the wholesale price in different parts of the country is between Rs. 45-60/kg. The information given below is a model to workout cost of production for a medium size mushroom production unit keeping in view an average yield. One has

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to keep in mind the above factors while working out the cost of production.

Table 1: Annual Expenditure

Sl. No	Item	Quantity (kg)	Cost (approx.)
1.	Paddy straw	36500	54,750.00
2.	Spawn	4600	2,30,000.00
3.	Polythene bags for growing	500	38,500.00
4.	PP bags for packing	500	38,500.00
5.	Casing material	--	10,000.00
6.	Thread ball	--	2,000.00
7.	Formaldehyde	50 litres	3,750.00
8.	Bavistin	2.5kg	2,000.00
9.	Melathion/Nuvan	2 litres	1,600.00
10.	Bleaching powder	50kg	1,000.00
11.	Labour (Rs.3,000/-month) (12 months)	3 Nos.	1,08,000.00
12.	Water		2,400.00
13.	Electricity		3,400.00
14.	Transport		10,000.00
15.	Rent of building/Shed		12,000.00
16.	Miscellaneous expenditure		12,000.00
	Total		**5,29,900.00**

Table 2: Annual fresh mushroom production (kg)

1.	Fresh mushroom produced	**36,500**
2.	Self consumption	**180**
3.	Wastage	**360**
4.	Balance for sale	**35960**
5.	Realization @ Rs.45/kg	**Rs. 16, 18,200/-**
6.	Net annual profit = (Sale realization - Cost of production)	**Rs. 10,88,200/-**
7	Cost of production/kg	**Rs. 14.74/Kg**

CONCLUSION:

Milky mushrooms have a high biological efficiency, better keeping quality, simple cultivation technique and white attractive colour. Milky mushroom production being an indoor activity, labour intensive and high profit venture provides ample opportunities for gainful employment of small, farmers, landless labourers, women and unemployed youth. Therefore, promotion of milky mushroom cultivation shall a step to meet nutritional needs to reduce malnutrition and providing livelihood to landless poor.

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MANAGEMENT OF DISEASES IN MUSHROOMS CULTIVATION

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A number of harmful fungi are encountered in compost and casing soil during the cultivation of white button mushroom. Many of these act as competitor moulds adversely affect spawn run whereas others attack the fruit bodies at various stages of crop growth producing distinct disease symptoms. At times there is complete crop failure depending upon the stage of infection, quality of compost and environmental conditions. At any phase, an undesirable growth of certain mould may adversely affects the final mushroom yield. Most frequent moulds that generally attack the mushrooms cultivation are ink caps, green mould, yellow mould, pink mould, lipstick mould and olive green mould. Besides moulds some bacteria, viruses and nematodes also infect the mushrooms. Integrated approaches including biological, physical, botanical and chemical methods area best suggested for maintaining healthy production unit and management of diseases.

INTRODUCTION:

Initial inoculum load, density, the rate at which the disease develops/spreads and the time of infection determines the control measures to be applied. Major fungi that attack the mushroom cultivation are 1. False 2. Olive green mould 3. Brown plaster 4. Yellow mould 5. Sepedonium yellow 6. Ink caps 7. Cinnamon mould 8. Pink mould 9. Lipstick Mould 10. *Oedocephalum* 11. White plaster 12. Green mould 13. Cob web 14. Green blotch 15. Brown rot and 16. Sibirina rot. Besides fungi, bacteria, virus and nematodes also attack the mushrooms.

The following preventive and/or eradicative control measures are adopted for the management of diseases:

- Ecological - by manipulations of environmental factors such as temperature, humidity and ventilation.
- Biological - by incorporation of biocontrol agents and organic amendments
- Chemical - by use of safe and minimum doses of specific fungicides, antibiotic, etc

A close relationship exists between crop management practices and some endemic disease problems like dry bubble, brown blotch and truffle. Biological agents are being increasingly tried throughout the world but with a limited application on commercial scale. Sanitation and hygienic measures are most essential to manage the disease particularly under Indian conditions although under certain situations use of chemicals is inevitable.

MANAGEMENT PRACTICES:

1. **Sanitation and hygiene:**

Hygiene covers all the measures, which are necessary to minimize the possible incidence of the pests and pathogens. Thus, hygiene and sanitation go hand in hand at all stages of mushroom growing. Farm hygiene is the best defense for a mushroom grower against mushroom pests and diseases particularly during the present time, when use of chemicals on food crops is being discouraged.

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Based on the critical observations during all the stages of mushroom production, the following steps should be adopted as a routine practice for successful mushroom cultivation.

- The location of mushroom unit should be away from chemical industries and should be free from toxic fumes or gases
- Floor for the preparation of compost should be cemented/tiled and covered with a roof.
- Substrates used for compost preparation should be fresh, protected from rain and mixed in exact proportion.
- Pasteurization and conditioning of the compost should be for optimum duration at right temperatures as over/under pasteurization may produce poor quality compost and invite disease problems.
- Do not allow free access of persons working in composting yards to spawning and other cleaner areas without changing the dress and foot-dip.
- Spawn should be fresh and free from all contaminants. O Spawning area must be washed and disinfected with 2% formalin.
- The fresh air should be filtered before it enters the growing rooms to exclude all particles of 2 micron and above.
- Casing mixture should be properly sterilized (65°C for 5-6 hours).
- Casing mixture should be stored in a clean and disinfected place. All the containers, equipments and machinery used for casing should be thoroughly washed and disinfected.
- Picking should start from new or cleaner crop towards older crops.
- Waste from picking, trash, stems, unsaleable mushrooms should be carefully collected not allowing to fall on the floor and be disposed off carefully.
- Avoid surface condensation of water on developing mushrooms.
- Add bleaching powder (150ppm) at every watering to manage bacterial disease.
- Remove heavily infected bags from the cropping rooms or treat the patches by spot application of 2% formalin or 0.1% Bavistin.
- Maintain optimum environmental conditions in the cropping rooms to avoid abiotic disorders.
- Control insect-pests well in time to avoid the spread of pathogen by them.

2. Use of chemicals

Some of the most common fungicides recommended for the control of major fungal pathogens of mushrooms and used in mushroom industry are:

- Benomyl (Benlate 50 wp)- For control of Cladobotryum, Mycogone, Trichoderma, Verticillium, mix 240 g/100 m² with casing or dissolve in water at 240 g/200 litres/100 m² during first watering.
- Carbendazim (Bavistin) same as for benomyl.
- Chlorothalonil (Bravo or Repulse) - to control Mycogone and Verticillium. Apply as spray 2 week after casing and repeat after 2 weeks later @ 200 ml in 100-200 litre water/100 m2 .
- Prochloroz Manganese (Sporgon)- to control Mycogone, Verticillium, Cladobotryum, give a single application of 300g/100litres/100m², 7-9 days after casing. For double application, use 113g/100litres/100m², 7-9 days after casing and repeat again between second and third flushes. For triple application, use 57g/100litres/100m², 7-9 days after casing and after first and third flushes (presently sporogon is not available in India).
- Thiabendazole(Tecto)- to control Cladobotryum, Mycogone, Verticillium, Apply at the same rate as Benomyl.
- Zineb- to control Dactylium, Mycogone, Geotrichum and Verticillium, Use 350 g/ 100 m²

every week after casing. For wettable powder, 1 kg/1000 litres @ 5 litre/ 100 m² after casing and between flushes.

- At the end of crop, cook out at 70°C for 12 hours is very essential to eliminate all pests and pathogens.

CONCLUSION

As a general practice, cook out of compost, fumigation of cropping rooms after cropping with formaldehyde and spray with copper fungicides helps in removing primary inoculum. Similarly it may be appropriate to spray 0.5% formalin or 0.1% bavistin just after casing to check the primary inoculum. The chances of infection are much higher at these stages as there is lot of movement of air, materials and persons and all are potential carrier of diseases.

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INTERACTION OF ZINC - PHOSPHORUS IN SOILS

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Phosphorus and zinc are essential nutrients for plant growth. Unfortunately, these nutrients can act antagonistically with one another in certain circumstances. Yield reductions due to this interaction are caused by either phosphorus or zinc deficiencies. The deficiency of these nutrients becomes even more serious in alkaline calcareous dry soils. The oppositely charged ions of P and Zn exhibit an electrical attraction that facilitates the formation of chemical bonds in soil and plant tissues. The main causes for P-Zn are dilution effect, lower rate of translocation of Zn from the roots to tops, difference in the distribution of Zn between roots and tops as Zn is less mobile in plant. Physiological effects like phosphorus interference in the utilization of Zn by plant

INTRODUCTION

Phosphorus and zinc are essential nutrients for plant growth. Unfortunately, these nutrients can act antagonistically with one another in certain circumstances. Yield reductions due to this interaction are caused by either phosphorus or zinc deficiencies. Deficiencies typically occur when a nutrient is present in short supply. In this case, the nutrient is present in marginal to normal levels, but the antagonizing nutrient is present in such a large quantity that it forces a deficiency of the other. In other words, excessive phosphorus can cause zinc to become deficient in plant tissue. Similarly, excessive zinc can cause phosphorus deficiency, however, this phenomenon is very rare. The mechanism of this phosphorus-zinc interaction occurs primarily in the plant root, rather than in the soil, as many people suppose. Excessive concentrations of phosphorus in the plant root result in the binding of zinc within root cells. The zinc becomes part of the "fabric" of the root and, therefore, becomes unavailable for transport to leaves, where it is needed for normal plant growth.

Chemistry of phosphorus and zinc in soil and plant tissues

Zinc and Phosphorus are absorbed by plants as Zn^{2+}, di hydrogen phosphate ($H_2PO_4^{-1}$) or mono hydrogen phosphate (HPO_4^{-2}) respectively. These oppositely charged ions exhibit an electrical attraction that facilitates the formation of chemical

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bonds in soil and plant tissues. The relative strength of the P-Zn bond is robust and does not readily separate without dramatic changes in the physical or chemical environment. If excess soil or plant P binds Zn normally available to the plant, the result can be a P-induced Zn deficiency. Precipitates of Zn and P, such as zinc phosphate [Zn_3 $(PO_4)_2$] and zinc ammonium phosphate ($ZnNH_4PO_4$), formed in high pH soils (7.0-8.5) could partially explain reduced Zn uptake by plants grown in the presence of excess P. Another possible soil explanation is that high P may reduce mycorrhizal infection, which in turn could reduce Zn uptake and lead to P-induced Zn deficiency.

Causes of P-Zn interaction

1. Dilution effect observed when added P increases shoot growth while Zn uptake rate remains constant, thus resulting in reduced tissue Zn concentration occur when both soil P and Zn are low an increased physiological requirement for Zn or physiological inactivation of Zn observed at excess P levels. 2. as lower rate of translocation of Zn from the roots to tops. 3. Difference in the distribution of Zn between roots and tops as Zn is less mobile in plant. 4. Physiological effects like phosphorus interference in the utilization of Zn by plant. 5. Metabolism defect in plant cells that is related to zinc and phosphorus imbalance, so by increasing the phosphorus concentration, zinc is impaired at specific positions in the cells and 6. Precipitation of Zn by phosphorus in the veins and conductive tissues.

Loneragan and Webb distinguish two different types of zinc-phosphorus interactions:

Type 1. Increasing phosphorus applications decrease concentrations of zinc in the shoot. Where phosphate salts bring about a decrease in zinc concentrations and this usually occurs where the supply capacity of the soil for both zinc and phosphorus are marginal, so the addition of phosphatic fertilizer promotes growth sufficiently to cause the dilution of zinc concentrations in plant tissues to levels which induce or enhance zinc deficiency. Type 2. Those in which increasing phosphorus applications do not decrease zinc concentrations in the shoot. In other situations, in which zinc deficiency has been induced by phosphorus without the dilution of zinc concentrations in plant shoots.

There are four possible mechanisms by which phosphorus can reduce the absorption of zinc from soils:

i) Arbuscular mycorrhizae (AM) infection of roots is suppressed by high concentrations of phosphorus. ii) Cations added with phosphate salts can inhibit zinc absorption from solution. iii) H^+ ions

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generated by phosphate salts inhibit zinc absorption from solution. iv) Phosphorus enhances the adsorption of zinc onto soil constituents.

Inactivation of Zinc by High Phosphorus

Loneragan and Webb (1993) considered that there was evidence for the precipitation of zinc by high phosphorus in plants to be the primary mechanism responsible for the syndrome of zinc deficiency leading to the formation of phosphorus toxicity. At all levels of zinc supply, increasing the supply of phosphorus decreased the proportion of zinc extracted from the roots, stems and leaves from around 60% to nearly 30%. In cotton, increased phosphorus supply enhanced the symptoms of zinc deficiency in leaves but had no effect on their total zinc concentrations. Stanton & Burger (1970) proposed that phosphate was adsorbed and zinc formed links to the surface through adjacent phosphate molecules. There are two possible hypotheses about the proposed Zn-P complexes at the surface. In one it is assumed that the phosphate reacts first and Zn reacts to form the complex only at the surface, then the amount of the complex depends on the concentration of Zn ions in solution and not on the concentration of Zn-P complexes in solution. In this case, it would be assumed that the Zn-P complexes in solution would come to equilibrium with the surface complex.

Four distinct mechanisms may be suggested these are: One possible mechanism is change in pH. Adding phosphate may affect the pH in three different ways. First, the reaction itself may change the pH. Reaction with phosphate makes the reacting surfaces more negative. If, for example, the charge conveyed to the surface is less than the average charge on the ions in solution, electrical neutrality is maintained by the release of hydroxide ions. The pH therefore rises. Second, the phosphate fertilizers added, or the phosphate solutions reacting with the soil, may be acid in themselves and so decrease the pH. Third, in the field, phosphate may induce indirect changes in pH through stimulated plant growth and nitrogen fixation.

Phosphorus-enhanced zinc requirement: In situations where phosphorus induces the symptoms of zinc deficiency without bringing about a decrease in zinc concentrations, it is considered that the increasing phosphorus concentrations within the plant increase the plant's internal zinc requirement. The accumulation of high concentration of P at low levels of Zn is considered to be responsible for the "P-enhanced Zn requirement syndrome". In some crops such as potato, okra and cotton, low Zn

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combined with high P supplies induced P toxicity by enhancing phosphate uptake into the plant, causing phosphate to accumulate in the leaves by reducing the translocation of phosphorus out of the leaves. Thus, three distinct mechanisms involving P have been shown to decrease Zn concentrations in plant tops under conditions which could induce Zn deficiency in plants growing on soils. 1. Dilution of Zn in plant tissues by promotion of plant growth by P fertilizers 2. Inhibition of Zn absorption by the cations added with P fertilizers 3. P enhancement of Zn adsorption by oxides and hydroxides of Fe and Al in the soil resulting in decreased absorption of Zn by plant roots.

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VALUE ADDITION IN MUSHROOMS-A WAY TO PREVENT POST HARVEST LOSSES AND GREATER RENUMERATION

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The focus of Indian mushroom industry is predominantly on trade of the fresh produce rather than the real value-addition. Almost entire domestic trade is in the fresh form while most of the export is in the preserved form (canned or steeped). Current era is characterized by greater awareness about quality and, above all, with the demand for the readymade or ready-to-make food products. As mushrooms contain high moisture and are delicate in texture, these cannot be stored for more than 24 hours at the ambient conditions of the tropics. This leads to weight loss, veil opening, browning, liquefaction and microbial spoilage of the product making it unsaleable. Effective processing techniques will not only prevent the post harvest losses but also result in greater remuneration to the growers as well as to the processors.

INTRODUCTION

Mushrooms can be used in different forms in cooking. Whole of mushroom is used and there is no need to peel the mushroom - hence there is no wastage like other vegetables. Only the stem end needs to be cut to remove debries if any. They can be used as whole in few of the recipes like mushroom munchurian, cut into halves or quarters, can be sliced into thick or thin slices and can be used in soups and salads. Mushrooms can be coarsly or finally chopped for sandwiches, pakodas and koftas. In few of the recipes caps of the big sized mushrooms can be used such as stuffed mushrooms in which we can use different kinds of fillings to stuff mushrooms and bake them. Oyster and shiitake mushrooms can be minced in food processor for use in koftas or pakodas. Do not wash the mushrooms if you need to store them for one or two days, preferably keep them in a paper bag and store in a refrigerator.

Real value-added product in the Indian market is the mushroom soup powder. Technologies for production of some other products like mushroom based biscuits, nuggets, preserves, noodles, papad, candies and readymade mushroom curry in retort pouches have been developed but are yet to be popularized. Attractive packaging of the value-added products is yet another area, which may be called the secondary value-addition. While small growers may add value by grading and packaging, industry may go for the processed products for better returns as well as improvement in the demand, which shall have cascading positive effect on the production.

Value added products of the mushrooms:

1. **Mushroom Soup Powder**:

   Dried button mushroom slices or whole oyster mushrooms were finely ground in a pulveriser and passed through 0.5 mm sieve. Mushroom soup powder is prepared by mixing this powder with milk power and corn flour. This has to be mixed with equal quantity of water for the preparation of good quality mushroom soup with characteristic aroma and taste. The mushroom soup powder can also be made by using the vacuum concentrated whey, a byproduct of dairy industry.

Fig 1 Mushroom Soup Powder

2. **Mushroom Nuggets:**

'Nuggets' are generally prepared out of 'pulse' powder namely, black gram powder, soybean powder, urad dhal powder, etc., and used in the preparation of vegetable curry in North India. For preparation of mushroom nuggets, mushroom powder (dried and coarsely ground mushrooms) is mixed with the 'Urad' dhal powder and a paste is prepared by adding required quantity of water. Ingredients and spices are added to the prepared paste and round balls of 2-4 cm diameters are made out of the paste. The prepared balls are spread over a steel tray and dried by sun-drying method and thus the mushroom nuggets are prepared.

Fig 2: Mushroom Nuggets

3. **Mushroom Ketch-Up:**

Freshly harvested button mushrooms are washed, sliced and cooked in 50% of water for 20 minutes. Mushroom paste is prepared using a mixer grinder. Arrarote (0.2%), acetic acid (1.5%) mixed in the paste and cooked to bring its TSS to 350 Brix. Then the ketch-up is filled in the sterilized bottles or jars.

Fig 3: Mushroom Ketchup

4. **Mushroom Pickle:**

Mushrooms are washed, sliced and blanched for 5 min in 0.05% KMS solution. The blanched mushrooms are washed in cold water for 2-3 times and the excess water is drained off. Then the mushrooms are subjected to salt curing process, in which 10% sodium chloride is added and kept over night. The excess water oozed-out of mushrooms is removed on the next day and spices & preservatives are mixed to the desired taste and quality of mushroom pickle. The various spices namely turmeric powder, black mustard seed powder (rai), red chilly

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powder, cumin seed powder, fenugreek seed powder, aniseed powder (suwa/ shopa), black pepper, carom seed (ajwain), nigella seed (kalonji), fennel seed powder (saunf) and mustard oil are added to prepare tasty pickle. Acetic acid and sodium benzoate within the permitted limits are used as preservatives. This pickle can be stored upto one year in the lug bottles.

Fig 4: Mushroom pickle

5. **Mushroom Chips:**

The freshly harvested button mushrooms are washed, sliced (2 mm) and blanched in 2% brine solution. The mushrooms are dipped overnight in a solution of 0.1% of citric acid + 1.5% of NaCl + 0.3% of red chilly powder. After draining off the solution, the mushrooms are subjected to drying in a cabinet dryer at 600C for 8 h. Then it is fried in the refined oil and good quality chips are prepared. Garam masala and other spices can be spread over the chips to enhance the taste. After mixing the spices, the chips are packed in polypropylene packets and sealed after proper labelling.

Fig 5: Mushroom chips

6. **Mushroom Kofta:**

Grind mushrooms in a mixer, add gram flour, salt, chilly powder, garam masala and little water to make a thick paste. Make round koftas and deep fry the same on the medium heat. When golden brown, take out of the pan and drain extra oil. Heat oil in a pan, fry cumin seeds in it. Add onion, garlic and ginger paste and fry on low heat till golden brown. Add tomato puree and cook till the paste thickens and starts leaving oil. Add other ingredients, pour two glasses of water ,stir well and let it boil for 6- 7 minutes on high flame. Add koftas and boil 4-5 minutes on low heat. Garnish with coriander leaves. Serve hot with rice or chapati.

Fig 6: Mushroom Kofta

7. **Mushroom Pakoda**:

Place washed mushrooms in 1 litre of water and add salt (half spoon). Boil for 5 minutes and drain the mushrooms and let it dry for 10 minutes by spreading on a dry cloth. Cut mushrooms into pieces and squeeze properly so that no water remains in mushrooms. Add all ingredients and salt as per your taste in gram flour. Pour little water to make thick paste. Add mushrooms to it and mix well. Deep fry in hot oil on medium heat. Serve hot with pudina chutney.

8. **Mushroom Curry:**

Heat oil in a deep heavy based pan, put red chillies and fry until deep brown then add chopped onion, garlic and ginger. Cook for 3-4 minutes. Pour puree and fry until contents start leaving oil. Pour in curry powder and corn flour and cook for a minute adding salt, spices and desired water, bring to boil for 5 minutes. Add mushrooms and cook for another 5-6 minutes. Garnish with coriander leaves. Serve with steamed rice.

9. **Mushroom Dum Biryani:**

Wash mushrooms and cut into four pieces. Soak rice for ½ hour. Grind ginger and garlic in a mixer. Beat curd thoroughly, soak saffron in milk. Take a heavy based pan and boil 4 cups of water, add cassia, clove, cardamom, cinnamon, mace and one table spoon of salt and boil till the spices start leaving their colour and flavour. Add soaked rice, keep stirring and cook till the 3\4 part of rice is cooked. Drain extra water and keep aside. Heat oil in a non stick pan and add onion, fry till golden brown. Pour ginger , garlic and other spices and cook till it thickens to hard consistency. Add beaten curd, garam masala, coriander leaves, mint leaves and salt, cook for 2 minutes then add mushrooms and cook on high flame for 2-3 minutes till the mushrooms stop leaving water. Take an oven-proof dish, put boiled rice and mushroom masala into layers one by one adding coriander leaves and sprinkle saffron milk after every layer. Top layer should be of rice and sprinkle coriander leaves and saffron milk. Seal the dish with foil and put it in the pre-heated oven for 10 minutes at 700C temperature. Serve hot with pudina chutney and curd.

CONCLUSION

Value can be added to the mushrooms at various levels, right from grading to the readymade snacks or the main-course items. Current era is characterized by greater awareness about quality and, above all, with the demand for the readymade or ready-to-make food products. Mushrooms are more common in menu of parties and restaurants then in Indian household kitchens. A common man or a housewife is still hesitant to cook mushrooms due to less exposure about its cooking methods. Creative cooking with mushroom has a lot of potential in our kitchens. We need to spread this among the masses that mushrooms are not only tasty but have lot of nutritive and medicinal values. In few regions of the country, it is still associated with non-vegetarian food. To overcome with this myth we really need to popularize mushroom recipes and its cooking methods.

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VIRAL DISEASES MANAGEMENT IN CHILLI

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Increasing outbreak of viral diseases in chilli is a major problem in India as well as Andhra Pradesh due to combined effect of different factors such as increase in chilli area, abundant insect vector population, and environmental changes. More than 45 types of viruses have been identified to infect the chilli crop causing economic losses in terms of reduction in quality and quantity, sometimes 100%. The chilli mosaic virus, leaf curl, tomato spotted wilt, veinal mottle virus, cucumber mosaic virus and PV-Y are most important viral diseases which causes losses up to 40%. The major management option for viral infection in chilli is by integrated approach. Most importantly, cultivation of disease resistant varieties, eradication of infected plants, improved cultural practices and judicious use of insecticides especially when plants are young and easily colonized by vectors. In recent years, eco-friendly control measures are necessary and needful to reduce the occurrence of viral diseases in chilli.

INTRODUCTION:

Chilli (*Capsicum annum*) is one of the most important spice and vegetable crop growing in India and Andhra Pradesh. Viral diseases are most important among the diseases that infect the chilli, they cause tremendous yield losses. They cause diseases that not only reduce the yield and quality of fruits, but also increase the cost on pesticides (inputs) and cost of production of virus free planting material. In addition to this, high genetic variability of virus strains and their accumulation in propagation material leads to easy spread into uninfected areas.

More than 45 viruses have been identified to infect chilli causing reduction in quality and yield. The major viruses that infect chilli includes chilli leaf curl virus, cucumber mosaic virus, tomato mosaic virus, tomato spotted wilt virus, chilli veinal mottle virus, PV-Y, tobacco etch virus, tobacco mosaic virus and alfalfa mosaic virus.

The viruses are mainly transmitted by aphids, whitefly and thrips. However, mechanical transmission and seed transmission are efficient means of transmission of viruses. Current management option for viral diseases in chilli is the integration of different approaches. These include use of protected nurseries, cultivation of resistant varieties and ensure phytosanitary conditions after transplanting.

Generally, eco-friendly management of options are needful to reduce the viral diseases intensity in chilli and also decrease the spread of disease to affected area to un affected areas.

Major viral diseases and its management in chilli:

1. **Chilli leaf curl virus:**

Symptoms: General symptoms of chilli leaf curl virus includes severe stunting, flower bud abscission, reduced pollen production, curling of leaves, leaf chlorosis and elimination of fruit production. Yied losses may be between 90 and 100% in severe cases.

Management: The most widely used treatments include use of insecticides and other cultural methods to control vector population. Other methods to control the spread of virus include planting resistant or tolerant plants, crop rotation and border planting and plastic mulching.

2. **Cucumber mosaic virus:**

Symptoms: Generally, the virus have number of strains and all strains can infect the chilli but symptom expression is different. Type of symptom expression depends upon the age of the plant. Most important symptoms include mild mosaic, dull coloured leaves, mottling, shoe string, fern leaf, vein banding, vein clearing, leaf deformation, stunted growth and reduced fruit size. Virus can be transmitted by aphid, seed, mechanical and parasitic weeds.

Management: Removal of weeds, border crops with maize, use of certified seed material, disinfection of seed and tools, planting resistant varieties**.**

3. **Tomato mosaic virus:**

Symptoms: The virus natural mode of transmission is by contact with infected sap but it is also transmitted by mechanically during farm operations. Typica symptoms include severe stunting, chlorotic pattern, distorted leaves, premature defoliation and necrotic patches on leaves.

Management: Crop rotation, improved cultural practices, use of resistant cultivars, disinfetion of tools and implements, sterilization of seed with 10% TSP.

4. **Tomato spotted wilt virus:**

Symptoms: Transmitted by thrips. Symptoms include yellowing or browning of leaves, chlorotic or necrotic ring spots on leaves and fruits, necrotic streaks on stems with terminated shoots and fruits.

Management: Rouging of infected plants, intercropping with zinger, additional use of insecticides.

5. **Chilli Venial Mottle Virus:**

Symptoms: The winged aphids are generally the most efficient vectors to transmit the virus from field to field and symptoms include leaf mottle and dark green vein-banding.

Management: Timely disposal of infected seedlings, application of mineral oil-based insecticide, use of disease-free seedlings, use of resistant varieties and removal of solanaceous weeds.

6. **Potato Virus –Y (PV-Y):**

Symptoms: The virusis transmitted in a non-persistent manner through aphids. Also spread by grafting and unsterilized farming equipments. Symptoms include stunting, vein clearing, banding, leaf mosaic, small deformed fruit with a mosaic pattern.

Management: Use of resistant varieties, elimination of solanaceous weeds, rouging of infected plants, intercropping with maize.

7. **Tobacco Etch Virus:**

Symptoms: Transmitted by aphids in a non persistent manner. Symptoms include mosaic of leaves, vein banding, stunting, leaf curl and fruit distortion.

Management: Use of resistant varieties, removal of weeds and application of mineral oils.

8. **Tobacco Mosaic Virus:**

Symptoms: The virus mainly transmitted by contact, seeds and mechanical but not by insect vector. Typical symptoms includes chlorotic leaves, mosaic pattern, leaf distortion, stunted growth and reduced fruit size

Management:

Careful handling of plants, disinfection of farm tools, eradication of infected plants, seed treatment with tri-sodium ortho phosphate, use of resistant cultivars and crop rotation.

9. **Alfalafa Mosaic Virus:**

Symptoms: Transmitted by aphids in a non-persistant manner and also transmitted by seed and pollen. blotchy yellow mosaic on leaves, stunted growth and deformed fruits.

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Management: Use of insecticides, growing of resistant cultivars and removal of weeds.

CONCLUSION: Viruses remain a primary constraint to production of chilli worldwide. Weeds are te main reservoir hosts for vectors and viruses. The severity of infection mainly depends upon the environment, host and individual virus. Generally the viral infection cannot totally eradicated in plants. However, prompt action against the damage caused by viruses is with use of resistant varieties and ensuring adequate phytosanitory measures. Therefore, awareness of local farmers on the impact of field hygiene must be improved as adjunct to using tolerant varieties. Screening of virus infected seedlings and ultimately development of eco-friendly approaches of viral disease management will help to improve the chilli fields.

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GRASSLANDS MANAGEMENT

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Grasslands are as ground covered by vegetation dominated by grasses, with little or no tree cover. The nearly 7,000 kinds of grasses make up the most widespread plant family in the world. Grasslands are areas often referred to as prairies or meadows, consisting primarily of grasses with associated wildflowers. Natural grasslands occur in temperate zones with annual rainfall 25 to 80 cm, while in tropics they may be found in areas receiving rainfall up to 150 cm. The favourable conditions for development of a stable grassland are frequent rainfall and sufficient warmth during the growing season. Importance of grassland management are to improve natural and sown hayfields and pastures to develop highly productive planted lands to ensure the most efficient use grasslands. It is mainly concerned with production fodder and creation of stable fodder supply for public livestock.

INTRODUCTION

"Grassland" may be defined as ground covered by vegetation dominated by grasses, with little or no tree cover. UNESCO defines grassland as "land covered with herbaceous plants with less than 10 percent tree and shrub cover" and wooded grassland as 10-40 percent tree and shrub cover. Grasslands area in world is 40.5 percent of the terrestrial area (World Resources Institute, 2000). The nearly 7,000 kinds of grasses make up the most widespread plant family in the world. Grasslands are areas often referred to as prairies or meadows, consisting primarily of grasses with associated wildflowers. Natural grasslands occur in temperate zones with annual rainfall 25 to 80 cm, while in tropics they may be found in areas receiving rainfall up to 150 cm. The favourable conditions for development of a stable grassland are frequent rainfall and sufficient warmth during the growing season. Grasslands created and maintained by human activity are called anthropogenic grasslands.

Main objective of grassland management is to improve natural and sown hayfields and pastures to develop highly productive planted lands to ensure the most efficient use grasslands. It is mainly concerned with production fodder and creation of stable fodder supply for public livestock.

Establishment of grassland

1. Site Conditions: Site conditions to consider before planting having constrains of potential weed, drainage, erosion potential, and soil type, depth, texture, and fertility. Some grasses and legumes do better on dry sites, and others grow well on wet areas. Timothy grass - grows well on sandy-loam soils that are fairly well drained.

2. Site Preparation and Planting Rates: Conventional tillage uses plowing and disking to

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prepare the seed bed to ensure proper seed to soil contact and depth and no-till planting that cuts a narrow trench through the sod and soil, drops seed into the trench at the correct depth and distance apart, and presses the soil back in place.

3. What to Plant and Where: Planting more than one kind of grass will provide the variety of grass heights and density. Warm and cool season grasses tend to grow well on sandy, droughty, and better on well drained soils of sandy loam respectively.

4. Stand Management: To keep the stand in high-quality grasses and legumes, management tools such as burning, mowing, discing, fertilizing, and grazing may be needed which are stimulate regrowth and reduce the competition from woody plants; increase stand vigor; and provide quality grassland habitat

5. Inter seeding: Inter seeding is the process of sowing seed into the existing soil. Hand broadcasting, machine broadcasting, or drilling with a no till planter are inter seeding methods. Try to match the seed mix to the soil type, using plants that like moist conditions or sites in low lying areas and plants that prefer dry soils on upland sites. Grasses and legumes that are hayed or should be "top dressed" with fertilizer or manure after on a three-year rotation.

6. Balanced vegetation composition: Trees and shrubs are important features of many types of grassland. To manage vegetation, a technique called clearing involve removal of stones, termite hills and other obstructions, or thinning woody vegetation to improve access and grass growth.

General Principles in Grassland Management

1. Grasslands require management, 2. Know the grassland that is being managed, 3. Maintain large grasslands, 4.minimize fragmentation of grasslands, 5. Delay cutting, 6. Avoid converting fields and pasture to row crops, 7. Minimize chemical use, 8. Control Invasive Exotics and 9. Maintain Biodiversity Management of grasslands should strive to maintain biological diversity. While rare species are important and should be considered at all times, management of grasslands should also strive to maintain the greatest number and variety of plants and animals.

Role of fire in grasslands management

Fire was an important natural part in the development and maintenance of grasslands, forests, and wetlands, throughout history. A prescribed burn is a planned fire, burning with a specific management tool for maintaining and enhancing grasslands. It can recycle nutrients tiedup in old plant growth, control many woody plants and herbaceous weeds, improve poor quality forage, increase plant growth, reduce the risk of large wildfires, and improve certain wildlife habitat. To achieve the above benefits, fire must be used under very specific conditions, using very specific techniques. Cattails and sedges are returned to vigor by an occasional burn. Prescribed burns are often used today to kill or set back the growth of undesirable vegetation such as woody plants or noxious weeds and to promote the regrowth of warm season plants such as switchgrass. Most burns take place in the spring, however depending on what you hope to accomplish a fall burn may be in order

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Recommendations of the task force for grassland management

1. Detailed and updated GIS based inventory of degraded rangelands and measurement of the impact of rehabilitation programmes. 2. Higher priority on information on grasslands with emphasis on (i) low input, clover-based sheep grazing system; (ii) ideal pasture for mixed grazing systems; (iii) inventory of grazing routes and grazing systems; (iv) designing of suitable production system for migratory graziers of Himalaya and the Thar desert. 3. To develop a policy of regulated grazing that is managed on scientific principles so that desirable vegetation development could be ensured. 4. The practice of stall-feeding should be encouraged among livestock owners in order to prevent over grazing consequent depletion of available forest fodder resources. 5. There is a need of capacity building at various levels for the rangeland development and seed production of range species activities with the objective of restoring range health. 6. Demonstration of range improvement and management technologies at different locations should receive higher priority and the feed back.

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Dairying as a means of Social and Economic Security

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The term "democratic" is used in our preamble of the constitution in the broader sense embracing not only political democracy but also social and economic democracy. The one another term is also there "justice" and that embraces three distinct forms of justice- social, economic and political. These both terms (democracy and justice) of the preamble are being secured through various provisions of fundamental rights and directive principles and the supreme court of India consider both these terms as a part of constitutional morality.

1. Right to equality (Article 14-18)
2. Protection of life and personal liberty (Article 21)
3. Promotion of welfare of the people by state (Article 38)
4. Organization of animal husbandry and improvement of standard of living by state (Article 46 & 48) and many more.

In India, 58 percent population of the country mainly rural households directly or indirectly depends upon agriculture and allied sectors (Livestock's, horticulture, sericulture, apiculture etc). Agriculture and allied sectors contribution to the country Gross Domestic Product (GDP) is 15.6 percent (According to Agricultural Ministry). Although, share of primary sector has been decreasing since economic reforms of 1991 but it still occupies a center stage in Indian economy due to embodying three thrust area:-

1. To promote inclusive growth
2. To enhance rural income
3. To sustain food security of the country

The farmers of India practicing mixed farming system from Indus civilization time (2350 BC to 1450 BC). The mixed farming system is still an economic viable system, where the output of one enterprise becomes the input of another enterprise thereby providing sustainability, climate resiliency and economic of scale. Among allied sectors of agriculture, the one important sector is dairy sector that contribute 31 percent in agriculture GDP and also impacted upon poverty elevation in developing countries like India. Therefore, this demonstrates the role of diary in the upliftment of the status both socially and economically of Indian population.

"Milk is a unique crop that farmers harvest daily" –Verghese Kurien

India has transformed from a country of acute milk shortage to the world's leading milk producer. This phenomenal success is attributed to a Government of India initiative known as "Operation Flood" (1970-1996). Some measures outcomes of this program are following.

1. The value and production of milk get increased more than that of rice and wheat combined, so it is now India's biggest agri-produce.

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2. The milk is becoming a major source of income to small and landless agri-houses. Therefore, dairying provides a source of regular income where crops is seasonal and minimizing socio-economic related risks upon farmer lives.

3. Small and marginal farmers now own 33 percent of land and about 60 percent of female cattle and buffaloes and 70 percent of those earning their livelihood are from women (According to agriculture census 2013).

4. Per capita availability of milk reached to 400gm. There have been number of studies conducted that reported due to White revolution, the untouchability and other prohibited activities get reduced in village due to economic mobility and people per capita expenditure also get increased in villages.

5. The Indian dairy industry is usually governed by organized sector (20%) and unorganized sector (80%) which is mainly dominated by Village vendors, local halwai, small dairies

Various challenges facing dairy sector:-

1. Indian cattle and buffaloes have among the lowest productivity.

2. Deficit of organized dairy farms and dire needs of private and public investments to upgrade dairy industry to global standard.

3. Slowdown in dairy sector is mainly attributed to the decline in investment since the end of the Operation Flood.

4. Despite the importance of the dairy sector, it receives less government budget allocation and absence of government fixed market (MSP) prices in times leads to price clashes due to supply and demand mismatches.

5. Covid 19 pandemic, seriously impacted dairy sector due to cut in the demand from urban sectors.

6. Flooding of dairy products from other countries like European Union, Australia, USA at low prices as India having free trade agreements with many dairy advanced economies. Recent threat looming over dairy sector is coming RCEP agreement if in future, India will join it.

7. In addition, various phyto-sanitary measures and countervailing duties imposed by different countries impact the export of dairy products in global markets.

8. Many governments imposed unreasonable blanket sanctions for example in 2017, Government of India passed order to probhit trade of animals for meat and other purposes.

Government Initiatives-

Government of India time to time make different intervention to overcome above mentioned constraints by launching various schemes:

1. National programme for bovine breeding

2. Rashtriya Gokul Mission

3. National programme for dairy development

4. Many governments statutory and non-statutory organizations like APEDA, NDDB, ICAR, FSSAI etc. to make dairy sector more competitive and remunerative.

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Way Forward:-

1. Government should do time to time procurement of milk directly through National Dairy Development Board and distribute it to the needy society at reasonable cost. With this both price issues and nutrition issues can be treated.

2. Dairy products can be distributed at midday meal and in Integrated Child development programme.

3. To increase productivity of animals, Government of India can work in integrated manner by taking all stakeholders into board.

4. Augment value chain addition and processing infrastructure by following end to end approach using public investment.

Conclusion:

Demand for dairy products in India is likely to grow significantly in the upcoming years driven by population increase, increase per-capita income and greater interest toward more nutritious and balanced diet. Moreover, the dairy industry is critical to realizing many sustainable Development Goals of United Nations like SDG 1 and 3 etc and having full caliber to double farmer income. Therefore, keeping all these facts into mind governments at both centre and state levels with panchayati raj machinery into board should work in consensus and cooperative manner to make dairy sector more viable and remunerative.

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Functional Attributes of Camel Milk Bioactive Peptides

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Milk is an integral component of the human diet since time immemorial and probably it is the only food which has been consumed at every stages of life. Various species have been utilized for the production of milk. Although the majority of milk traditionally comes from dairy cows and buffaloes, advances in dairy science have investigated the beneficial, functional, medicinal, and health attributes of non-bovine milk from minor dairy species such as goats, sheep, camels, yaks, mares, donkeys, and mithuns, among others. Milk from non-bovine species is becoming increasingly important over the world, and its value is increasing in accordance with its predominance in a given region or country. According to reports, non-bovine milk production increased by 165 percent between 1983 and 2013, whereas bovine milk production increased by just 41 percent (Nunez and de Renobales, 2016).

Milk, a lacteal secretion derived from a healthy milch animal, has a wide range of nutritional and functional qualities, including proteins, carbohydrates, lipids, minerals, and vitamins. However, the content of milk, including main and minor elements, varies among species, depending on dietary, genetic, and environmental factors (Table 1). Furthermore, scientific research have determined that the content of ruminant and non-ruminant milk differs. Ruminant milk, for example, has a high total solid content, as well as increased fat, protein, and ash content. Non-ruminant milk, such as mare, donkey, and human milk, on the other hand, has a higher lactose content (Martini *et al.* 2014). Protein (usually 3.2 g/100 mL) is one of the most functionally diversified nutrients among the other nutrients, and its amount and functional qualities vary between species. Milk protein and its fractions are significant sources of bioactive peptides with a variety of biological activities, including antithrombotic, antibacterial, antioxidative, antihypertensive, immunomodulatory, and sometimes multifunctional activity, from a nutritional standpoint (Park and Nam, 2015).

Bioactive peptides, their discovery, characterization, and use in functional foods have all been studied extensively using cow's milk and milk derivatives. However, few research have focused on the study of bioactive peptides from small dairy species milk in the recent two decades. As a result, the focus of this article is on bioactive peptides generated from camel milk, as well as their physiological functions in the human body.

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Table 1: Gross composition (%) from milk of non bovine dairy species

Species	Total solids	Protein	Lactose	Fat	Ash
Camel	14.4	3.7	5.1	4.9	0.7
Goat	12.1	3.1	4.6	3.5	0.8
Sheep	16.3	5.5	4.6	5.3	0.9
Yak	16.8	5.2	4.6	7.0	–
Donkey	10.2	1.7	6.9	1.2	0.4
Mare	11.0	2.7	6.1	1.6	0.5

Source: Modified from (Park and Haenlein, 2006)

Bioactive peptides derived from Camel milk

Camel milk is very important in human nutrition, especially in hot and arid climates. Camel milk output is expected to reach 5.3 million tonnes worldwide, with Somalia being the leading producer. There are four major forms of caseins in camel milk's protein fraction: αs_1-casein, αs_2-casein, β-casein, and κ-casein. In terms of quantity, β-casein content is the largest (65%), followed by αs_1-casein (22%), and κ-casein (3%) (Farrell *et al*. 2004).

Protein is one of the most functionally diverse nutrients in camel milk among others, and its fractions are rich sources of bioactive peptides with a variety of biological activities, including antithrombotic, antibacterial, antioxidative, antihypertensive, and immunomodulatory properties. The specific functionalities of these bioactive peptides found in camel milk have been discussed herein:

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Figure 1: Potential functional attributes of Camel milk bioactive peptide

Antioxidative peptides**:** Antioxidants are chemicals that help our bodies to fight against free radicals. Free radicals are substances that can harm our bodies if their quantities rise too high. They've been connected to diabetes, heart disease, and cancer, to name a few. Camel milk protein peptides have been shown in tests to have anti-oxidant properties and have been used to treat a variety of diseases. Several studies are documented the antioxidative properties of camel milk peptides which are usually, synthesized through enzymes. The antioxidative capabilities of camel milk bioactive peptides have been reported to be obtained by hydrolysis of camel milk employing the enzyme (pepsin-pancreatin), which has been proven for antioxidant and anti-cytotoxic action (Homayouni-Tabrizi *et al.* 2017). They further reported that the three peptides with the sequences LEEQQQTEDEQQDQL (MW: 1860.85 Da, LL-15), YLEELHRLNAGY (MW: 1477.63 Da, YY-11), and RGLHPVPQ (MW: 903.04 Da, RQ-8) were shown to have strong free radical scavenging activity among the other peptides investigated. Ibrahim *et al.* (2018) fractionated the camel milk proteins (casein and whey) and hydrolyzed them separately using pepsin. They revealed that antioxidant peptides with molecular weights between 913 to 2351 Da were derived from α-casein and lactoferrin, respectively, thus suggesting that both casein and whey proteins from camel milk have the potential for being utilized as an ingredient in nutraceuticals or functional foods. Kumar *et al.* (2016) compared the effect of different enzymes on the bioactivity of camel milk casein fraction using commercial proteases namely papain, alcalase and chymotrypsin to hydrolyse the protein. They reported that the hydrolysate obtained by chymotrypsin had a higher antioxidant activity, while alcalase and chymotrypsin both yielded peptides with comparable antimicrobial activity. They concluded that the whole milk protein hydrolysate could be more beneficial when used as a nutraceutical or functional food ingredient in comparison to hydrolysates of milk protein fractions. Jrad *et al.* (2014) had studied the antioxidant properties of camel milk casein hydrolysate using 2,2′-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid (ABTS) radical cation and concluded that antioxidant activity of camel milk casein was much more efficient after digestion with pepsin and pancreatic enzymes. On similar lines, Kumar *et al.* (2016a) investigated the antioxidant activity of casein hydrolysate after hydrolysis by alcalase and papain. They found that both the hydrolysates obtained exhibited a significant increase in 2,2-diphenyl-1-picrylhydrazyl (DPPH), Ferric Reducing Antioxidant Power (FRAP), and ABTS, with an increase in the duration of hydrolysis and degree of hydrolysis. Three novel antioxidant peptides have been isolated from Bactrians camel milk hydrolysate by Wali *et al.* (2020). All purified and sequenced peptides: RLDGQGRPRVWLGR (TFI-b1), MW: 1665.94; TPDNIDIWLGGIAEPQVKR (TFI-b2), MW: 2122.13, andVAYSDDGENWTEYRDQGAVEGK(TFI-b3), MW: 2489.09 exhibited very high antioxidant activity as free radical scavengers.

ACE inhibitory peptides: Angiotensin-converting-enzyme inhibitors (ACE inhibitors) are a class of medication used primarily for the treatment of high blood pressure and heart failure. They work by causing relaxation of blood vessels as well as a decrease in blood volume, which leads to lower blood pressure and decreased oxygen demand from the heart. ACE inhibitors inhibit the activity of angiotensin-converting enzyme, an important component of the renin–angiotensin system which converts angiotensin I to angiotensin II, and hydrolyses bradykinin. Therefore, ACE inhibitors decrease the formation of angiotensin II, a vasoconstrictor, and increase the level of bradykinin, a peptide vasodilator. This combination is synergistic in lowering blood pressure. Higher proline content in the structure of casein fraction of camel milk is reported to be a contributory factor for better ACE inhibitory activity of camel milk as compared to the milk from other species (Moslehishad *et al.* 2013). ACE inhibitory activity of camel milk hydrolysate obtained by in vitro gastrointestinal digestion was studied by Tagliazucchi *et al.* (2016). They studied the different fractions and found that 17 peptides was known to possess ACE inhibitory activity. In another study Alhaj (2018), investigated the ACE inhibitory activity from fermented camel milk of Dromedary species. Camel milk was fermented with two potent bacterial cultures namely, L. *helveticus* and L. *acidophilus*. HPLC MALDI-TOF analysis showed the presence of ten potent peptides exhibiting ACE-inhibitory activity. By comparing the activity among these fermentable microbial species they found that the camel milk

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fermented with L. *helveticus* yielded stronger ACE-inhibitory activity than other strains (L.*acidophilus*). Biological function of camel milk protein fractions, namely β-casein and whole casein, were also studied by Salami *et al.* (2010), they showed that the digestion with pepsin enhanced the ACE-inhibitory activity of the whole as well as β-casein. Therefore, camel milk was suggested to release innate peptides with antihypertensive properties. The functions of the gastrointestinal tract in the digestion of camel milk proteins (whey and casein) were investigated by Jrad *et al.* 2014. They discovered that the protein's ACE inhibitory activity was mediated via pepsin digestion, and that 25 of the 180 peptides tested were known to be related with ACE inhibitory activity.

Gastrointestinal functionalities for digestion of camel milk proteins (whey and casein), was studied by (Jrad *et al.* 2014). They revealed that the ACE inhibitory activity of the protein was achieved by the digestion with pepsin and among the 180 studied peptides, only 25 were known to be associated with ACE-inhibitory activity. Furthermore, they demonstrated the camel colostrum also exhibited a higher ACE-inhibitory activity following digestion by pepsin enzyme. Apart from the casein and colostrum, skim milk fraction of camel milk is also proven for the ACE inhibitory activity. Shuangquan *et al.* (2008) studied the ACE inhibitory activity of fermented skim camel milk by culturing with L. *helveticus* 130 B4. Peptide sequences exhibiting the strongest antihypertensive activitywere derived from κ-casein and it was also demonstrate that inhibitory activity was quite stable after treatment at100 °C for 20 min. According to these studies, It can be concluded that the camel milk and its fraction are the potent ACE inhibitors.

***Anti-diabetic and Anti-obesity peptides*:** Diabetes mellitus (DM) is a chronic disorder that can alter carbohydrate, protein, and fat metabolism. It is caused by the absence of insulin secretion due to either the progressive or marked inability of the β-Langerhans islet cells of the pancreas to produce insulin, or due to defects in insulin uptake in the peripheral tissue whereas, overweight and obesity are defined by an excess accumulation of adipose tissue to an extent that impairs both physical and psychosocial health and well-being. Obesity is considered a health disaster in both developed and developing countries. Both of these non-communicable metabolic disease is well documented for the precursor of the various diseases as well as death globally. Camel milk protein fraction has been studied extensively in the treatment of diabetes and obesity. Nongonierma et al. (2017) also identified the anti-diabetic peptides with dipeptidyl peptidase 4 (DPP-IV) inhibitory activity, in camel milk protein hydrolysates. Their results revealed the presence of potential and novel DPP-IV inhibitory peptides (Leu-Pro-Val-Pro-Gln and Trp-Lys) which were reported to be absent in bovine milk hydrolysates. This indicated the unexplored potential of camel milk as a substrate for diabetes management. Later on, Nongonierma *et al.* (2018) identified nine novel peptides possessing DPP-IV inhibitory activity (FLQY, FQLGASPY, ILDKEGIDY, ILELA, LLQLEAIR, LPVP,LQALHQGQIV, MPVQA, and SPVVPF) upon the hydrolysis of camel milk protein with trypsin. Thus, camel milk was reported to be an important commodity having a role in glycemia regulation. Further, Mudgil *et al.* (2018) obtained the novel antidiabetic and anti-obesity peptides (KDLWDDFKGL, MPSKPPLL) from the hydrolysates of camel milk protein. Cholesterol esterase has been reported to be associated with the development of obesity and other related complications. In an interesting study conducted by Mudgil *et al.* (2019), novel peptides were isolated from camel milk protein hydrolysate for their inhibition of cholesterol esterase. Results revealed that hydrolysate obtained by the digestion with papain exhibited the highest degree of hydrolysis. Further, Peptide identification showed three peptides with sequences KFQWGY, SQDWSFY, and YWYPPQ, exhibiting high affinity towards the binding site of cholesterol esterase. It is evident from these reports that the camel milk protein fraction is well known inmanagement of diabetes and obesity and their related complications.

Antimicrobial peptides**:** Antimicrobial peptides (AMPs) are a class of small peptides that widely exist in nature and they are an important part of the innate immune system of different organisms. AMPs have a wide range of inhibitory effects against bacteria, fungi, parasites and viruses. The antibacterial activity of camel milk peptides has also been thoroughly investigated by numerous researchers, and the beneficial effect of camel milk peptides as an antibacterial activity is well documented. In a study by Algboory and Muhialdin (2018), protein hydrolysates found in fermented camel milk produced using *Lactobacillus plantarum*, exhibited antimicrobial activity against *Staphylococcus sp., Shigella*, and *E. coli*. Further, their study suggested that the *L. plantarum* can be utilized as a suitable starter culture for the production of antimicrobial peptides in camel milk-based functional products. Jrad *et al.* (2014) investigated the antimicrobial properties of camel colostrum as well as camel milk proteins and demonstrated that colostrum and milk both had an inhibitory effect on the growth of *E.coli* and *L. innocua*. Abu-qatouseh (2019) derived immune proteins and peptides from camel milk and evaluated their efficacy against *Propionibacterium* acnes. It was shown that peptidoglycan recognition proteins exhibited the strongest antimicrobial activity as compared to lactoferrin. Thus, camel milk was suggested to be utilized for the treatment of Acne vulgaris. As a result of these studies, the importance of camel milk peptides as an antibacterial is well understood.

CONCLUSION

In conclusion, it should be noted that the camel milk bioactive peptides are having the capabilities in enhancing health conditions as well as in disease management. These inherent therapeutic abilities of the camel milk caseins, colostrum, and whey proteins can be explored in the creation of novel therapeutic agents for the treatment of a variety of metabolic diseases.

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