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Crop Diversity Among Rural Households

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INTRODUCTION

In Nigeria, most rural and urban households consume mainly staples as their main food, which are high in carbohydrates, but low in nutrients and vitamins. Staple food items might increase energy availability but do not improve nutritional outcomes if not consumed in conjunction with micro-nutrient rich foods (Kennedy *et al,* 2007). Therefore it is imperative to know the determinants of crop diversity among rural households. More recently some studies have attempted to establish the relationships between Cropping pattern and dietary diversity of households (Thompson and Meerman, 2010; Pellegrini and Tasciotti 2013; Smale et al, 2013). Apart from these studies, Herforth (2010) and Jones et al (2014) determined the relationship between farm diversity and dietary diversity among households in African countries. Despite these efforts, there is still a dearth of knowledge on studies that analyze the determinants of crop diversity among rural households. Crop diversification is one of the four main strategies advocated internationally for the improvement of micronutrient intake and status, especially in undernourished individuals (Maunder *et al*., 2001). Studies have shown that an increase in crop diversity is associated with socioeconomic status and household food security (Hoddinot and Yohannes, 2002). Crop diversification affects the choice made by farmers in term of enterprise combination on their farms. Crop diversification is a strategy to maximize the use of land, water and other resources and for the overall agricultural development in the country. It provides the farmers with viable options to grow different crops on their land. The diversification in agriculture is also practiced with a view to avoid risk and uncertainty due to climatic and biological vagaries; diversification of crops emerges as a major strategy (Saraswati *et al*., 2011). Crop diversification involves the cultivation of a variety of crops involving intensity of competition amongst field crops for arable or cultivable land. According to Swades and Shyamal (2012), Crop diversification in the developing Countries is a pungent applied concept to remove the plight of subsistence agricultural economy and to ensure diversified nutrition status particularly for rural households. Crop diversification is intended to give a wider choice in the production of a variety of crops in a given area so as to expand production related activities on various crops and also to lessen risk. Crop diversification as a farming strategy believed to have a number of advantages, e.g., ability to reduce and spread risk, improve income and employment opportunity, ability to reduce disease and pest infestations and improve soil fertility in some cases (Singh, 2000).

Conclusions

The literature on the impact of crop diversification is quite mixed. For example, Guvele (2000) noted that crop diversification reduces income variability in Sudan, whereas Van den Berg et al. (2007) noted that it sustains income level for farmers in China. Kar et al. (2004) and Rahman (2009) noted that crop diversification increases agricultural production in India and Bangladesh, respectively. Llewelyn and Williams (1996) and Haji (2007) noted that crop diversification decreases farmers' production efficiency in Indonesia and Ethiopia, respectively while Coelli and Fleming (2004) and Rahman (2009) reported that crop diversification actually improves farmers' production efficiency in Papua New Guinea and Bangladesh, respectively. The implication is that the conclusions on the effect of crop diversification vary substantially from region to region, and therefore requires being addressed on a case-by-case basis. Crop diversification is intended to give a wider choice in the production of a variety of crops in a given area so as to expand production related activities on various crops and also to lessen risk. Crop diversification is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crops. Crop diversification and also the growing of large number of crops are practiced in rain fed lands to reduce the risk factor of crop failures due to drought or less rains. Farmers can also use diversification in response to output risks or input market risks; by choosing crops with different characteristics (i.e. crops that are more or less drought resistant, or crops that are harvested in different seasons). The farmer can use diversification to choose an optimal portfolio of crops to help insure against drops in profit or utility that occur if the price for one crop is lower than average in a given year (Bromley and Chavas, 1989). Farmers can also diversify in response to biological, physical, or economic constraints that affect the farming system or input availability.

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Aflatoxin: The killer organism in most Nigerian foods

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ABSTRACT

Aflatoxins are wide-spread harmful carcinogenic secondary metabolites produced by *Aspergillus* species, which cause serious feed and food contaminations and in order to minimize the risks involved both pre-harvest and post-harvest strategies need to be applied.

INTRODUCTION

Aflatoxins are a family of the extremely toxic secondary metabolites that are derived from polyketides produced by fungal species such as *Aspergillus flavus, A. parasiticus*, and *A. nomius*, which are abundant in warm and humid regions of the world. Aflatoxin-producing fungi can contaminate crops in the field, at harvest, and during storage. These fungi usually infect agricultural crops such as cassava, maize, millet, groundnut, rice, sorghum, melon, wheat, soybean, beans milk and a variety of spices, meat products and can lead to serious threats to human and animal's health by causing various complications such as liver diseases and death. They are ubiquitous and can be found in air, soil, water etc so aiding their spread by wind, insects and decomposed soil wastes. Once released, aflatoxin producing fungi are difficult to eradicate as they remain unwavering throughout the agricultural produces' value chain i.e. from the field through storage to the consumption of these commodities. ((Kumar *et. al.,* 2017).

Major sources of aflatoxin

Fungi such as *A. flavus, A. parasiticus,* and *A. nomius* are the main sources of aflatoxins, although they are also produced by other species of *Aspergillus* as well as by *Emericella* spp. Presently, there are over 20 known aflatoxins, but the four major ones are aflatoxin B1 (AFB1), aflatoxin B2 (AFB2), aflatoxin G1 (AFG1), and aflatoxin G2 (AFG2), while aflatoxin M1 (AFM1) and M2 (AFM2) are the hydroxylated metabolites of AFB1 and AFB2 ().

In Sub Sahara African (SSA), both human and animals are highly exposed to different types of aflatoxin contamination and this has a profound negative impact on Sustainable Development Goals (SDGs) related to personal, social, economic, and national development opportunities (Sirma *et. al.,* 2018).

Aflatoxin and food safety

Food safety is a global challenge and since 1985, the United States Food and Drug Administration (USFDA), World Health Organisation, FAO etc has controlled the amount of mycotoxins permitted in many food products. Furthermore, different countries have implemented strict regulations for AFs in food and feed to maintain the health. The safe limit of AFs lies in the range of 4–30 mg/kg for human consumption. The European Union has the strictest standard level with AFB1 and total AFs not beyond 2 mg/kg and 4 mg/kg, respectively, in any product meant for direct consumption (EC, 2010). Similarly, the maximum acceptable limit set for AFs in the United States is 20 mg/kg for all food commodities, except milk. Understanding that there is no safe level for Aflatoxin exposure, the Standards Organization of Nigeria (SON), has set the acceptable limit for grain commodities at 4 ug/kg and 20 ug/kg. Results from different studies raise major concerns relating to food safety for the Nigerian consumers and they also revealed the need for more research to understand how to handle the levels and growth of aflatoxins along the value chain processed foods (Baha'uddeen *et. al.,* 2020).

Effects and Implications of Aflatoxin Contamination

1. Deterioration of food value and quality due to continuous fungal growth
2. Contaminated kernels are unfit for human and animal consumption
3. Reduced price for the produce on local and international markets
4. Causes decay in both seeds and non-emerged seedlings
5. Less cash revenue from contaminated crops, when contamination is confirmed
6. Reduced productivity of dairy cattle, chicken and turkey
7. Increased costs of production due to the imperative for Aflatoxin testing
8. Rejection of consignments destined for national and exports markets
9. Banning of countries from admission into international markets

Aflatoxin management strategies have been sought after for more than 50 years. Most pre- and post-harvest strategies may reduce occurrences and severities of aflatoxin contamination. However, the adoption of a single management strategy in isolation may not prevent initiation of aflatoxin contamination and be insufficient to reduce aflatoxin contamination to acceptable levels [i.e., at least below 20 parts per billion (ppb)] (). Therefore, aflatoxin management strategies must address the contamination process throughout crop production and until crops are consumed using holistic interventions (Bandyopadhyay *et al.*, 2019)

Aspergillus flavus contaminated dried meat displayed for sale in an open market in Nigeria

On-farm management of aflatoxin

1. Use healthy aflatoxin resistant improved seedlings/varities.
2. Dress seeds with appropriate agro-chemicals before planting
3. Remove dead plants and unhealthy plants especially before harvest
4. Apply dry farm yard manure.
5. Use biological control measures such as aflasafe
6. Avoid using farm from which maize, cotton, tobacco and tomatoes, have just been harvested as these crops are susceptible to soil borne Aflatoxin producing fungi.
7. Avoid mechanical damage during harvest
8. Maintain recommended plant populations for each type of plant
9. Control soil inhabiting insects such as termite
10. Avoid end-of-season drought with irrigation, if possible
11. Harvest the crop at right maturity
12. Maintain minimum of 2 years of crop rotation in order to reduce the build-up of Aflatoxin producing fungi.

On-farm postharvest aflatoxin management operations

1. Dry the produce until the safe moisture content (mostly between 8-12%).
2. When using mechanical threshers, use appropriate sieves based on size so that immature seeds or pods are blown off

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3. Sort out mechanical and insect damaged produce.
4. Conduct routine check during drying to ensure maximum and uniform dryness.
5. Sorting, cleaning/winnowing, washing, crushing combined with de-hulling of grains can reduce aflatoxin contamination.

Management of Off-farm Post-harvest Operations and Marketing

1. Thoroughly clean storage facilities (containers and stores) before storage
2. Prevent insect damage infestation during storage
3. Maintain safe moisture content
4. Basic sanitation measures such as removal and destruction of debris should be encouraged
5. During processing, quality management systems such as HACCP (Hazard Analysis Critical Control Point) have been recommended as a strong tool for managing aflatoxin along the product chain
6. Avoid entry of air and moisture into packaged products
7. Shipment should be covered using airtight containers or tarpaulins, temperature fluctuations that could lead to condensation should be avoided

CONCLUSION

Nigeria is a diversified country, reduction in aflatoxin is dependent on the concerted actions of all actors along the food production and distribution chain. Multidisciplinary approaches are therefore critical. Any possible intervention strategies to reduce mycotoxins in Nigeria as elsewhere must begin from good Agricultural practices that involves both pre-harvest and post harvest stages followed by Good manufacturing practices (GMP), Risk Assessment for Mycotoxin Contamination and Good Storage Practices

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Information communication technology and agricultural marketing

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INTRODUCTION

Agricultural marketing is the process of making agricultural products available in the form, place and time required by the consumer (Olukosi*et al*., 2005). A well-developed market for agricultural produce provides access to consumers who depend on the market for their food supplies, and farmers who shift from subsistent farming to commercial production. An increase in marketable crops, call for larger and improved marketing facilities. If markets function efficiently, farmers would allocate their resources according to their comparative advantages and intensify their production. An efficient marketing system is an important means for raising the income levels of farmers and for promoting economic development of a region (Tamimi, 1999). However, Obasi and Emenam (2014) asserted that marketing usually begins at the farm, when the farmers harvest his products. The product when harvested cannot get to the consumer; firstly, it is likely to be located some distance from the place of consumption in a regular and continuous manner, throughout the year. In addition, storage is required to adjust supply to meet demand. Moreover, a product, when it has been harvested, is rarely in a form acceptable to consumers. Hence, it must be sorted, cleaned and processed in various ways and must be presented to consumers in convenient quality and quantities for sale (Asogwa and Okwoche, 2012). Seasonality as well as cost and location to the market may influence distribution from producers to consumers. Several other factors affect agricultural commodity marketing which includes; distance, cost of transportation, seasonal variation, storage, processing, grading and communication among others mitigate the flow of goods in the agricultural sector (Alabi and Adebayo, 2008). Over the years, there have been inefficiencies in the marketing of agricultural commodities as a result of these problems. The distorted marketing channels and the price fluctuations also constitute a problem.

Information and communication technology (ICT) is a term used for communication devices and applications. It refers to technology that provides information through telecommunications such as print media, radio, television, mobile phone and Computers. It comprises of new technologies as well as old technologies which have been put together to give efficient and effective information processing and communication. Through different studies in various countries, it has been demonstrated that investment in ICT be it mobile technology internet positively correlates with GDP- Gross domestic products. Access to information, an important input for making agricultural decision in production, marketing and finance has historically been very costly in Africa. Farmers who want to sell their products have to search for the right place and price the right buyers and often travel to market their goods, loading and unloading of

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commodities in search of buyers or brokers sometimes cause deterioration of perishable commodities. Excessive market searching cost causes small holders to produce very limited range of goods and services. In the extreme case it leads household to produce only for home consumption. It may also cause them to apply low levels of external input and become less responsive to market changes. ICT can offer small holder farmers the opportunity to create network with other farmers, obtain market information and access information (Ifad, 2008). Due to their potential and the recent surge in mobile phones ownership throughout Sub Saharan Africa, ICTs have become an important consideration for social and economic development programs. Singh *et al* (2015) reported that Agricultural information system is a computer-based information system which contains all interrelated information which could really help farmers' in managing information and policy decision making.

The ICT device that helps to facilitate farming activities encompassed technologies such as; radio, television, cellular phones, computers and tablets. Through the use of ICT, farmers can create new opportunities by penetrating international market and get contact with new partners and exchange relevant information for their business sustainability. Consequently, farmers can advertise their goods both in national and international market. Similarly, Yimer (2015) indicated that ICT furnish up to date knowledge and information on Agricultural Technologies, best practices, market prices trends and weather condition. The above argument also agreed with Munyna and Adera (2009) that ICT help in providing capacity building, access marketing and credit, restructuring of extension and scaling up inter linkages of development interventions. Ramil *et al* (2015) stated that ICT is an effective solution to problems that occur in the agricultural industry such as weak marketing linkages, poor information management, low productivity, low income and lack of diversity. Agriculture is an important sector with the majority of the rural population in developing countries depending on it. Agriculture in the 21st century is one of the most diverse economic sectors, encompassing individual farmers, farmers' organizations, government agencies, research institutes, traders, multinational corporations, NGOs and many others. The sector faces major challenges of enhancing production in a situation of dwindling natural resources necessary for production. The growing demand for Agriculture products, however also offers opportunities for producers to sustain and improve their livelihoods (McNamara, 2009). Information and communication technologies (ICT) play an important role in addressing these challenges and improving the livelihoods of the rural poor.The advent of Information Communication Technology (ICT) and its subsequent adoption by both the developed and developing countries ushered in the application of electronic extension for information dissemination for agricultural producers.

CONCLUSION

ICTs are major catalyst for information and knowledge that can create development opportunities and choices for rural communities whose livelihood depend largely on agriculture. Information is the pivot around which development revolves; provision of current and up-to-date information to the rural populace on the various activities such as current market prices of goods, market locations, food processing techniques and agricultural practices. It is essential for increased productivity and income growth. Since information is prerequisite for sustainable development and agriculture, farmer's access to ICTs infrastructure is important to increasing the flow of information and this

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information could serve as a means of empowering the farmers to face the challenges of their immediate environment in the process of carrying out their business effectively. The contribution of ICTs to the overall improvement of the farming business and attainment of the goal of every farmer cannot be over emphasized. The appropriate use of information and communication technologies (ICT) is pertinent to the improvement of farmer's income. Information and communication technologies are unique tool in the fight against poverty which is influenced by weak market links, high transportation cost, low return on investment, low savings etc. ICTs have been associated with an increase in efficiency, productivity, and communication between buyers and sellers while reducing waste and price dispersion (Aker 2011; Muto and Yamano, 2009). More recent technologies such as cell phones and increased internet access have the potential to democratize information access, especially in places where communication infrastructures is lacking. Despite these benefits of ICT's their adoption throughout sub-Sahara Africa has not been uniform. In Nigeria, where majorly all the rural populace are farmers, subscription rate for mobile and internet communication services is still quite high when available and in some very rural areas connectivity and network may be very poor and even absent; this coupled with other factors such as poor electricity supply, farmers literacy level and household income also constitute major constraints to farmers even when they tend to adopt new ICT technologies.

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Overview of Atomic Absorption Spectrophotometer

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Introduction

Soil, water, and plant analysis determine both qualitative and quantitative attributes to interpret the obtained results. However, presence of elements (Fe, Zn, Cu, Mn, Mo, As, Sb, Pb, Cr etc.) in trace amount within these systems also influence the systems characteristics to a great extent (Cantle, 1986).

To determine such elements accurately and urgently, more sophisticated instrument was needed for obtaining result with much rapidity. In 1955, a group of Australian physicists, led by Sir Alan Walsh, have invented Atomic Absorption Spectrophotometer (AAS) from the principle of resonant spectrum in spectrochemical analysis as described by Robert Wilhelm Bunsen and Gustav Robert Kirchhoff (Walsh, 1955). This spectroanalytical tool quantitatively determines trace elements at appreciable accuracy. The method is rapid and robust.

Principle

In AAS, resonant wavelength is absorbed by an element under study when the spectrum is passed through that element at ground state from a specific light source. On a long-term study on sodium spectrum, Bunsen and Kirchhoff concluded that each element possesses their unique characteristic spectra, used for detecting the element(s) of interest in its vapour form.

They also described that the unique characteristic spectra or resonant spectra of an element can be absorbed besides its emission by that particular element because the resonant wavelength is specific to a specific transition of electrons. The absorbed radiation loses its intensity which can be measured by Beer-Lambert law in terms of absorbance:

$$A= \log_{10}\frac{I_i}{I_t} = abc$$

Where, A = Absorbance.
I_i = Incident light intensity.
I_t = Transmitted light intensity.
a = Absorption coefficient.
b = Path length of flame.
c = Atom concentration per cc.

Instrumentation

AAS consists of following four components:

1. Atomizer: In atomizer, samples are converted to vapour form for the ease of exposing atom population to the incidental spectrum. Like other spectrophotometric analysis, AAS also uses liquid samples for atomization. The most commonly used atomizers in AAS are two of types:

a. Flame atomizer.
b. Graphite furnace atomizer.

In case of flame atomizers, nebulizers make aerosols (< 10 µm) from liquid samples to pass through the spray chamber (Fig. 1A). The air-acetylene and nitrous oxide-acetylene fuels are used to generate 2300 °C and 2700 °C temperature, respectively. The nitrous oxide-acetylene creates more reducing environment, protecting reactive trace elements to form their respective oxides.

Whereas, in case of graphite furnace, a minimum amount of sample undergoes sequential drying (150 °C), pyrolysis (600 °C), atomization (2300 °C), and cleaning (2700 °C) for specified periods (Welz, 1976). The main advantage of the graphite furnace is that it requires less sample size (10 µL or 1 mg). The sensitivity is also very high in case graphite furnace.

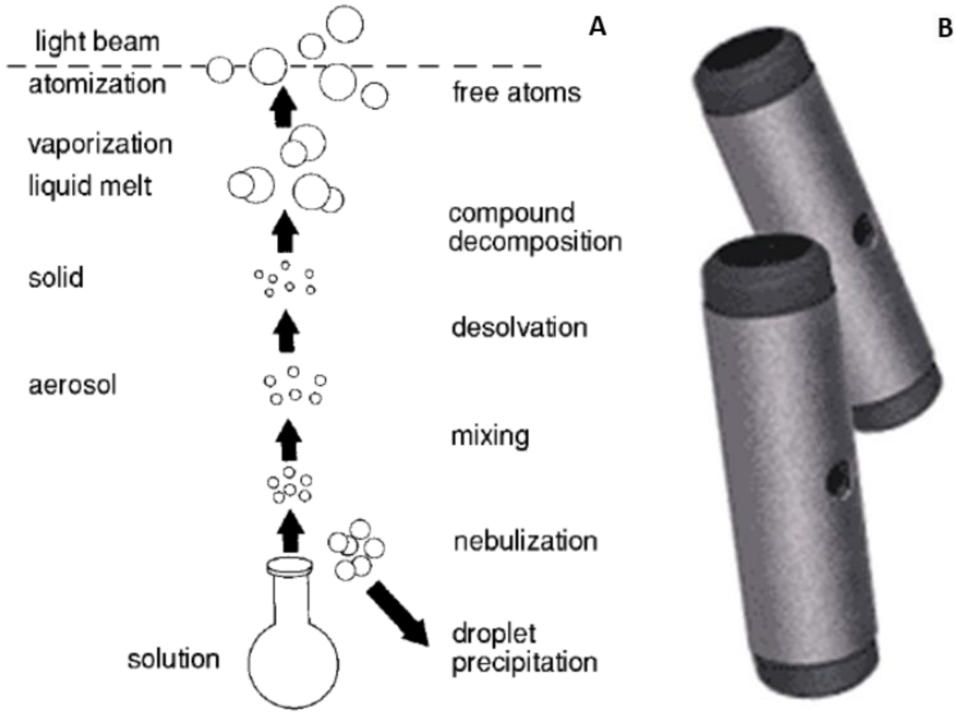

Fig. 1 Schematic diagram of (A) flame atomization process and (B) graphite furnace

Besides glow-discharge atomizer, cold vapour atomizer, hydride atomizer etc. is also used.

2. Light source: Hollow cathode lamp is mostly used in AAS as a source of resonant wavelengths. The cup shaped lamp is made up of normal bulb with a quartz window at one side. The cathode is made up of specific element of interests and the bulb is filled with argon (Ar) or Neon (Ne) gas.

When the lamp is operated at near 100-150 V, the Ar or Ne gas gets ionized and starts bombardment on cathode metals. This phenomenon is known as "sputtering". Then metals of the cathode get released and with the collision of ionized gas, the dislodged metal atoms get excited and emit characteristic resonance wavelengths which passes the transparent quartz window to be absorbed by the element of interest.

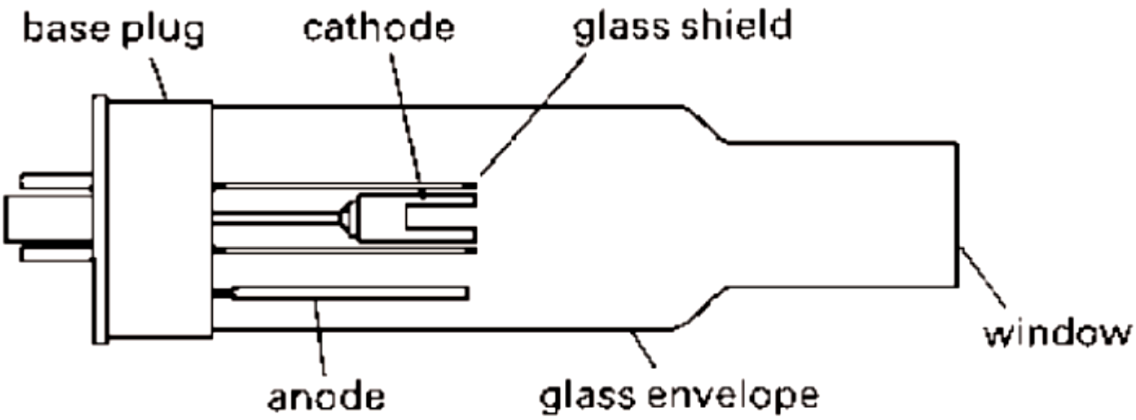

Fig. 2 A schematic diagram of hollow cathode lamp

3. Spectrometer: The spectrometer carries two parts, i.e., a monochromator and a detector. The monochromator separates the resonant wavelength from the rest. Generally, for hollow cathode lamp, a medium-resolution monochromator is used as hollow cathode lamp is a line source. The gratings and prism are also used for modulating better resolution. The detector must have better signal to noise ratio. For such, photomultiplier tube or solid-state detector are helpful.

4. Readout device: This system includes meters, recorders, and a digital display unit.

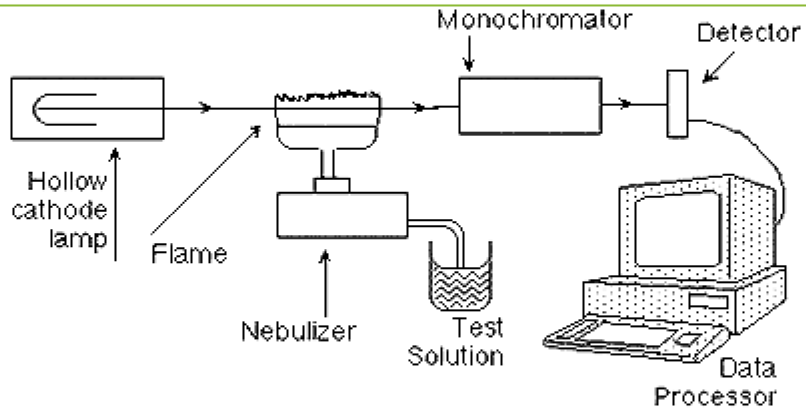

Fig. 3 Working diagram of Atomic Absorption Spectrophotometer

Types

The AAS is configured into two types: Single beam AAS and double beam AAS. The difference between them is the presence of chopper (mechanical/electrically modulated) and rotating mirrors. The chopper in single beam AAS affects the pulse generated in detector, reducing the noise; while, mirrors direct the spectrum of hollow cathode lamp by directing them round the flame. One splitter is used for diverting the incoming resonant spectrum.

Interferences

It is the change in intensity of analyte signals due to non-spectral and spectral interferences. The non-spectral interference occurs due to sample matrix, presence of chemical species, and smaller ionization potential of atoms. Whereas, overlapping of spectral lines and scattering by solvent molecules create background absorption by spectral interference. This background absorption can be corrected by deuterium lamp, Smith-Hieftje correction, and Zeeman effect.

Conclusion

The use of AAS is vigorous in agricultural fields. It has several advantages over other modes of soil analysis. High specificity for sample element creates good accuracy. The background correction allows it to reduce the spectral interference. Generally, small amount of sample is needed. A wide range of elements can be detected. Simple processing and handling allow it to operate at higher scale.

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Mulching – A Soil and Moisture Conservation Practices in Dryland Agriculture

Article ID: 10701

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Introduction

In India, out of the total cultivated area 70 per cent is dryland agriculture. Crop production in dryland agriculture limited by soil constraints, climatic constraints, lack of production technology and socio-economic status of the farmer. Crop production in dryland agriculture is solely depends on rainfall of the region. Most of the rainfed area of the country, severe loss of soil and water erosion is the major problem. Soil and moisture conservation practices is very important in rainfed areas of the country to reduce the runoff losses as well as improving the moisture retention in the soil. Conserving soil moisture in the rainfed region is a challenging task as it plays a significant role in crop productivity and livelihood security of rainfed farmers. Based on the slope of the land soil and moisture conservation practices are classified:

1. Agronomic or cultural practices.
2. Mechanical or engineering practices.
3. Agrostological practices.
4. Forestry approaches.

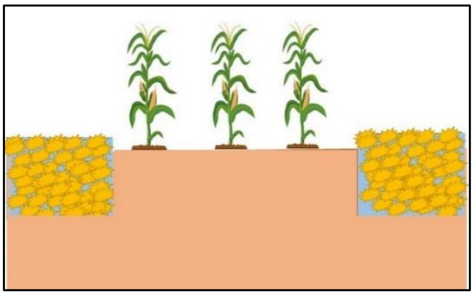
Among the soil and moisture conservation practices agronomic or cultural practices are commonly followed when the land slope is <2%. Among the agronomic practices, mulching is the commonly followed cheapest *in-situ* soil and moisture conservation practices.

The word mulch has probably derived from the German word "molsch" means soft to decay, which apparently referred to the gardener's use of straw and leaves as a spread over the ground as mulch (Jack *et al.,* 1955). Mulching is an application of any plant residues or other materials for covering top soil surface for conserving soil moisture, reducing the runoff and thereby to control soil erosion, checking weed growth, improving soil temperature, modifying the micro environment of soil to meet the needs of seeds for their good germination and better growth of seedlings (Chavan *et al.,* 2010).

Types of Mulch for Soil and Moisture Conservation in Dryland Agriculture

1. Straw / stubble mulch: Straw / stubble mulch is covering of soil with paddy straw or any crop residues like stubbles, groundnut shells, cotton stalks etc; for soil and moisture conservation. In addition, applied straw / crop residues will decompose and improves the soil organic matter.

2. Vertical mulching: It is a technique wherein trenches of 40 cm wide, 15 cm deep are dug at 2 to 4 m interval across slope and filled with stubbles or organic wastes to a height of 10 cm above soil surface. Runoff is checked, collected in the shallow trenches and redistributed to adjoining soil layers and infiltration is increased in black soils.



3. Plastic mulching: Plastic mulches are very effective as mulches for evaporation control provided cost is not a limiting factor. The plastic mulches may be either white or black. Black plastic mulches will absorb the solar radiation and enhance the soil temperature for hastening the germination of winter crops like wheat; barley etc., White plastic mulches will reflect the incident radiation and reduce evaporation of soil moisture.

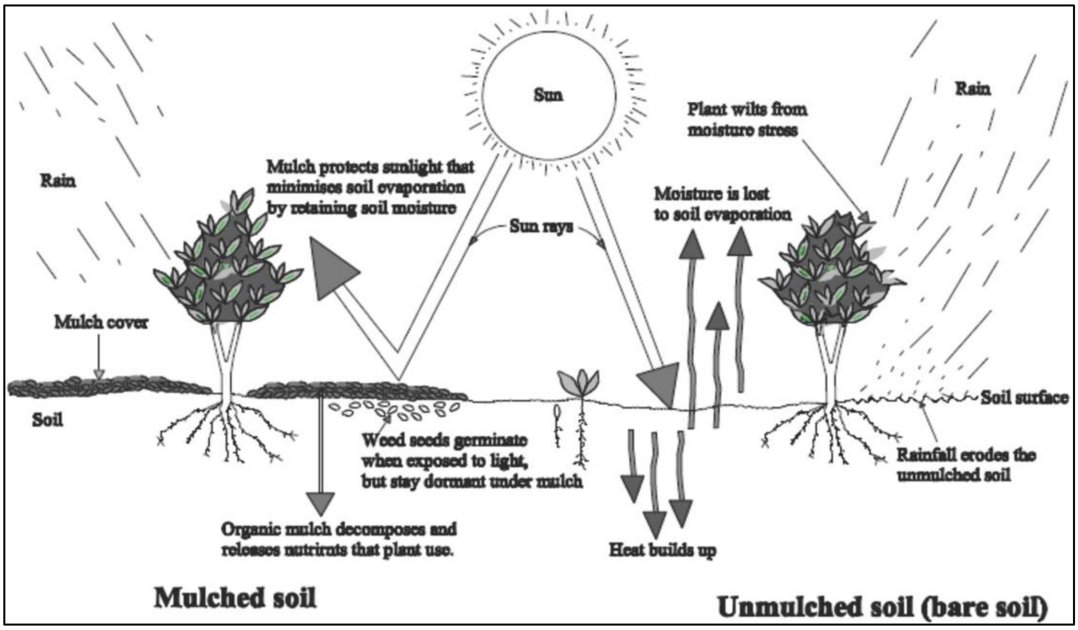
4. Pebble mulching: Where small pebbles like stone are placed on the soil surface. This mulching will be successful in dryland fruit tree culture. The pebbles placed on the basis of trees not only reduce evaporation but also facilitate infiltration of rain water into the basin.

5. Soil/dust mulching: Soil mulch is a thin layer of loose soil surface that can be created by frequently stirring the soil with surface tillage implements like danthis, guntakas (blade harrows) etc., Soil mulch of surface 5-8 cm dry soil effectively reduces the evaporation losses by obstructing the raise of soil moisture through capillary action. The soil mulch also prevents deep cracks in soils (especially black soils) by reducing the direct action of atmosphere and hence evaporation is also reduced. Among the different mulches soil mulch is the cheapest.

6. Live mulch: Live mulch is the covering of soil surface through the plant canopy in intercropping system. E.g., Sorghum + forage cowpea.
Sorghum + sword bean.

Advantages of Mulch on Soil and Moisture Conservation

1. Mulching will reduce the soil erosion
2. Improves the soil structure
3. Regulates the soil temperature
4. Reduce the evaporation losses from soil
5. Effectively controls the weed growth
6. Improves the soil organic matter
7. In dryland area soil salinization avoided.



(Kader *et al.* 2017)

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Hydrologic Modelling

Article ID: 10702

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Abstract

A hydrologic model is a simplified model of a real-world system that may be used to better understand, forecast, and manage water resources. Hydrologic models are frequently used to investigate water flow and quality. Conceptual models are frequently used to depict the essential components that relate hydrologic inputs to outputs. The essential capabilities of the system of interest are represented by these elements, which are often created using entities and interactions between them. The important watershed features like land use, land cover, soils, subsoils, geology, wetlands, lakes. Atmospheric exchanges like precipitation, evapotranspiration. Human uses like agricultural, municipal, industrial, navigation, thermo- and hydro-electric power generation. Flow processes like overland, interflow, baseflow, channel flow and transportation would then be specified in the watershed model like low-, flood, and mean-flow conditions are interrelated with hydrologic modelling.

Introduction

The modelling objectives influence the complexity of a model, systems modelling is a method of developing conceptual models that filled with mathematical relationships. Symbolic hydrologic models are mathematical models that reflect the transport mechanisms in a watershed quantitatively and qualitatively. It is possible to create a three-dimensional conceptual model of a watershed as a continuous system. As examples, this notion is represented mathematically as a distributed system and as a lumped system. The term hydrology may be considered an important issue for humans and their environment. It is concerned with the occurrence, circulation, and distribution of the earth's water, as well as its chemical and physical properties, and its interaction with the environment, particularly its link with living organisms. It also investigates how water interacts with the environment throughout the hydrologic cycle. As a result of increased urbanisation and industry, many changes in hydrologic systems have occurred, including deforestation, land cover change, and irrigation. In addition to climate change, soil heterogeneity has had a direct impact on the flows of several rivers in and around the world.

Types of Models

Rainfall-runoff models are classified based on model input and parameters, as well as the extent to which physical principles are followed in the model. Based on the other requirements, it may be classified as lumped and distributed models, as well as deterministic and stochastic models, depending on the model parameters as a function of space and time. For a single set of input values, a deterministic model will provide the same outcome, but stochastic models may produce numerous output values for the same set of inputs. By splitting the entire catchment into tiny parts, generally square cells or triangulated irregular networks, a distributed model may produce predictions that are dispersed in space, whereas a lumped model ignores the parameters and generates outputs without addressing the spatial processes, and another distinction is made based on the passage of time: static and dynamic models. The static model does not account for time, while the dynamic model does.

Empirical Models (Metric Model)

These are observation-oriented models that just employ data from current sources without considering the features and processes of the hydrological system. Hence, they are also known as data driven models. The actual catchment processes use mathematical equations derived from simultaneous input and output time series. The unit hydrograph is a good example of this method. In statistically based methods, regression and correlation models are used to determine the functional connection between inputs and outputs. The machine learning techniques employed include artificial neural networks and fuzzy regression are also classified under this model.

Conceptual Methods (Parametric Models)

The complex hydrological processes are mainly falling under this model. This model involves series of linked reservoirs that represent the physical components in a watershed, and they are supplied by rainfall, infiltration, and percolation are represented as input and emptied by evaporation, runoff, and drainage as output. Model parameters are determined not just from field data but also through calibration in this technique, which uses semi-empirical equations. A significant quantity of meteorological and hydrological records is required for calibration. The calibration process entails curve fitting, which makes interpretation challenging.

Physically Based Model

This is a mathematically idealised representation of a real-life event, because they include physical process principles, these are often known as mechanistic models. It employs measurable state variables that are both time and spatial dependent. The hydrological processes of water flow are represented by finite difference equations. The calibration of these models does not require extensive hydrological or meteorological data, but it does necessitate the assessment of a vast number of parameters that define the watershed physical characteristics.

Conclusion

The most used methods for investigating hydrological processes are rainfall-runoff models. From small catchments to global models, a wide range of models with diverse applications have been built. Each model has its unique set of characteristics and applications, some of them are large and geographically and temporally scattered, dependent on the physics of underlying hydrological processes. The models help with flood predictions, effective water resource management, and water quality evaluations, as well as erosion and sedimentation, nutrient and pesticide circulation, land use, and climate change. For successful prediction, several techniques of model evaluation are required. It is also worth mentioning that the calibrated parameter values will represent the root of any modelling errors. Model calibration will suffer unless you have a good hold of subsurface flow pathways and hydraulic characteristics. Several researches are still being carried out in attempt to enhance projections and solve major concerns. Existing theories must be updated or new theories must be created in order to evaluate the impact of climate change and land use changes on the system.

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Applications of Flow Cytometric Methods in Semen Analysis for in Vitro Fertility Appraisals of Bull Semen

Article ID: 10703

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Summary

Flow cytometric evaluation of semen offers enough scope to identify the subtle differences between the high and low fertile spermatozoa. Thus, this robust technology has an immense potential to be applied in semen stations. Modern semen evaluation techniques take into consideration all important structural biochemical, cellular and molecular aspect on sperm physiology viability and fertility. Sperm cell is a complex structure with almost all its parts contributing to successful fertilization of the ovum, therefore accurate assessment of semen quality would imply that the applied test is able to discern deviation in the sperm cells including their internal structure organelles and their functional status as to be correlated with ultimate freezing potential.

Introduction

Male infertility is in increasing trend irrespective of the species. In animal sciences, bull fertility is the major problem limiting the genetic improvement of diary animals at field condition. The accurate prediction of male fertility is of major economic importance in the animal breeding industry. Conventional semen analysis is not so ideal and results are variable and time consuming. A quick precise and accurate method for semen evaluation has been a goal of the breeding industry. A model comprised of in vitro diagnostic test of sperm function may prove the most accurate method of determining the fertilizing ability of the bull in vitro (Gillian et al. 2008). Extensive research is being carried out on identification of fertility markers and development of fertility assessment assay for predicting the frozen semen fertilizing potential and to maintain semen quality control standards in semen evaluation.

Applications of Flow Cytometric Methods in Semen Analysis

Accurate prediction of male fertility is necessary to increase breeding efficiency in animal production. Finding the sub-fertile bulls that “fly under the radar” could potentially save considerable amount of money, especially if sub-fertility could be determined early on before the bulls reach breeding age. Since CASA variables are known to be more useful in predicting the fertility of semen. Adoption of latest CASA techniques along with routine semen analysis could help in better assessment of quality of frozen semen to improve fertility on AI. Further research on relating CASA variables with fertility would be useful for better utilization of CASA analysis. As CASA yields repeatable and highly reliable results on kinematics of ejaculates based on measurements of individual sperm cells and based on objective evaluation avoiding human judgmental error (Sundararamas et al. 2012). Flourescent biomarkers measured by flow cytometry can aid in detection of sub-fertile bulls as they can identify abnormal spermatozoa that may not be properly identified as inferior with standard methods of subjective semen analysis. Being able to identify markers of good fertility as well as poor fertility in semen samples in a fast and objective manners could reduce the need for multiple inseminations and prevent expenses covering offspring testing of sub-fertile producing poor pregnancy rates in AI service.

Flow cytometry is fast, accurate, highly repeatable, and can analyze significantly more sperm per sample (upto 10,000) than standard semen analyses (Christensen et al. 2004). In addition to the speed, repeatability, and accurate, flow cytometery allows close examination of numerous sperm characteristics; including sperm viability/membrane integrity and mitochondrial function and membrane potential (Garner et al., 1997, Graham et al., 1990) chromatin structure (Bochenek et al., 2001). Recently, a combined flow cytometric analysis and mi RNA profiling as a tool to discriminate between High and low fertility bulls has been studied (Turrie et al. (2021).

Sperm DNA integrity is important for success of natural or assisted fertilization including normal development of the embryo, foetus or offspring. DNA fragmentation can be studying using acridine orange staining.

1. Sperm chromatin structure assay (SCSA): This is test to measure the level of DNA fragmentation in the sperm, to enhance the diagnosis of male infertility. Sperm that appears to be normal by traditional semen analysis parameters (motile, morphologically normal sperm) may even have extensive DNA fragmentation. In an effort to achieve the most effective measurement of male fertility, the SCSA reports the percentage of the major populations of fragmented sperm present in a semen sample and this test is performed using flow cytometer in which cells that have been stained with a fluorescent dye are sent through a glass channel in liquid suspension. The cells pass through a laser beam and the light from the beam causes the dye to emit fluorescent light of a certain colour. When performing as SCSA, the colours measured are red and green; green fluorescing sperm have very low levels of fragmented DNA and red fluorescing sperm have moderate to high levels of fragmented DNA. SCSA can measure 5000 individual sperm in just seconds and the data provides both a diagnostic and prognostic evaluation of the male's potential for sub fertility or infertility. Another advantage is the fact that the data are from objectives, machine defined criteria rather than from biased human eye measurements as with a standard semen analysis. In addition to having higher level of repeatability than that of any other semen types in the semen samples as opposed to evaluation of only washed samples (Kumaresan et al. 2020) studied sperm DNA integrity and male fertility in farm animals and described prognostic value of sperm DNA quality on male fertility and suggested that incorporation of sperm DNA fragmentation assay in the breeding soundness evaluation could improve the accuracy of selection of quality breeding males for an artificial breeding programme.

2. Flowcytometric assessment of sperm motility: Flow cytometery is a process in which fluorescently labelled cells (in this case, spermatozoa) travel individually at high speed through a flow cell, where they are illuminated by one or more lasers. This causes light scattering and fluorescence excitation of markers located on specific parts of the sperm, which is then picked up by photo detectors and sent to a computer program. The computer program presents the information in the form of relative fluorescent intensity units, which are typically displayed as either scatter plots or histograms (Marinez-Pastor et al 2010).

3. One of the main concerns with analyzing spermatozoa by flow cytometery is the present of non-sperm events in the samples such as immature forms of spermatogenic cells, bacteria, blood cells, tissue and in frozen thawed semen, extender contaminants such as egg yolk particles. During the data analysis, these non-sperm events can be taken into account and most of the time can be eliminated from evaluation by gating of scatter diagram/Histogram.

4. Flow-Cytometery (FACS Analysis), is a technology that examines thousands of spermatozoa within minutes, yet latter's high cost further poses a hindrance in its wider applications in semen labs.

5. Flowcytometry also utilizes fluorescence probes for sperm staining and increases the objectivity of analysis allowing large number of spermatozoa to be evaluated in a short time while providing reliable results. Flowcytometery allows simultaneous evaluation of multiple sperm characteristics, hence providing precise description of the sperm population.

6. Sperm viability/membrane integrity assessment: Living sperm cells have undamaged membrane and therefore the integrity of the plasma membrane can be considered an indirect indicator of sperm viability. Sperm viability is assessed using fluorescent dyes that stain either living or dead sperm cells, or a combination of both dyes. The most commonly used dye for staining dead sperm cells is propidium iodine (PI). PI is not membrane-permeable, making it useful to differentiate necrotic, apoptotic and healthy cells based on membrane integrity. PI binds to DNA by intercalating between the bases with little or no sequence preference and colour the DNA to red. It is often combined with some with vital dyes such as carboxyfluorescein diacetate (CFDA) or SYBR-14, which stain living spermatozoa and give green fluorescence. The CFDA staining principle is based on the ability of nonfluorescent CFDA staining principle is based on the ability of nonfluorescent CFDA to penetrate into cells, however only in viable, metabolically active cells, it can be cleaved by means of enzymes into fluorescing carboxyfluorescein.

7. Sperm Acrosomal Reaction Status assessment: Acrosome is a cap like structure covering the anterior portion of spermatozoon nucleus and having enzymes useful in acrosomal reaction. During acrosomal reaction outer acrosomal membrane is exposed, it has disaccharide with terminal galactose. Fluorescein isothiocyanate peanut agglutinine derived from arachis hypogea binds to β –Galactose found on outer surface of membrane. PSA (Pisum sativum agglutinine), derivative of Pisum sativum binds to α-Mannose and α-Galactose found on inner surface of membrane. Acrosome reaction status can be analyzed using Fluorescein isothiocyanate-Pisum sativum agglutinin (FITC- PSA) or Peanut Agglutinin (FITC-PNA)

8. Sperm Intra-cellular calcium status assessment: Sperm intracellular calcium status can be assessed using Fluo dyes. Fluo-3 is a fluorescence indicator of intracellular calcium (Ca2+) and is used measure Ca2+ inside living cells in flow cytometry using visible light excitation (compatible with argon laser sources operating at 488 nm) Fluo-3 is an essentially nonfluorescent compound, but upon binding of Ca2+ its fluorescence increases sharply with an emission maximum at 525 nm suitable for conventionally used detectors designed for fluorescein isothiocyanate (FITC) measurements. Fluo-4 is an analog of Fluo-3 with the two chlorine substituents replaced by fluorines, which results in increased fluorescence excitation at 488 nm that gives higher fluorescence signal. Fluo-4 is essentially nonfluorescent without Ca2 present, but the fluorescence increases at least 100 times on Ca2+ binding.

9. Assessment of sperm protamine deficiency: Sperm protamine deficiency can be assessed using Chromomycin A3. An antibiotic exhibiting anti-bacterial, anti-fungal and antitumor activities and also serves as a fluorescent DNA stain. This is useful for the detection of protamine deficiency in sperm chromatin. During spermatogenesis histones are replaced by protamines. Protamines causes tight packagaging of chromatin. Chromomycin competitively binds to the binding site of protamine and detects protamine deficiency.

10. Assessment of sperm mitochondrial ROS status: The production of superoxide by mitochondria can be visualized using the MitoSOX™ Red reagent permeates live cells and selectively targets mitochondria. It is rapidly oxidized by superoxide and the oxidized product is highly fluorescent upon binding to nucleic acid.

Conclusion

An overview of study on applications of flow cytometric methods in semen analysis for in vitro fertility appraisals of bull semen revealed that a combination of various diagnostic tests and parameters along with flow cytometeric analysis of semen is robust technology to predict the fertilization potential of semen of bulls before inclusion in breeding programme. Also, it could be used to aid in the development of new cryopreservation techniques for better quality retrieval of semen with good fertility.

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Impact of COVID-19 Crisis on Livestock Sector

Article ID: 10704

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Introduction

The COVID-19 has taken the form of a global pandemic. Livestock sector and food security are most at risk due to the COVID-19 pandemic. The COVID-19 pandemic and the associated lock-downs have led to significant adverse impacts on various sectors including that of the livestock, agriculture sectors in India and several other countries. COVID-19's impact on the livestock production, processing industry and food supply chain was unexpected. The lives and livelihoods are at risk from this pandemic. COVID-19 has significantly impacted the agricultural and livestock sector starting from production of the product to distribution chain. Throughout whole supply chain, the different food processing industry is experiencing disruptions that will have a lasting impact on the economy of food industry and livestock sector (Biswal, 2020).

Impact of COVID-19 Crisis on the Livestock Sector are as Follows

1. Decreased sale and consumption of animal origin food: The closure of hotels, fast-food shops, crisis in the hospitality and tourism industry led to fall in milk product and poultry meat consumption. The restaurants are shutting up sales of products such as flavoured milk, curd, khoya and skimmed milk powder have completely dried up. In the dairy industry also about 35% reduction in consumption in the initial weeks of lockdown period. Due to unemployment in the society and change in the economic have left people with little or no income to buy food for them. The sale of livestock milk and meat products decreased due to reduction in purchasing power of consumers. Fake news on social media and rumours among the people can also affect demand of chicken In India (Parmar,2020). With the incidence of COVID-19, the dairy industry in India has suffered significantly due to the reduced overall demand of about 25-30% in the country, at least during first 1st month after the lockdown, that is, since March 25, 2020. In most of the countries of the world, closure of small hotels, large restaurants and reduced tourism, movement of people leading to a sharp decrease in demand for food by these sectors. Freshly collected fish from different sources and aquatic products, which are highly perishable in nature and therefore need to be sold, processed or stored in a relatively limited time are at particular risk. The COVID-19 lockdown has affected 500 million people in China, several people affecting the consumption of goods. This lockdown not only severely affects the native's economy but leaves an unbearable loss to the rest of the countries which are dependent and interlinked with other country economy. The decrease in imports of different products may increase the prices of essential commodities due to decreasing stock quantity. From the point of view of imports, various livestock products such as raw meat, sea products, etc. are imported from China. But due to the coronavirus outbreak, the export of these products from China has reduced in a big way. The sale fish and meat, milk has also been affected during the lockdown period as the uptake by the organized industry players has been affected due to shortage of workforce and transport issues (Chetia, 2020). The uncertainty faced by farmers growing perishables product and also impacted 70 million households in rural India who own small dairies. Sales of milk products, ice creams or cottage cheese, fell sharply in the lockdown period. Demand for milk, milk products has fallen sharply since the hotels, restaurants and the catering industry is practically shut. Milk and milk products are usually sold by way of an extensive network of small shops. Not more than 60% of these are functional. The consumer is also purchasing only what is really essential. (Bera, 2020). The post-COVID-19 lockdown further reduced the demand of the meat all across the India due to several other logistic factors.

2. Impacts on animal production:

a. Reduced availability to animal feeds and animal health service: Social distancing and shortage of personal protective gears have been reduced the efficiency animal fodder and industrial feed enterprises which affected the production of animals. Restricted movement and illness are resulting in labour shortages and reduced supply of raw materials or other ingredients. Disruption of supply and trade routes has further curbed feed supply (FAO,2020). In India at least during the 1st phase of lockdown inadequate availability of critical inputs such as feed and fodder, significantly affected the growth and production of the rearing animals, leading to substantial economic loss. Due to the close down of the feed plants, availability of the animal feed in most of the places was difficult. With no proper access to the feed supply, the dairy farmers in the initial period had to compromise the feeding of their cattle and buffaloes largely with the available dry crop residues and brans. The banning of transport caused shortage of logistical supplies, along with limited veterinary services. Also, delivery and use of vaccines and medicines were interrupted. In Bangladesh Paravet's income reduced. Farmers call paravet's only in case of serious ill health of their animal.

b. Reduced access to inputs and services: Transport restrictions and disruption of national and international routes is reducing farmer access to breeding materials and replacement stocks (e.g., day-old chicks and semen). The disruption of public services (e.g., food testing, food safety inspection and animal health and extension services), combined with interrupted delivery and use of vaccines and medicines is increasing the likelihood of new epidemics, including those involving animal diseases that cause major livestock losses.

c. Reduced access to markets: Closure of live animal markets, slaughter house/processing in many parts of country means small-scale producers cannot sell their goods. The interference of the logistical channel and drop in demand were reducing sales and lowering prices. As a result of restricted access to slaughterhouses, meat, milk processing plants, livestock market farmers had to keep their stock longer or dump milk, left them with higher production costs or important losses (FAO,2020). In India due to paucity of sufficient storage facilities, for eggs in large layer poultry farms and also cold-chain facilities led to forced disposal of the produce at a through-away price.

3) Impacts on animal origin food processing:

a. Diminished processing capability: Livestock product industry such as meat and milk processing product have labour intensive nature and facing shortage of labour staff due to lockdown, quarantine and sick leaves taken by workers. This led to decreased capability of processing of animal products and by-products. Most processing plants lost their employees due to quarantine contributing to the reduced processing capacity of the plants.

b. Compromised storage and up keeping: Some meat and milk collectors were forced to stock up due to change in consumption habit, retailing and interrupted transport.

c. Constrained informal businesses and non-availability of labour: Most of meat and dairy processing in developing countries is informal COVID-19 disrupts these businesses. This disruption removes an outlet for small-scale livestock producers, who often lack the basic infrastructure facility of cold storage and capacity to sell the livestock product to formal markets. Moreover, severe disruption to the supply of perishable meat, milk, different dairy products, fish having mobilized to meet the increasing demand from a bulging middle class and urban or rural consumers, may create irreparable damage to all sector in the supply chain system. The migration of workers from few parts to their native places has also leads to impacts on livestock industry, as they are crucial for animal farm, dairy operations and post-harvest handling of different product, also produce in storage and marketing centres. There is also non-availability of sufficient labour for the small and large organized poultry, hatcheries, goats' farms, feed plants and also dairy processing units had been a constraint, especially during 1st phase of lockdown.

4. Impacts on transportation of animal origin food:

a. National transport: Interstate and intro state transport restriction reduced the supply of livestock and livestock goods. Fisher folk were being forced to dump their catch back into the sea due to the closure of ice factories, fishing harbours, and transportation facilities to move their cargo. The lack of transportation facilities and middle-men have hampered the proper distribution, which has led to the deterioration of livestock products. In India during lockdown period limited access to the veterinary dispensary, paravets and even veterinarians and also problems of transportation of animals to the polyclinic at the time of need led to a high level of morbidity of animals and even death of the animals. Due to limited health care service in long run would greatly impact the reproductive efficiency and productivity of the farm animals. The shutdowns in China's provinces have hit supply chains, with transport restrictions preventing much needed animal feed such as soybean meal from getting delivered to poultry farms (Singh *et al.*2020). In Ghana country also especially during the early days of the lockdown, decongestion and closure of some market centers to enforce social distancing among different traders reduced food supplies leading to increased e in food prices in most urban markets across the country, (Asante and Mills, 2020).

b. International transport: Travel bans affected the importation of food into the country, as well as the transportation of farm produce from food-producing areas within the country to market centers. Restriction on trade affected countries. Spared of covid 19 pandemic has slashed export of Indian buffalo meat. The trading of Indian buffalo meat is 100,000 tonnes / year but in March 2020 export dropped to around 40,000 tonnes. Livestock producers, butchers, livestock processing traders, lost their income as they were unable to sell their products (Parmar, 2020). In the Ghana country also most agricultural inputs imports from other parts of the world. COVID-19 prevention process protocols have decreased access to inputs and different services for animal production and breeding. Due to movement restrictions of national and international trade routes have curbed farmer access to animal breeding materials and replacement stocks. Most livestock and agricultural industry inputs are more expensive during lockdown period to import due to the closure of borders and restricted to commercial flights, thus increasing production cost and reducing profit margins of farmers. As stated by FAO (2020), meat export reduced in Latin America, especially in Argentina and Uruguay country and this has further dropped the farmer's revenues.

Conclusion

COVID-19's significant adverse impact on the food supply chain, livestock economy and livestock value chains have experienced strong disruption. Access to basic resources such as animal feed and livestock product production has become increasingly difficult, with both the production supply and the producers. Incomes of livestock farmers and livestock processer being affected by the crisis.

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Health Promoting Properties of Citrus Peel Waste

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Citrus fruits are the most abundantly grown fruit throughout the world and are broadly dispersed in the tropical, subtropical and temperate areas of the earth. One-third of the total citrus fruits are processed and the peel is discarded as waste. The citrus fruits are rich in vitamins, minerals, dietary fibre, pectins and active phytochemicals (e.g., flavanoids, phenolic acids).

Citrus peels of various origins are considered as a vital source of health-promoting bioactive substances such as phenolic compounds. It is used as an ingredient in dietary supplements, raw material in cosmetics, natural additives in food products and pharmaceuticals and nutraceutical sectors. The peel of citrus fruit is an easily available, economical and cost-effective plant-based resource to address lifestyle associated disease.

Mineral Content in Peel

The peel of citrus fruits is a valuable source of various minerals including calcium, sodium, magnesium, phosphorous, iron, etc. and discarding the peel causes a significant loss of nutritional content. The potassium content in the peel of an orange, lime and lemon was found to be more than in pulp whereas sodium content was found to be higher in the peel of an orange, lime, and mandarin relative to their pulp (Barros et al., 2012).

These minerals are responsible for the regulation of water and electrolyte balance. The calcium that plays a significant role in building bones is found to be more in the peel of citrus fruits. The phosphorous content in peel along with calcium contributes to the formation of strong bones and teeth (Takeda et al., 2004).

The peel of citrus fruits is also a rich source of micronutrients such as iron, zinc and magnesium. Iron is the dominant micronutrient that is present in higher quantities in the peel as compared to the pulp in all varieties. Zinc that protects the body against oxidative stress and stimulates immune mechanisms is higher in the peel of lemon, orange, and all grapefruit varieties than in the pulp (Czech et al., 2020).

Citrus fruits are rich in selenium that are beneficial in strengthening the immune system. This element is also higher in the peel. The maximum variation in the peel and the pulp was found in the lemon, in which the peel had more than twice as much selenium as the pulp (Czech et al., 2020).

Bioactive Compounds in Citrus Peel

Phytochemicals are major bioactive compounds that are known for their health benefits. The peel contains high content of polyphenols, especially phenolic acids and flavonoids, which have vital antioxidant, anti-inflammatory, antiatherogenic, anticlotting, antitumor activity, anti-inflammatory, anti-allergic, antiproliferative, antiviral, anti-carcinogenic, neuroprotective and anti-microbial properties (Oboh and Ademosun, 2012; Ani and Abel, 2018).

Phenolics have an antioxidant effect and the mechanism involves free radical scavenging and metal chelating effect. Phytophenols has an effective role in preventing and treating free radical-mediated diseases such as diabetes, cancer, neurodegenerative diseases, the process of ageing and cardiovascular dysfunction by scavenging free radicals and quenching reactive oxygen species (ROS) (Rafiq et al., 2018).

Wang et al. (2014) stated that peels of citrus fruits have more quantity of flavonoid in comparison with the edible parts of the fruit that provides various beneficial properties including anticancer, antiviral, and anti-inflammatory activities, reduced capillary fragility and restrict human platelet aggregation. Saponin reduces uptake of certain nutrients such as glucose and cholesterol at the gut through intraluminal physico-chemical interactions. They have hypoglycemic and hypocholesterolemic effects (Price et al., 1987).

The limonoids present in citrus peel display a wide range of biological activities, comprising antibacterial, antioxidant, anti-angiogenic and anti-inflammatory effects (Liu et al., 2021). Biological activities of alkaloids include antitumor, diuretic, antiviral, antihypertensive, antidepressant, antimicrobial, and anti-inflammatory (Aberoumand, 2012).

The studies also revealed that the alkaloid fraction of dried citrus peels have significant anti-asthmatic effects. The chief alkaloid components present in the citrus peel are synephrine and N-methyl tyramine. Synephrine, the most abundant alkaloid in dried citrus peel possessing the effect of constricting blood vessels, increasing hypertension, and expanding the trachea and it can also improve metabolism and increase calorie consumption (Liu et al., 2021).

Most of the citrus peels contain monoterpenes and sesquiterpene hydrocarbons and their oxygenated derivatives including aldehydes, ketones, acids, alcohols and esters. Limonene and **γ-**terpinene are the major components in essential oils of citrus peels that have anti-microbial, antioxidant and anticancer properties. The pectin content in citrus peel has been shown a remedy for intestinal inflammation, reduce the incidence of heart disease and reduce cholesterol levels (Liu et al., 2021).

Health Benefits

The most important citrus fruits are sweet orange (*C. sinensis*), bitter orange (*C. aurantium*), lime (*C. aurantifolia*), lemon (*C. limon*), grapefruit (*C. paradise*) and mandarin orange (*C. reticulate*) (Tranchida et al., 2012). The health benefits of the discarded peel of these species are given in the following Table.

Table 1: Health benefits of peels of different species of citrus fruits:

Peel source	Beneficial effect
Lemon *(C. limon)*	Antidiarrheal activity; anti-diabetic activity; anti-urolithic activity
Mandarin *(C. reticulate)*	Anti-inflammatory; anticancer; anti-proliferative activity; hypocholesterolemic and antidiabetic effects
Orange *(C. sinensis)*	Antioxidant; cytotoxic effect against cancer cells; hypocholesterolemic and hypoglycemic effects; improves intestinal health and function; antiproliferative activity; anti-inflammatory activity.
Grapefruit *(C. paradise)*	Inhibits oral carcinogenic.
Bitter orange *(C. aurantium)*	Attenuated liver fibrosis; anticancer.

(Singh et al., 2020; Liu et al., 2021)

Conclusion

The peel of the citrus fruits is a valuable source of micro and macronutrients along with the presence of bioactive compounds such as flavonoids, alkaloids, limonoids and pectin that contributes to the health-promoting relevant effect of citrus peel. The low cost and easily available peels are considered as a potential nutraceutical resource. The use of citrus peel is also useful in alleviating the problem of pollution caused by peels because of poor disposal of this non-edible residue.

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Nutritional Intervention to Muddle through COVID-19 Pandemic

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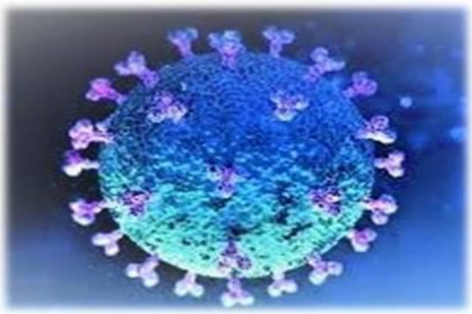
Abstract

The prevailing COVID-19 pandemic has shown the loopholes in the mechanisms of our preparedness and response towards dealing with a catastrophe of such proportion. The hard lessons learned during the second wave of COVID-19 has not only shown the need to improve resilience and enhance the efficacy of public health system, but it has also shown the effects of inadequate nutrition which can have long-lasting effects on human health and even increase susceptibility towards various diseases including COVID-19. Thus, it's high time to evaluate our preparedness against such global catastrophe and develop precise and effective response strategies to avert any disaster waiting to happen in near future, including third wave of COVID-19.

Keywords: Pandemic, Immunity, PEM, PUFA, COVID-19.

Introduction

The COVID-19 pandemic has led to a global catastrophe of immense proportion and caused a do or die situation in front of the new world order, each country, particularly under developed and developing countries now faces dire consequences of over strained medical capacities along with failure of critical medical infrastructures, including availability of medical oxygen producing units and distribution and transportation of the same.



Due to of lack of resources i.e., proper medical infrastructure, availability of vaccines, and other essential medical infrastructure, many conflicting decisions have been made by both the authorities and the medical fraternity, particularly with difficult ethical and legal issues The second wave of Covid -19 has shown the loopholes in the mechanisms of our preparedness and response and have led to a pandemic catastrophe. It's right time to undergo self-evaluation and develop precise and effective response strategy to avert any disaster waiting to happen in near future, including third wave of COVID-19. There should be a periodic review and regulations of the level of pandemic preparedness i.e., clear and legal aspects of the responses need to be streamlined with enhanced participation between different stakeholders (both government and private agencies).

The existing contingency plans usually involve disease surveillance, community containment and travel restriction, and mass vaccination drives. However, little attention has been directed towards nutritional status of the poor and deprived who are more vulnerable and susceptible towards falling prey of the novel corona virus. All the health and medical strategies require people to adopt covid appropriate behaviour and follow ways to avoid exposure, prevent infection, or halt disease transmission. This article covers the nutritional intervention required to muddle through COVID-19 Pandemic.

Nutritional Intervention

Nutrition plays an essential role not only in maintaining an efficient and effective immune system, so it is of outmost importance to avoid deficiencies of essential nutrients that play an essential role in immune cell triggering, interaction, differentiation or functional expression. Malnutrition decreases immune defences against invading pathogens and makes the individual more susceptible to infection. Nutritional aspects need to be taken into consideration, while developing suitable strategies to combat diseases including pandemic preparedness.

Proteins and Energy Status

It is clinically proven that inadequate protein intake impairs host immune response particularly those involving T-cells, leading to increased susceptibility to pathogens and other infections. Deficiency of proteins in diets, impairs immunity as immune system is associated with a high rate of cell proliferation and protein synthesis particularly those with important biological activities, i.e., antibodies, cytokines etc. In human beings' protein-energy malnutrition (PEM) has been frequently associated with low levels of differentiated T lymphocytes particularly CD4+ and CD8+ helper and suppressor cells, respectively. Thus, significantly impairing phagocytic cell function, cytokine production and complement formation. Essentially, all forms of immune responses have been shown to be adversely affected by PEM, depending on the severity of the protein deficiency relative to energy intake.

Vitamins and Minerals

Vitamins are known to mediate myriad immune functions. Deficiencies of vitamins i.e., fat-soluble (vitamins A and E) and water-soluble vitamins (folic acid, B6, B12 and C) severely impair immune function and decreases the ability to resist infection within humans. Vitamin supplementation may help restore immunity. Minerals are also known to act as immune-modulators, particularly zinc, iron, magnesium, manganese, selenium and copper. Iron deficiency is known to be associated with increased morbidities from various infectious diseases. Similarly zinc supplementation may be used as a treatment for the common cold. However, excesses of some minerals (particularly iron and zinc) can even impair immune function and increase susceptibility to infection. Hence, supplements should be taken only as required and regular monitoring of iron status (serum ferritin and blood haemoglobin) and zinc status (erythrocyte zinc) is probably a good idea.

Essential Fatty Acids-Polyunsaturated Fatty Acids (PUFA)

Dietary polyunsaturated fatty acids (PUFA) are known to affect a wide variety of physiological processes. Two groups of PUFA are known to be essential for the body: the omega-6 (n-6) and the omega-3 (n-3) fatty acids, derived from linoleic and linolenic acid, respectively. These are essential fatty acids and cannot be synthesized within the body and therefore must be derived from the diet. Recent findings have shown that diets rich in either of these polyunsaturated fatty acids improve the conditions of patients suffering from diseases characterized by an over-active immune system i.e., anti-inflammatory effects. More evidences have now been accumulating through a number of epidemiological studies and clinical trials, showing possible role in myriad immune responses and dietary intervention is recognized as a key measure in therapy and maintenance of health in general.

Community Resilience via., Dietary Immunostimulants

Dietary immunostimulants play an essential role in enhancement of non-specific defence mechanisms apart from increasing resistance towards specific pathogens, they usually activate leukocytes. β-Carotene (pro-vitamin A) acts both as an antioxidant and an immunostimulant, there by acts by increasing the number of T-helper cells in healthy individuals apart from stimulating natural killer cell activity. Several herbal preparations are also known to possess immune modulatory effects and have pharmacological properties and therefore may be treated as functional foods. There is an urgent need to incorporate dietary immunostimulants in management of various diseases including COVID-19 so as to increase individual and community resilience and acting as first line of defence in emergency preparedness.

Conclusion

The current COVID-19 pandemic has shown the need to improve resilience and enhance the efficacy of public health system. Inadequate nutrition, can lead to long-lasting effects on human health and even increase susceptibility towards various diseases, as well as have psychological and behavioural consequences. It's time to adopt suitable action plan keeping in view the requirement of optimal nutrition at the individual, community and national levels as well as identifying and managing psychological and social factors likely to influence human behaviour particularly during a pandemic. Diet has a profound effect on individual's immune system and disease susceptibility, so nutritional requirements need to be taken into consideration to combat viral infections, including COVID-19, as nutrients play an essential role in an effective immune response. Thus, it's high time to consider nutritional status of the population, particularly the most vulnerable groups as an indicator of resilience against the preparedness against pandemic similar in magnitude as COVID-19.

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Applications of Smart Packaging

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Introduction

The act, process, industry, art, or style of packing is the packaging. Heat, light, moisture, gaseous emissions, pressure, microorganisms, and other external environmental variables might cause the product to deteriorate. Smart packaging, on the other hand, is an innovative technique to package a product that provides a quick, inexpensive, and effective means to monitor the environmental conditions of food in the supply chain.

It is a rapidly expanding field in the food industry, comprising many fields of technology to assist in environmental control, detecting changes in the headspace, and tracing product history. The terms "active," "intelligent," and "smart packaging" refer to food, pharmaceutical, and other product packaging systems. This article discusses various smart packaging technologies and their uses in food packaging, as well as packaging research and development.

Smart, Active, and Intelligent Packaging

Active packaging, intelligent packaging, and smart packaging are terms that have appeared in literature over the last two decades and are frequently used interchangeably. Foods, beverages, pharmaceuticals, cosmetics, and a range of other perishable things are all packaged in these systems. In a strict sense, there is a distinction to be made between smart, intelligent, and active packaging.

1. According to Kerry et al. (2006), active packaging is defined as the "incorporation of specific additives into packaging systems with the goal of maintaining or extending product quality and shelf-life."

2. According to Otles and Yalcin (2008), intelligent packaging is "a packaging system capable of carrying out intelligent functions such as sensing, detecting, tracking, recording, and communicating to facilitate decision-making to extend shelf life, improve quality, enhance safety, provide information, and warn about potential problems to facilitate decision-making to extend shelf life, improve quality, enhance safety, provide information, and warn about potential problems."

3. Other authors, such as Otles and Yalcin (2008) and Vanderroost et al. (2014), characterized smart packaging as "one that possesses both intelligent and active packaging characteristics." Smart packaging is a whole package solution that, on the one hand, monitors and reacts to changes in the product or environment (intelligent) and on the other hand, monitors and reacts to these changes. Biosensors or Chemical sensors are used in smart packaging to track food quality and safety from the farm to the table (Schaefer and Cheung, 2018).

Table – 1 depicts the common examples of active packaging, intelligent packaging and smart packaging.

Types of packaging	Examples
Active packaging	Moisture regulator Oxygen scavenger Ethylene emitter Ethanol preservatives Corban dioxide scavenges PCM based thermal insulation packaging
Intelligent packaging	Chemical sensor Time- temperature indicator Gas indicator RFID based tags Biosensor edible sensor

	Freshness indicator
Smart packaging	Chromogenic chemo sensors Electromechanical based sensor Real time- temperature monitoring system All intelligent packaging systems.

Smart Packaging Applications

It's unsurprising that the development of biosensors to detect infections in food is one of the most important applications of smart packaging technology. Moisture absorbers, antimicrobial packaging solutions, carbon dioxide emitters, oxygen scavengers, and antioxidants integrated in the packaging are some of the other applications.

Smart packaging technology offers a wide range of possible applications, ranging from food safety and drug usage monitoring to tracking postal delivery of packages using integrated security tags. New techniques of tracking and monitoring purchased goods with related apps has emerged into a key economic potential for organisations to boost consumer happiness and loyalty in this day and age of people being permanently linked to the Internet.

Smart packaging, according to Pacquit et al. (2007), can be used to discover supply chain inefficiencies, minimise costs and errors, improve product performance, and raise profit margins. One of the most important methods in minimising food loss and waste is technological advancements connected to food safety (Vilarino et al., 2017). Unique packaging materials and designs, temperature-controlled and energy-efficient storage systems, and sophisticated monitoring systems are just a few of them (Bahadur et al., 2016).

New technologies are desperately needed to assure food security. Advanced SP systems are emerging and being adopted by the pharmaceutical and food industries not only to supplement traditional packaging functions, but also as a tool or a solution to extend the shelf-life of food products, make the production process easier, reduce food loss and waste, eliminate preservatives, and, most importantly, to ensure consumer safety and satisfaction.

Food deterioration is a multi-step process that can be triggered by a variety of physical, chemical, enzymatic, or microbiological events. Bacterial growth and metabolism can cause pH shifts, as well as poisonous compounds, off-odors, gas, and slime production. Unpleasant odours and adverse effects can come from chemical reactions such oxidation, irradiation, and lipolysis.

In addition to intrinsic qualities, extrinsic influences (temperature, pH, and humidity) can affect chemical, physical, and biological food deterioration (physicochemical and structural). Integrity indicators, food spoilage indicators, microwave doneness indicators, ripeness indicators, rancidity indicators, and RFIDs are just a few of the technologies that can aid in the reduction of food spoilage. (Chen et al., 2020).

Conclusion

In recent years, a number of smart packaging technologies have emerged, which are now being incorporated into packaging systems to satisfy the needs of the food supply chain. Research into these smart packaging technologies may lead to enhancements to the current system.

In order to make smart packaging systems economically feasible and, eventually, in common packaging commodities, future research must include essential aspects. Smart packaging has unexplored potential in the future to provide customer benefits and convenience.

Another future technical goal is to integrate many functions into a single device (multi-functional intelligent packaging), as well as to develop new functionalities, such as a system that can transmit the presence of probable allergens, diet management warnings, and error avoidance alerts. Biosensors and biotechnology applied to food packaging systems are projected to make significant progress.

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Is Organic Practices Sufficient in Todays Modern Agriculture Era

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Importance of Organic Agriculture?

Alarming effect of insecticides leads to proceed toward traditional agriculture practices and our modern organic practices. Although they provide a healthy ecology and less health hazards it also reduces the problem like elimination of natural enemies' fauna, developing resistance to multiple classes of insecticides, secondary pest outbreak and these organic practices leave no harmful residue in environment and less effect to food chain. The modern chemical pesticides contain many carcinogenic compounds. Hence, to overcome these ecological as well as health problems the basic and important solution is to return back to organic farming. It means the utilization of naturally occurring substances while strictly prohibiting synthetic insecticides.

By knowing its importance government started many schemes in field of agriculture for inhancing organic agriculture. Many states are even in procedure to convert land into organic. As we know that Sikkim is totally an organic state and many states like Uttarakhand is under the process of convergence. The government schemes assistance for promoting organic agriculture across the country:

1. Paramparagat Krishi Vikas Yojana (PKVY).
2. "Mission Organic value chain development for North Eastern Region".
3. Capital Investment Subsidy Scheme (CISS) under Soil Health Management Scheme.
4. National Mission on Oilseeds and Oil Palm (NMOOP).
5. National Food Security Mission (NFSM).

Is Organic Farming being Sufficient?

As government provided many schemes to encourage the organic agriculture also by knowing the hazardous effect of conventional pesticides people are showing their interest towards organic farming. But still the question arises is organic farming is sufficient? For production of surplus food grain; no doubt that organic agriculture provides fresh and health food grains but without controlling the major insect pest or pest pathogen is it possible to obtain food grain. Yes, there are many botanical insecticides and fungicides, again the question arises if they are sufficient for every major insect pest or pathogens.

As organic agriculture includes no use of any inorganic or conventional pesticides. For organic certification of a land 3-year process is needed in which there should not be use of any pesticides during this period of time then only that land considered as organic. It seems to be an easy process but not. What if the land during this period is infested by termite attack? Or potato crop is infested by late blight disease? suddenly at this position we can't go for botanical pesticide because it leads to direct crop loss so what should be done in this condition.? Without using any inorganic pesticide, it is hard to control termites from soil. Yes, flooding the field could be an option for that but what about for unirrigated areas. Somehow, we know that total convergence of agriculture into organic land is a hard task.

Before implementation of organic agriculture, we should initiate it from IPM, so that only need based and harmless pesticides could be use. By using IPM, injudicious use of pesticides would be reduced and it would be proving a pioneer for future organic convergence.

Conclusion

As compare to synthetic or commercial insecticide, organic agriculture is a far better option for human health and environmental issues but it is also true that only by using organic culture practices we can't fulfil the need of entire population. Total organic agriculture should be our aimed but it shouldn't be the first step. Before going for organic agriculture, we should cultivate IPM Practices first.

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Resistant Starch and its Potential Health Benefits

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Introduction

Starch or amylum is a polymeric carbohydrate consisting of numerous glucose units joined by glycosidic bonds. It is a combination of amylose and amylopectin. Starch is a major agricultural product that is consumed on daily basis.

With the increasing pieces of evidence that part of the starch is not digested completely in the human GI tract, the concept of RESISTANT STARCH has emerged. This concept plays an important role in creating positive health impacts.

Apart from rendering various health benefits resistant starch also have positive implication in improving functional properties of food products. Thus, resistant starch becomes one of the emerging topics to be studied from different perspectives (Nisar *et. al*., 2017).

Resistant starch is the sum of starch and products of starch hydrolysis not absorbed in the small intestine. (European PLAIR concerned action on resistant starch). Resistant starch is both dietary fiber and a functional fiber as it is present naturally in the foods and can also be added exogenously to food preparations (Park *et. al*., 2004).

Resistant starch has been classified into five general subtypes called. RS1 – starch i.e., physically inaccessible as it is entrapped within whole or partly milled grains or seeds; RS2 – some types of raw starch granules (such as banana and potato) and high amylose (high-amylose corn) starches are physically inaccessible to digestion by alpha-amylase.

RS3 – retrograded starch is either processed from unmodified starch or results from food processing applications which involve moist heat cooking followed by cooling; RS4 – starches that are chemically modified to obtain resistance to enzymatic digestion (such as some starch ethers, starch esters, and cross-linked starches); RS5- Amylo-lipid complexes that are resistant to digestion are either present naturally or occur due to processing technique. (Ratnayake and Jackson, 2008; Sanz, *et. al*., 2009).

Food sources of resistant starch:
1. Very high (> 15%): Raw potatoes, Raw legumes, Amylose-maize, Unripe banana, Retrograded foods.
2. High content (5-15%): Cooked Legumes, Peas, Raw rice, Autoclaved and cooled starches, Cooked and frozen starchy foods.
3. Medium content (5-2.5%): Breakfast cereals, Fried potato, Extrude legumes.
4. Low content (<2.5): Refined flours, Boiled rice, Boiled potato.

The resistant starch content of foods can be increased by the application of:

a. **Physical treatments-principle:** Application of physical forces to alter morphology, size or distribution of starch

b. **Enzymatic debranching- principle:** Debranching of amylopectin followed by retrogradation.

c. **Chemical modification-principle:** Introduction of functional groups to make digestion resistance without affecting morphology, size or distribution.

Other novel techniques for increasing resistant starch content of foods are:

a. Application of gamma irradiation.
b. Complexion of amylose with lipids.
c. Genetic modification of starch to increase the amylose content.

Health Benefits of Resistant Starch

Anti-diabetic properties: Resistant starch intake modulate insulin sensitivity through alterations in fatty acid metabolism. Resistant starch improves insulin sensitivity through SCFAs and ghrelin.

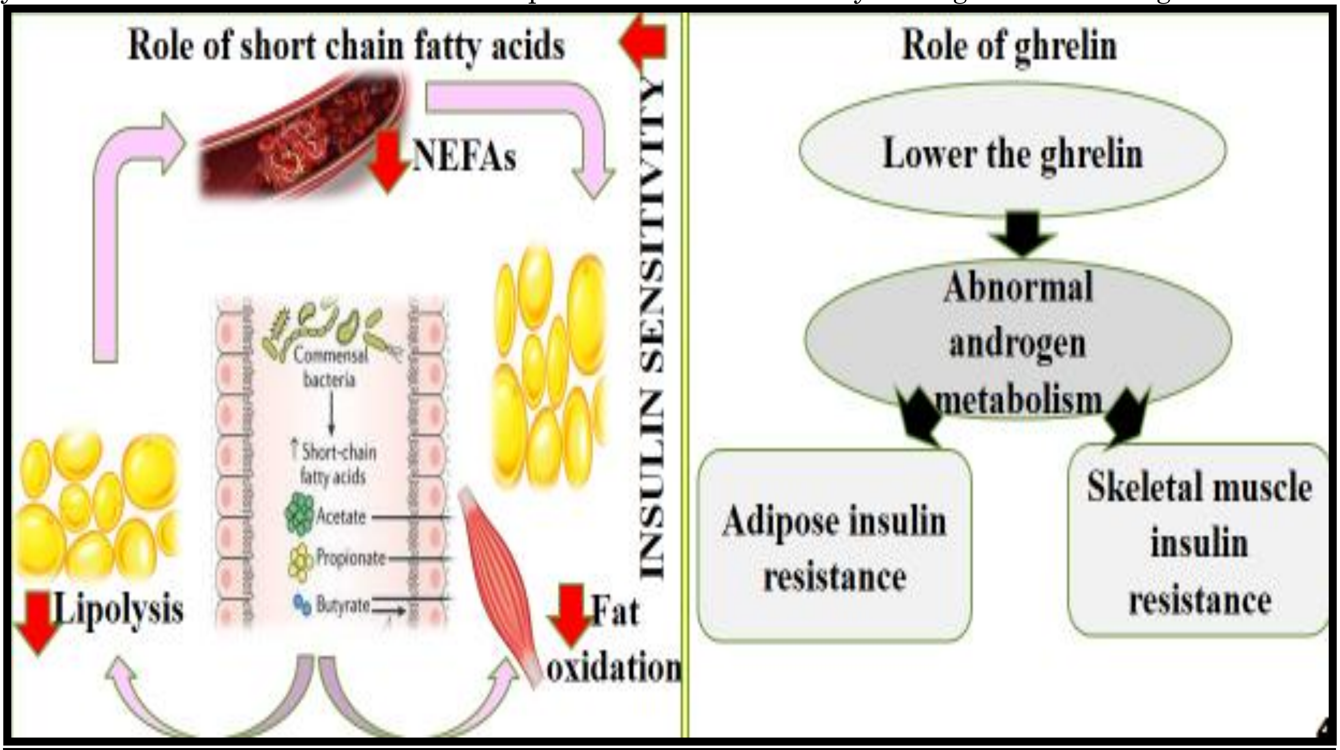

Figure. 1. Role of short-chain fatty acids and ghrelin on insulin sensitivity

Cardioprotective properties: Resistant starch lowers serum lipid concentration by increasing bile acid excretion and by inhibiting hepatic cholesterol production (propionate produced from the fermentation of resistant starch decreases the activity of hydroxyl methyl glutaryl-CoA reductase).

Thus, resistant starch has the potential to be used as one of the promising food ingredients for reducing risk factors involved in the development of atherosclerosis and cardiovascular diseases.

Obesity management: Resistant starch plays a role in the management of body fat by decreasing metabolizing energy values of foods and by increasing gut hormonal signalling via increased activity of gut peptide YY (PYY) and glucagon-like peptide (GLP)-1.

Anti-inflammatory and Anti-oxidant properties: Mechanism by which resistant starch lowers inflammation and oxidative stress are unclear. However, the production of SFAs and maintenance of gut barrier function would be the possible underlying mechanism.

Immunogenic property: Resistant starch is known to improve immunity mainly by producing short-chain fatty acids after fermentation in the large intestine. It is found that short-chain fatty acids play important role in the proliferation and metabolism of T and B lymphocytes. Thus, resistant starch play role in improving immunity.

Conclusion

Resistant starch escapes digestion by human digestive enzymes and is fermented in the large intestine to produce short-chain fatty acids that have many important physiological functions. The resistant starch of foods can be increased by various techniques and thus can be used as a functional ingredient.

Resistant starch plays important role in improving insulin sensitivity via SFA metabolism. The ability of resistant starch to excrete bile and inhibit the action of cholesterol synthesizing enzymes elucidates its cardioprotective ability.

Resistant starch also plays important role in reducing body fat via gut hormone signalling, reduces anti-inflammatory, anti-oxidant biomarkers. However further studies are required to test the efficacy of resistant starch in various aspects.

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"World Breast Feeding Week 1st to 7th August 2021". The Benefit of Breast Feeding for Both Mother and Baby

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World Breastfeeding Week is celebrated every year from 1st August to 7th August in over 120 countries to encourage breast feeding, highlighting nutritional and health benefits as well as it also promotes the importance of breastfeeding for the new born baby as well as the mother. This year the theme for Breastfeeding Week is 'Protect Breastfeeding: A Shared Responsibility'.

The American Academy of Pediatrics recommends breastfeeding as the sole source of nutrition for the baby for about 6 months and can be continued for as long as both mother and baby desire it.

Importance of Early Initiation of Breast feeding & Colostrum

After delivery highly concentrated form of breast milk is secreted from mammary gland which contains immune-boosting properties and is packed with protein, salts, antibodies and protective properties which is beneficial for the baby. The colostrums is yellow in color due to the presence of beta-carotene and Vitamin A which is usually found low in new born and good for eyes. Its laxative properties help to clear out first stool called Meconium and protect the child from jaundice. It is an excellent nutritional boost for premature babies.

When compared with regular breast milk, colostrum is higher in protein, copper and zinc but lower in sugar, fat, and calories. Hence, early initiation (within half an hour of delivery) of breast feeding is utmost important for the baby overall health.

Importance of Breast Feeding for the Baby

Breast milk is always at a right temperature and is filled with all the necessary nutrients in the proper proportions. It protects our babies against allergies, sickness, and obesity and also protects against diseases, like diabetes and cancer, ear infections etc. It is easily digested by the babies and thus it does not lead constipation, diarrhea or upset stomach. Studies have shown that those babies feed on direct breast milk or expressed breast milk has healthier weights as they grow and score higher on IQ tests. Further, the milk changes in volume and composition according to nursing frequency and age of baby. Most new born baby feeds 8-12 meals per day and often want to feed 2-3 hours. By 2 months, feeding every 3-4 hours is common and after 6-month baby want to feed every 4-5 hours. Exclusive breast feeding up to 6 month is utmost important without giving any other food. After 6-month babies digestive enzymes get developed and hence supplementary feeding along with breast milk is a must up to 2 years age of the child.

Importance of Breast Feeding for Mother Health

Breastfeeding provides health benefits for mothers beyond her emotional satisfaction. It was found that mothers who breastfeed recover from childbirth more quickly and easily than those who are unable to breast feed their child for some or other reasons. The hormone Oxytocin, released during breastfeeding, acts to return the uterus to its regular size more quickly and can reduce postpartum bleeding. Breastfeeding can promote a mother's health in various ways. It will reduce the risk of developing breast cancer, ovarian cancer, type-2 diabetes and heart diseases.

Hence, let us celebrate this 'Breast feeding week 2021' to encourage breast feeding to improve the overall health of the baby by following the theme 'Protect Breastfeeding: A Shared Responsibility' where a father can help in household activities, burping up of baby after every feeding, changing of diapers etc. i.e., sharing responsibilities.

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Cultivation Techniques of Cucumber Under Polyhouse Condition

Article ID: 10712

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Summary of Article

Cucumber (*Cucumis sativus* L.) is a very common and important crop cultivated in worldwide and often raw or eaten vegetable without cooking. It has been growing as a food or medicinal since ancient time in India. The seed of cucumber used for extraction of oil which is excellent for brain and body. Cucumber contains around 96% of water, which is good for summer season. Polyhouse cucumber cultivation is very famous in many countries of the world. Sandy loam soil containing high organic matter with good drainage facility and having electric conductivity less than 2 dS/m and range of pH from 6.5-7.5 are considered ideal for cultivation of cucumber. Moderately warm climate is requiring for better growth. The plants are large in size, hairy leaves, triangular shape and yellow coloured flower. Cucumber is an excellent source of molybdenum, vitamin and potassium and also used to cure of skin problems, kidney, heart problem and used as alkalizer. Protected cultivation of cucumber ensures higher productivity and superior quality than open cultivation.

Introduction

Cucumber (*Cucumis sativus* L.) is an important vegetable crop from Cucurbitaceae family and having a chromosome number 2n=14. Cucumber is native of south Asia, specifically warm and humid climate of the Himalaya in North West India and probably northern Africa. It gives best response under high temperature, humidity and light intensity with sufficient supply of water and nutrients. In India cultivation of cucumber is noted at least 3000 years ago and during 100 B.C. in China.

The immature fruit of cucumber is used as salad and for making pickles, pahari rayata and brined on commercial scale (Bairagi 2013). The fruit contains around 93- 95 % water and it delivers sodium, magnesium vitamins, potassium, sulphur, silcon, fluorides etc. in a good amount. The mineral which presents and make it alkaline represents 64.05 % and acid creating material is about 35.95 %. These are helpful to make it maintaining the human blood alkalinity. Cucumber contains carbohydrates 2.6 gm, protein 0.6 gm, calcium 18 mg, thiamin 0.02 mg, energy 12 cal, riboflavin 0.02 mg, Iron 0.2 mg, C vitamin 10 mg, and niacin 0.01 mg in each 100 g edible portion (Rashid 1999). Cucumber is a good source of calcium, potassium, magnesium and folate also. It also provides silica, which helps to give strength and connecting tissue and helps to relief from joint pain. Cucumber also contains secoisolariciresinol, lignans, lariciresinol and pinoresinol, which are helpful to reduce risk of different kinds of cancer.

The total area of cucumber, growing in India is 78,000 hectares with an annual production of 11.42 lakh MT (National Horticulture Board 2016-17). Now-a-days, greenhouse is most effective against adverse climatic conditions. Vegetable production under polyhouse by using advanced technology to make control over the environment increased crop productivity per unit area and produced the quality of vegetables (Singh 2005). It further, protects the crops from adverse conditions like extra solar radiation, high temperature, rain, pest and disease. It also helps to increase photosynthetic rate which results in increased productivity and improved quality of food under better management. Other important factors affecting increased crop productivity under polyhouse are number of plants per unit area and good management practices.

Soil Requirement

A well-drained, good soil structure, fertile soil with high porosity is required for cucumber crop. Good soil structure stability and high porosity are important with frequent water supply. For making these conditions, application large amount of organic matter and compost is recommended. Sandy loam soils having 5.5 to 6.5 pH is suitable for production of cucumber.

Soil Preparation

Around 80% cucumber roots insert, develop and spread in soil up to 20 cm form the surface; they have poor tolerance capacity like drought, flooding and low temperature. Preparation soil should be done very carefully like other vegetables inclusive of loose soil to provide good aeration for cucumber. In polyhouse, both flat bed and raised bed can be made. Bed width should be of 60-100 cm, which depends up on space between rows, and depth should be 25-30 cm. Top of soil of cucumber bed should be finer than sub soil layer. Plastic is used as a mulch material for covering raised bed. Application of plastic mulch has numerous benefits like as weed control, maintenance of soil temperature and reduction of water loss and these ultimately increase the yield. Plastic mulch should be laid when the soil is moist. The ideal time of laying of plastic mulch is afternoon, so that it will be tighter and more stretched (Egel, 2015). Cucumber can be grown in different media other than soil. Rockwool is a widely used medium. Other media are perlite and pumice. Bags or slabs are also used with 15-30 cm depth for cucumber cultivation. Cucumber is very much disturbed in high salinity; electric conductivity needs to be maintained around 2 dS m-1 at initial stage and should be up to 2.5 dS m-1 during growing stage (Savvas *et al*. 2013). High salinity condition creates serious problems, which results in unsatisfactory yield.

Temperature

Atmospheric temperature has impact on growth of plant, flower initiation and growth of the fruit and quality of fruits. An optimum temperature of ≤ 25 °C is required for faster growth of cucumber. At germination, average temperature is needed between 25–35 °C with good soil moisture and it takes 2-3 days to germinate. If the temperature comes down between < 13–15°C, then shoot dose not grow properly. Maximum tolerable temperature for cucumber is around 38–40°C. Under protected cultivation maintenance of such temperature can easily be done.

Planting

In polyhouse, mainly cucumber is cultivated by transplanting. However directly seeding in bed is implemented for early autumn or late summer planting, when the temperature is generally high for good germination of seeds. Cucumber cultivation is successfully possible, if transplantation can be done properly. The root system of young seedlings may be damage and growth are restricted if soil temperature is low. On the other hand, overgrown or aged seedlings do not establish in soil. Cucumber seedling should be placed deeply in soil and irrigated immediately for stand establishment. Irrigation water helps to plant to protect from fluctuation of temperature during day and night.

Plant Density

Density of plant in polyhouse depends upon expected light conditions, growth stage and method of pruning. Shading and overlapping of leaves may take place. A plant requires about 0.5 m2 area with good sunlight. But in northern states of India, much space is required because of low light intensity. In general, for proper growth of cucumber plant density should be 2.2–2.5 m2 is adequate in polyhouse conditions. Spacing between two rows and between plants depends on growers' preference. But the rows should be 1.2-1.5 m apart and between two plants spacing should be 0.40- 0.45 m.

Trellising and Pruning

Wire technique and string require for trellising for cucumber. Grower adopts different kinds of method according to their preference and availability of materials. In polyhouse uniform sunlight throughout growing season is available. To get optimum yield, it is important to make optimum balance between fruit load and vegetative growth in growth cycle. Pruning of shoot, foliage, flower and even fruits is necessary because if there is a greater number of fruits then maximum is aborted, poor colored and malformed. The situation also increases if proper sunlight is not there. In general, for long fruit cultivars, one fruits per axial should be allowed to develop, but vigorous cultivars allow more than one when the plant is matured. It is very much important that remove the lateral branches, flower and tendrils for 7-8 leaf nodes. All the lateral branches should be removed and plants are to be trained to single stem. The bottom leaves are removed gradually as the new leaves are present in upper part of stem. Once plant gets support with wire then it is allowed to reach a growth up to 20 cm according to wire height.

Irrigation

Irrigation management is essential for both yield and product quality. Cucumber has pretty high-water requirement; irrigation frequency also requires high. It is very much important that water and aeration in root zone should be maintained to provide adequate supply of oxygen to root. Daily water requirement depends on many factors like temperature, light intensity, relative humidity, plant density and phonological stage. In light sandy soil water drains off quickly; so, application of water needs frequently to maintain the moisture in root zone. When mulching is applied significantly less irrigation is needed because it reduces evaporation. Drip irrigation is most suitable techniques for cucumber grown in polyhouse. The EC of irrigation water should be < 1 dS m-1 and pH slightly acidic.

Fertilizer

The demand of nutrients for cucumber is higher at fruiting stage and it remains high during fruit production stage. Though cucumber requires high dose of nutrients, it is very much sensitive to application of excesses or sudden variation of nutrients, as well as significant fluctuation in concentration of nutrients in soil. To avoid such types of cases, it is recommended analyze the soil frequently and on the basis of soil test results; application of fertilizer is done in splits.

Harvesting and Post-Harvest

Cucumber can harvest on good environment which start around 30-35 days after transplanting and depends on cultivars chosen, climate conditions and modern technology used. Harvesting of cucumber is mainly done at immature stage, when length has reached. Mature cucumber price is less and over maturity reduces the production, if left in plant. Fruit should be harvested on cool climate, excess heating damages the cucumber. To reduce minimum damage and spreading disease it has been recommended to use clean and sharp tool at the time of harvesting. Cucumber loses the moisture content rapidly and to make soften immediately after harvest it should be transferred to the cold shortage. After harvesting cucumber should be kept in dry and clean container and in shady place and then shifted immediately to packing house. It should be handled carefully to avoid skin damage. The optimum temperature in cold storage required is 10-12.5 °C with relative humidity of 95 %.

Conclusion

Cucumber is a major vegetable crop of the world as well as in India. It is the second largest cultivated cucurbit after water melon. India ranks second in cucumber production in the world after China. Cucumber content of 90-95 percentages of water and having some limited nutrient value compare than other seasonal vegetable. The above-mentioned technology is suitable for enhancing quality and productivity of cucumber grown under protected cultivation.

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Intensify Productivity in Non-Availability of Quality Seeds

Article ID: 10713

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Abstract

"Good seed on good land yields abundant produce"-appearing in the ancient Hindu scriptures, the Manu Smriti provides an age-old recognition to the good quality seed in crop production. The use of good quality seed is indispensable for the successful production of any crop. The cost of seed is small fraction of the total cost of inputs involved in raising the crop maturity. Availability of hybrid seed at cheaper rate should be ensured. Crop and location specific production technologies should be standardized for hybrids. Multiple disease resistant hybrids should be developed to reduce the use of harmful chemicals. It increases water use efficiency, reduces weeds and cost of weeding and also can be laid out in undulating land. Vegetables being seasonal crops, the impact of climate changes is not visible at faster pace but much more has to be done to increase productivity of vegetable. Development of varieties resistant to abiotic stress helps to expand the area under vegetable crops. Technological advances in molecular biology and information technology help to increase production, facilitate marketing and transfer of technology in addition to food requirements nutritional requirement of human beings should also be addressed. By conventional breeding methods, many high yielding varieties and hybrids have been developed in almost all vegetable crops. The major bottleneck in enhancing productivity is non availability of quality seeds.

Keyword: Seed, Productivity, Vegetable, Hybrid.

Introduction

Vegetable plays a vital role in the health and nutritional security of human beings in addition to improve the economics of the people of the country. Vegetable production in India before 1947 was only 15 million tonnes. Today, India is the second largest producer of vegetables in the world after China with an annual production of 125.89 million tonnes from an area of 7.80 million ha (NHB, 2008). Our vegetable requirement in the country is estimated at 100 million tons by 2000 A.D. and by 2020 to 225 million tones. Immediately after independence, growth rate in value of vegetable production was only 0.6 per cent (1950-59). The growth rate of vegetable production is 2.60 percentage and productivity of 16.10 tones/ha (Indian Horticulture Data Base, 2008). However, the daily requirement of the vegetables per day per capita is 300 g but availability of vegetable is only 210 g.

Improved Gene Pool

The per capita production of vegetables per annum was 30 kg in 1981-85 and raise to 120 kg in 2006-07 thanks to innovative and risk-taking farmers and introduction of high yielding technologies by private and public agencies. Technological advancements with improved gene pool and management practices have helped to achieve a productivity of 15 tounes/ha in the country though much lower than in many countries. India requires about 127.2 million tonnes of vegetables other than potato and tubers to meet the nutritional requirement estimated 1200 million people by 2020-21.

The required growth rate over 2006-07 to achieve the domestic demand in 2020 is 0.9 per cent over the production of 111.8 million tons in 2006-07. So far 230 high yielding open pollinated varieties, 99 hybrids and 40 vegetable varieties resistant to biotic and abiotic stresses have been released by public funded research in India. Even though the productivity levels of our crops have increased, it will not be sufficient to feed the increasing population.

By conventional breeding methods, many high yielding varieties and hybrids have been developed in almost all vegetable crops. The major bottleneck in enhancing productivity is non availability of quality seeds. As per Seed Association of India, the present seed shortage itself is 6,968 tonnes, total requirement being 15,820 tonnes. the quantity of seeds from Organized sector is only 4517 tonnes.

Main Advantages of F1 Hybrids

The development of pest and disease resistant varieties helped in reducing use of pesticides fungicides and other harmful chemicals high productivity earliness superior quality uniform produce and resistance to biotic and biotic stresses are the main advantages of F1 hybrids. Both public and private sectors have made tremendous progress in development of F_1 hybrids in tomato, cabbage, brinjal, chilli, capsicum, cauliflower, cucumber, musk melon water melon, okra, bottle gourd, bitter gourd, pumpkin etc. use of F_1 hybrids application of high production technologies (HPT) and minimized pre- and post-harvest losses (30-40 per cent) will enhance total production of vegetables.

Commercial Venture

F_1 hybrids require advanced management practices for realizing their full production potential starting from seeding production in nursery to harvesting storage and transport of produces containerized seedling production is a commercial venture in India to produce seedlings of tomato, capsicum, cauliflower, cabbage, chilii and brinjal hybrids. This method provides better crop stand and uniform crop growth. Grafting of vegetable crops on desired rootstock is done to induce vigour, precocity, enhanced yield, quality and better survival under abiotic and biotic stresses. Grafting reduced dependence on chemicals to treat soil to manage soil borne diseases and opened up new vista in organic farming of vegetables. Protected cultivation can be done in polyhouses, low-cost net houses or rain shelters. Use of rain shelters helps in producing vegetables in high rainfall areas. Important practices in raising vegetable crops are preparation of planting beds, planting. Mulching, drip irrigation, fertigation, pruning, foliar nutrition and plant protection. Micronutrient deficiencies are observed in vegetable crops in recent years due to intensive cropping loss of top soil by erosion and micronutrients by leaching. Liming of soil and reduced use of farm yard manure.

Foliar Feeding

Foliar feeding is an effective method of fertilizer application; training and pruning are followed in tomato, capsicum, cucumber and bottle gourd grown under protected conditions. Farmers in Kerala grow cucurbits like bitter gourd, snake gourd ridge gourd and ivy gourd on pandals to get higher yield and better quality. Ecofriendly and environmentally safe plant protection measures like pheromone traps, uses of bio-agent Trichoderma, bio-chemicals and plant derived neem kernel extracts etc. are to be encouraged. Possibility of planting trap crops like mustard should be explored. Use of plant growth promoting Rhizobacteria (PGPR) helps in increasing yields in addition to conventional plant protection. The important PGPR are Azospirillum, Azotobacter, Pseudomonas, fluorescence, phosphate solubilising bacteria (PSB) and *Bacillus subtilis*. Biotechnology has the potential to increase productivity in crops and facilitate incorporation of genes for resistance to pests' diseases and abiotic stresses. Micro-propagation technologies are standardized in India in asparagus, tomato, cauliflower, cabbage, onion, musk melon, cucumber, peas, beans, carrot, garlic, brinjal and pumpkin. *in-vitro* technology for triploid seedless water melon production is now available. The nutrient and mineral contents of food crops can be enhanced through gene transfer in 1994. Tomatoes with extended shelf life, processing tomatoes with deep red colour, squashes with virus resistance with deep genetically modified potatoes capable of producing an insect killing protein are early examples of biotechnological advancements. Purple tomatoes having higher anthocyanin, bioforitied lettuce having 25-32 per cent more calcium and GM tomatoes against Alzheimers disease are a few examples of biotechnological applications. Development of varieties resistant to abiotic stress helps to expand they are under vegetable crops. Technological advances in molecular biology and information technology help to increase production facilitate marketing and transfer of technology in addition to food requirements nutritional requirement of human beings should also be addressed.

Eco-Friendly Production Technologies

Over one billion people, mostly women and children suffering from micro nutrients and vitamin A deficiencies in developing countries. It weakens the immune system of people, causes preventable blindness, and contributes to higher rates of anemia, respiratory diseases, diarrhea, measles and malaria.

Policy support is also needed to popularize eco-friendly production technologies like crop diversification, organic farming and processing and by product utilization.

Availability of hybrid seed at cheaper rate should be ensured. Crop and location specific production technologies should be standardized for hybrids. Multiple disease resistant hybrids should be developed to reduce the use of harmful chemicals. Water being a limiting factor in vegetable production micro irrigation especially is promoted. It increases water use efficiency, reduces weeds and cost of weeding and also can be laid out in undulating Land vegetables being seasonal crops, the impact of climate changes is not visible at faster pace but much more has to be done to increase productivity of vegetables.

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Sesuvium portulacasturm is an Excellent Plant for Saline Soil Reclamation

Article ID: 10714

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Abstract

Sesuvium portulacastrum is a common halophyte growing well in adverse surroundings and is exploited mainly for the environmental protection including phytoremediation, desalination and stabilization of contaminated soil. Salt bladders are an adventitious anatomical feature of the plant, which act as storage sites for the sequestration of excess Na^+.

In addition to the Na^+ accumulation, they play a significant role in the protection of plants from water loss and also prevent from UV damage. Salinity and drought affect photosynthesis due to decreased CO_2 availability as well as alterations in photosynthetic metabolism or oxidative stress.

Under salt stress, reduction in photosynthetic pigments chlorophyll-a and chlorophyll-b has been reported due to impaired biosynthesis or accelerated pigment degradation. Selection of the plant system is the first step for affordable soil desalinization at a wider scale in arid and semi-arid regions. Thus, halophytic plant species can be considered as ideal successor for revegetation and remediation of salt affected soils.

Keywords: Phytoremediation, desalination, *Sesuvium*, Reactive Oxygen Species, antioxidative enzyme.

Introduction

Sesuvium usually grows in wet sandy locations such as beaches, mangroves, dunes, salt flats and marshes. It is seen to inhabit areas with annual rainfall as little as 50 to 150 cm and can remain green in areas with long dry seasons and in habitats subjected to salt spray. *S. portulacastrum* grows on the coastlines of five continents and is widely distributed as a pioneer strand species on tropical and sub-tropical shores extended from the equator about 34° north latitude and 42° south latitude. It grows naturally in the sub-tropical, Mediterranean, coastal and warmer areas around the world.

Traditional Uses

The plant has a long history in folk medicine and was traditionally used in given salads due to its salty taste. Moreover, it is used a remedy for fever, kidney disorders scurvy and in the treatment of various infections and scurvy. The secondary metabolites from these plant species have been believed to have great potential substitutes for some synthetic raw materials in food, perfumery, cosmetics and pharmaceutical industries. The plant is grown as ornamental plants because of its flowers and succulent foliage of leaves. Traditional healers in Zimbabwe and South Africa use the plant to treat various infections and kidney disorders.

Saline Soil Reclamation

Sesuvium portulacastrum is a common halophyte growing well in adverse surroundings and is exploited mainly for the environmental protection including phytoremediation, desalination and stabilization of contaminated soil. Soil salinity affects every aspect of plant growth and development, and is a major constraint of crop yield.

Excess concentration of salt in soil has immediate effect on cell growth and associated metabolism. Salt tolerance involves the three mechanisms; osmotic stress tolerance, accumulation of Na^+ ions in the shoot, and tissue tolerance of Na^+ ions. The salt tolerant mechanism is mainly achieved by compartmentalization of ions in the cell vacuoles, the accumulation of compatible solutes, succulence, salt excreting glands and epidermal bladder hairs.

Salt stress also leads to the production of reactive oxygen species (ROS) and to counter this, plants have developed mechanisms of ROS scavenging mechanisms. The antioxidative enzyme machinery includes catalase (CAT), glutathione reductase (GR), superoxide dismutase (SOD), ascorbate peroxidase (APX), monodehydroascorbate reductase (MDHAR), dehydroascorbate reductase (DHAR), glutathione peroxidase (GPX), guaiacol peroxidase (GOPX) and glutathione-S-transferase (GST). Plant growth under salinity stress depends on the ability to keep low levels of sodium ions in the cytoplasm in order to protect the cells.

Salt bladders are an adventitious anatomical feature of the plant, which act as storage sites for the sequestration of excess Na^+. In addition to the Na^+ accumulation, they play a significant role in the protection of plants from water loss and also prevent from UV damage. Salinity and drought affect photosynthesis due to decreased CO_2 availability as well as alterations in photosynthetic metabolism or oxidative stress.

Under salt stress, reduction in photosynthetic pigments chlorophyll-a and chlorophyll-b has been reported due to impaired biosynthesis or accelerated pigment degradation. On the basis of response to soil salinity, plants have been distinguished as salt tolerant or salt preferring halophytes and salt susceptible glycophytes.

The ability to tightly regulate ion homeostasis, withstand against salt shock and presence of some special morphological characters (salt glands, salt bladders, hairs) have made halophytes as model plants to study salt stress tolerance mechanism in plants. In between these two groups are facultative halophytes which are endowed with the ability to grow and complete their life cycle in both saline as well as non-saline conditions.

These species are closer to crops and will give more insights into mechanism of salt tolerance which will help to improve salt tolerance in crops. *Sesuvium portulacastrum L.* is a multipurpose facultative halophyte and is an ideal system to study salt adaptation mechanism and explore its ability for saline soil reclamation. It is a fast growing, herbaceous, perennial halophyte and grows at low soil nutrient concentrations.

Also, it serves as food and forage for domestic animals, is useful as an essential oil source, for ornamentation, desert greening, secondary (phytoecdysteroids) metabolite production and also has capacity to accumulate heavy metals. This plant has a tremendous ability to accumulate toxic salt ions into its vacuoles.

Halophytes adjust to saline conditions by the accumulation and sequestration of ions in the vacuoles. The vast majority of these ions are Na^+ and Cl^- which contribute 80–95% to maintain the shoot osmotic and turgor pressure. A gradual rise in the sodium content with a corresponding reduction in potassium in the plants exposed to salt stress (EC 4–20 dS m^{-1}).

Salinity stress has been shown to restrict K^+ uptake in halophytes with a significant increase in Na & K ratio. However, at high salinity levels, plant growth inhibition, as observed and this may be due to Na^+ and Cl^- toxicity and damage due to ROS. The growth improvement in *S. portulacastrum* plants grown up to EC 12 dS m^{-1} might be associated with sequestration of ions into the vacuole and better osmotic adjustment besides sustained photosynthetic gas exchange.

The role of antioxidative enzymes in scavenging of salinity induced ROS has been shown to be a prime component of defense mechanisms in halophytes. Activities of SOD, CAT, GR and APX are reported to increase under various environmental stresses. The increase in SOD and CAT activity in response to salt stress can be considered as a defense mechanism for scavenging ROS ultimately leading to salt tolerance. The desalination of salt-affected soils by halophytes or reclamation of saline soils using such plant systems has benefits for saline agriculture. Selection of the plant system is the first step for affordable soil desalinization at a wider scale in arid and semi-arid regions. Thus, halophytic plant species can be considered as ideal successor for revegetation and remediation of salt affected soils.

Conclusion

The growth of *S. portulacastrum* plants in the saline soil conditions which showed a significant reduction in electrical conductivity of the soil from 7.1 dS m^{-1} to 4.9 dS m^{-1} and a high content of Na+ in the plants. A halophytic plant such as *S. portulacastrum* grown under saline conditions with significant saline soil reclamation or remediation of slats in the filed through phytodesalination.

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Herbicide Resistance in Weeds and its Management

Article ID: 10715

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Abstract
Even though herbicides provide efficient and cost-effective weed control resistance will make them obsolete, if they are overused. Herbicide resistance is the acquired and inherited ability of a plant to survive and reproduce following exposure to a dose of herbicide normally lethal to the wild type. Altered site of action and change in any of the processes that intervene in the herbicide action are the two mechanisms of herbicide resistance. Management strategies (alternative herbicides, herbicide mixture, crop rotation and other agronomic practices) providing the crop with a competitive edge over weeds be the first line of defense in controlling weeds to avoid herbicide resistance and enhance sustainability of the production weed.

Keywords: Herbicide resistance, altered site of action, biotypes.

Introduction
Herbicides helped the farmers to control some of the noxious pests and thus reduced the yield loss caused by them at an affordable cost. But there are some disadvantages like development of resistance against these pesticides in targeted organisms was the most prominent among them. Herbicide resistance was reported as early as 1957 against 2,4-D from Hawaii (Hilton, 1957), in day flower (*commelina diffusa*) plant but the first confirmed report of herbicide resistance was against triazine herbicide in common groundsel (*Senecio vulgaris*) and was reported in 1968 from U.S.A. (Ryan, 1970). Since then, the number of resistant weed biotypes against various herbicides is on the rise. Till recently, 383 biotypes belonging to 208 weed species (122 dicots and 86 monocots) are spread over 570,000 fields of the world. Infestation of isoproturon R population caused >65% wheat grain yield reduction with the recommended rate of isoproturon (1000 g ha^{-1}) application. Continued reliance on isoproturon after the evolution of resistance resulted in a heavy build-up of *Phaloris minor* populations, as competition from other weeds was removed and caused heavy yield losses.

The Evolution of Herbicide Resistance
Two theories have been suggested to explain how gene mutations causing herbicide resistance, the gene pool theory, and the selection theory.

1. Gene pool theory: It is based on the idea that herbicides act as mutagens *i.e.,* plant mutates as a result of herbicide treatment due to which the genetic background of the plant changes there is little evidence supporting this theory.

2. Selection theory: Most widely accepted theory, which states that in any population of weeds, there will be some plants that can naturally tolerate a particular herbicide *i.e.,* one or more individuals in a population will be resistant because of natural variation. Selection pressure is directly proportional to the efficacy of the herbicide (Wrubel and Gressel, 1994).

Herbicide Resistance Management
1. Proactive management practices:

a. Cultural practices:

i. Crop Rotation: Growing the same crop every season will invite same inputs including herbicide because of the same ecological culture. Crop rotation allows the following options:

- Different crops will allow rotation of herbicides having a different site of action.
- The growth season of the weed can be avoided or disrupted

- Crops with differing sowing times and different seedbed preparation can lead to a variety of cultural techniques being employed to manage a particular weed problem.
- Crops also differ in their inherent competitiveness against weeds. A strongly competitive crop will have a better chance to restrict weed seed production.

ii. Close spacing and higher seed rate: Higher seed rates and close row spacing may allow less weeds to grow and competing ability in favour of crop.

iii. Proper time of sowing: Early sowing of crop e.g., wheat favors initial growth and crop competitiveness against weeds. This is more important under rice-wheat cropping system because *Phaloris minor* germinates more profusely during last week of November to December and even January. Therefore, sowing of wheat in the last week of October to second week of November will be of enormous help in combating the emergence and early growth of *Phaloris minor* in particular and other weeds, in general. Early sowing of wheat can easily be possible under zero-tillage.

b. Mechanical: weed control may include inter-row cultivation, preplant tillage, hand rouging etc. Cultural control may be an important part of reducing the over reliance on herbicides. This includes using varieties or hybrids that are more competitive, seeding in narrow rows or planting cover crops.

c. Herbicide mixtures and rotation

i. Use herbicides only when necessary
ii. Use the recommended rate
iii. Use herbicide mixtures that include 2 or more herbicide groups
iv. Rotate herbicides between herbicide groups
v. Use of herbicides with short residual life if we are using herbicides having long residual life then the selection pressure will be more. So, use herbicides having short residual life. Also, if we are increasing the dose of herbicide the residual period will be high. So, use the recommended dose.

Herbicide mixtures and herbicide rotation strategies work on the premise that if a weed carries the genes to resist 1 group of herbicides, an alternate herbicide group will kill it. The difference between the two approaches is that herbicide mixtures kill the resistant weed using many active ingredients in the same season. Rotating herbicides controls the resistant weeds in the years when effective herbicide groups are used with the goal of reducing the resistant weed population. It is concluded that mixtures are more effective than rotations in mitigating the resistance evolution.

2. Reactive management practices:

a. Mechanical options:

i. Control of weed escapes and sanitation of equipment to prevent spread of resistant weeds:
ii. Scout the fields for resistant weeds. Post-harvest grazing, where practical.
iii. Stubble burning, where allowed, can limit weed seed fertility. In extreme cases of confirmed resistance, fields can be cut for hay or silage to prevent weed seed set.

b. Herbicide options:

i. Apply the most effective post emergence herbicide with a different mechanism of action.
ii. If low level herbicide resistance has been identified and no other options are available, apply the maximum labelled rate of the same post emergence foliar herbicide.

Mechanism of Herbicide Resistance

Mechanisms of herbicide resistance can be broadly grouped into two categories (Dekker and Duke, 1995).

1. Non target site mechanism/exclusionary: Those that exclude the herbicide molecule from the site in plants where they induce toxic response. In exclusionary resistance mechanism the herbicide is excluded from the site of action in many ways.

a. Differential herbicide uptake: In resistant biotypes the herbicides are not taken up readily due to morphological uniqueness like overproduction of waxes, reduced leaf area etc.

b. Differential translocation: In resistant biotypes the apoplastic (cell wall, xylem) and symplastic (plasma lemma, phloem) transport of herbicide is reduced due to different modifications.

c. Compartmentation: Herbicides are sequestered in many locations before it reaches the site of action or it gets attatched to cell wall where it exerts no effect e.g. some lipophilic herbicide may become immobilized by partitioning into lipid rich glands or oil bodies

d. Metabolic detoxification: Herbicide is detoxified at a faster rate before it reaches the site of action. The biochemical that detoxifies herbicides can be grouped into four major categories: oxidation, reduction, hydrolysis, and conjugation. Three enzyme systems are known to be involved in resistance due to increased herbicide detoxification.

i. Glutathione-s-transferase that detoxifies atrazine.
ii. Aryl-aylamidase that detoxifies propanil.
iii. Cytochrome P450 monoxygenase is responsible for resistance to inhibitors of ACCase, ALS and PSII in a number of grasses weed species.

2. Target site mechanism:

a. Altered site of action: Site of action is altered in such a way that it is no longer susceptible to the herbicide *e.g.* In *Lactuca sativa* biotypes which are resistant to sulfonylurea herbicides, the ALS enzyme which is the site of action of herbicide is modified in such a way that herbicide can no longer bind with the enzyme and inactivate it.

b. Site of action overproduction: This causes the dilution effect of the herbicide. Here the site of action is overproduced so that the herbicide at its normal rate of application will not be able to inactivate the entire enzyme produced. Some glyphosate-resistant Palmer-amaranth has been shown to express increased levels of herbicide-susceptible EPSPS target-site protein. This case is the only known example of this type of mechanism.

Conclusion

Genetic variation is almost always present in plant population. Given the existence of genetic variation, sufficient duration and intensity of selection will likely result in the development of resistance. Herbicide resistance cannot be avoided as it is a random chance. Rotational use of herbicides and herbicide mixtures are the main components of management strategies. Adoption of an integrated weed management approach would help to manage resistant weeds.

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Herbicide Resistance in Littleseed Canarygrass (*Phalaris minor* Retz.) in India

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Abstract

A troublesome weed of wheat in India, littleseed canarygrass (*Phalaris minor* Retz.) has evolved multiple herbicide resistance across three modes of action. Resistance was observed in field where isoproturon was used for over 10 years. Due to resistance the control of *Phaloris minor* dropped from 78% to 21% in a time span of 3 years.

This is the most serious case of herbicide resistance in the world, which may cause 30-90 percent reduction in wheat yield and a total crop failure under heavy infestation. However, the evolution of multiple resistance against the four groups is a threat to wheat production. To prevent the spread of MHR *Phaloris minor* populations, as well as the extension of multiple resistances to new chemicals, concerted efforts in developing and implementing a sound, integrated weed management programes are needed.

The integrated approach, consisting of crop and herbicide rotation with cultural and mechanical weed control tactics, should be considered as a long-term resistance management strategy that will help to sustain wheat productivity and farmers' income.

Resistance Mechanism

Resistant *Phaloris minor* biotype is degrading the isoproturon through the same metabolic pathway as that in wheat (degradation via N-dealkylation and ring alkyl oxidation by NADPH-cylochrome p-450 monoxygenase) and has evolved multiple herbicide resistance across three modes of action, photosynthesis at the photosystem II site A, acetyl-coA carboxylase (ACCase) and acetolactate synthase inhibition s (Heap, 2016). Resistance in *Phalaris minor against* isoproturon was reported by Malik and Singh (1995).

Types of Resistance

1. Partial resistance: It occurs when plant growth is severely inhibited but it still reproduces seeds.

2. Negative cross-resistance/ collateral sensitivity: Negative cross-resistance occurs when the resistant plant is more susceptible to some other herbicide than the wild susceptible biotype. It is for this reason that management-strategies must incorporate more than simply a switch of product.

3. Cross-resistance: When resistance to two or more herbicides (with the same or different mode of action) resulting from the presence of single resistance mechanism (one genetic mutation) is termed as cross-resistance.

The presence of such a mechanism can complicate the selection of alternate herbicides as tools to control a resistance situation. In some cases, resistance that develops to a Sufonylurea confers cross resistance to imidazolinones.

It is target site cross-resistance if all the herbicides affect the precise target. It is metabolic cross-resistance, if all the herbicides or their toxic products are degraded by the same mechanism.

4. Multiple resistance: Multiple resistance in weeds occurs when more than one mechanism contributes to resistance. This occurs through the accumulation of resistance mechanisms, either as a result of sequential selection, such multiple resistant individuals may contain two or more of the resistance mechanisms.

Herbicide Resistance Management

Herbicide mixtures and herbicide rotation strategies work on the premise that if a weed carries the genes to resist 1 group of herbicides, an alternate herbicide group will kill it. The difference between the two approaches is that herbicide mixtures kill the resistant weed using many active ingredients in the same season. Rotating herbicides controls the resistant weeds in the years when effective herbicide groups are used with the goal of reducing the resistant weed population. It is concluded that mixtures are more effective than rotations in mitigating the resistance evolution.

Factors Influencing Herbicide Resistance

Weed as well as the Herbicide and cultural characteristics influence in the development of herbicide resistance in plants that are discussed below briefly:

1. Weed Characteristics:

a. Initial frequency of resistant biotype: If the initial frequency of the resistant individual is high in a natural weed population, then the resistance will surface more quickly than in a population where the frequency of the resistant individual is low, provided we are continuously applying the herbicide to which the biotypes exhibit resistance. Some estimates have shown that approximately one out of a billion seeds
from a population could be resistant.

b. Annual growth habit: Annual plants complete their life cycle in a relatively shorter time and produce tremendous amounts of tiny seeds that have more rapid dissemination over perennials mode of growth. The spread of resistance occurs more rapidly in cross pollinated species compared to self-pollinated species. Therefore, resistant genes most likely arise in an area through mutation, and gene flow would facilitate the spread of the resistance genes among individuals within that.

c. Seed dormancy: Little or low seed dormancy will lead to death of most susceptible plants by herbicide. Consequently, the remainder resistant though fewer, will have better chance to grow with vigour and reproduce with increased resistant trait.

d. Hypersensitivity of weeds to a particular herbicide: It is also called hypersensitivity of weeds to a particular herbicide. Due to hypersensitivity, a single application of herbicide can eradicate most (90-95 %) population consequently, high selection pressure will allow the resistant biotypes to prevail and thrive best to stand fit in the field.

e. Weed seed residue in the soil seed bank: For a species if the seed residue is more in the soil seed bank, appearance of resistance will be delayed due to continuous recruitment of susceptible individual from soil seed bank. That is, Nature will allow the resistant species to flourish only after major portion of the susceptible weed seeds have been exhausted from the soil.

2. Herbicide Characteristics:

a. Herbicides with highly specific mode of action: If an herbicide has only one site of action in weeds, then a biotype need to be different in that particular site to be resistant. So, the evolution of resistance against such herbicides will be quicker than against herbicides having multiple sites of action.

b. Herbicides with long residue period: This result in continuous suppression of Susceptible biotypes for a longer period, thus allowing the resistant species to flourish.

c. Cultural Characteristics:

i. Monoculture often encourages the use of the same herbicide which results in continual selection pressure.

ii. Lack of rotation of the herbicides: Continuous application of the same herbicide or different herbicide with the same mode of action will create selection pressure and will allow resistant population to flourish.

iii. Cultivation/Tillage: Minimum tillage favours weeds especially annual grasses and perennial weeds, and consequently there is often an increased requirement for herbicides. Weed species whose seeds can germinate at or near the soil surface and become established have the greatest potential to proliferate under conservation tillage systems (Buhler *et al.*, 1997).

iv. Sub lethal doses of herbicide: Sub lethal doses of herbicides influence the frequency of mutation as seen in *chenopodium album* against sub lethal doses of triazine.

Conclusion

Resistance is micro-evolutionary process which takes several years for development. The evolution of multiple resistances in Phalaris minor against the four groups is a serious threat to wheat production in the world. Decreasing the selection pressure, delaying the onset of herbicide resistance and thereby increasing the efficiency of existing herbicides through weed management strategies is the need of hour. Adoption of an integrated weed management approach and rotational use of herbicides and herbicide mixtures would help to avoid occurrence of resistance in weeds.

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Laser Levelling: A Resource Conservation Technology in Rice Wheat Cropping System

Article ID: 10717

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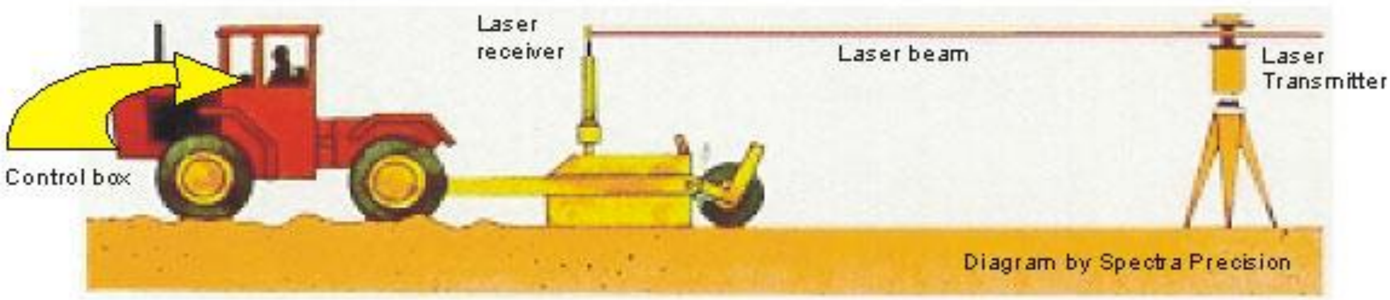
Predominant cropping system in India is the Rice-wheat cropping system as both rice and wheat are main staple food for the people of the country. Threat to sustainable food production has resulted due to the continued adoption of exhaustive rice-wheat cropping system. In order to address the problems like stagnant productivity, increasing production costs, declining resource quality, receding water table and increasing environmental problems alternative technologies are the major drivers. For improving and sustaining higher yields there are various efficient technologies that can be adopted in rice wheat system. Various Resource conservation technologies are Laser land-levelling, direct seeded rice (DSR), Zero tillage (ZT), furrow-irrigated raised-bed system (FIRBS) etc. Direct seeded rice under double no till with laser land levelling reduced cost of cultivation and improved the crop yields and system productivity while conserving natural resources and should be practiced in different ecologies including upland, lowland, deep water and irrigated areas by large as well as small farmers.

For surface-irrigated areas, a properly levelled surface with the required inclination according to the irrigation method is absolutely essential. Traditional farmers' methods for levelling by eyesight, particularly on larger plots, are not accurate enough and lead to extended irrigation times, unnecessary water consumption, and inefficient water use. The use of laser-guided equipment for the levelling of surface-irrigated fields has become economically feasible and, through hiring services, become accessible even to lower-income farmers. With laser levelling, the unevenness of the field is reduced to about ±2 cm, resulting in better water application and distribution efficiency, improved water productivity, better fertilizer efficiency, and reduced weed pressure. Water savings of up to 50% have been reported in wheat and 68% in rice (Jat *et al.,* 2006). Laser land leveller consists of a laser source (transmitter) which emits a parallel laser beam to a laser receiver attached to a scraper bucket behind a tractor and the vertical movement of scraper bucket is controlled by a hydraulic jack in a control box for levelling the field.



Laser Land Levelers have the Following Advantages

1. Increase water application efficiency up to 50 %
2. Reduces labour requirement by 35%
3. Increases crop yield by 15 to 66%
4. Saving in time by 24%
5. 3-4 % additional land recovery.

A field experiment was conducted by Jat, *et al*., 2011 at Modipuram (U.P) to quantify the benefits of precision land levelling and crop establishment technique and it was observed that Precision levelling with raised bed planting (PLRB) with recommended amount of balanced nutrients such as 120 kg·N·ha^{-1}; 26 kg·P·ha^{-1} and 50 kg·K·ha^{-1} (N120 + P26 + K50) gives higher yield than other treatments (Table 1). Increasing trend of number of laser levellers with respect to time in Punjab is in Fig 1.

Table 1. Effect of laser land levelling and planting techniques on growth and yield of wheat:

Treatment	Plant height at harvest (cm)		Productive tillers m–2 (No.s)		Length of spike (cm)		Grains/spike (No.s)		Grain yield (t·ha–1)		Straw yield (t·ha–1)	
	2002-2003	2003-2004	2002-2003	2003-2004	2002-2003	2003-2004	2002-2003	2003-2004	2002-2003	2003-2004	2002-2003	2003-2004
T1	99.9a	101.7a	311a	316a	9.9	10.15a	44.2a	46.43a	5.00a	5.19a	6.00a	6.23a
T2	87.9c	90.1b	282c	285b	9.7	9.90ab	41.4c	43.45b	4.60b	4.74b	5.30b	5.44b
T3	95.5b	97.5c	300b	305c	9.8	9.93ab	43.0b	45.07c	4.60b	4.78b	5.20b	5.41b
T4	87.4c	88.4d	264d	268d	9.6	9.73b	41.1c	43.35b	4.30b	4.42c	4.50c	4.60c
T5	76.1d	75.7e	231e	229e	9.1	8.93c	39.2d	38.82c	2.70c	2.64d	2.90d	2.88d
SE ±	0.76	0.56	3.06	2.42	0.21	0.138	0.383	0.328	0.165	0.111	0.184	0.102

Means with the same letters are not significantly different at P = 0.05.
(T_1) Precision levelling with raised bed planting (PLRB) with recommended amount of balanced nutrients such as 120 kg ·N ·ha–1; 26 kg ·P ·ha–1 and 50 kg ·K ·ha–1 (N120 + P26 + K50).
(T_2) Traditional levelling with raised beds (TLRB) with N120 + P26 + K50.
(T_3) Precision levelling with flat beds (PLFB) with N120 + P26 + K50.
(T_4) Traditional levelling with flat beds (TLFB) with N120 + P26 + K50.
(T_5) Traditional levelling with flat beds (TLFB) with o fertilizer application (N0 + P0 + K0).

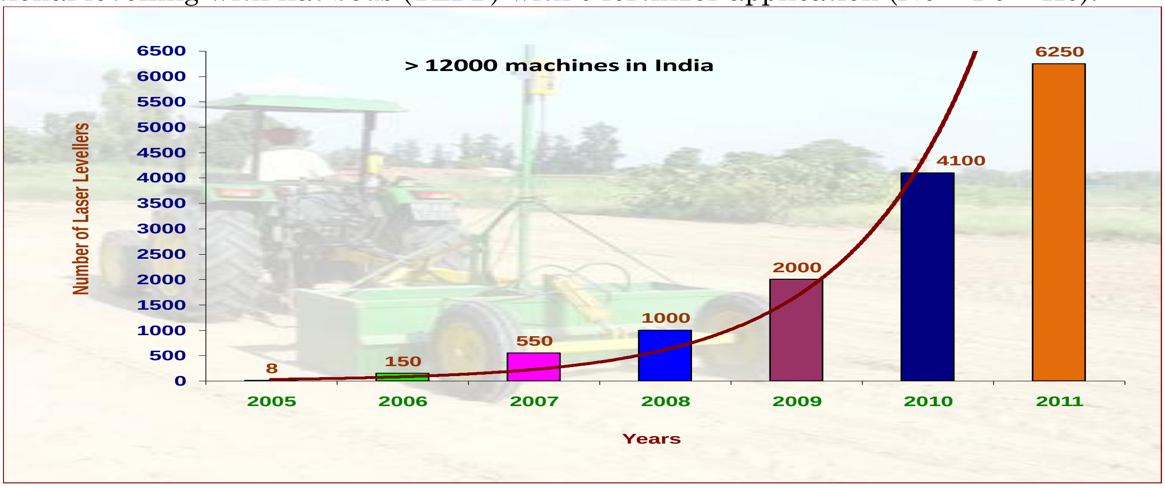


Fig 2 GROWTH OF LASER LEVELING IN PUNJAB

RWC, 2004

Fig. 2 Increasing trend of number of laser levellers with respect to time in Punjab.

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Rice Wheat Cropping System Threats in India

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Rice-based cropping systems accounts for more than half of the total acreage where rice is grown in sequence with rice or upland crops like wheat, maize or legumes in South Asia. Rice based cropping systems provides food security and livelihoods for millions of people. Rice-wheat cropping systems alone occupy 13.5 million hectares in the Indo- Gangetic Plains (IGP) of South Asia (Gupta and Seth, 2007). Area under rice – wheat cropping system in different states in India is shown in Table 1. During the past 30 years, agricultural production growth in this region has been able to keep pace with population demand for food in the country mainly due to adoption of green revolution technologies inducing yield growth, followed by area expansion. But this opportunity is ceasing very fast due to limited scope for increasing the availability of arable land and natural resources. The other issue is the conservation of the basic resources of land and water for sustainability of agriculture in the Indo- Gangetic Plain. It is generally believed that the rice wheat system has strained the natural resources in this region and more inputs are required to attain the same yield levels (Lal *et al*., 2004).

Table 1. Area under rice-wheat cropping system in different states in India

State	Area (m ha)
U.P & Uttarakhand	4.522
Bihar & Jharkhand	1.936
Punjab	1.614
MP + Chhattisgarh	1.064
Haryana	0.462
West Bengal	0.274
Jammu & Kashmir	0.228
Assam	0.183
Himachal Pradesh	0.093
Orissa and AP	0.042
Total	**>10.5**

Threats Facing the Rice-Wheat Cropping System

Important issues emerging as a threat to the sustainability of rice-wheat system are:
1. Over mining of nutrients from soil,
2. Disturbed soil aggregates due to puddling in rice
3. Decreasing response to nutrients
4. Declining ground water table
5. Build-up of diseases/pests
6. Build-up of *Phalaris minor*
7. Low input use efficiency in north western plains
8. Low use of fertilizer in eastern and central India
9. Lack of appropriate varietal combination.

The threats of rice – wheat cropping system in Indo-Gangetic plains are shown in Fig.1. Water is one of the most precious natural resources for agricultural production and agriculture accounts for 70 percent of water use (FAO, 2002). It is predicted that by 2025 water consumption will exceed "blue water" availability if current trends continue (Ragab and Prudhomme, 2002). Traditionally rice is grown by hand transplanting of 25–30-day old seedling after puddling. Puddling requires lot of tillage and water (>300 mm) that destroys soil structure, which affects growth and development of succeeding upland crops in the rotation, thereby reducing system productivity (Hobbs *et al*. 2003), sealing and compacting of the soils due to which excess water cannot infiltrate and recharge the aquifer results in growing number of flood catastrophes (DBU, 2002), declines water table and also poor-quality water for irrigation. Groundwater table is falling at a rate of 0.7 m per year in Punjab due to intensive irrigated agriculture (Aulakh, 2005). In regions where water is already the limiting factor for agricultural production, puddling, rising temperatures and evapo transpiration rates combined with more erratic rainfall threatens the sustainability of agriculture (Met Office, 2005). More over ever-increasing energy prices for pumping water and running tractors for puddling and other operations, limited water and labour availability for transplanting, stressed the farmers as well as researchers to develop alternative production systems for rice. Resource-conserving technologies (RCT) have been developed in order to reduce the use of and damage to natural resources through agricultural production; and increase the efficiency of resource utilization. Most of these technologies target the two most crucial natural resources: water and soil, but some also affect the efficiency of other production resources and inputs (e.g., labour, farm power and fertilizer).

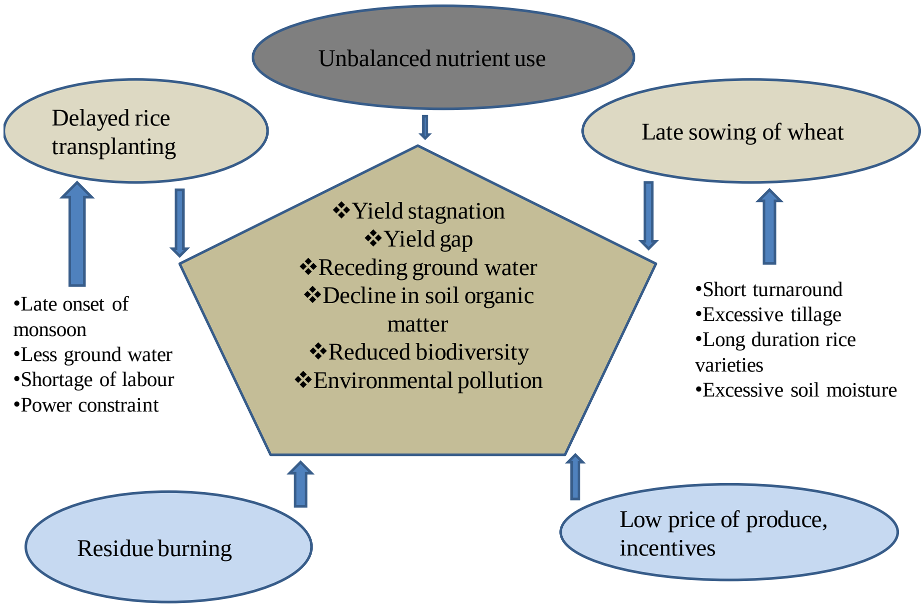

Fig. 1. Threats facing the Rice-Wheat cropping system

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Benefits of Zero or Reduced Tillage in Rice Wheat System

Article ID: 10719

Sabia Akhter, Ambreen Nabi, Rukhsana Jan, Vaseem yousuf, Mir Nadeem, Khurshid Ahmad Sofi.

Reduced-till system combines the tillage done by a rotavator with seeding. Planting is done in a single pass. Reduced tilling and seeding can be accomplished both by the 2-wheel and 4-wheel tractors. In the zero- or no- till system, an inverted- T coulter or a chisel opener is attached to a normal seed drill. This coulter makes a narrow groove/slit in the soil for the placement of the seed and fertilizer in one pass. Soil is disturbed in a very narrow groove 5 cm wide and 5 to 7 cm deep. Intensive soil tillage is the main cause for the reduction in soil organic matter and hence degradation of soils. In addition to this, zero-tillage results in water savings and improved water-use efficiency. Since the soil is not exposed through tillage, the unproductive evaporation of water decreases. At the same time, water infiltration is facilitated (DBU 2002). On average, water savings of about 15–20% can be expected (PDCSR 2005). However, used in isolation, zero-tillage might face problems with weed control, compaction, or surface crusting depending on the soil type. Zero-tillage wheat has a number of advantages, alleviating a number of constraints in the rice-wheat system: it permits earlier wheat planting, helps control obnoxious weeds like *Phalaris minor*, reduces costs, and saves water (Erenstein and Laxmi 2008).

Among the different stand establishment techniques double zero tillage technique attained the highest plant height (136 cm) over Direct seeding of rice, Brown manuring of rice, Transplanting on beds and Conventional transplanting. The productive tillers per unit area (m^2) were recorded highest in direct seeding followed by double zero tillage and bed planting (Aslam *et al.* 2008). The effect of different stand establishment techniques on rice yields, its attributes and on benefit cost ratio is shown in Table 1 and 2.

Table-1: Effect of different stand establishment techniques on rice yields and its attributes:

Treatments	Plant height (cm)	Productive tillers/m^2	Panicle length (cm)	Number of grains/panicles	1000 grain wt.(g)	Paddy yield (t/ha)
Double Zero tillage	136.1[a]	219.0[ab]	27.93[a]	96.50[a]	23.17[a]	4.80[a]
Direct seeding	126.6[c]	231.7[a]	25.23[b]	72.67[b]	22.17[b]	3.36[c]
Brown manuring	128.2[bc]	186.3[c]	27.67[a]	93.83[a]	22.83 [ab]	4.23[b]
Bed planting	129.2 [bc]	206.7[abc]	27.93[a]	95.73[a]	23.17[a]	4.43[b]
Conventional planting	130.2 [b]	200.2[bc]	27.93[a]	98.57[a]	23.50[a]	4.72[a]
LSD at α: 0.05	2.782	26.65	0.9019	8.851	0.9676	0.2844

The means in rows bearing same letters do not differ significantly (P<0.05).

Table-2: Effect of different stand establishment techniques on cost benefit ratio:

Treatment	Paddy yield (t/ha)	Cost (Rs./ha)	Income (Rs./ha)	Profit	Cost benefit ratio
Double Zero tillage	4.80	59660	114000	35643	1: 1.91
Direct Seeding	3.36	55057	79800	5793	1: 1.14
Brown manuring	4.23	60402	100462	21310	1: 1.66
Bed Planting	4.43	60452	105212	26010	1: 1.74
Conventional Planting	4.72	61045	104975	25180	1: 1.72

The review of zero tillage in India found a yield effect amounting to a 5–7 percent yield increase for wheat being reported across studies (including on-station trials, on-farm trials, and surveys (Erenstein and Laxmi, 2008). Researchers of both India and Pakistan reported higher grain yield in Zero tillage as compared to Farmer's practice, it may be due to the fact that the Zero tillage eliminates the preparatory tillage that facilitates the timely sowing of wheat and hence gives the higher yield (Table 3 and 4).

Table 3. Grain yield of wheat in zero-tillage and farmers' practice after puddled transplanted rice in Pakistan and India

Year	Country	No. of farmers Involved	Grain yield (kg/ha) Zero tillage practice	Farmers'
1985–1988	Punjab, Pakistan	34	3890a	3528b
2001–2004	Western Uttar Pradesh, India	27	5120	4980
1999–2000	Haryana, India	124	5380	5110
2000–2003	Eastern UP and Bihar	357	3350	2980

Table 4: Benefits of zero-tillage over conventional tillage for planting of wheat after rice in Haryana, India:

Item	Farmers' perceptions	Researchers' findings
Sowing	Wheat sowing earlier by 5-8 days (small-to-medium farms) to 2 weeks (large farms)	On average, wheat sowing can be advanced by 5-15 Days
Fuel savings	Not available	On average 60 l diesel per ha
Cost of cultivation	US$ 42-92 ha-1	US$ 37-62 ha-1
Plant population	20-30% more plants in zero-tillage fields	13.5% more plants in zero-tillage fields
Weed infestation	20% less and weaker weeds in zero-tillage fields	43% less weeds in zero-tillage fields
Irrigation	Saves30-50% water in the first irrigation and 15-20% in subsequent irrigations	36% less water used, on average
Rice stubble	Decayed faster	Decayed faster
Fertilizer-use efficiency	High	Higher because of placement
Wheat yields	Higher than under conventional system depending on days planted earlier	420-530 kg more per ha

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Effect of Vermicompost on Vegetable Crops

Article ID: 10720

Dr Ambreen Nabi, Dr Sabia Akhter, Dr Mir Nadeem Hassan, Dr Vaseem Yousuf, Dr Rafiya Munshi, Dr Khurshid Ahmad Sofi, Afroza Akhter.

Abstract

Vermicomposting is the simple process of producing organic fertilisers from biodegradable materials through the action of different species of earthworms. it is an environment friendly method of recycling organic materials in the farm and household such as plant residues and animal manures. It is farmer friendly fertilisers with all the beneficial properties of inorganic fertilisers free from harmful effects on soil and human health. Vermicompost contain significant amount of macro and micronutrients, beneficial microbial population and biologically active metabolites particularly growth harmones like gibberlins, auxins, cytokinins and vitamin B complex. Vermicompost has revolutionised vegetable farming and kitchen gardening. In organic farming, it has shown the best results among all other fertilisers. All kind of fruiting, underground and leafy vegetables can be grown by using vermicompost as a primary fertiliser, whether grown in containers or on raised beds.

Introduction

In recent years, the disposal of organic wastes from domestic, agricultural and industrial sources has caused increasing environmental and economic problems and many different technologies to combat this problem has been developed (Olle 2019). Vermicomposting is the process in which worms turn organic wastes into very high-quality compost. A Scientific method of breeding and raising earthworms in controlled condition is called vermiculture. Certain species of earthworm (*Eisenia fetida* and *E. Andrei*) adapted to decaying organic material. These worms thrive in rotting vegetation and compost. The worms create Vermicast also called worm castings is the end-product of the breakdown of organic matter by the worms. Vermicompost contains water-soluble nutrients and it is an excellent, nutrient-rich organic fertilizer and soil conditioner. Earthworms consume large quantities of organic matter and excrete soil as cast and they reduce the volume by 40-60%. The average weight of earthworm is about 0.5-0.6g and feed on waste equivalent to its body weight and produce cast equivalent to about 50% of the waste it consumes in a day (swaroop and Ramawatar ,2015). The worm castings contain nearly 2 times higher percentage of both macro and micronutrients. Earthworm castings increase plant growth, stem diameter and flower numbers as reported by Hidalgo *et. al*. (2006). It contains N (1.2-1.6%), P_2O_5 (1.8-2.0%), K_2O (0.5- 0.75%), Ca, Mg, S, Fe, Mn, Zn, Cu and B. Perner *et. al*., 2006 carried a study and reported that the efficiency of vermicompost in improving growth in crops mainly result from its organic matter and plant nutrient content thus promoting plant growth and inhibiting soil borne plant diseases.

Lot of research work has been done to study effect of using vermicompost on vegetable crops and reveal increase in growth, yield and quality of vegetable crops. Addition of vermicompost into vegetable crop fields with N, P, K nutrients have very effective response on growth of vegetable crops. It is evident that vermicompost influences growth and yield parameters, improve seed germination rate, seedling growth, flowering and fruiting of vegetables. The best growth response was exhibited when vermi compost constituted relatively small proportions (10%-20%) of the total volume of the container medium in which a crop is grown. Adhikary 2012 reported higher yields in tomatoes (*Lycopersicon esculentum*) and brinjal *(Solanum melongena) with the application of vermicompost.* He further reported significantly higher productivity in potato (*Solanum tuberosum*), with the application of 6 tons/ha as compared to control. In egg plant yield was significantly increased with the application of 5t/ha and the increase in crop yield was probably because of higher nutrient uptake (seethalakshmi,2011). Application of vermicompost increase chlorophyll content, pH of the juice, total soluble solids of juice, micro and macronutrients, carbohydrate (%) and protein (%) content and improved the quality of fruit and seed. Leafy vegetables like spinach require lesser quantity of vermicompost as compared to tuber crops e.g potato.

Advantages of vermicompost in vegetable crops (Ahirwar and Hussain, 2015):

1. Vermicompost is rich source of all the essential plant nutrients required for growth and development of plants.
2. Vermicompost shows significant effect on overall, plant growth. It encourages the growth of new shoots/leaves and improves quality and shelf life of produce.
3. It provides excellent conversion of organic farm waste, crop waste and animal waste into an odourless, free flowing, easy to handle, apply and store.
4. Vermicompost affects the soil properties also and improves soil structure, texture, aeration, water holding capacity and prevents soil erosion. it has a negative effect on pathogenic microbes and is an efficient and enriched soil conditioner.
5. It improves soil environment and biological properties of soil also in terms of beneficial micro flora such as fixers, p solubilizers, cellulose decomposing microflora etc.
6. It prevents nutrient losses and increase nutrient use efficiency of chemical fertilisers.
7. It helps in reducing toxicity of heavy metals.
8. It is free from pathogens, toxic elements, weed seeds etc.

Method of Application

Vermicompost can be applied in any crop at any stage, but it would be more beneficial if mixed in soil after broadcasting. The rate of application is as:
1. Field crops @ 5-6 t/ha;
2. Vegetables @10-12 t/ha;
3. Flower plants @ 100-200 g/sq ft;
4. Fruit trees @ 5-10 kg/tree.

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Direct Seeded Rice (DSR): A Way of Reducing Resources

Article ID: 10721

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With direct seeding, rice seed is sown and sprouted directly into the field, eliminating the laborious process of planting seedlings by hand and greatly reducing the crop's water requirements (Polycarpou 2010). Resource conservation by adopting direct seeded rice (DSR) with the help of seed-cum-fertilizer drill have the potential to reduce the production costs by easier and timely planting, reduced labour burden at least 50% (Pandey and Velasco 1998), 8-10 days earlier crop maturity higher water and nutrient use efficiency, efficient root system development that enhance drought tolerance reduced lodging problem and higher yield of succeeding upland crops.

In a long-term trial on crop establishment methods in rice-wheat system, results revealed that growing rice and wheat without tillage and direct seeding in presence of residues led {ZTR-ZTW (+R)} to stable and higher crop yields of rice and wheat plots over the years. However, in initial years the grain yield of rice was slightly higher in puddle transplanted rice but since 2008 not much difference in rice yield was observed due to puddling and transplanting (Fig 1), while the cost of production was significantly low in zero tillage rice (ZTR).

Grain yield of wheat was always higher when wheat is planted after Unpuddled rice than puddle transplanted or direct seeded rice. Wheat growth was always better in Unpuddled soils, resulting highest system productivity. It is interesting to see that zero-tillage rice followed by zero tillage wheat with residue retention {ZTR-ZTW (+R)} continuously improved the rice and wheat yield over the years.

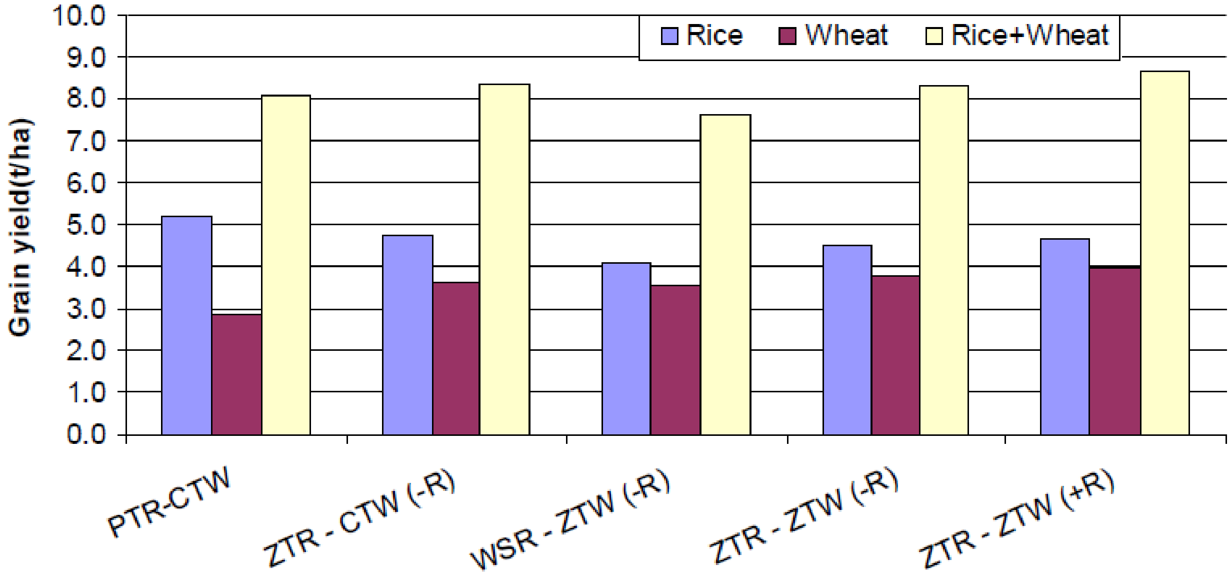

Fig 1: Effect of crop establishment methods on productivity of rice in rice-wheat system (3 years mean) (Ravi Gopal, unpublished 2010).

The average yield of paddy was more in DSR due to a greater number of panicles per unit area. Besides this rice-wheat system productivity was more than 90 quintal per ha (Table-1 and 2) when rice was sown upto 28th June. This was reduced by more than 30% when fields were transplanted after 25th July (75 quintal/ha) (Singh, *et al.*, 2012).

For higher system productivity is desired, the rice crop must be sown/planted early with the onset of monsoons by raising rice nurseries with ground water and vacating the main fields early in the season for the succeeding wheat or other crop (Gupta *et.al*. 2002). It has also been observed that in case of timely sown rice by DSR average number of tillers was 16-17 per plant with plant height of 108-116 cm.

Table 1. Performance of demonstrated Paddy technologies under DSR in Kushinagar district:

Variety	Average grain yield (q/ha)		Increase in yield (%)	Average cost of cultivation (Rs/ha)		Net profit (Rs.)		Profit ratio
	Demo.	Local Check		Demo.	Local Check	Demo.	Local Check	
Krishna Hans	56.57	38.71	46.14	13570.78	13673.22	35941.72	22642.1	1.59
Sarju-52	52.53	41.97	25.20	12958.81	13842.67	33743.19	21874.3	1.54
PRH-10	62.35	41.97	48.56	16842.6	13842.67	38444.90	21874.3	1.76
PB-1	30.41	30.51	-0.33	21,867.1	21,779.5	34,288.9	20,415.5	1.68
Rajendra Mansoori	41.52	38.83	6.93	17663.4	23722.9	27770.3	18805.7	1.48
Pusa-44	42.53	36.21	17.45	18665.5	21692.5	27392.0	17817.5	1.54
Rajshree	46.71	30.87	51.31	18791.6	15625.5	32397.3	17746.1	1.83

Table 2 Yield attributes of rice crops under two methods of crop establishment at Kushinagar:

Treatment	Panicles/m2 (No.)	Grain weight/ panicle (g)	1,000-grain weight (g)
Transplanted	243	2.7	30.3
Direct-seeded	361	2.1	30.1
CD (5%)	21	0.2	NS

Singh, *et al*., 2012.

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Role of VAM (Vesicular Arbuscular Mycorrhiza)

Article ID: 10722

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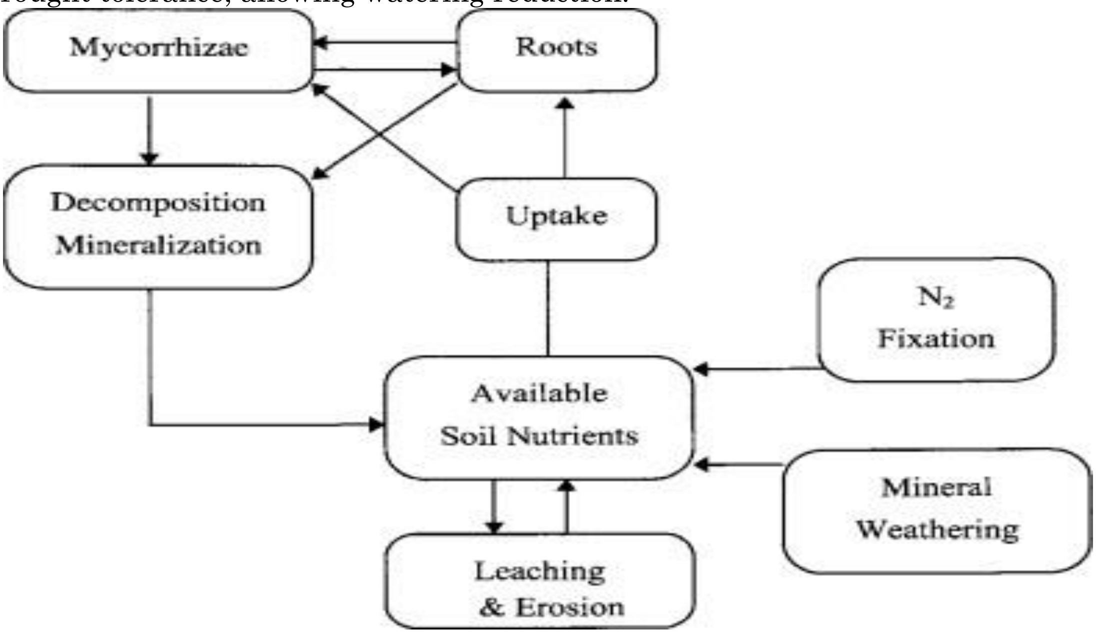
Introduction

The word mycorrhiza is derived from classical Greek word for "mushroom" and "root". In a mycorrhizal association, the underground mycellium are in contact with plant roots, but without causing any harm to the plant. It is one of the first microbiological product. VAM is a fungus which penetrates a vascular plant's roots to support them to capture nutrients from the soil. Endo mycorrhiza is a type of fungi that presents in a symbiotic relationship with the plants and it directly penetrates within the cells of the plants and direct exchange of material takes place in the cells.

The arbuscules are the most characteristic structures, formed intracellularly and probably having an absorptive function. The vesicles are terminal swellings of hyphae formed inter and intracellularly having a storage function. There are six genera of fungi belonging to Endogonaceae which have been shown to form mycorrhizal associations: Glomus, Gigaspora, Acaulospora, Entrophospora Sclerocystis and Scutellospora.

Benefits of VAM

1. Produce more vigorous and healthy plants.
2. Increase plant establishment and survival at seedling or transplanting.
3. Enhance flowering and fruiting.
4. Increase yields and crop quality.
5. Improve drought tolerance, allowing watering reduction.



Following are the various benefits attributed to the plant through mycorrhizal symbiosis:
1. The VA mycorrhiza increases plant tolerance to various biotic and abiotic stressants including alkalinity, toxicities associated with mining operations, heavy metals and mineral imbalance.
2. The VA mycorrhiza have a potential use as biofertilizer and replaces the fertilizer requirements of trees in areas of marginal fertility and reduces the needs of current levels of chemical fertilizer
3. The mycorrhizal symbiosis plays a vital role in changing the ecology of a given site and mycorrhiza promotes mineral cycling and are key component of efficient and closed nutrient cycle of natural ecosystems.

VAM as a Bio-Fertilizer

Bio-fertilizers are a mixture of naturally occurring substances that are used to improve soil fertility. These fertilizers are very useful for soil health as well as for plant growth and development. Different research studies conducted on AMF during the past two decades have highlighted their countless benefits on soil health and crop productivity. Therefore, it is widely believed that AMF could be considered as a replacement of inorganic fertilizers in the near future, because mycorrhizal application can effectively reduce the quantitative use of chemical fertilizer input especially of phosphorus.

VAM reduce drought stress these are:
1. VAM fungi expand the roots by adding their own expansive network of absorbing strands to mine the soil for water and the dissolved minerals carried therein.
2. VAM fungi affect the opening or closure of the breathing pores in leaves. These pores are called "stomates." Under conditions of drought stress, the plant will close the stomates to reduce water loss. VAM fungi can affect the closure of these pores and help provide more efficient water conservation.

VAM fungi increase water pressure (turgor) in plant tissue (via 1 and 2 above), thereby preventing or delaying wilting. This supports cell function, allowing growth and photosynthesis to continue.

Studies on the Effect of Salinity on Yield and Quality of African Marigold (*Tagetes erecta* L.)

Article ID: 10723

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Introduction

Salinity is one of the major abiotic factors limiting plant growth in many areas of the world, which is progressively increasing as a result of decline in fresh water for irrigation and increasing use of effluents that contain high concentrations of salts that damage agricultural and landscape plants when used for irrigation (Carrow and Duncan, 1998; Munns and Tester, 2008). Marigold is one of the important annual ornamental species used in beds or borders of landscape settings and as cut flower. Huang and cox (1998) rated the tall marigold 'First Lady' as moderately tolerant to salinity; plants grown in a peat and perlite medium exhibited symptoms of toxicity only when the electrical conductivity (EC) of NaCl + $CaCl_2$ solution exceeded 7.9 dSm^{-1}. However, little is known about the effect of salinity on marigold performance when the high concentrations of HCO_3^- and Co_3^{2-} and eventually alters plant growth by rendering micronutrients (e.g., iron and zinc) insoluble. The present study was designed to compare the growth of two cultivars of marigold in response to irrigation with solutions differing in ionic concentrations and pH, imitating the saline conditions.

Effect of Salt Stress on Crop Growth

Abiotic stress leads to a series of morphological, physiological, biochemical, and molecular changes that adversely affect plant growth and productivity (Wang *et al.* 2001). Drought, salinity, extreme temperatures, and oxidative stress are often interconnected, and may induce similar cellular damage. Salinity imposes a variety of stresses on plant tissues. Two of these are osmotic stress which results from the relatively high soil solute concentrations and ion cytotoxicity. The decreased rate of leaf growth that occurs after an increase in soil salinity is primarily due to the osmotic effect of the salt around the roots, which inhibits plant water uptake and causes leaf cells to lose water. However, this loss of cell volume and turgor is transient and reductions in cell elongation and also cell division lead to slower leaf appearance and smaller final size over the longer term (Munns and Tester, 2008).

Perez-Bslibrea *et al.* (2008) reported that plants grown in given habitat are exposed to various abiotic stresses that may have significant effects on their growth and productivity, environment factors such as light, water as well as salinity are important variables affecting phytochemical production in plants.

Under salinity stress changes in the nutritional balance on NaCl results in higher levels of Na^+/Ca^{2+}, Na^+/K^+, Na^+/Mg^{2+}, Cl^-/H_2Po^{4-} thus causing plant growth (Grattan and Grieve, 1999). Among ornamental bedding plants, marigold to grow well under saline conditions (Escalona *et al.*, 2012). Valdez-Aguilar *et al.* (2009) reported that some marigold cultivars that are used as cut flowers or as bedding plants in landscaping can grow by maintaining with an EC of less than 8dS m^{-1}.

In *Chrysanthemum moriflorum*, when grown hydroponically and confronting with a seven-day stress treatment at concentrations of 2, 4 or 6dSm^{-1}, rooting of cuttings from stressed plants was depressed, with a 45% decrease in root numbers, almost 70% in root length and 52% for root weight (Prabucki *et al.*, 1999). Sonneveldt *et al.* (1999) reported that the salinity is even more serious in smaller root volumes generally used in soilless cultures because accumulation of salts may occur very quickly. Especially, when crops are grown in closed growing systems, the accumulation of salts in the root environment occurs rapidly.

Plant response to salinity depends not only the osmotic potential of the external solution, but also on the kinds of salts that contribute to salinity. Salt tolerances of many crops are available (Mass and Grattan, 1999). Low Na and Cl concentrations (2-4mM) in irrigation water have been reported to cause toxicities (Hughes and Hanan, 1978), and have led to the recommendation to be avoided in greenhouse rose production (White, 1987). McKersie and Leshem (1994) reported that effects of salinity on plant growth such as follows: (a) Reduction of H_2O uptake by roots, (b) Inhibition of plastic extensibility of cell walls, (c) Solute effects on the physical state of water, (d) Foliage scorch, tip burn and mottling necrosis, reduced photosynthesis: Cl^- induced damage, Na^+ induced damage, (e) Reduction of cell division, cell expansion, leaf size and overall plant stunting.

Effect of Salt Stress on Yield

Salinity affects the establishment, growth and development of plants, thus leading to a great loss in productivity (Giri *et al*., 2003; Katerji*et al*., 2003; Mathur *et al*., 2007) and may also affect ornamental quality of cultivated and wild species (Morales *et al*., 2001). Falcon *et al*. (1986) reported that continual yield reduction of rose as EC of the soil increases. Such relationships are often curvilinear, and the fact that plants can adjust to increasing salt concentration changes the relationship so expressed. An EC of 4dS m^{-1} corresponds to a total salt concentration of about 50meq l^{-1}, whereas an EC of 8.0 is approximately 90 meq l^{-1}.

Bolarin *et al*., 1991 reported that tolerance of plants can be expressed by amount of yield reduction by a specific salt concentration in the growing medium as compared to the yield under salt free conditions. Bar-Yosef*et al*. (2001) reported a yield reduction of 8% for an EC of 4.5dS m^{-1} with bell peppers (*Capsicum annuum* L.). The critical EC value is about 2.0-3.0dS m-1, and yield reductions of 9 to 16.7% per unit increase in EC have been reported in pepper hybrids (Chartzoulakis and Klapaki, 2000).

Adams and Ho (1989) reported that used a high EC combination (8dS m^{-1}) in the day time and a low EC (3dS m^{-1}) in the night hours (DH/NL). Such a combination increased blossom-end rot and reduced yield compared to treatment with 5dSm^{-1}in tomato. Crop plants respond to high salt concentrations in growing medium depending on their salt sensitivity with leaf injury, general growth retardation, yield depression and reduction in quality of the end products (Dinkelberg, 1990). Pasternak and Nerd (1996) reported that wild relatives of *Limonium* sp. showed no reduction in yield when irrigation waters reached electrical conductivities of up to 15dS m^{-1}.

New Findings from the Experiment

Plants, like other organisms, are mostly under threat of various stresses, both by biotic and abiotic factors. Being sessile, plants lack the mechanism to flee from these unfavorable conditions. The development of exclusive and complicated response to these environmental stresses in plants has fostered through evolution. The experiment conducted at Botanic gardens, Department of Floriculture and Landscaping, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore during 2016-2017 included application of different levels of salt through irrigation water for African marigold varieties (Coimbatore Local and Nilakkottai Local). The experiment comprised of six treatment combinations with three replications in Factorial CRD. The morphological, physiological and biochemical characters were observed at 60 days after imposing salt treatments. Based on the overall performance, it was concluded that Coimbatore Local was found to be the best up to 40 mM salinity level under Coimbatore conditions followed by Nilakkottai Local with respect to morphological, physiological and biochemical parameters.

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Methods of Immunodiagnosis

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Abstract
Diagnosis of disease now a days is mostly laboratory dependent. Due to recent advances in medical science and molecular biology, most of the diagnosis of uncommon, complicated, unusual presentation of disease has left the option of molecular diagnosis as the number one diagnostic modalities. Many molecular techniques are now being widely used throughout the world including PCR, flow cytometry, tissue microarray, different blots, and genetic diagnosis. Among these PCR is the most widely accepted, commonly used diagnostic modalities with very high specificity and sensitivity for correct diagnosis. We have reviewed the principle, application, advantages and disadvantages of PCR in laboratory diagnosis of disease.

Keywords: PCR, Molecular techniques, Immunodiagnosis methods, Review.

Introduction
PCR is the technique of modern molecular biology labs. If you need to copy, sequence or quantify DNA, you need to know PCR. In short, PCR (polymerase chain reaction) is a biochemical technique that uses thermo cycling and enzymes to quickly and reliably copy DNA, and it was invented in a flash of inspiration by a scientist driving on Highway 128 from San Francisco to Mendocino.

The advent of the polymerase chain reaction (PCR) radically transformed biological science from the time it was first discovered (Mullis, 1990). For the first time, it allowed for specific detection and production of large amounts of DNA. PCR-based strategies have propelled huge scientific endeavors such as the Human Genome Project. The technique is currently widely used by clinicians and researchers to diagnose diseases, clone and sequence genes, and carry out sophisticated quantitative and genomic studies in a rapid and very sensitive manner. One of the most important medical applications of the classical PCR method is the detection of pathogens. In addition, the PCR assay is used in forensic medicine to identify

criminals. Because of its widespread use, it is important to understand the basic principles of PCR and how its use can be modified to provide for sophisticated analysis of genes and the genome.

Basic PCR Ingredients
1. Polymerase: Polymerases are enzymes that, under the right conditions, can assemble new strands of DNA from template DNA and nucleotides. The original PCR reaction was cumbersome because the high temperatures needed to denature the DNA would kill the polymerases. This meant that after every heating cycle, new polymerases needed to be manually added to the reaction – an expensive endeavor. However, in modern PCR this is not a problem, as the polymerases used in modern PCR usually come from one of two thermophilic bacteria sources, Thermus aquaticus or Pyrococcus furiosus. These polymerases, respectively, Taq (pronounced “tack”) and Pfu (pronounced “P-F-U”) easily withstand the high temperatures associated with a PCR reaction. Commercial Taq and Pfu polymerases are engineered for speed, fidelity, processivity (ability to complete long reads), and their ability to read GC rich templates. Companies are constantly coming out with new polymerases.

2. Template DNA: This is the DNA that you design your primers to. It is the DNA that your polymerase will read and copy. Your template DNA can be genomic, plasmid or c DNA, but whatever your source quality counts. The more intact and purer your template DNA the easier it is to get good PCR results. Also keep in mind the ideal amount of DNA will depend on your source, usually 1pg – 1ng of plasmid DNA or 1 ng – 1 µg of genomic DNA per PCR reaction.

3. Primers: Primers are short fragments of synthesized DNA that bind to your template DNA. You will need to design one “forward” primer and one “reverse” primer. Your forward primer designates the start of your PCR. This primer's sequence is the same as your 5´-3´ template DNA sequence. Your reverse primer designates the end of your PCR. This primer's sequence is the reverse complement of your template DNA. In general, primers are 18-22 base pairs long. However, more important than their length is the melting temperature of your primers. The melting temperature of your primers should be 54-60°C and as similar as possible to each other. There are lots of online calculators that can calculate primer annealing temperatures, and most companies that synthesize primers supply such calculators.

4. Nucleotides: As the monomers of DNA, nucleotides are necessary for making DNA copies. For most DNA PCRs you will use Deoxynucleoside triphosphates (dNTPs). You can buy these separately or as a dGTP, dCTP, dATP and dTTP mix. Whatever you buy though, keep in mind that nucleotides are very sensitive to freeze/thaw cycles. Therefore, it is best to always create small aliquots of your dNTPs. Also make sure that you store them properly – do not use a frost-free freezer that goes through automatic defrost cycles.

5. Buffer: Most commercial polymerases come supplied with their ideal buffer. These buffers not only supply the correct pH, but they always have additives like magnesium, potassium, or DMSO, which help optimize DNA denaturing, renaturing, and polymerase activity. There will be more about these additives in an upcoming article.

6. Thermocycling: This is where the magic happens. All of the above ingredients are added to a PCR tube and the tube is thermocycled. In order to achieve thermocycling when PCR was first invented individual PCR tubes were manually moved between heated water baths. (And you think your bench work is tedious!) Now, thanks to the invention of "Mr. Cycles", the first thermocycling machine, temperature regulation is now done automatically by thermocyclers. The following is a typical PCR thermocycler profile:

a. Initialization: In this step the reaction is heated to 94-96°C for 30 seconds to several minutes. This step is usually only done once in the very beginning of your PCR reaction. This step is important for activating hot-start polymerases, if you are using such a polymerase, and to denature your template DNA. Keep in mind that if your template GC content is high you may need to perform an extra-long initialization step.

b. Denaturation: (Repeated 15-40 times) In this step, the reaction is heated to 94-98°C for 15-30 seconds. This step denatures your DNA and primers, which will allow them to anneal to each other in the next step.

c. Annealing: (Repeated 15-40 times) In this step, your reaction's temperature is rapidly lowered to 50-64°C for 20-40 seconds. The temperature in this step needs to be low enough that your denatured primers can form Watson-Crick base pairs with your template DNA. But high enough that only the most stable (perfectly paired) double-stranded DNA structures can form. Usually, this perfect annealing temperature is a few degrees lower than the melting temperature of your primer pair. Also, during this step your polymerase will binds to your primer/template DNA complex. Although your polymerase will not start reading until the temperature is raised in the next step.

d. Elongation or Extension: (repeated 15-40 times) In this step your reaction is rapidly heated to 72-80°C. This is when your polymerase will begin reading (in the 5´-3´ direction) and copying your template DNA (in the 3´-5´direction). The higher temperature during this step reduces non-specific primer/template DNA interactions, thus increasing the specificity of your reaction. However, the exact temperature will be determined by the preference of your polymerase, so read your packaging. The length of this step depends on how long your DNA copy will be. Typically, DNA polymerase can copy 1,000 base pairs per minute. Therefore, you need to allow at least 1 minute of extension time per 1,000 bases. At the end of this incubation new double-stranded pieces of DNA will have been created, consisting of both template and new DNA. Step 2-4 are then repeated 15-40 times. It is true that the more cycles you program the more DNA copies you will create. However, there is an upper limit. At some point available free nucleotides become limiting and prematurely truncated DNA copies can become a problem. So do not get greedy with your cycling. Less but good clean PCR product is preferable to lots of dirty product.

e. Final elongation: This is an optional but often recommended step. In this step the reaction is held at 70-74°C for several minutes. (Usually, you will use the same temperature as you used in the Elongation or Extension step.) This step allows the polymerases to finish reading whatever strand they are currently on. This optional step can help reduce the number of truncated copies in your final product.

f. Final hold: Your reaction is now complete. Since the entire process can take a few hours, PCR reactions are often done overnight or when you have otherwise stepped away; it is recommended that you program your thermocycler to hold your PCR product at 4°C until you return. At which time you can analyze or use your product, or transfer it to more suitable long-term storage like your refrigerator.

The PCR Process

PCR is a simple, yet elegant, enzymatic assay, which allows for the amplification of a specific DNA fragment from a complex pool of DNA. Dr. Kary Mullis, who discovered the PCR assay, stated it “lets you pick the piece of DNA you’re interested in and have as much of it as you want” (Mullis, 1990). PCR can be performed using source DNA from a variety of tissues and organisms, including peripheral blood, skin, hair, saliva, and microbes. Only trace amounts of DNA are needed for PCR to generate enough copies to be analyzed using conventional laboratory methods. For this reason, PCR is a sensitive assay.

Each PCR assay requires the presence of template DNA, primers, nucleotides, and DNA polymerase. The DNA polymerase is the key enzyme that links individual nucleotides together to form the PCR product. The nucleotides include the four bases – adenine, thymine, cytosine, and guanine (A, T, C, G) – that are found in DNA. These act as the building blocks that are used by the DNA polymerase to create the resultant PCR product.

The primers in the reaction specify the exact DNA product to be amplified. The primers are short DNA fragments with a defined sequence complementary to the target DNA that is to be detected and amplified. These serve as an extension point for the DNA polymerase to build on. The above-mentioned components are mixed in a test tube or 96-well plate and then placed in a machine that allows repeated cycles of DNA amplification to occur in three basic steps.

The machine is essentially a thermal cycler. It has a thermal block with holes, into which the test tubes or plates holding the PCR reaction mixture are inserted. The machine raises and lowers the temperature of the block in discrete, precise and pre-programmed steps (Weier & Gray, 1988). The reaction solution is first heated above the melting point of the two complementary DNA strands of the target DNA, which allows the strands to separate, a process called denaturation. The temperature is then lowered to allow the specific primers to bind to the target DNA segments, a process known as hybridization or annealing. Annealing between primers and the target DNA occurs only if they are complementary in sequence (e.g., A binding to G). The temperature is raised again, at which time the DNA polymerase is able to extend the primers by adding nucleotides to the developing DNA strand. With each repetition of these three steps, the number of copied DNA molecules doubles.

Advantages and Limitations of PCR

1. There are multiple advantages to PCR. First, it is a simple technique to understand and to use, and it produces results rapidly (Bolognia et al, 2008).
2. It is a highly sensitive technique with the potential to produce millions to billions of copies of a specific product for sequencing, cloning, and analysis.
3. This is true of qRT-PCR as well, but qRT-PCR has the advantage of quantification of the synthesized product. Thus, it can be used to analyze alterations of gene expression levels in tumors, microbes, or other disease states.
4. Although PCR is a valuable technique, it does have limitations. Because PCR is a highly sensitive technique, any form of contamination of the sample by even trace amounts of DNA can produce misleading results (Bolognia et al, 2008; Smith & Osborn, 2009).
5. In addition, in order to design primers for PCR, some prior sequence data is needed. Therefore, PCR can only be used to identify the presence or absence of a known pathogen or gene.
6. Another limitation is that the primers used for PCR can anneal non-specifically to sequences that are similar, but not completely identical to target DNA. In addition, incorrect nucleotides can be incorporated into the PCR sequence by the DNA polymerase, albeit at a very low rate.

Disadvantages of PCR

1. Requires costly instruments like thermal cycler, agargel diffusion tray, DNA separation kit, other chemicals & reagents which not all laboratories can afford to buy.
2. Requires trained, experienced, qualified manpower and technologists.
3. Adequate space with aircondition, dehumidifier, laminar flow facilities.
4. Limited scope for diagnosis of diseases.
5. Costly and not all people can afford to do the test.
6. False positive and false negative results may lower specificity & sensitivity.

Conclusions

For accurate diagnosis of some disease with more sensitivity and specificity PCR is a very common and widely accepted method now a days throughout the world and it is also gaining popularity in Bangladesh. Many advance medical centers, modern diagnostic labs and medical institutions are using PCR as routine lab diagnostic and research modalities. PCR can play an important role in diagnosing disease with diversify and a typical clinical presentation and can lead to early and definitive diagnosis which helps the clinician to start early treatment, manage better treatment plan and follow up for the patient. This leads to reduce economic and social burden the patient and the family.

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Management of Poultry During Disease Outbreak

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Introduction

Poultry owners should immediately begin an investigation if a disease is suspected in a flock. Obvious disease signs and symptoms can be identified on the farm, while others may require laboratory assistance for proper diagnosis. Recognize disease early. Set aside a certain period each day to observe the flock. Look for unhealthy birds. Note the bird's actions and how they are eating and drinking. Listen for any unusual sounds — sneezing or rattling. The spread of the disease and the cost of treatment may be reduced if the disease is recognized early. Flock records can aid in recognizing a disease in its early stages. A slump in feed and/or water consumption is usually the best early indicator. Keep daily feed and water consumption, egg production and mortality records. Major changes in these flock records from day to day, or over a period of time, may indicate that a disease is present in the flock.

Important Rules

Certain rules are helpful in evaluating the importance of a developing disease problem. For example, if you notice more than 1 percent of the flock sick at any one time, disease is probably present that needs immediate attention. To make it easier to see increased illness in the flock, remove obvious culls as soon as they show evidence of never returning to economic growth or egg production. You can expect a mortality of about 2 percent in baby chicks and 3 percent in turkey poults during the first three weeks of age. If losses are greater than this, there may be cause for alarm. The so-called normal mortality after three weeks of age should not exceed 1 percent per month. A slight rise in mortality can be anticipated as adult flocks come into egg production.

Diagnosis at the Farm

Do not attempt to identify all poultry diseases on the farm. The risk is too high. Most modern poultry farms represent a large investment with a heavy loss if the wrong medication is given. Only a limited number of diseases can be accurately identified without laboratory aids. When in doubt, use the laboratory facilities in your area to get an accurate diagnosis.

Collecting History

The veterinarian will need a history of your flock of birds are taken or sent to a laboratory. The basic questions asked by each laboratory are much the same. The sample form gives some of the usual information required by the laboratory diagnostician

A complete history on the flock gives the veterinarian a clear picture of what has taken place. From this history, the veterinarian will select the information that relates to this particular disease outbreak. If you want other persons such as your feed dealer or hatchery owner to receive a copy of a lab report, be sure to submit their names and addresses along with the flock history. This service is usually without charge; however, these requests should be kept to a minimum to reduce postage and mailing costs for laboratories. If phone reports are desired, most laboratories require that these must be made collect to the owner or other persons receiving the report. Individual laboratories vary whether the call should be initiated by the diagnostician or by the person desiring the report.

Advantages and Limitations of PCR

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2. It is a highly sensitive technique with the potential to produce millions to billions of copies of a specific product for sequencing, cloning, and analysis.

3. This is true of qRT-PCR as well, but qRT-PCR has the advantage of quantification of the synthesized product. Thus, it can be used to analyze alterations of gene expression levels in tumors, microbes, or other disease states.

4. Although PCR is a valuable technique, it does have limitations. Because PCR is a highly sensitive technique, any form of contamination of the sample by even trace amounts of DNA can produce misleading results (Bolognia et al, 2008; Smith & Osborn, 2009).

5. In addition, in order to design primers for PCR, some prior sequence data is needed. Therefore, PCR can only be used to identify the presence or absence of a known pathogen or gene.

6. Another limitation is that the primers used for PCR can anneal non-specifically to sequences that are similar, but not completely identical to target DNA. In addition, incorrect nucleotides can be incorporated into the PCR sequence by the DNA polymerase, albeit at a very low rate.

Specimen Selection

The poorest long-standing culls in the flock are not the type of birds to take to the laboratory. Instead, try to collect specimens representing the current, most troublesome disorder. It is best to take two or three live birds to the lab rather than a one-bird sample. A general rule is that the sicker a bird becomes, the more likely it is to have developed internal damage that points to the cause of the illness.

Specimen Transportation to Lab

Most laboratory diagnosticians prefer that specimen be brought to the laboratory by a person acquainted with the history and present circumstances of the flock in question. If other methods are used, a detailed history as described should be sent with the specimens, either attached directly or carried by the person transporting the specimens. Where direct transport is not available, specimens can be shipped by public carrier.

However, this is discouraged because infectious disease may be spread while the birds are en route. Hatchery or feed company trucks should not be used to transport diseased birds if vehicles are to be used later to transport chicks or feed to premises having healthy birds. Any shipment of specimens by public carrier in preserved form should be made only after getting expert advice on postal regulations and packing methods. The best source of information is the local veterinarian.

Diagnostic Lab Procedures

The procedures for diagnosing poultry diseases are similar in most laboratories. Notations are made of the history; birds are observed for symptoms and appropriate numbers are examined after death. A laboratory will use primary and secondary tests in making a diagnosis. Primary tests include bacterial cultures, bird inoculations, direct microscopy of tissues and body fluids, and serum tests. Secondary tests might include virus isolations, chemical analysis and microscopic examination of prepared tissues.

Results of all tests conducted would be considered in making the final report. Time required to get the final report might range from one day to six weeks. The longer period would be necessary for culture growth and identification of some types of bacteria such as Avian T.B. and some fungi. Many of the laboratories will give a preliminary report at or soon after the first examination of the birds.

Then it is often necessary to change this tentative diagnosis as more information is accumulated. The objective is to get a true identification of the source of the disease and then to make sound recommendations that will help return the birds to good health with the least loss.

Lab Results and their Application

Conscientious application is necessary if the results of laboratory findings and recommendations are to be of the greatest benefit. However, the usual laboratory report is not intended to be a detailed coverage of all measures that should be carried out. Most reports are written to emphasize specific measures applying to the problem in question. The sick flock should be frequently observed to check reaction to drugs and to see that birds are eating and drinking properly. Observe any change in symptoms that would indicate a change in the course of the present disease, or possible development of other diseases.

It is quite common, particularly in large flocks that two or more diseases are found in the flock at the same time. Should changes occur, it is often helpful to consult again with your veterinarian to determine whether further examinations or changes in control measures may be necessary. It is particularly important to vacate the building and clean and disinfect everything following a severe disease outbreak. When a disease is present that cycles back to younger birds, it may be necessary to remove all birds. Then, after cleaning and disinfecting all buildings, the enterprise can be reestablished on a healthy basis.

Conclusions

Management of birds during a disease outbreak is of paramount importance to prevent the spread of the disease in a farm setting. Early management will result in less disease spread, more healthy flock and increased returns for the farmer. A farm owner must have the knowledge about the disease symptoms and must inform a veterinarian in case of any such symptom among the birds in the flock.

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Epidemiology Related to Plant Bacterial Pathogens

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Epidemiology

Study of disease in populations or Study of patterns, causes and control of disease in populations or Study of disease in population. Science that deals with the increase or decrease in plant disease in a population in time and space. The massive occurrence of a disease in a limited time period (Agrios, 2005).

Epidemics and Epiphyotics

When a pathogen spreads to and affects many individuals within a population over a relatively large area and within a relatively short time, the phenomenon is called an epidemic. It is the dynamics of change in plant disease in time and space.

Plant disease epidemics, sometimes called epiphytotics, occur annually on most crops in many parts of the world. (Epidemics – term for both animal and plant diseases). The study of epidemics and of the factors that influence them is called epidemiology.

Some Important Bacterial Diseases Elements of Epidemics

1. Susceptible host plants.
2. Virulent pathogen.
3. Favourable environmental conditions.
4. Time.
5. Humans.

An endemic is present in a community at all times but in low frequency.

An epidemic involves more than the expected number of cases of disease occurring in a community or region during a given period of time. An epidemic is typically a sudden severe outbreak within a region or a group. A pandemic is an epidemic that becomes very widespread and affects a whole region, a continent, or the world.

Sporadic: Occurring upon occasion or in a scattered, isolated or seemingly random way.

Host Factors in Epidemics

Level of genetic resistance or susceptibility of host: Susceptible host plants lacking genes for resistance against the pathogen provide the ideal substrate for establishment and development of new infections. Host plants carrying race-specific (vertical) resistance do not allow a pathogen to become established in them, and thus no epidemic can develop.

Host plants carrying partial (horizontal) resistance will probably become infected, but the rate at which the disease and the epidemic will develop depends on the level of resistance and the environmental conditions.

Degree of genetic uniformity of host plants: a. When genetically uniform host plants, particularly with regard to the genes associated with disease resistance, are grown over large areas, a greater likelihood exists that a new pathogen race will appear that can attack their genome and result in an epidemic. b. the highest rates of epidemic development generally occur in vegetatively propagated crops, intermediate rates in self-pollinated crops, and the lowest rates in cross- pollinated crops.

Example: In the early 1960's a dwarf rice cultivar IR8 - high yields, non-lodging and had good response to nitrogen. Planted throughout Southeast and South Asia. Also, very susceptible to bacterial leaf blight caused by *Xanthomonas oryzae pv. oryzae*.

Type and Age of Crop

1. In diseases of annual crops, such as corn, vegetables, rice, and cotton, and in foliar, blossom, or fruit diseases of trees and vines, epidemics generally develop much more rapidly (usually in a few weeks) than they do in diseases of branches and stems of perennial woody crops such as fruit and forest trees.

2. Suppression of the blossom-blight phase of fire blight is a key point in the management of this destructive and increasingly important disease of apple and pear.

3. For example blossom infection to occur, the causal bacterium, *Erwinia amylovora*, needs to increase its population size through an epiphytic phase that occurs on stigmatic surfaces.

4. *Xantomonas stewartii* – stewart wilt of corn – mature plants – depends on organic nitrogen which appeared on matured plants only.

Defence Mechanism of the Host

1. Formation of abcission layer – *Xanthomonas pruni* in peach on infection.
2. Deposition of gums in intercellular spaces– stone fruits –*Pseudomonas syringae*.
3. Resistance of tomato to *Psedomonas solanacearum* – tomatin concentration.

Distance of Host from Pathogen

The pathogen in soil move to host through irrigation water. The host plant present near the pathogen is affected early than the farther host. The spread of bacteria is faster in air than in soil.

Pathogen Factors in Epidemics

Quantity of inoculum near hosts:

a. The greater the number of pathogen propagules (bacteria, fungal spores and sclerotia, nematode eggs, virus infected plants, etc.) within or near fields of host plants, the more inoculum reaches the hosts and at an earlier time, thereby increasing the chances of an epidemic greatly
b. Plant debris, seed surface, insects ,air, irrigation, soil
c. Multiplication of *P. lachrymas, X.glycenia, X. versicatoria* in young buds of cucumber, soybean, pepper and bean.

Level of virulence: Virulent pathogens capable of infecting the host rapidly ensure a faster production of larger amounts of inoculum, and, thereby, disease, than pathogens of lesser virulence.

For example, hill potatoes were affected by race 2 and plain grown potatoes were affected by race 1 of *Pseudomonas solanacearum*.

Type of Reproduction of the Pathogen

Bacteria produce many off springs compared to few fungi, all nematodes, and all parasitic plants which produce relatively small numbers of offspring.

Some plant pathogenic fungi, bacteria, and viruses have short reproduction cycles and therefore are polycyclic, i.e., they can produce many generations in a single growing season.

Polycyclic pathogens include leaf spot causing bacteria. Monocyclic pathogens, the smaller number of offspring and conditions of their dispersal limit their potential to cause sudden and widespread epidemics in a single season Eg. Wilts.

Ecology of the Pathogen

Knowledge of the ecology of the pathogen (*Erwinia amylovora*) on stigmas has been key to the development of predictive models for infection and optimal timing of antibiotic sprays. Vascular bacteria which reproduce inside the plant, spread of the pathogen is rare or impossible without the help of vectors.

Therefore, such pathogens can cause epidemics only when vectors are plentiful and active. Still other pathogens, such as soil borne fungi, bacteria, and nematodes, produce their inoculum on infected plant parts in the soil, within which the inoculum disperses slowly and presents little danger for sudden or widespread epidemics.

Environmental Factors in Epidemics

Moisture: Abundant, prolonged, or repeated high moisture, whether in the form of rain, dew, or high humidity, is the dominant factor in the development of most epidemics of diseases.

The presence of high levels of moisture allows all these events to take place constantly and repeatedly and leads to epidemics.

In contrast, the absence of moisture for even a few days prevents all of these events from taking place so that epidemics are interrupted or stopped completely.

Rain, flooding: BLB of rice, Black arm of cotton severe when rain followed by bright sunshine during the months of October and November are highly favorable. Splash- fire blight disease Surface irrigation – wilt of banana Relative humidity- Bacterial leaf streak (*Xanthomonas campestris p.v. oryzicola*) High relative humidity (83-93%) or dew during morning hours for 2 to 3 hours.

Temperature: Epidemics are sometimes favoured by temperatures higher or lower than the optimum for the plant because they reduce the plant's level of partial resistance. At certain levels, temperatures may even reduce or eliminate the race-specific resistance of host plants. Plants growing at such temperatures become "stressed" and predisposed to disease, provided the pathogen remains vigorous. Infections by *Erwinia amylovora* are only found much later in spring or in early summer for the first time. This bacterium has a higher growth temperature optimum (28- 30°C). *C. michiganensis* subsp *sepedonicus* causing bacterial ring rot of potato (*Solanumtuberosum*). The dispersal linked to occurrence of host and cool climatic area (21ºC) of the bacterium. (Janse, 2005).

Other Factors in Epidemics

Some plant pathologists have elaborated on the disease triangle by adding one or more parameters. Suggested additional parameters have included time and humans.

Time in Epidemics

Of these, only time is absolutely required so other elements represent special case applications. The disease onset and intensity are affected by the duration that the three factors are aligned. Naturally, disease may not happen in the first instant the three parameters are aligned favorably but will occur after some duration.

Understanding how disease levels increase or decrease over time is one of the most basic elements of plant disease epidemiology and ecology. Statistical models are often applied in order to summarize and describe this complexity, so that disease processes can be more readily understood (Hirano and Upper,1983: Ronald Gitaitis and Ronald Walcott. 2007). For example, comparisons between patterns of disease progress for different diseases, cultivars, management strategies, or environmental settings can help in determining how plant diseases may best be managed. Bacteria and viruses are capable of building up enormous populations in a very short time, only days or even hours under the right conditions.

The importance of time is observed in monocyclic, polycyclic and polyetic diseases. The time over epidemic also observed by disease incidence, disease severity and AUDPC models.

Humans in Epidemics Site Selection and Preparation

Ex: Bacterial leaf spot and stem canker *(Xanthomonas campestris pv. Cajani*) disease incidence is generally higher in low-lying waterlogged areas of the field than in well drained areas.

Date of sowing: Sowing date effect on development of Erwinia soft rot in Chinese cabbage in which early sowing (15th of July) was a high risk due to favorable weather conditions for the pathogen. Bacterial blight or Angular leaf spot or Black arm of cotton is severe when early sowing, delayed thinning, poor tillage, late irrigation and potassium deficiency in soil.

Selection of Propagating Material

The use of seed, nursery stock, and other propagative material that carries various pathogens increases the amount of initial inoculum within the crop and favors the development of epidemics greatly. The use of pathogen-free or treated propagative material can reduce the chance of epidemics greatly. Cultural Practices Continuous monoculture, large acreages planted to the same variety of crop, high levels of nitrogen fertilization, dense plantings, overhead Irrigation, injury by herbicide application, and poor sanitation all increase the possibility and severity of epidemics.

Pseudomonas solanacearum, persists between crops in moist soil and apparently unable to survive in dry soils. Cultural practices that enhance soil drying help to reduce the pathogen population.

Bacterial stem blight in chrysanthemum, caused by *P. cichorii*, is a big problem under conditions of close planting, high humidity and high N fertilization. Bacterial leaf blight of rice is severe when clipping of tip of the seedling at the time of transplanting, heavy rain, heavy dew, flooding, deep irrigation water, severe wind, temperature of 25-30°C and application of excessive nitrogen, especially late top dressing.

Disease Control Measures

Chemical sprays, cultural practices (such as sanitation and crop rotation), biological controls (such as using resistant varieties), and other control measures reduce or eliminate the possibility of an epidemic. Sometimes, however, certain controls, e.g., the use of a certain chemical or planting of a certain variety, may lead to selection of virulent strains of the pathogen that either are resistant to the chemical or can overcome the resistance of the variety and thus lead to epidemics.

Introduction of New Pathogens

The ease and frequency of worldwide travel have also increased the movement of seeds, tubers, nursery stock, and other agricultural goods. These events increase the possibility of introducing pathogens into areas where the hosts have not had a chance to evolve resistance to these pathogens. Such pathogens frequently lead to severe epidemics. Example: citrus canker caused by the bacterium *Xanthomonas campestris pv. citri*.

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Drying or Dehydration of Fruits and Vegetables

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The removal of water from fruits and vegetables is one way of preservation. The drying of fruits and vegetables under the influence of non-conventional energy sources like sun and wind is known as drying while dehydration means the process of removal of moisture by the application of artificial heat under controlled conditions of temperature, humidity and air flow. In the former, there is no control of temperature and humidity.

In the process of dehydration, a single layer of fruits or vegetables either whole or pieces or slices are spread on trays which are placed inside the dehydrator. The initial temperature of the dehydrator is usually 43^0C which is gradually increased to $60\text{-}66^0$C in the case of vegetables and $66\text{-}71^0$C for fruits.

Factor Affecting Rate of Drying

Composition of raw material, Size, shape and arrangement of stacking of produce, Temperature, humidity and air velocity of the dehydrator, Pressure (baromaetric or vacuum), Heat transfer to surface (conductive, connective or radiative).

Advantages if Dehydration Over Sun Drying

The process of dehydration is very rapid, Dehydration requires less floor area, Dehydration is done under hygienic condition, Mechanical dehydration is not dependent on the weather, The colour of dehydrated product remains uniform.

Advantages of Dehydration Over Other Methods of Preservation

Weight of the product is reduced to ¼ to $1/9^{th}$ its original or fresh weight and thus cost of transport is reduced, Due to reduction in bulk of the product, it requires less space for storage, Cost of dehydration is very low, as less labour is involved and the absence of sugar addition to the product.

Principle of Drying or Dehydration

The microorganisms require plenty of free water for their survival. Drying or dehydration removes biologically active water, thus growth of microorganisms is stopped. This also results in reduced rate of enzyme activity and chemical reactions. The food value, natural flavor and characteristic cooking quality of fresh material are retained after drying. Fruits show no sign of moisture or stickiness and vegetables become brittle on drying. The residual moisture should not be more than 6-8 per cent in vegetables and 10-20 per cent in fruits. Dried fruits can be used as such or after soaking, while dried vegetables are usually soaked in water over night before cooking.

Flow Chart for Drying/ Dehydration of Fruits and Vegetables

Fruits/vegetables

↓

Washing

↓

Peeling

↓

Preparation

↓
Spreading on flat wooden trays
↓
Sulphuring (@ 1.8 to 3.6 kg per tone of fruits)
↓
Drying / dehydration
↓
Sweating
↓
Packing
↓
Storage

Schedule for Drying of Fruits and Vegetables

Fruit/vegetables	Preparation and pre-treatment	Sulphuring time	Drying temperature
Banana	Wash, peel, cut lengthwise or slice 12mm thick	30 min	55-60^{0}C.
Date	Wash, dip in boiling 0.5% caustic soda solution then rinse	-	45-50^{0}C or sun drying.
Fig	Wash	1 hr	55-60^{0}C or sun drying.
Grape	Dip in boiling 0.5% caustic soda, then rinse	1 hr	55-60^{0}C or sun drying.
Mango	Wash, peel, cut into 12 mm thick slices	2 hr	45-50^{0}C or sun drying.
Papaya	Wash, peel, remove seeds, cut into 6 mm thick slices	2 hr	60-65^{0}C or sun drying.
Apple	Wash, peel, core and cut into 5 mm thick slices	30 mts. Or immerse in 1-2% KMS for 30 mts and drain	60-65^{0}C or sun drying.
Amla	Wash, grate, add salt @ 40 g per kg grated material	-	Sun-drying.
Cauliflower and cabbage	Wash removes stalks, break flowers apart/cut into fine shreds.	Blanch 4-5 min, immerse in 0.5-1% KMS solution for 60 Mts (cauliflower) for 10 mts (cabbage)	55-60^{0}C or sun drying.
Peas	Wash, remove shell and collect the seeds.	Blanch for 3-4 min, immerse in 0.5% KMS solution and drain	60-65^{0}C or sun drying.
Onion and garlic	Remove outer dry scales, cut into 5mm thick slices.	Dip for 10 min in 5% salt solution and drain	60-65^{0}C or sun drying.
Leafy vegetables	Sort, peel and cut into 10 mm slices.	Blanch for 2 min	60-65^{0}C or sun drying.
Potato	Wash, peel and cut into 10mm slices.	Blanch for 3 to 4 min and immerse in 0.5% KMS solution	60-65^{0}C or sun drying.

Bitter gourd	Wash, ct both ends, cut 10 mm slices.	Blanch for 7-8 min	60-70^{0}C or sun drying.

Reconstitution of Dried Products

Water is added to the product which is restored to condition similar to that when it was fresh. This enables the product to cook as if the fresh fruit or vegetable is used.

Methods of Reconstitution

1. Quick method: Cold water, ten times the weight of dry product, is added to the dried product. The container is covered, brought to the boil and immersed until the product is tender. The cooking time may be 15 to 45 minutes after boiling point has been reached.

2. Slow method: Cold water is added to the dried product and is left to soak for 1 to 2 hours before cooking. The product is then cooked in the same water and the time will be shorter than the above method.



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Scenario, Nutritional Security, Importance and Challenges of Dragon Fruit Production in India

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Abstract

Dragon fruit a recently introduced super fruit in Indian market. It is getting tremendous popularity among growers because of its attractive fruit color and mouthwatering pulp with edible black seed imbedded inside the pulp, nutraceutical value, excellent export potential and highly remunerative in nature as produces yield from 14- 16 months after planting of stem cutting and yield up to 20 years with long crop cycle from May – December in different flushes in each and every year.

It is also a part of urban horticulture because of its beautiful nocturnal showy white flowers which can be used in moon garden. This article deals with the knowledge regarding cultivation of dragon fruit in Indian condition so all become familiar with dragon fruit.

Keywords: Balanced tree frameworks, fruit quality, productivity, tree health.

Introduction

Dragon fruit or Pitahaya (*Hylocereus undatus*) also known as "The Wonderous Fruit" of the 21st century belongs to Cactaceae family and is known to be originally native to a region including Mexico, Guatemala, Nicaragua, Costa Rica, El Salvador and northern South America. North-eastern region of India is endowed with rich diversity of crops due to its diverse soil and agro-climatic conditions.

It is a hub for many underutilized horticultural crops which may not know to other parts of the country. Most of the lands in this region is virgin and remain unexploited which may be used up for cultivation of different crops which are emerging lately in these areas.

Dragon fruit can be grown as an ornamental crop as well as for consumptions. They are consumed either as fresh fruits or in salads, for production of jam, jelly, ice-cream, juice, wine, face-packs etc. *Hylocereus costaricensis*, red fleshed pitaya and *H. undatus*, a white fleshed pitaya is two major species growing under Indian condition especially in West Bengal.

Scenario of Dragon Fruit Cultivation in India

The low maintenance and high profitability of dragon fruits has attracted the farming community throughout India. This has led to a steep increase in dragon fruit cultivation in Maharashtra, Karnataka, Andhra Pradesh, West Bengal, Telangana, Tamil Nadu, Odisha, Gujarat and the Andaman and Nicobar Islands, as well as in many north eastern states. A recent estimate by Indian Council of Agricultural Research-National Institute of Abiotic Stress Management, Baramati in Maharashtra found that dragon fruits are cultivated on 3,000-4,000 hectares in various states of India. The country produces approximately 12,000 tonnes of the fruit every year. The fruit can be exported to Persian Gulf countries, the European Union and the United States. In June 2021, India exported its first consignment of dragon fruit from a farmer of Maharashtra to Dubai in the United Arab Emirates.

Fig.1. Dragon fruit Products like, Dragon fruit Flavours, Jam, Powder and Puree respectively.

World Dragon Fruit Production

Major dragon fruit producing countries (area, production and productivity, 2017–2018):

Country	Production area (ha)	Production of Country (in MT)	Productivity (MT ha–1)
Vietnam	55,419	10,74,242	22–35
China	40,000	7,00,000	17.5
Indonesia	8,491	2,21,832	23.6
Thailand	3,482	26,000	7.5
Taiwan	2,490.6	49,108	19.7
Malaisia	680	7,820	11.5
Philippines	485	6,062.5	10–15
Cambodia	440	4,840	11.0
India	400	4,200	8.0–10.5

Nutritional Security and Importance of Dragon Fruit

Proximate nutraceutical values in g or mg per 100 g edible portion of white-flesh dragon fruit are as follows: Moisture (85.3 %), Protein (1.1), Fat (0.57), Crude fiber (1.34), Energy (Kcal) (67.7), Ash (0.56), Carbohydrates (11.2), Glucose (5.7), Fructose (3.2), Sucrose (not detected), Sorbitol (0.33); Vitamin C (3.0), Vitamin A (0.01), Niacin (2.8), Ca (10.2), Fe (3.37), Mg (38.9), P (27.75), K (272.0), Na (8.9) and Zn (0.35) and for red-flesh fruit:, Moisture (82.5-83.0), Protein (0.159-0.229), Fat (0.21-0.61), Crude fiber (0.7-0.9) and Ascorbic acid (8-9).

Regarding different uses of Dragon fruit, young stems of *H. undatus* are edible as well as fresh flower buds that are eaten as vegetables, while dried ones are used for homemade medicine. In Taiwan, dry flowers are consumed as vegetables besides this it is also taken in the form of juice, jam, or preserves according to the taste needed, besides used as fresh table fruit. It is widely used as juice and in fruit salads at restaurants. Regular consumption of Dragon fruit helps in fighting against cough and asthma; also, it helps for healing wounds and cuts quickly due to it contains high amount of vitamin C.

However, the high level of vitamin C found in Dragon fruit plays an important role to enhance immune system and also to stimulate the activity of other antioxidant in the body. In addition to being used as a food colouring agents, consumption of Dragon fruit mostly as fresh fruit as relieving thirst due to it contains high water level compared with other nutrient levels Health benefits of Dragon fruit is also rich in flavonoids that act against cardio related problems, also dragon fruit aids to treat bleeding problems of vaginal discharge.

Dragon fruits are rich in fibers; however, it aids in digestion of food. Dragon fruit is also packed with B vitamin group (B1, B2 and B3) which possess an important role in health benefit. Vitamin B1 helps in increasing energy production and in carbohydrate metabolism, Vitamin B2 in Dragon Fruit acts as a multivitamin; however, it aids to improve and recover the loss of appetite. And Vitamin B3 present in dragon fruit plays an important role in lowering bad cholesterol levels; it provides smooth and moisturizes skin appearance. As well as it improves eye sight and prevent hypertension.

Dragon fruit is also helpful in reducing blood sugar levels in people suffering from type 2 diabetes, studies suggest that the glucose found in Dragon fruit helps in controlling the blood sugar level for diabetes patients. It contains high level of phosphorus and calcium. It helps to reinforce bones and play an important role in tissue formation and forms healthy teeth.


Fig.2. Red colour fruit and flesh. Fig.3. Yellow colour fruit with white colour flesh.

Challenges in Dragon Fruit Production

1. Nursery and varietal improvement problems:

a. High cost and non–availability of quality sapling materials. The stem sapling materials can be available in three different forms viz., fresh cut, rooted sapling without soil bags and rooted sapling with soil bags for easer transportation and cost reduction depending on distance, soil types and climatic conditions.
b. Lack of nursery standards and choice of sapling of different varieties particularly for diversifying dragon fruit in drought prone /degraded areas. Presently saplings of one or two varieties i.e., red skin–white flesh and red skin–red flesh are available with nursery owners.
c. Identification and development of new varieties for overcoming problem of irregular flowering & pollination.

2. Orchard establishment and training system related challenges:

a. Lack of awareness among the growers about ideal plantation practices and seasons for initial establishment of orchards. Sometimes, it may lead to complete damage of dragon fruit saplings if planted during offseason or prior to extreme weather conditions. The growers must be well aware about site selected for orchard viz., soil types, slope, drainage, runoff and water logging pattern etc.
b. High initial investment of orchard establishment (INR 6.5–7.5 lakhs/ha) is the biggest constraint of dragon fruit cultivation at marginal and small farmers levels. It includes cost of sapling materials, installation of drip irrigation and trellis system (concrete pole, iron/concrete ring, continuous pyramid, 'T' stands and iron wires and ladder etc.).
c. Standardization and selection of regional specific trellis designs, planting geometry and trellis materials is highly essential for improving yield performance, easy harvesting and achieving high load bearing capacity in diversified agro–climatic regions.

3. Stunted growth and sun burning of canopy: Stunted growth and sun burning injuries closely related to heat stress experienced by the several (80−95%) dragon fruit farmers across India. It occurred particularly during summer season in Rajasthan, Gujarat, Maharashtra and Southern India. The symptom appeared during the month of March and April that witness higher variation in day and night temperatures in regions crosses above 38℃. The intensity of sun burning on plant leaves and stem varies between 10−50%. To overcome this problem, an attempt has been made on trial basis for growing dragon fruit under shade net house and spraying of anti-transpirants to control the sun burn injury on dragon fruits.

4. Reduction in fruit size and yield: This is typical problem experienced by several farmers mostly in old orchards (after 5–6 years) at least once in two years particularly during 1st and 2nd harvesting. However, this problem can tackle through good agronomic practices for nutrients and water management.

5. Non uniform fruit size: This is common problem starts from initial to the ends of the fruiting season in all kinds of dragon fruit orchards. However, its intensity is higher at first and the last harvesting of dragon fruit. It can be resolved by maintaining appropriate fruit density and soil moisture–nutrients management practices at initial stage of fruiting.

6. Canopy and residues management in older orchards:

a. Lack of standards on canopy management practices for Indian conditions is one of the major concerns of dragon fruit growers.
b. Mostly farmers are not willing to follow standard canopy management practices since crop of dry land areas and its thorny leaves which calls for engineering interventions.
c. Collapse of poles/wires due to ever increasing heavy loads of canopy in older orchard is another issue to be addressed through research.
d. Most of Indian growers are unaware about the importance of pruned out canopy residues, as a lignocellulose rich substrate for preparation of compost.

7. Post–harvest management practices:

a. Need to standardize quality and maturity indices based on size, color and TSS.
b. Lack of ideal pre–cooling, packaging (like HDPE, polypropylene, polyethylene plastic/corrugated box etc.) and transportation facilities.
c. Lack of controlled storage facility to prevent the chilling injury, ethylene production, respiration rate, optimum temperature for enhancing shelf life of fresh fruits.
d. Lack of round the year supply of dragon fruits for continuous operation of processing plant.
e. Poor marketing infrastructure and network.

Conclusion

Commercially, dragon fruit appear to have numerous selling points; they are attractive in shape and color, and very good nutraceutical property which attract growers from all over the India. The red flesh species i.e., *H. costaricensis* are additionally rich in betalains, meeting the increasing trade interest for antioxidant products and natural food colorant. Fruits are easy to keep fresh under room condition. Several processed products can also be made from the pulp of the fruit. The crop is hardy and can survive in any type of climatic condition favorable for flowering and fruiting and soil condition provided with good drainage. In general, they produce fruits quickly and few diseases and pests are encountered at the present time. In order to meet the current as well as future demand for this amazing fruit, it would be a great opportunity for the growers to start up dragon fruit farming in the North east India, which is befitted for its cultivation. This region has wide range of both soil and climate that are suitable for its cultivation. Farmers of this region may be benefitted from its cultivation because it is an easy income generation crop due to its early and yielding ability.

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Food Crops and its Non-Food Uses

Article ID: 10729

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Introduction

The fact that agriculture is a provider of non-food products is not new. Agriculture, including animal rearing and forestry, has traditionally been a source of fibres, fuel, construction and other materials like hides and skins.

To name a few of the more illustrative examples: the large-scale use of feedstock and biomass to produce biofuels, the use of oilseeds to produce oleo-chemical products, the expansion on the use of starch in a wide range of products including polymers for biodegradable plastics, or the expansion on the use of fibres in the textile and automotive industry.

Fuel, fibres, starch, oils, solvents, dyes, resins, proteins, speciality chemicals and pharmaceuticals, are today to various degrees of biological, agriculture origin. The range of crops which can be used for non-food purposes is very large but in practice only a small amount of this potential is used on a commercial basis. The principal end products sought for non-food use are carbohydrates, fats and fibres.

Rice

Rice is the most important cereal crop in India. Several rice varieties have been identified which possess medicinal properties.

Njavara rice

1. Njavara is an important medicinal rice in Kerala, used in panchakarma treatment. Rice bran and husk are the major by-products obtained during the processing of grain.
2. Rice bran oil also has some medicinal properties.
3. Rice straw, besides being used for feeding the cattle, can be incorporated in the field itself, which will enhance the productivity.

Sorghum, Bajra and Maize

1. Sorghum, bajra and maize are the other important food crops which are used for making biofuel and also used as cattle feed.
2. Starch extracted from maize has also got many uses.

Sugarcane

1. Biofuel is the major product from sugarcane which is produced from the bagasse.
2. Other important sugar-based products include sucrose esters, sucrose epoxy and bioplastics.
3. Pressmud is used to make compost.
4. Molasses is widely used as an additive and also for alcohol preparation.

Cassava

1. Cassava is another important food crop having many non-foods uses.
2. Cassava starch is used as an adhesive and is having great use in paper and textile industry.
3. Cassava hay is produced from young plants after sun drying and biofuel is another product.

Banana

1. Banana, one of the important fruit crops, also has wide uses.
2. Banana plants along with bunches are used for ceremonial purposes.
3. Banana bunches, especially Nendran, were offered as *Kazhchakkulai* to the landlords during Onam festival and now these are offered to Lord Guruvayoorappan.
4. Banana fibre is obtained from stem and leaves.
5. Clothes from banana fibre is the national dress of Philippines, called ìBarongî.
6. Banana starch is used for making glue and fruit juice for making alcohol.
7. Silage can also be prepared from green banana.

Shirt made of banana fibre

Coconut

1. Coconut, commonly known as *Kalpavrikshai* is highly valued for its non-food uses. Coconut husk is used as a growing medium for orchids, anthuriums etc.
2. Husk burial is an important practice to conserve soil moisture.
3. Coir produced from coconut husk is a major product which is used to make ropes, coir mats, beds etc.
4. Coir geotextiles are widely used for soil conservation in slopy areas which is eco-friendly.
5. Coconut shell is used for making different products and the most important product is activated charcoal.
6. Coconut leaf is mainly used for thatching and to make baskets, mats, hats, *etc*.
7. Coconut oil is the main ingredient in soaps, cosmetics and hair oils.
8. Oil cake is used as cattle feed. Biodiesel can be made from the coconut oil.
9. Coconut trunk is useful for making furniture, boats, handicrafts *etc*.

Conclusion

The wider range of crops grown for non-food purposes will allow new opportunities for crop rotation and diversification, and thus potentially enhancing biodiversity. Non-food uses of food crops can also make a positive contribution to environmental protection and conservation. The rapid progress of new technologies such as biotechnology has provided a solution for a wide range of problems in using agricultural raw materials for non-food purposes.

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QTL Mapping in Crop Improvement - The Basic Concept

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Introduction

A QTL (Quantitative Trait Locus (Loci)) term is coined by Gelderman (1919) and is defined as "a region of the genome or locus of gene that is associated with an effect on a quantitative trait". Or it can also be defined as "the regions within genomes that contain genes associated with a particular quantitative trait are known as quantitative trait loci (QTLs)".

The process of constructing linkage maps and conducting QTL analysis–to identify genomic regions associated with traits–is known as QTL mapping (also 'genetic,' 'gene' or 'genome' mapping) (McCouch & Doerge, 1995; Mohan et al., 1997).

Principle of QTL Mapping

The basic Principle is the co-segregation of marker locus and QTL together. Co-segregation is due to linkage between marker and QTL. QTL analysis depends on linkage disequilibrium which is the non-random association of alleles at different loci in a given population.

QTL analysis is based on the principle of detecting an association between phenotype and the genotype of markers. Markers are used to partition the mapping population into different genotypic groups based on the presence or absence of a particular marker locus and to determine whether significant differences exist between groups with respect to the trait being measured (Tanksley, 1993; Young, 1996).

Methods to Detect QTL

Three widely-used methods for detecting QTLs are single-marker analysis, simple interval mapping and composite interval mapping (Liu, 1998; Tanksley, 1993).

1. Single-marker analysis (SMA): Single-marker analysis (also 'single-point analysis') is the simplest method for detecting QTLs associated with single markers. The statistical methods used for single-marker analysis include t-tests, analysis of variance (ANOVA) and linear regression.

Linear regression is most commonly used because the coefficient of determination (R2) from the marker explains the phenotypic variation arising from the QTL linked to the marker. This method does not require a complete linkage map and can be performed with basic statistical software programs.

However, the major disadvantage with this method is that the farther a QTL is from a marker, the less likely it will be detected. This is because recombination may occur between the marker and the QTL. This causes the magnitude of the effect of a QTL to be underestimated (Tanksley, 1993). The use of a large number of segregating DNA markers covering the entire genome (usually at intervals less than 15 cM) may minimize both problems (Tanksley, 1993).

The results from single-marker analysis are usually presented in a table, which indicates the chromosome (if known) or linkage group containing the markers, probability values, and the percentage of phenotypic variation explained by the QTL (R2) (Table 3). Sometimes, the allele size of the marker is also reported. QGene and MapManager QTX are commonly used computer programs to perform single-marker analysis (Manly et al., 2001; Nelson, 1997).

2. Simple Interval Mapping (SIM): The simple interval mapping (SIM) method makes use of linkage maps and analyses intervals between adjacent pairs of linked markers along chromosomes simultaneously, instead of analyzing single markers (Lander & Botstein, 1989).

The use of linked markers for analysis compensates for recombination between the markers and the QTL, and is considered statistically more powerful compared to single-point analysis (Lander & Botstein, 1989;

Liu, 1998). Many researchers have used MapMaker/QTL (Lincoln et al., 1993b) and QGene (Nelson, 1997), to conduct SIM.

3. Composite Interval Mapping (CIM): More recently, composite interval mapping (CIM) has become popular for mapping QTLs. This method combines interval mapping with linear regression and includes additional genetic markers in the statistical model in addition to an adjacent pair of linked markers for interval mapping (Jansen, 1993; Jansen & Stam, 1994; Zeng, 1993, 1994).

The main advantage of CIM is that it is more precise and effective at mapping QTLs compared to single-point analysis and interval mapping, especially when linked QTLs are involved. Many researchers have used QTL Cartographer (Basten et al., 1994, 2001), MapManager QTX (Manly et al., 2001) and PLABQTL (Utz & Melchinger, 1996) to perform CIM.

Factors Influencing the Detection of QTLs

There are many factors that influence the detection of QTLs segregating in a population (Asins, 2002; Tanksley, 1993). The main ones are genetic properties of QTLs that control traits, environmental effects, population size and experimental error.

1. Genetic properties of QTLs controlling traits include the magnitude of the effect of individual QTLs. Only QTLs with sufficiently large phenotypic effects will be detected; QTLs with small effects may fall below the significance threshold of detection. Another genetic property is the distance between linked QTLs. QTLs that are closely-linked (approximately 20 cM or less) will usually be detected as a single QTL in typical population sizes (The most important experimental design factor is the size of the population used in the mapping study.

2. The larger the population, the more accurate the mapping study and the more likely it is to allow detection of QTLs with smaller effects (Haley & Andersson, 1997; Tanksley, 1993).

3. An increase in population size provides gains in statistical power, estimates of gene effects and confidence intervals of the locations of QTLs (Beavis, 1998; Darvasi et al., 1993).

4. The main sources of experimental error are mistakes in marker genotyping and errors in phenotypic evaluation. Genotyping errors and missing data can affect the order and distance between markers within linkage maps (Hackett, 2002).

5. The accuracy of phenotypic evaluation is of the utmost importance for the accuracy of QTL mapping.

6. A reliable QTL map can only be produced from reliable phenotypic data. Replicated phenotypic measurements or the use of clones (via cuttings) can be used to improve the accuracy of QTL mapping by reducing background 'noise' (Danesh et al., 1994; Haley & Andersson, 1997).

7. Some thorough studies include those where phenotypic evaluations have been conducted in both field and glasshouse trials, for ascochyta blight resistance in chickpea (FlandezGalvez et al., 2003a), bacterial brown spot in common bean (Jung et al., 2003), and downy mildew resistance in pearl millet (Jones et al., 2002).

Conclusions

Despite lack of precise information about the molecular nature of the QTL, introgression of QTLs into elite lines or germplasm and marker assisted selection for QTLs in breeding could be undertaken in some crop plants such as maize, tomato and rice with reasonable success.

QTLs conferring resistance to downy mildews of maize was mapped and validated at IARI. It also transferred two major QTLs for downy mildew resistance into CM 139 an elite but downy mildew susceptible inbred line. There are still some important caveats regarding QTL analysis. Only the QTLs of largest effect and those closest to a marker locus, will show statistically reliable association. Particularly important is fine mapping or high-resolution mapping of the QTL, if the QTL information is to be effectively applied in field.

We believe that recent developments and improvements in marker techniques, the integration of functional genomics, better theoretical models and high throughput strategies are expected to enable greater power and precision in detection of QTL and utility of QTL information for crop improvement in future.

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Agricultural Sustainability: Various Projects and Programmes

Article ID: 10731

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Introduction

Sustainable agriculture: It is a type of agriculture that focuses on producing long-term crops and livestock while having minimal effects on the environment. This type of agriculture tries to find a good balance between the need for food production and the preservation of the ecological system within the environment.

The long-term viability of agricultural systems is critical to ensuring the survival and well-being of humanity around the planet. Sustainability is a multifaceted topic including a variety of issues from the economic, social, and environmental areas. Agriculture is a source of livelihood for an estimated 75% of rural people. It is one of the largest and most important economic activities and has a significant impact on Gross Domestic Product (GDP) growth in developing countries. Agriculture contributes at least twice as much to poverty reduction as any other industry. Sustainability is a profession that brings man closer to nature and requires that it be in tune with the surrounding environment in order to develop and sustain optimal conditions between man and the environment.

India is a worldwide agricultural powerhouse because agriculture, together with its associated sectors, is the country's most important source of income. Sustainable agricultural management strategies are primarily focused at ensuring sustainable production with low or no chemical inputs, prioritizing farm-grown inputs while minimizing pollution and damage to natural resource bases. Farmers are honored as food Gods, and their participation is critical in preventing hunger and ensuring food security in the country.

Multilateral Efforts to Promote Sustainability in Agriculture System

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

Various Projects and Programmes for Environmental Awareness and Agricultural Sustainability are Highlighted, which are Conducted Nationally and Internationally

1. Project: Global Environmental Facility (GEF).

Status: International

Objectives:

a. Sustainable agriculture
b. Food security
c. Climate change adaptation.

d. Efficient land use

Source: www.thegef.org.

2. **Project:** International Fund for Agricultural Development (IFAD)

Status: International

Objectives: To ensure that poor rural people have better access to resources and the skills and organizations they need to sustainably take advantage of natural resources. It is a specialized agency of the UN that funds agricultural development projects in areas that depend largely on agriculture.

Source: www.ifad.org

3. **Project:** Environmental Education Awareness and Training (EEAT)

Status: National

Objectives: To enhance the understanding of people at all levels about the relationship between human beings and the environment and to develop their capabilities.

a. National Green Corps (NGC)- Eco-club programme.
b. National Nature Camping Programme (NNCP).
c. Capacity Building Activities.

Source: www.moef.nic.in.

4. **Project:** National Environment Awareness Campaign (NEAC)

Status: National.

Objectives: To create awareness on environmental issues followed by field actions at the local, regional and national level. Spectrum of short duration programmes supported by MoEF & CC for creating environmental awareness through new themes each year like Swatch Bharat mission, Ganga rejuvenation and river cleaning.

Source: www.moef.nic.in.

5. **Project:** Environment Education in School System (EESS)

Status: National.

Objectives: The Environment Education and Training Scheme of the Ministry is precisely meant for environmental awareness. Under this scheme, various programmes are conducted every year for creating environmental awareness both through nonformal activities as well as through formal education system. To provide handson activities through Global Learning and Observations to Benefit the Environment (GLOBE) programme.

Source: www.archive.india.gov.in.

6. **Project**: National Action Plan to Combat Desertification (NAPCD)

Status: National

Objectives: Activities to increase the quality of life and raise awareness of the local communities, promote R&D initiatives and interventions which are locally suited, supports drought management, preparedness and mitigation. It is a 20-year comprehensive National Action Program (NAP) for combating desertification, which is part of UNCCD and implemented by MoEF & CC in India.

Source: www.envfor.nic.in

7. **Project:** National Food Security Mission (NFSM)

Status: National

Objectives: National Food Security Mission (NFSM) is a Central Scheme of GoI launched in 2007 for 5 years to increase production and productivity of wheat, rice and pulses on a sustainable basis so as to ensure food security of the country. The aim is to bridge the yield gap in respect of these crops through dissemination of improved technologies and farm management practices. Sustainable increase in the production of targeted crops through area expansion and productivity enhancement.

Source: www.agricoop.nic.in

8. **Project:** Rashtriya Krishi Vikas Yojana (RKVY)

Status: National

Objectives: Organic farming is promoted through adoption of organic village by cluster approach and PGS certification. Neem Coated Urea (NCU) Scheme for production of agriculture products free from chemicals and pesticide residues by adopting eco-friendly low cost technologies.

Source: www.rkvy.nic.in

9. Project: National Mission for Sustainable Agriculture (NMSA)

Status: National

Objectives: Popularizing integrated farming system for climate resilience

a. Rain-fed Area Development (RAD) programme

b. Climate change and sustainable agriculture: Monitoring, modeling & Net Working (CCSAMN).

c. Soil Health Management:

i. Soil Health Card Scheme (SHC).

ii. Paramparagat Krishi Vikas Yojna (PKVY).

Source: https://nmsa.dac.gov.in.

10. Project: National Mission on Agricultural Extension and Technology (NMAET)

Status: National

Objectives To restructure and strengthen agriculture extension and enable delivery of appropriate technology and improved agronomic practice to farmers:

a. Sub Mission of Agricultural Extension (SAME)

b. Sub Mission on Seed and Planting Material (SMSP)

c. Sub Mission on Plant Protection and Quarantine (SMPP)

d. Sub Mission on Agricultural Mechanization (SMAM)

Source: www.agricoop.nic.in.

11. Project: Pradhan Mantri Krishi SinchaiYojana (PMKSY)

Status: National

Objectives: Sustainable water management through Diggi, Jal Hauz, Farm Pond (Khet talai) and irrigation Pipeline programmes are being implemented by Agriculture Department.

a. Accelerated Irrigation Benefits Programme (AIBP)

b. Har Khet Ko Pani

c. Per Drop More Crop

d. Watershed Development

Source: www.agriculture.rajasthan.gov.in

12. Project: Green Agriculture project

Status: International + National

Objectives: To transform agricultural production and to generate global environmental benefits. a. Policy Transformation b. Management

Source: www.fao.org.

Conclusion

Sustainable agriculture is the way to maintain a parity between the increasing pressure of food demand and food production in the future. As population growth, change in income demographics, and food preference changes, there are changes in the demand of food of the future population.

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Herbivore Induced Plant Volatiles (HIPVs)

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Introduction

Because of their sessile nature, plants have evolved numerous strategies to defend themselves against pests. One method that plants avoid herbivory is by direct defences such as hard waxes, thorns, or poisonous chemicals that function as repellents, deterrents, or anti-nutrients or anti-digestive substances. Furthermore, plants have indirect defensive systems that aid in the recruitment of predatory insects that target herbivores. One such indirect defensive technique is volatile emission, which draws herbivore enemies to injured plants. By this volatile emission plants send out a signal to predatory insects that perceive it as an oviposition sign. Volatiles also operate as feeding deterrents, which serves as a direct defence. Despite the importance of direct defence in plant resistance, indirect defence confers phenotypic flexibility and is a helpful pest management approach in agriculture.

Plant Perception of Herbivory

A signalling network controlled by the plant's sensory mechanism regulates volatile emission. In order to distinguish their attacks from those of other biotic agents, plants are considered to have developed the ability to recognise herbivore-associated molecular patterns (HAMPs). These are specific type of molecules derived from herbivore saliva and oral secretions, which stimulate the plant to respond against the herbivore attack.

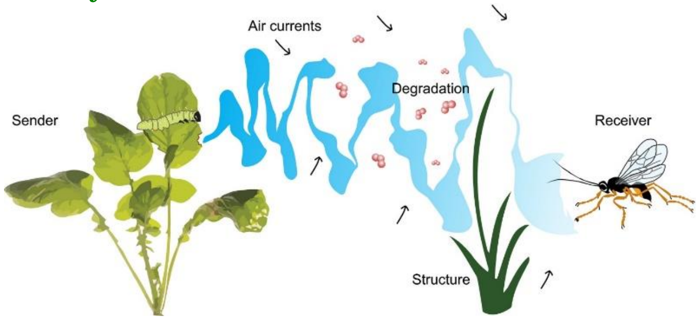
Array of HIPVs

Plant volatiles are a complex combination of chemical molecules with molecular weights less than 300 Da that make up around 1% of plant secondary metabolites. Over 2000 volatile chemicals from various plant groups have been identified. Plant volatiles can be emitted from leaves, fruits, and flowers and also from roots. HIPVs are generally a mixture of various chemical substances, primarily terpenes, fatty acid derivatives, amino acid derivatives, and phenyl propanoids. HIPVs are usually plant and herbivore specific, and their composition is also influenced by a variety of environmental variables.

Functions of HIPVs

1. Indirect plant defenses - attraction of natural enemies.
2. Direct defenses - repellent and toxicant.
3. Plant to plant communication.

Attraction of Natural Enemy of Herbivore



Induced indirect defences are used by plants in response to herbivore attacks. The release of HIPVs increases herbivore mortality by attracting natural enemies (Kessler and Baldwin, 2001). HIPVs can attract natural enemies to herbivore-affected plants and cause surrounding plants to produce indirect defences of their own. HIPVs can both stimulate and activate the indirect defensive mechanism of extrafloral nectar (EFN) production in Lima beans, as well as act as a cue for the plant, allowing for more specific EFN production (Heil and Kost, 2006). Silveria et al, (2018) investigated the olfactory preference of *Encarsia desantisi* to the chemical profile of flowering melon plants induced by the phloem-feeding of *Bemisia tabaci*. The volatile profile consisted of mainly monoterpenes, benzenoids and alkanes. The volatile profile released from the melon plants damaged by the whitefly *Bemisia tabaci* attracted its natural parasitoid *Encarsia desantisi and increased the parasitism.*

Table 1: some of the HIPVs and attracted natural enemies:

Crop	HIPV	Pest	Natural enemy
Tobacco	β- caryophyllene	*Helicoverpa virescens*	*Cardiochiles nigriceps*
Maize	β- farnasen	*Spodoptera littoralis*	*Cotesia marginiventris*
Maize	4,8-dimethyl-1,3,7-nono trine	*Mythimna separata*	*Exorista japonica*
Maize	Linalool and pienene	*Mythimna separata*	*Campolestis chloredea*

Direct Toxicity of HIPVs

HIPVs' larvicidal or ovicidal activity on insect herbivores is not new, but its direct effect on insect herbivores is poorly known. This is owing in part to the fact that volatile components have been largely ignored when considering various phytochemicals acting as selection forces driving insect pest feeding strategies. These phytochemicals that are widespread among different plant taxa will be less toxic to generalist insects compared to specialist. Veyrat et al, (2016) investigated the potential direct benefits of indole, a major HIPV constituent of in maize plant synthesised as response to feeding by *Spodoptera littoralis*. The study proved that indole has direct toxicity against the herbivore itself and it also trigger defense responses in surrounding maize plants.

Limitations of HIPVs in Pest Management

1. Attraction of non-target insect pests.
2. Reducing the preference some pollinator insects.
3. Limited distance of action.

Conclusion

In diverse environments, HIPVs mediate a wide range of interactions between plants and arthropods, microbes, undamaged adjacent plants, and undamaged areas of the plant. Many critical concerns regarding the effect of HIPV emissions for parasitoid foraging behaviour and host–parasitoid population dynamics in field settings remain unresolved, despite promising developments in research on plant responses to herbivory.

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Farming System for Nutrition - An Agri Nutri Specific Intervention to Combat Malnutrition Among Rural Households

Article ID: 10733

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Despite of the green, white, yellow and blue revolutions in happened in India, majority of its population is malnourished. Hidden hunger or micro nutrient deficiency is prevalent among vulnerable groups such as pregnant and lactating women, infants and preschool children is in rural areas. To demonstrate the feasibility of agriculture-based remedy to malnutrition, MSSRF, Chennai demonstrating farming systems for nutrition models in six KVKs of Andhra Pradesh for validating the Farming System for Nutrition (FSN) approach. On-farm demonstrations of FSN is an interventional approach , conducted in KVK instructional farms which includes a combination of sustainable measures including advanced crop production practices, bio-fortification, promotion of nutrition gardens of fruits and vegetables, livestock and poultry development, small scale fisheries and nutritional gardens as stimulant for rendering consistent output of higher income and better nutrition along combined with nutrition awareness programmes especially to women. This resulted wide choice of cereals, pulses, nutritive vegetables which can enhance the food diversity and ensure higher availability of nutritive vegetables to the households. The additional nutritional gain through FSN can be calibrated to ensure that the households get the recommended daily intake of nutrition. Accordingly, FSN approach is evolved to provide nutritional security to every household. This paper discusses the importance of FSN approach for house hold nutritional security to combat malnutrition.

Keywords: Farming systems for Nutrition (FSN), Hidden hunger, Household nutritional security.

Introduction

Agriculture is way life and major source of livelihood in India. After independence, sincere efforts were made to increase productivity in agriculture and allied sectors to feed its population. As a result, India has witnessed green revolution in food grains, white revolution in milk, golden revolution in fruits and vegetables, yellow revolution in oil seeds and blue revolution in fisheries and looking forward for achieving rainbow revolution, in all the activities of agriculture and allied sectors including value addition. Despite all these revolutions, major sections of Indian population are suffering from nutritional deficiencies. The quality of food people consuming in rural areas is not meeting their nutrient requirements, so the food is deficient in micronutrients such as the vitamins and minerals that they need for their growth and development which is ultimately leading to hidden hunger or micronutrient deficiency. The consequence of malnutrition is caused by multiple factors such as small land holdings, lack of nutritional education, low purchasing power; lack of availability of nutrient foods etc., hence a multipronged need to be devised to address the issue of malnutrition.

After fifty years green revolution in India, MS Swaminathan Research, Chennai Promoting Farming Systems for Nutrition (FSN) model by inclusion of agriculture and allied sectors with a main focus on availability of nutrients to entire farm family. MSSRF has been leading a study since mid-2013 to demonstrate the feasibility of a FSN approach under a research programme on Leveraging Agriculture for Nutrition in South Asia (LANSA). According to Dr. M S Swaminathan, the father of green revolution in India, the Farming Systems for Nutrition approach is defined as:

“The introduction of agricultural remedies to the nutritional maladies prevailing in an area through mainstreaming nutritional criteria in the selection of farming system components involving crops, animals and wherever feasible fish”. (Nagarajan et.al2014).

It is an interventional approach that includes a combination of sustainable measures including advanced crop production practices, bio-fortification, promotion of nutrition gardens of fruits and vegetables, livestock and poultry development, and setting up of small-scale fisheries, combined with nutrition awareness, as stimulant for rendering consistent output of higher income and better nutrition. Primarily, the approach calls for the promotion of location –specific farming systems that integrate arable farming, horticulture, backyard farming and animal farming, feasible agricultural interventions to address the nutritional deficiencies of the household/community/location would have to be incorporated. In the words of M.S. Swaminathan," the design of farming system can include specific crop varieties that can address the identified deviancies. Sweet potato might provide vitamin A, drumstick tree (*moringa olifera*) and Amaranthus sp. Could address the lack of iron." (Rao and swaminathan) In addition, the approach recognizes the need for other direct interventions-to improve production and market linkages of nutritious crops- and indirect intentions- to improve women's empowerment, nutrition, education, drinking water, sanitation and natural resource management, along the pathway from agriculture to nutrition (Das et al.; Gillespie and Kadiyala, 2012; Shetty, 2015).

The objective is to address malnutrition in all its forms, viz. calorie deprivation, protein deficiency and hidden hunger or micronutrient deficiencies.

The Objectives of FSN

1. To encourage small and marginal farmers for implementing mixed farming in 1 acre so that they can meet the nutritional security.
2. To encourage farmers to address the problems of under nutrition and nutritional deficiencies by introducing bio fortified varieties and nutri-dense crops.

The Principle of FSN

The underlying principle of FSN is ensuring the availability, accessibility and utilization of nutrient dense foods to farm families for their nutritional security. Because Food Security encompasses 'Availability', 'Accessibility' and 'Utilization' which includes 'absorption' and bioavailability of food making it inclusive of 'Nutrition Security' (Rainer et al., 2000). Increasing food production alone cannot address the issue of malnutrition, unless there is a nutrition focus and the poorest have access to sources of diversified and nutritious foods. Underlying the concept of FSN is a principle that household.

Food production contributes positively to the diets of farm families, particularly small holders. In other words, a diversified food production system has the potential to diversify the consumption basket of farm families. The FSN model is a location-specific, inclusive model based on the resource endowments and specific environment, to address the nutritional needs of families. Given that FSN is a flexible model that takes into account the nature of resource endowment, specificities in environment and nutritional problems, ideally a farmer can decide on the possible combinations of different components of FSN depending on his/her location. Nutrition literacy has to be an integral component of the FSN approach, as an understanding and acceptance of the concept is crucial for sustained practice.

The Main Focus of FSN

Farming systems for nutrition broadly focuses on macro (Carbohydrates, Proteins and fats) and micro (Vitamins and minerals) nutrient requirements thus ensures the nutritional requirement of the farm families. FSN will help to not only improve the yield of crops but also mainstream the nutrition dimension in the choice of crops. In order to enable farmers to identify crops, which can provide specific nutrients like vitamin A, a Genetic Garden of Biofortified Crops is being established as part of FSN.

Examples of FSN

Some examples of farming systems are:
1. Crop Husbandry with different nutrient-dense/nutrient rich crop combinations+ Nutri Garden.
2. Crop Husbandry + Livestock+ Nutri Garden.
3. Crop Husbandry + Livestock + Poultry/sheep+ Nutri Garden.
4. Crop Husbandry + Horticulture + Sericulture + Nutri Garden.
5. Crop Husbandry (Rice) + Fish culture+ Nutri Garden.

6. Crop Husbandry (Rice) + Fish + Mushroom+ Nutri Garden.
7. Crop Husbandry + Fishery + Duckery + Poultry+ Nutri Garden.

Based on the feasibility different nutri sensitive agriculture models can be taken up by farm families to guarantee nutritional security of its members.

Crop Husbandry

The crop-based interventions under the FSN approach focuses on promotion of nutrient dense millets like (sorghum, pearl millet, foxtail millet etc..,) pulses crop diversification through varietal substitution and crop intensification for small and marginal landholders. Varietal substitution through introduction of nutrient dense improved package of practices in order to increase the production and productivity, thereby increasing nutrient availability per farm household. Like, wise crop intensification though intercropping systems will aim in increasing land use efficiency and generating higher monetary income.

Animal Husbandry

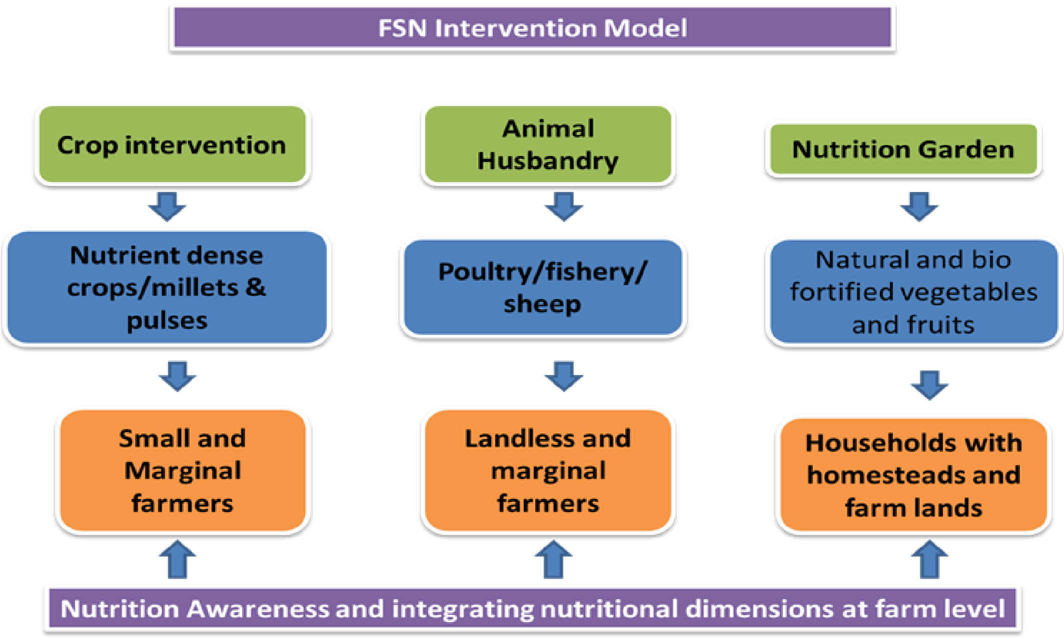
To improve health and productivity of livestock and fodder for livestock are the important component of this approach. Poultry farming will be introduced for landless and marginal farmer households as it provides livelihood support and enhance in consumption of quality protein.

Nutrition Garden

The major objective of promoting nutri garden is to increase availability and access to nutri dense vegetables and fruits for household consumption, homestead nutrigardens can make a critical contribution to diversifying the food basket of the household. It will enhance the consumption of fresh vegetables and fruits which are rich sources of both micro and macro nutrients and can majorily address the problem of micro nutrient problems.

The Expected Results of FSN are

Converting the agriculture into nutri - sensitive and income generating agriculture. The pathways through which agriculture can influence nutrition outcomes cover four broad areas: (1) consumption of own production or agriculture as a source of food; (2) income from agriculture; (3) food prices; and (4) aspects related to gender such as the status of women in agriculture and women's nutritional status that directly or indirectly influence food, nutrition and health. Of the different linkages that prevail between agriculture and nutrition, 'cultivation and consumption of own production' is a pathway that can bring about direct changes in food production system enhancing availability and access to food for farming households, in particular the small holders.



Conclusion

Agriculture is the major stay for majority of rural households in India. Due to cereal based cropping system, micro nutrient deficiency or hidden hunger is more predominant among vulnerable groups such as infants, preschool children, adolescent girls, pregnant and lactating women in farm families. Hence, promotion of nutri-sensitive agriculture programmes or initiatives like farming Systems for Nutrition (FSN) addresses the challenges related to malnutrition.

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Application of Thermal Barrier Coating in IC Engine

Article ID: 10734

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Introduction

Nowadays several research programs, in automotive industries, are carrying out in order to decrease engine fuel consumption and pollution. Design of diesel engines with lower heat rejection, by applying thermal barrier coating (TBC) is increasing according to fast increase in fuel costs, decrease in fuel production with high quality and environmental problems. Normally, in diesel engines about 19-22 percent of fuel energy is rejected to coolant fluid. Using TBC can reduce this heat loss and lead to better thermal efficiency. Also engine components durability can be improved. Therefore, better combustion, lower pollution, higher thermal efficiency and good fatigue lifetime are the results of using proper TBC in engine combustion chamber and exhaust system (Shikhariya *et al.,* 2017).

The diesel engine with its combustion chamber walls insulated by ceramics is referred to as LHR engine. Thermal barrier coatings (TBC) are used to improve reliability and durability of hot section metal components and enhance engine performance and thermal efficiency and elimination of the cooling system in diesel engines. Because the combustion chamber temperatures of ceramic-coated engines are higher than those of uncoated (base engine) engines, it may be possible to use a fuel with a large distillation range and lower quality fuels. Thermal barrier coatings are duplex systems, consisting of a ceramic topcoat and a metallic intermediate bond coat. The topcoat consists of ceramic material whose function is to reduce the temperature of the underlying, less heat resistant metal part. The bond coat is designed to protect the metallic substrate from oxidation and corrosion and promote the ceramic topcoat adherence.

Thermal Barrier Coating

Thermal barrier coatings are highly advanced material systems applied to metallic surfaces, such as gas turbine, aero-engine and diesel engine parts, operating at elevated temperatures. These 100μm to 2mm coatings serve to insulate metallic components from large and prolonged heat loads by utilizing thermally insulating materials which can sustain an appreciable temperature difference between the load bearing alloys and the coating surface.

Materials Used for Thermal Barier Coating in IC Engine

Thermal barrier coating consists of three layers. They are the metal substrate, metallic bond coat and ceramic top coat. The metal substrate and metallic bond coat are the metal layers and topcoat are ceramic layer. The metal substrate is typically a high temperature aluminium alloys that is either in single crystal or polycrystalline form. The metallic bond coat is an alloy typically with the composition of Nickel, Cobalt, Chromium, Aluminium. The bond coat creates a bond between the ceramic coat and the substrate. The third coat is the ceramic top coat Zirconia ($ZrO3$), Mullite ($3Al2O3$-$2SiO2$), Alumina ($Al2O3$) which is desirable for having a very low conductivity while remaining stables at nominal operating conditions. This layer creates the largest thermal gradient of the thermal barrier coating. Following are the materials used in ceramic top coat (Sridhar *et al.,* 2013).

1. Zirconates: The main advantage of zircontes are their low sintering activity, low thermal conductivity, high thermal expansion coefficient and good thermal cycling resistance. The main problem is the high thermal expansion coefficient which results in residual stress in the coating, and this can cause coating delamination.

2. Yittria: Stabilized Zirconia:7-8% yittria stabilized zirconia has high thermal expansion coefficient, low thermal conductivity and high thermal shock resistance.

3. Mullite: Mullite is an important ceramic material because of its low density, high thermal stability, stability in severe chemical environments, low thermal conductivity and favourable strength and creep behaviour. Compared with yittria stabilized zirconia, mullite has a much lower thermal expansion coefficient and higher thermal conductivity, and is much more oxygen resistant than yittria stabilized zirconia. The low thermal expansion coefficient of mullite is an advantage relative to yittria stabilized zirconia in high thermal gradients and under thermal shock conditions.

4. Alumina: It has very high hardness and chemical inertness. Alumina has relatively high thermal conductivity and low thermal expansion coefficient compared with yittriastabilized zirconia. Even though alumina alone is not a good thermal barrier coating candidate, its addition to yittria stabilized zirconia can increase the hardness of the coating and improve the oxidation resistance of the substrate.

5. Spinel: Although spinel has very good high temperature and chemical properties, its thermal expansion coefficient prevents its usage as a reliable choice for thermal barrier coatings.

6. Forsterite: The high thermal expansion coefficient of forsterite permits a good match with the substrate. At thicknesses of some hundred microns, it shows a very good thermal shock resistance.

Coating in Internal Combustion Engines and Coating Methods

Usage of tribological coatings in internal combustion engines have been increasing every day. Metal and metal alloy are needed in many fields due to fast developing technology. One of these fields is engines. With various methods combustion chamber elements are coated with coating materials in internal combustion engines. Leading method among these is thermal barrier coating. Thermal barrier coatings are used in order to increase reliability and strength of hot parts of metal components, increase yield and performance of engines. Engine parts which are coated with thermal barrier are; piston, cylinder head cylinder sleeve and exhaust valves. Engines with thermal barrier coating are called low heat loss engines (Thiruselvam, 2015).

Different methods are used in order to coat the surface of metals. These methods differ according to characteristics of material to be used; suitable to the intended use.
1. Physical Vapour Decomposition (PVD)
2. Chemical Vapour Decomposition (CVD)
3. Ion Coating
4. Splash Coating
5. Electron Beam Evaporation Coating (EBE)
6. Flame Spray (FS).
7. Plasma Spray (PS).
8. Sol-gel (SG).
9. Detonation Gun (DG).
10. Reactive ion coating (IP).
11. Hot izostatical press coating (HIP).

TBC Coating in Piston

The performance and emission effects of thermal barrier coating used in piston investigated experimentally by laksmanan.

Thermal barrier coating used in piston increasing the brake thermal efficiency and decreasing the specific fuel consumption for Light heat Rejection engine with thermal coated piston compared to the standard engine. There was increasing the NOx emission and O_2 for thermal barrier coated engine. However, there was decreasing the CO and HC emissions for thermal coated piston engine compared to the standard engine.

TBC, using PSZ, applied to the combustion chamber of the internal combustion engine showed some improvement in fuel economy with a maximum of up to 4% at low engine power.

The peak cylinder pressures were increased by a magnitude of eight to ten bars in the TBC piston engine, in particular at high engine power outputs, though the exhaust gas temperatures were generally lower, indicating good gas expansion in the power stroke. The unburned hydrocarbon concentrations were increased most seriously at low engine speed and/or low engine power output with a TBC piston engine. The authors suspected that this could be due to the porous quenching effect of the rough TBC piston crowns, where oxidation of hydrocarbons was unable to be achieved by the combustion air. Sampling of cylinder pressures in the cylinders showed that the ignition points of the TBC piston engine advanced slightly relative to the baseline engine, indicating the improvement in ignitability and heat release before the top dead center, which caused the peak cylinder pressure to rise.

TBC Coating in Cylinder Liner

At present TBCs are applied to combustion components of IC engines, mainly for pistons crow, valves, cylinder cover, and cylinder liner. However, the extended application of TBC to cylinder liner has not been explored practically. Cylinder liner is one of the important components of IC engine which severely under goes wear and tear due to reciprocating motion of piston. At the same time, linear as subjected to thermal stresses caused by hot gasses of combustion. TBC in the place of linear has to play very important role in minimizing wear and tear, heat transfer from cylinder to surroundings. The problem presently faced in implementing of TBC as engine cylinder is thermal mismatch which mainly occurs due to improper adhesion and difference in thermal expansion coefficient between bond coat and cylinder materials. TBC must also withstand wear and tear (Thiruselvam, 2015).

Conclusion

The applications of thermal barrier coatings to various components of combustion zone of an engine such as piston and cylinder liner has produced significant improvements in thermal and mechanical efficiency and other performance parameters of the engine like specific fuel consumption and reduces exhaust emission.

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Effect of Agricultural Inputs on Honeybee Behavior

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Introduction

The use of pesticides has become inevitable in modern agriculture. Most of crops are attacked by some or the other pests. The control of insect pests, diseases and weeds, in most cases is finished by applying some pesticide. Pesticides used on field crops for the control of pests have their own side effects, one in every of which is their toxicity to honey bees.

Honey bees are in danger of the many pesticides, especially insecticides. Annually honeybee colonies are damaged or destroyed by pesticides, primarily insecticides. Such losses have devastating impact on the beekeepers, which may must relocate damaged hives or maybe even be forced out of business. It's very difficult to assess the extent of losses of bees from pesticides.

These effects may happen as results of the direct exposure of bee fauna to pesticides or through indirect contact with their residues. Direct exposure occurs from treatment of bee hives with pesticides for disinfestation purpose or honey bees visiting the fields at the time of spray.

While the indirect exposure occurs from spray drift from nearby fields or bee foraging in sprayed crops. Honeybees may be available in contact with spray fluid spilled inadvertently or thrown within the water courses. Poisoning or death of bees during the gathering of pollen and nectar from the pasturage plants because of the appliance of toxic chemicals is assumed as bee poisoning.

Symptoms of Bee Poisoning

1. Dead or dying bees near the doorway of hives /colonies.
2. Dead bees on the best of frames or bottom board.
3. Lack of recognition of guard bees.
4. General aggressiveness.
5. Fighting among bees at the doorway or inside colonies.
6. Paralyzed or stupefied bees crawling on nearby objects of the colony.
7. Sudden cessation of food storage and brood rearing.
8. Dead and deserted brood within the hive.
9. Poor recognition of pollen and nectar.
10. Contamination of bee products.

Causes of Poisoning

Bee poisoning mainly occurs when pesticides are applied to crop during bloom. it's visiting even be caused by drift of toxic chemicals onto non-target areas or bees contacting residues of pesticides on plants for pollen and nectar and also bees drinking or contacting contaminated water in water courses or spillage. If the chemical is incredibly poisonous the bees may get killed in or near the sphere.

However, if the chemical has mechanism the bees may reach their hives but die near the doorway. Type of workers may even enter the hive and store nectar and pollen inside and thus, end in exposure of the nurse bees to the contaminated pollen, carried by the foragers and stored within the comb.

The resultant cumulative effect of the contaminated pollen may cause depletion of brood, death of young ones, nurse bees and other workers. Hence, not only the population of colony decreases substantially but also winds up in contamination of bee products.

Symptoms of bee poisoning

Factors of Bee Poisoning

Many factors involving pesticides affect the potential for honey bee poisoning. The important factors are described below.

Plant growth stage: Severe bee poisoning most frequently results from spraying insecticides directly on flowering plants, either the crop itself or flowering weeds within its margins.

Relative toxicity of chemical: Pesticides vary in their toxicity to honeybees. Among the pesticides, most fungicides and herbicides are relatively less toxic to honeybees. Insecticides are most toxic. Honeybees are most at risk of broad-spectrum insecticides. Insecticides that are highly toxic cannot be applied to blooming crop when bees are present without causing serious to colonies. Insecticide like dimethoate, Malathion, methyl parathion etc. Carbaryl come under this category. However, insecticides like endosulfan are less toxic.

Choice of formulation: Different formulations even of same pesticide, often vary considerably in their toxicity to bee. Dust formulations are typically more hazardous than sprays because they're picked up to the mark bee hairs. A wettable powder like Sevin 80 S would usually remain toxic within the arena for a extended time than Sevin XLR Plus, an Emulsifiable concentrate. Granular insecticides are less hazardous to bee. However, micro encapsulated materials like Penncap-M are particularly dangerous to use around bees because, the capsules have a bent to remain to bees due to their size and charge.

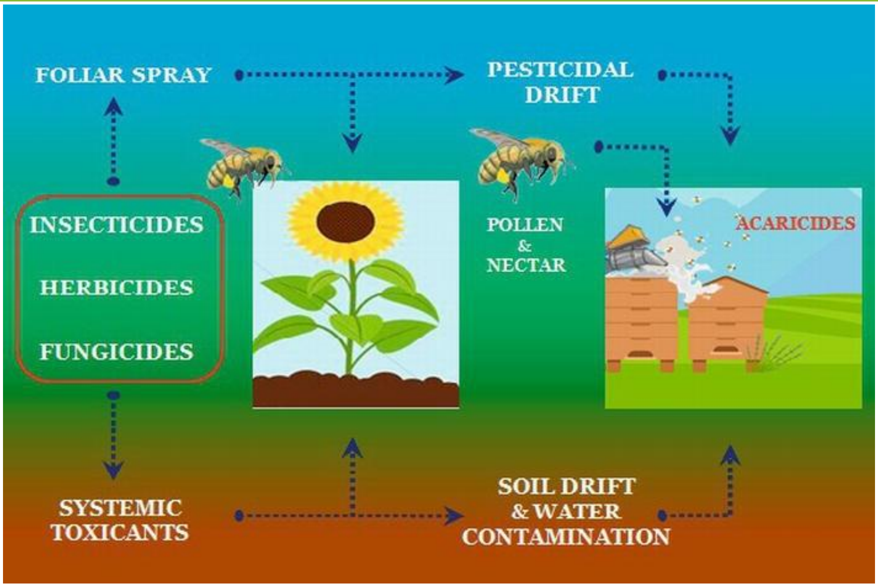
Residual action: Residual activity of an insecticide could also be a significant give some thought to determine its safety to pollinators. An insecticide that degrades rapidly can generally be applied with minimum risk when bees don't seem to be foraging.

Drift: Drift of spray application can cause significant bee poisoning, particularly when drift reaches colonies adjacent flowering weeds. Normally sprays shouldn't be applied when wind speed exceeds 10 km/hr.

Temperature: Temperature can have a considerable effect on bee poisoning hazard. If temperatures following treatment are unusually low, insecticide residues can remain toxic to bee repeatedly longer than if normal temperature prevails.

Distance from treated fields: the foremost severally damaged colonies are usually closest to fields where insecticides are being applied. However, in periods of pollen or nectar shortage, hives within 6 – 7 km of the treated areas is injured.

Time of application: Evening application of a fast residual insecticide can greatly reduce any potential for bee damage.



Conclusion

Proper understanding of above-mentioned principles can go an extended way in reducing pesticide hazards to honey bees. The basic principle, of course, is that honey bees shouldn't get exposed to the toxic effects of insecticides as far as possible. Reducing pesticide injury to honeybees requires communication and cooperation between beekeepers and farmers. Since both mutually like honeybees, the beekeeper in terms of its products and also the farmer in terms of increased production of crops. While it's unlikely that everybody poisoning are avoided, a balance must be struck between the effective use of insecticides, the preservation of pollinators and so the rights of all the beekeeper, farmers and also the community.

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Biofortification of Vegetables

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Introduction

Fortification is the practice of deliberately increasing the content of an essential micronutrient, i.e., vitamins and minerals (including trace elements) in a food, so as to improve the nutritional quality of the food supply and provide a public health benefit with minimal risk to health. In the past few decades, the major concern on this planet was food security. After making a successful lead in food security now, the developing nations are focusing on nutritional security, which includes food that is enriched in minerals and vitamins.

Micronutrients and vitamins are essential for human growth and development. Any deficiency of these components leads to “hidden hunger.” Enhancing these components can alleviate malnutrition in women and children in the developing world. Micronutrients like Fe, Zn, Se, Mg, Ca, Iodine, and vitamins like provitamin A and folate are an important component of the biofortification program. Biofortification of vegetable with vitamins and micronutrients is the present need of an hour to fight different health issues faced by the developing countries.

For biofortification of vegetable and other staple crops, three major techniques are used, viz. conventional breeding, agronomic approach (use of mineral fertilizer), and genetic engineering. These approaches have enormous potential to address this vitamin and micronutrient malnutrition. Many genes are available for the target traits by which it will be possible to improve micronutrient in vegetables. These tools can be very much helpful in improving the level of micronutrients and vitamins by several-fold in staple cereals and vegetables.

Strategies of Biofortification of Vegetables

In general, three complementary strategies can be employed to increase mineral concentrations in edible crops:

1. Agronomical biofortification.
2. Conventional breeding.
3. Genetic engineering.

Agronomical Biofortification

Application of fertilizers to increase the micronutrients in edible parts. The degree of success in agronomic biofortification is proportional to the mobility of mineral element in the soil as well as in the plant. Most suitable micronutrients for agronomic biofortification Zinc, (foliar applications of $Znso_4$), Iodine (Soil application of iodide or iodate), Selenium (as selenate). Foliar application is the quick and easy method of nutrient application to fortification of micro nutrients (Fe, Zn, cu etc.) in plants. Several studies have found that the mycorrhizal associations increase Fe, Se, Zn and Cu concentrations in crop plants. AM-fungi increases the uptake and efficiency of micronutrients like Zn, Cu, Fe etc.

Conventional Breeding

Traditional breeding mainly focused on yield attributes breeding from last four decades and lack of priority on nutritional aspects leads to decreased amount of nutrient status in the existed varieties. Recent progress in conventional plant breeding has given emphasis on fortification of important vitamins, antioxidants and micronutrients. The potential to increase the micronutrient density of staple foods by conventional breeding requires adequate genetic variation in concentrations of β-carotene, other functional carotenoids, iron, zinc, and other minerals exists among cultivars, making selection of nutritionally appropriate breeding materials possible.

Steps in Biofortification by Breeding are

Discovery:

a. Identify target populations.
b. Set nutrient target levels.
c. Screen germplasm and gene.

Development:

a. Breed biofortified crops.
b. Test performance of new crop varieties.
c. Measure nutrient retention in crops/food.
d. Evaluate nutrient absorption and impact.

Dissemination:

a. Develop strategies to disseminate seeds.
b. Promote marketing & consumption of biofortified food.

Outcomes: Improve nutritional status of target populations.

Breeding Criteria for Biofortification of Vegetables

1. Yield of crop to be maintained.
2. The enhanced micronutrient should have significant effect on human health.
3. The trait should be stable between generation and in various ecological zones.
4. The bioavailability of micronutrients in enriched line must be tested in humans.
5. Taste and cooking quality must be checked.
6. The variety must be widely accepted by farmer.

Genetic Engineering

Lack of sufficient variation among the genotypes for the desired character/trait within the species, or when the crop itself is not suitable for conventional plant breeding (due to lack of sexuality; e.g., banana) then genetic engineering offers a valid alternative for increasing the concentration and bioavailability of micro nutrients in the edible crop tissues. One of the main concerns is the so-called 'gene flow' environmental problem, i.e., the concern of transfer of foreign genes to non-target species. Targets for transgenes include, redistributing micronutrients between tissues, increasing the efficiency of biochemical pathways in edible tissues, or even the reconstruction of selected pathways. Some strategies involved in the removal of 'antinutrients'.

Target Vegetable Crops for Biofortification

Biofortification works have been practiced in most of the vegetable crops like Cassava, Beans, Potato, Orange sweet potato (OSP), Cowpea, Pumpkin etc. Several conventional and transgenic varieties have been released.

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Battery Technology

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Introduction

Advancements in battery technology have been relatively slow due to the complex chemistry involved and the challenges to commercialize while maintaining safety. Improvements in battery technology, though, would mean enhanced energy availability and consumer electronics performance. The promises of emerging battery technology include enhanced smartphone battery life, reliable electric transportation, more efficient energy storage for large-scale buildings, and even energy storage for the grid. New designs could also address environmental and safety concerns regarding raw material sourcing, as well as battery disposal. However, it remains difficult for even the most promising battery experiments to find their way out of research labs and into the devices we carry. Despite these conditions, there are many researchers and innovators working towards the cause.

At a national level, many countries have acknowledged the important role that novel battery technology will play in clean energy production, as well as competitiveness in the automotive sector. Though the United States has regulations of existing technology and investment plans for emerging technology research and development, there is still an observable gap in policy and the public sector engagement. With the emergence of competitive strategies from other nations and blocs, such as the European Union's Strategic Action Plan on Batteries, it is increasingly important for the U.S. to focus and develop a public approach to battery technology investment that capitalizes on the promises of the technology, while minimizing foreseeable harms (Rahman *et al.,* 2014).

A battery, made up of one or more separate *electrochemical cells*, is a device which stores chemical energy and converts it to electrical energy. The chemical reactions in a battery produce a flow of electrons through an electric circuit, generating an electric current that can be used to power devices.

Types of Batteries

2.1 Lithium-ion batteries (Li-ion) are the most common modern battery type. They are most common in consumer electronics, but they are also being increasingly adapted to other uses and are the locus of innovation in battery technology today.18 In Li-ion batteries, lithium ions shuttle through the electrolyte solution from one electrode to the other. The anode is usually made of carbon-based compounds like graphite. The cathode is usually made of transition metal compounds that contain lithium in their molecular structure19. Differences in the battery's cathode, anode, and electrolyte solution give the battery different strengths and weaknesses (Badwal *et al.,* 2014).

Li-ion batteries tend to outperform the other most common battery type, lead-acid batteries, across every metric, but their increased cost of production and safety concerns have limited broader commercial adoption until the last few years. They remain the focus of most energy storage research today and are expected to have the broadest range of commercial applications in the near future. Lithium-ion batteries are usually classified by the electrochemical properties of their electrodes. Depending on the intended use case of the lithium-ion battery, different chemistries are used.

Beyond Traditional Lithium-Ion Batteries

Lithium-air batteries currently in the earliest stages of development would use oxygen from their environment as the cathode material. This would make the battery much lighter than other lithium-ion battery and give it much greater theoretical energy density.22 One obstacle is finding an electrolyte material that can keep the anode from reacting with the air and becoming unstable. Exposing the battery cell to the air can also result in other chemical reactions that produce compounds that cover the electrode's surface and impede it from working (Girishkumar *et al.,* 2010).

Lithium-sulphur batteries have a cathode made of a sulphur-based compound and an anode made of lithium. These batteries have a higher energy density than lithium-ion batteries, and are potentially much cheaper, but commercialization remains a long way off due to a lower capacity, higher self-discharge rate, and worse safety.

Sodium-ion batteries have a cathode made of a sodium-based compound. Sodium is more abundant and easily sourced than lithium, making this battery potentially much cheaper than Li-ion alternatives, but has less energy density and is still not widely commercially available. This makes sodium-ion batteries more likely to be applied in renewable energy storage than consumer electronics in the future.

Aluminium-ion batteries could be much cheaper than other alternatives given the ubiquity of aluminium on Earth. In addition, it offers high theoretical capacity and safety. However, the electrochemical reaction associated with aluminium is fairly sluggish, limiting its power output. This technology has seen focused research over the last five years and is probably at least a decade away from feasibly being deployed at scale.

Solid state batteries refer to lithium-ion batteries where the electrolyte is a solid rather than a liquid. Using a solid electrolyte is safer and lighter than a liquid electrolyte and can be made more compact. This gives solid state batteries higher energy density than traditional lithium-ion batteries. However, this technology is not only more expensive than liquid electrolytes, but also unstable during fast charging when scaled up to the battery pack level. Solid electrolytes come in two variants: solid polymers and ceramics.

Solid polymers operate at high temperatures of 220 degrees Fahrenheit or greater, while **ceramics** operate at room temperature have the advantage of acting like a liquid without the safety concern. In future, a number of companies such as Toyota, Quantumscape and others claimed to have a feasible solid state battery technology that can be potentially scaled up to electric vehicle battery packs in an economically feasible manner.

Lead-acid batteries are a kind of battery in which the cathode is made of lead oxide, the anode is made of lead, and the electrolyte is a sulfuric acid solution. This battery was the first type of rechargeable battery invented, and remains among the most commonly used, particularly for combustion vehicles and domestic energy storage in developing countries due to their low cost and high current (May *et al.,* 2018).

Battery Recycling

This technology is increasingly important both to alleviate waste management and environmental protection concerns around materials used in Li-ion batteries. Recycling will enable lowering of manufacturing costs by recovering valuable raw materials such as cobalt, nickel, and lithium from end-of-life batteries and from batteries that fail quality control after manufacture. Recovery of raw material is crucial to the battery supply chain being aligned with globally increasing demand, as it buffers the shortfall from the slow mining and chemical processing steps. Recycling technologies are becoming increasingly prevalent inside battery manufacturing plants, but currently the process is quite energy and capital intensive. Steps need to be taken towards making this process sustainable in the long run. Some independent start-ups making huge progress in setting up large-scale recycling plants in 2021 are Li-Cycle and Redwood Materials. Fluctuations in raw material prices also cast long term uncertainty in the economic feasibility of battery recycling at scale (Harper *et al.,* 2019).

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Can On-Farm Vermiwash Production Reduce Today's Demand of Chemical Fertilizers of India?

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Summary

India is experiencing the enormous challenge of non-judicious use of chemical fertilizers and rising price from last few decades. This problem can be resolved by producing nutrients locally or at farm level. Vermi-technology is one of the tools can helpful to solve the problems. Vermiwash is a self-made, cheap, guaranteed purity and natural organic liquid product. It is useful for plant growth and development, which increases crops yield and develops plant resistance to stress. Therefore, it can be used for long term sustainable crop production for improving economy and livelihood of farmers.

Introduction

Fertilizer's price has been rising for the last few years which are becoming a matter of concern and secondly, we faced the challenge of non-judicious use of chemical fertilizers resulted in poor soil health, reduction in produces, increases in incidences of pest and disease and environmental pollution. Above factors is not only raise the farmers input costs which also decrease the benefit cost ratio of the farmers. Of course, government and scientist look at this situation very closely and have been taking suitably stepped. But, the demand for fertilizers has been increasing day by day. Therefore, the question is rising "Can we reduce today's demand of chemical fertilizers of India?" The answer will be 'Yes'. For dealing to these distinct problems, the vermi-technology will be one of the suitable remedial devices used as fertilizers/pesticides, recycle and regenerate waste into economic wealth, improve soil, plant, animal and human health, creating an eco-friendly, sustainable and economical bio-system models.

Vermiwash is product of vermi-technology, it is a very effective liquid organic nutrient product, but we hardly know about the proper preparation and paramount importance. We all think the branded and expensive nutrient products available in the market are the best, powerful and very good, but the use of these products increases the cost of crop production significantly. While vermiwash is a self-made, guaranteed purity and natural organic liquid product. Vermiwash is a liquid collected after the passage of water through a column of worm action. This liquid mixture of excretory products contains all essential nutrients and enzymes like protease, amylase, and phosphatase. These are useful for plant growth and development, which increases crops yield and develops plant resistance to stress. It has also shown nitrogen fixing bacteria such as *Azotobacter*, *Agrobacterium* and *Rhizobium* as well as *Phosphate-soluble bacteria*. Therefore, vermiwash application can be used as a replacement or supplement of agro-chemicals for their unique capacity to provide nutrients effectively and quickly to the crops. Therefore, India needs to rethink and emphasis on vermicompost and vermiwash production at farm level which will potential alternative or substitute to chemical farming. Why here emphasis on vermicompost and vermiwash production at farm levels because, it has shown a diverse and significant impact on soil, plants and the environment. Secondarily, it is a self-made, cheapest and handy, requires less space and reduces the tomorrow's chemical demand of agriculture which will gain farmer's income and country's economy.

Another point we would like to raise here sustainable management of organic waste at field level is still a big question. In fact, the Indian soil has been deficient in organic carbon and many nutrients. Now a days, organic waste is collected for power generation, it's a good way to manage farm waste supposed to convert valuable by-product which will utilize again in agriculture. If it is not happening, we should think to reutilize this organic source in agriculture by utilizing earthworm *spp.* for regenerate valuable organic products by locally, economically, conventionally feasible way. These locally produced valuable organic sources will help to feed the crops efficiently in a suitable manner (either solid or liquid form) without or substitute the need for inorganic fertilizers. It can reduce the heavy burden of imported fertilizers and agro-chemicals. Thus, only such self-made, self-resilient products will help India to fulfill the dream of "**Self-resilient India**" in the future.

Establishment of Model Vermiwash Unit at Home/Farm

Here, we suggest following model and making procedure of vermiwash production at farm/home:

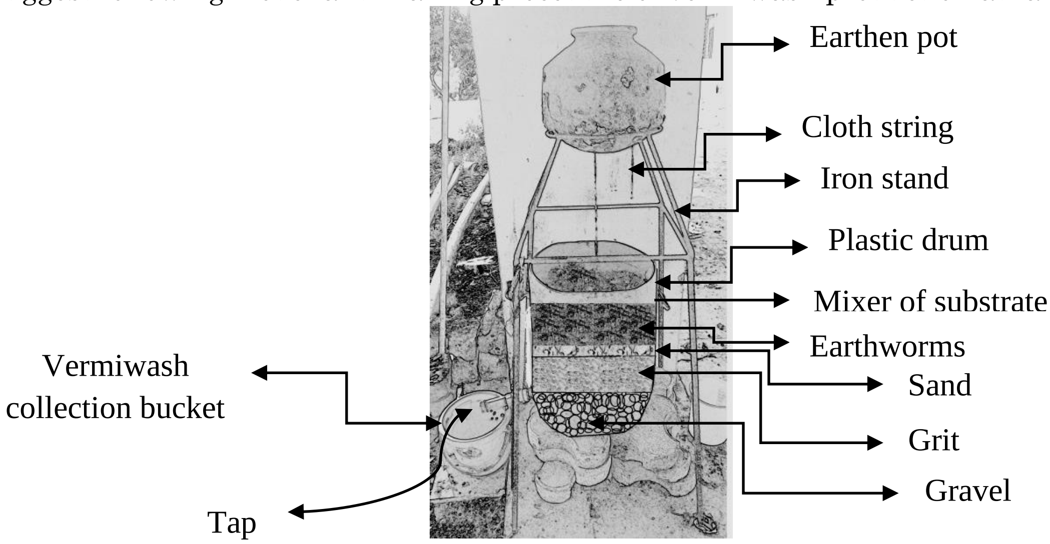

Figure 1: Model of vermiwash unit

There are many ways to make a vermiwash but the above model is very easy to operate and cheapest. Take the plastic drum or bucket of the required capacity (50 to 60 litre) as shown in Figure 1. Mark the horizontal four parts on it. Connect a small tap to the bottom. Now fill the lower first layer of about 15 cm in the lower part with gravel having diameter 20 to 25 mm in size. Following the lower layer, fill the grit about 10 cm and then fill the sand (0.5 to 2 mm) in the third layer of 15 cm. These three layers are to clean up the liquid that comes down from above layer. Now make a thin layer of soil over third layer. At the top of the layer, fill the loose partially decomposed farm waste and cattle dung in the same ratio (1:1). This layer is used as food stuff for earthworms. Release about 100 to 150 numbers of local as well as exotic earthworms. Daily 1 liter water release from the mounted earthen pot and then you can collect vermiwash after ten days. About 7-to-8-liter vermiwash you will get in one time. This cycle run up to 5 to 6 times than change feed/substrate of the earthworm for better quality of vermiwash. The quality of vermiwash can be maintain for about two to three months if the store in a dark and cool place. One unit is sufficient for one hectare land for soil and foliar application and cost of establishment of this unit is around the rupees 1000 to 1500.

Impact of Vermiwash on Soil, Plant and Environment

Vermiwash is very good bio-organic liquid product and affect significantly on the growth and productivity of crop using as foliar spray and soil application. Sundararasu (2016) reported the growth and yielding pattern of chilli was significantly increased in 50:50 vermiwash:water ratio and he quoted that vermiwash may be very much useful to improve the yield of chilli. Similarly, Tiwari and Singh (2016) reported that foliar applications of combinations of vermiwash obtained from animal dung and MSW with bio-pesticides neem oil, aquous extract of leaf, bark and vermiwash alone caused significant growth, start early flowering, enhance productivity of tomato crop. Meghavansi *et al.* (2012) found that 20 % foliar spray of vermiwash significantly increased growth and yield attributes of Naga chilli as compared to control. Similarly, Murali *et al.* (2010) also reported the significantly increased cob yield of maize by 5 to 10 % and 22 to 33 % increased fruit yield of okra with 20 % coconut leaf vermiwash (CLV) application as foliar spray. They also noted a concomitant increase in populations of general and plant beneficial microorganisms in the rhizosphere of CLV applied plants. Combination of vermicompost and vermiwash recorded a significant influence on the biochemical characteristics of the soil with marked improvement in soil micronutrients and better qualitative improvement in the physical and chemical properties of the soil (Ansari and Sukhraj, 2010). Tharmaraj *et al.*, (2011) reported that soil treated with vermicompost and vermiwash mixture had significantly enhanced soil physico-chemical properties when compared to unamended soil. The bio-pesticide are more effective against larvae and caterpillar of fruit and shoot borer without contamination of fruits, so vermiwash is the best alternative of agro-chemicals for management of *Lucinodes orbanalis* population and enhancement of the productivity of fruit yield of brinjal (Mishra *et al.*, 2014). Use of vermiwash (5 or 10 %) showed better performance against pest infestation in vegetable pea by over control (Mahto and Yadav, 2005). The Vermiwash (buffalo dung) + gram bran with neem oil and aqueous extract of garlic was effective for the control of pod borer infestation on gram plant (Nath and Singh, 2015).

Summary

Vermiwash is product of vermi-technology, it has inherent biophysico-chemical properties which act as potent source of readily available nutrients, boost and promote growth and yield of crops as well as develop tolerance mechanism against biotic and abiotic stress. Vermiwash is a self-made, guaranteed purity and natural organic liquid product. So, it can be used for long term sustainable crop production for improving economy and livelihood of farmers.

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Impact of Tropospheric Ozone on Plants

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Abstract

Tropospheric ozone is one of the most dangerous air pollutants. Naturally evolving ozone (stratospheric ozone) in the upper atmosphere forms a layer that absorbs the sun's harmful ultraviolet rays (UV-A, B &C) and protects all life forms on earth. Tropospheric ozone damages the plants by entering in to stomata and oxidizing plant tissue during respiration. This damage the plant leaves and causes reduced survival. So many factors can double the amount of tropospheric ozone injury such as soil moisture, presence of other air pollutants, insects or diseases, and other environmental stresses. Tropospheric ozone impairs growth primarily by inhibiting net photosynthesis and perhaps translocation processes, which limit availability of photosynthate needed for biomass production. It is clear that ozone results in biomass production. It is clear that ozone results in lower carbon fixation due to inhibition of Ribulose bisphosphate carboxylase (Rubisco) activity in the chloroplasts of leaves. With less carbon availability, plants produce fewer branches, leaves, roots, flowers and fruit. Ozone exposure also accelerates plant senescence, reduces leaf longevity, decreases water use efficiency, and inhibits pollen tube growth.

Keywords: Tropospheric ozone, Rubisco, Volatile Organic Compounds, Agricultural Crops.

Introduction

Tropospheric ozone is one of the most dangerous air pollutants. Naturally evolving ozone (Stratospheric ozone) in the upper atmosphere forms a layer that absorbs the sun's harmful ultraviolet rays (UV-A, B &C) and protects all life forms on earth. But tropospheric ozone can harm plants, animals and human health. It is formed when other pollutants, mainly nitrogen oxides and volatile organic compounds, react in the atmosphere in the presence of sunlight. Ozone causes significant damage to plants around the world, including agricultural crops and other plants in natural ecosystems. Tropospheric ozone damages the plants by entering in to stomata and oxidizing plant tissue during respiration. This damage the plant leaves and causes reduced survival. So many factors can double the amount of tropospheric ozone injury such as soil moisture, presence of other air pollutants, insects or diseases, and other environmental stresses.

Tropospheric Ozone Hazard

Tropospheric ozone is formed in the troposphere when sunlight causes complex photochemical reactions involving oxides of nitrogen (NOx), Volatile Organic Compounds (VOC) and carbon monoxide that originate chiefly from gasoline engines and burning of other fossil fuels. Woody vegetation is another major source of VOCs. NOx and VOCs can be transported too long distances by regional weather patterns before they react to create ozone in the atmosphere, where it can persist for several weeks. Seasonal exposures at low elevations consist of days when ozone concentrations are relatively low or average, punctuated by days when concentrations are high. Concentrations of ozone are highest during calm, sunny, spring and summer (March, April, and May) days when primary pollutants from urban areas are present. Ozone concentrations in rural areas can be higher than in urban areas, while ozone levels at high altitude regions can be relatively constant throughout the day and night.

Impact of Tropospheric Ozone on Plants

Tropospheric ozone enters leaves through stomata during normal gas exchange. As a strong oxidant, ozone (or secondary products resulting from oxidation by ozone such as reactive oxygen species) causes several types of symptoms including chlorosis and necrosis. It is almost impossible to tell whether foliar chlorosis or necrosis in the field is caused by ozone or normal senescence. The dicot species (soybean, cotton and peanut) are more sensitive to yield loss caused by ozone than monocot species (sorghum, field corn and winter wheat).

Several additional symptom types are commonly associated with ozone exposure, however. These include flecks (tiny light-tan irregular spots less than 1 mm diameter), stipples (small darkly pigmented areas approximately 2-4 mm diameter), bronzing, and reddening. Ozone symptoms usually occur between the veins on the upper leaf surface of older and middle-aged leaves, but may also involve both leaf surfaces (bifacial) for some species. The type and severity of injury is dependent on several factors including duration and concentration of ozone exposure, weather conditions and plant genetics. One or all of these symptoms can occur on some species under some conditions, and specific symptoms on one species can differ from symptoms on another. With continuing daily ozone exposure, classical symptoms (stippling, flecking, bronzing, and reddening) are gradually obscured by chlorosis and necrosis.

Ozone impairs growth primarily by inhibiting net photosynthesis and perhaps translocation processes, which limit availability of photosynthate needed for biomass production. It is clear that ozone results in biomass production. It is clear that ozone results in lower carbon fixation due to inhibition of Ribulose bisphosphate carboxylase (Rubisco) activity in the chloroplasts of leaves. With less carbon availability, plants produce fewer branches, leaves, roots, flowers and fruit. Ozone exposure also accelerates plant senescence, reduces leaf longevity, decreases water use efficiency, and inhibits pollen tube growth.

Conclusion

Due to increased population, industrialization and rapid exploitation of natural resources results in alarming the trace gas (tropospheric ozone) impact on plant ecosystem evidenced that the unmanageable loss of yield and productivity. The efforts to be made to monitor the trace gases impact on several crop plants in the ecosystem for future and maintaining the sustainability.

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MALDI-TOF MS for Rapid Detection and Diagnosis of Plant Pathogens

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Introduction

Development of an accurate and easy method for detection and identification of plant pathogens has become an urgent need although nucleic acid hybridization, PCR, DNA sequencing, dsRNA analysis and antibody-based methods are scientific methods that have the unique ability to detect strains at molecular and genetic level but they do require pathogen specific reagents.

In recent years, matrix assisted laser desorption/ionization time of flight mass spectrometry (MALDI-TOF MS) has emerged as a valuable tool for identification and diagnosis of microorganisms and also its process is rapid, sensitive, economical and user-friendly software for comparison as well as analysis purpose. It was first introduced by Hillenkamp and Karas in 1988 and microbes are identified by using either intact cells or cell extracts.

It has become an alternative to conventional microbiological and molecular methods since its possibility of automation along with fast and accurate molecular mass determination. Conventional identifications of fungi based on their morphological traits are hampered by phenotypic polymorphism. But, MALDI provides non-destructive vaporization and ionization of both large and small biomolecules.

Since, MS based proteomics with most characteristic biomarkers are available for analysis of intact organisms and also do not require extraction, separation or amplification so it has become a critical approach to identify, characterize and for better understanding of biology of fungus, oomycetes, bacterial and viral plant pathogens.

UV absorbing matrices function as energy mediators which transfer the absorbed photo energy from an irradiation source to the surrounding sample molecules resulting into a minimum fragmentation. In this technique, low and high molecular mass natural products like peptaibols can also be analysed. The methodology has remarkable reproducibility which is based on the measurement of constantly expressed and highly abundant proteins namely ribosomal molecules. The observable protein profiles molecular mass was ranged in between m/z region of 2000-20000 and can be used as characteristic biomarker peaks.

The Nobel Prize for chemistry in 2002 was awarded to Koichi Tanaka for the use of MALDI with biological macromolecules. This technique has been utilized for the optimization of quality control of Chinese fungal medicines like *Cordyceps* (Zhao *et al*., 2007).

Besides, its various applications consist of microbial identification, species characterization, strain typing, epidemiological studies, profiling of secondary metabolites, detection of biological warfare agents, detection of water and food borne pathogens, detection of antibiotic resistance *etc*. have been readily assessed earlier by several microbiologists.

MALDI-TOF MS Analysis for Fungal Pathogens

The use of MALDI-TOF MS for identification and characterization of single celled fungus *Saccharomyces cerevisiae* was reported in 2001by Amiri-Eliasiand. Besides, identification of filamentous fungus has also well documented where portions of mycelium or conidia are mixed with the matrix solution and spotted onto a MALDI plate to desorb protein biomarkers from filamentous fungi (Santos *et al.,* 2010). The various reports for rapid detection of some fungal pathogens are listed below:

***Aspergillus* species:** It has potential to differentiate inter specific differences in between *Aspergillus flavus* and *A. oryzae*, which are morphologically and phylogenetically similar to each other and were indistinguishable by ß-TUB sequence analysis, unless exploitation of tedious and time-consuming DNA based technique for their final discrimination. Highly reproducible mass spectral fingerprints for 12 species of *Aspergillus* and 5 strains of A. *flavus* were obtained in the range 5000-20000 Da which indicate that this technique may be used for clear-cut identification of *Aspergillus* at species and strain levels (Hettick *et al*. 2008). Likewise, mass spectra of intact fungal conidia have reported to have signals predominantly below 20000 Da. This approach was used successfully for distinguishing A. *flavus,* A. *parasiticus*, A. *oryzae* and A. *fumigatus* species.

***Fusarium* species:** Colored Fusaria represent a challenge for IC/IS MALDI-TOF MS as the presence of pigments of slightly orange to deep brown colour hinders on target crystallization with matrix and the subsequent measurements of mass spectrometric peptide/protein profiles. Dong *et al*. (2009) studied the use of washing steps with formic acid in washing solution prior to the sample preparation of conidia of *F. graminearum* and *F. poae* which brought about lighter co-crystals which could generate high quality spectra.

***Penicillium* species:** *Penicillium* being ubiquitous fungi with several species likes *P. expansum, P. italicum, P. digitatum, P. citrinum etc.* contaminate fruits with the production of mycotoxin. *Penicillium citrinum, P. italicum* and *P. digitatum* together with *P. expansum* and *P. pinophilum* were subjected to IC/IS MALDI-TOF MS analysis for differentiation and comparison of various strains within each individual species and the observed mass spectrometric profiles with characteristic ions appear in m/z region of 2500-7500 (Chen and Chen, 2005). Likewise, twelve *Penicillium* species were analyzed and found that spectra exhibiting significantly higher number of peaks with characteristic peaks appeared in m/z region of 5000-20000.

***Alternaria* species:** It has also been shown a powerful tool for the identification of ascomycete phytopathogenic fungi such as genus *Alternaria* (Brun *et al*., 2013). Many different species of *Alternaria* such as *Alternaria dauci*, *Alternaria porri*, *Alternaria solani* and *Alternaria tomatophila* causes blight diseases on various vegetables crops but their traditional diagnostics and identification based on their morphological characterization become problematic due to either their sterility in cultures or formation of species complexes of similar taxa. Then, when results of MALDI-TOF MS analysis of 37 strains were compared with combined DNA based data, a partial difference in clustering was found which was attributed to different chemical profiles that are needed for the pathogenicity in different host plants. Thus, its applicability for much younger culture of 3 days old make more advantageous for early detection of *Alternaria* as compared to profiling of metabolites which required 7-14 days old culture.

***Trichoderma* species:** IC/IS MALDI-TOF MS analysis of *Hypocrea* and *Trichoderma* strains comprising 29 different species were investigated to know their diversity in relation to its metabolite production as well as low mass proteomics and it has resulted with characteristic peaks in the m/z range of 5000-10000 and were assigned to hydrophobins (Neuhof *et al*., 2007). Likewise, analysis of 129 strains of *Hypocrea* and *Trichoderma* having morphologically and genetically different has also detected hydrophobins and it was similar from *Brevicompactum* clade depicting its importance in taxonomic studies.

MALDI-TOF MS Analysis for Bacterial Pathogens

It has emerged as a powerful tool for characterizing many broad-spectrum species of bacteria. Keys *et al.* (2004) developed a compilation of a MALDI-TOF MS database for the rapid screening and characterization of bacteria and data processing was performed with MicrobeLynx™. It was also applied to differentiate toxic and nontoxic cyanobacteria by their characteristic peaks of profiling of secondary metabolites.

Its ability in describing various strains of several bacteria *e.g., Clavibacter michiganensis*, *Bacillus subtilis*, *B. thuringiensis*, nitrogen fixing actinomycete *Frankia* (Hahn *et al*., 2011) were well demonstrated. It has been applied successfully including analysis of bacterial RNA and DNA, detection of recombinant proteins, characterization of unknown proteins, bacterial proteomics, detection of virulence markers and rapid characterization of bacteria at the genus, species and strain levels (Ahmad *et al*., 2012).

In addition, this technique also enables large scale comparative analysis of molecules such as many of the interesting aspects of bacterial physiology like electron transport, signal transduction, virulence and pathogenicity (toxin assembly, hemagglutinins, ligans, binding receptors, *etc*.). The differentiation in between closely related environmental strains of *Vibrio spp.* by MALDI-TOF MS has resulted with a higher level of strain grouping which confirmed its accuracy and reliability (Eddabra *et al*. 2011).

MALDI-TOF MS Analysis for Viral Pathogens

Identification can be broadly placed into three categories:
1. Based on the total mass of viral capsid protein (CP).
2. Based on using the masses of proteolytic peptides from the CP.
3. Resolution of amino acid sequences of CP peptides *via* MS/MS.

Analysis of infected tobacco leaves by MALDI-TOF MS has found that mass spectrum contained a single peak at 17491 Da, which corresponded to known mass of TMV CP (Thomas *et al*., 1998). Although, this diagnostic practice become problematic sometimes if the mass of the virus CP is unknown or if there is variance between the predicted mass from a nucleic acid sequence and the observed mass.

Further, the amino acid sequences of several brome mosaic virus isolate CPs were successfully resolved and discovered true amino acid sequence of the CP, whose genome sequence was incomplete by comparison (She *et al*., 2004) which showed the utility of MALDI-TOF MS in virus identification.

MALDI-TOF MS Analysis for Nematodes

Demonstrated verification of concept that protein profiles of nematodes can be generated readily it may be used as a new approach for rapid identification of plant parasitic nematodes. The results have suggested that even the closely related nematode species, separately (*Anguina tritici, A. funesta)* or in mixtures (*A. tritici* and *A. funesta* and *Meloidogyne javanica*) can be identified using MALDI-TOF MS (Perera *et al*., 2005).

When compared with other molecular methods for proper identification of nematodes, protein profiling in MALDI-TOF MS has described to be fast without any requirement of expensive chemicals. In this technique, the diagnostic profiles for juveniles of nematodes such as root knot nematodes and adult females would normally be adequate for a diagnostic. Thus, this technique shows assurance to enable rapid identification of nematodes due to its simple method of sample preparation along with rapid analysis as well as automated results of interpretation.

Conclusion

Identification of reliable and suitable method against multiple pathogens such as pathogenic bacteria, fungi, nematodes and viruses are most important step for implementing effective disease management strategies. Hence, early detection and identification of plant associated microorganisms is an inseparable part in successful implementation of appropriate control measures.

The application of MALDI-TOF MS as chemical analysis of microorganisms of pathogenic or non-pathogenic, characterization of polar compounds or non-polar lipids like quinones and long chain fatty acids have been investigated and these analyses provide a valuable idea for characterization of plant pathogens at genus and species level. Thus, the potentiality of MALDI-TOF MS has a promising future for the analysis of microbial samples for rapid detection and diagnosis in plant pathology.

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Field Day

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Abstract

Arrange a field day to project the new technologies demonstrated in front of a large group of interested farmers. It is an intensive educational activity in which farm experts, extension workers and farmers are involved and learn from each other. Plan the field day when the crop is fully matured yet green. Keep explanations of technologies and demonstrated as simple. Ask the demonstration farmers to explain the story of demonstration one by one to the assembled group of farmers and extension workers. Farmer-scientist-extension workers discussion should be an important feature of the field day. Use the field day to informally collect feedback on technology and farmer's need. Field day must be centered on a well-defined objective and a thorough understanding of the needs of the audience. Field days will be even more important as future advances in technology and management techniques are discovered.

Introduction

Arrange a field day to project the new technologies demonstrated in front of a large group of interested farmers. It is an intensive educational activity in which farm experts, extension workers and farmers are involved and learn from each other. Plan the field day when the crop is fully matured yet green. Keep explanations of technologies and demonstrated as simple. Ask the demonstration farmers to explain the story of demonstration one by one to the assembled group of farmers and extension workers. Farmer-scientist-extension workers discussion should be an important feature of the field day. Use the field day to informally collect feedback on technology and farmer's need. According to a report by the National Agricultural and Livestock Extension Program (NALEP) of Kenya, field days scored the highest in the effectiveness of information delivery both by the farmers and extension staff (NALEP, 2011).

The traditional role of field days has been to introduce growers and agricultural professionals to new technologies and techniques so that the audience could see how these technologies or techniques could be practically used and applied. Based on this concept, the use of field days to demonstrate the radically new technologies and site-specific management techniques behind precision farming is a perfect application of these tools. Field day must be centered on a well-defined objective and a thorough understanding of the needs of the audience. Field days will be even more important as future advances in technology and management techniques are discovered. However, future field days must be coupled with more issues or topics where precision agriculture technologies can be used to solve a practical problem and enhance management practices. A field day is a group extension event conducted at the site of any type of result demonstration. With single farmer result demonstrations, the field day is important to improve the cost-effectiveness of the demonstration. Field days provide the opportunity for 20 or more farmers to visit a demonstration site, learn about what is being demonstrated, ask questions, and encourage them to try new ideas themselves on their own farms. A series of field days, especially those that last for a year and show a cropping pattern, provide an ideal opportunity for farmers to meet again.

Planning of Field Day

Field days are arranged at key times during the demonstration, when particular management activities are implemented or when the benefits of the demonstration are most visible.

For crop production demonstrations, appropriate times could be:
1. At the time of planting.
2. When fertilizers or other inputs are provided.
3. At mid-season when differences in crop growth are apparent.
4. At harvest time when yields, costs and benefits can be compared.

A minimum of two field days for a single season demonstration is recommended. For cropping pattern demonstrations which involve three consecutive seasons, two field days in each season, or a total of six during the year, are recommended. Field days generally no more than an hour or so and involve no cost. There is no allowance for either extension staff or farmers. Dates and times should be fixed in advance, and advertised to neighboring farmers. Where there is a demonstration signboard, field day schedules should be added. The same group of farmers should be encouraged to attend consecutive field days at specific sites. However, the number of participants should not exceed 20 to 25 farmers. Smaller groups will have a better opportunity to see what is being demonstrated and hear the explanations of farmers and extension staff. Also, with fewer people, a greater proportion of participants will have the opportunity to ask questions and participate properly in the field day. Wherever possible, audio-visual aids or printed material should be used to improve the quality of the field day. This could include flash cards, flip charts, or leaflets which summarise the technology. As far as possible, existing material should be used.

A Useful Planning Checklist for a Field Day Includes

1. Fixing an appropriate date and time in consultation with the host farmer.
2. Checking the Resource Centre for materials which could be useful during the field day.
3. Advertising the field day to neighboring farmers and people who participated in earlier field days at the site. Where possible farmers should be from similar socio-economic backgrounds.
4. Ensuring that the farmer hosting the demonstration can correctly explain the objective of the demonstration, what has been done and the expected benefits, including costs and returns.
5. Visiting the demonstration site to ensure that access is easy, movement through the field is possible, that there is a clear visual impact for the field day.

Implementation of Field Days

The Block Supervisor or other member of staff responsible should arrive early with all the necessary materials and ensure everything is in order. Successful implementation requires:
1. An informal atmosphere where people feel free to raise questions.
2. An introduction where the purpose of the field day is explained and farmers are reminded of the original problem or need which the demonstration was designed to address.
3. The farmer hosting the demonstration is encouraged to take an active role in the field day, explaining the demonstration objective, what has been done, and their impression of the costs and benefits of the technology.
4. Farmers are able to walk around the demonstration and to take a close look at the crop. Where there is a demonstration and a control plot, farmers can be encouraged to look at the differences between them.

5. Extension staff to talk informally with the farmers to find out whether they understood the demonstration clearly, their impressions of the technology and whether they will try the technology on their own farm.
6. Recording the names of participating farmers and completing a Seasonal Extension Monitoring SEMS Form 1.
7. Concluding the field day by bringing participants together, reviewing the proceedings, and explaining any follow-up activities.

Monitoring, Evaluation and Follow-Up

One of the final points in implementing the field day is the completion of a Form. This should be done before the farmers leave the venue. The main parts of Form are:

1. Contact: How many farmers (male and female, large and small) attended the field day and what was the cost of the event (this should be zero).

2. Understanding: How many farmers who attended understood the demonstrated technology. This can be done by a show of hands and recording comments made during informal discussions with participants.

3. Testing: How many of the farmers who attended think that they will try the method on their own farm or homestead. Again, a show of hands and comments made during informal discussions with participants should provide an indication of intention to test.

This monitoring process will show how effective the field day was at contacting farmers, enabling farmers to understand a new idea, and encouraging farmers to consider trying a new technique on their farms. A field day can be evaluated by re-visiting the farmers who participated to see if they have tried new ideas. Knowledge, Attitude and Practice (KAP) surveys are a useful tool to conduct this type of evaluation. In a KAP survey, a sample of farmers who participated are selected, visited and interviewed. It is therefore extremely important that a list of participating farmers is made during the event.

Conclusion

Field days will be even more important as future advances in technology and management techniques are discovered. A field day is a group extension event conducted at the site of any type of result demonstration. With single farmer result demonstrations, the field day is important to improve the cost-effectiveness of the demonstration. Field days provide the opportunity for 20 or more farmers to visit a demonstration site, learn about what is being demonstrated, ask questions, and encourage them to try new ideas themselves on their own farms. A series of field days, especially those that last for a year and show a cropping pattern, provide an ideal opportunity for farmers to meet again.

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Indigenous Technical Knowledge in Organic Farming

Article ID: 10742

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Agricultural scientists and policy makers have understood that continuation of modern agriculture might lead to severe ecological, environmental and economic problems. So, we are searching for alternative technologies. Several alternatives have been proposed such as low external input agriculture, sustainable agriculture, organic farming, biodynamic farming etc., Hence for the developing countries, the other alternative *viz*., traditional methods have special advantages over modern agricultural techniques. Also, the capital and technological skill requirements in the use of traditional technologies are generally low and their adoption often requires little restructure of the traditional societies. The traditional technologies are nothing but indigenous technical knowledge. By adopting such indigenous knowledge, our ancestors did not face any problem of large-scale pest out break or economic crisis unlike the today's farmers.

Indigenous Technical Knowledge (ITK)

Is the systematic body of knowledge acquired by local people through the accumulation of experiences, informal experiments and intimate understanding of the environment in a given culture? Learning from ITK can improve understanding of local condition and provide a productive context for activities designed to help the communities. In addition, the use of ITK's assures that the end user of specific agricultural development projects is involved in developing technologies appropriate to their needs. All ITK's go by the principle of 'Permanence'. It is not so with modern technologies with synthetic inputs. Therefore, now the need has come to re-examine and then re-introduce the effective traditional methods of crop production and protection using organic sources, because there is considerable demand and scope for the development of organic technologies either individually or as a package, without necessarily aiming at full adoption of organic system.

ITK Based Organic Input Preparations

Panchagavya: Panchagavya or panchagavyam is a concoction prepared by mixing five products of cow. The three direct constituents are cow dung, urine, and milk; the two derived products are curd and ghee. These are mixed in proper ratio and then allowed to ferment. The Sanskrit word Panchagavya means "mixture of five products," and it has been used in traditional Indian rituals throughout history. It is also called cowpathy treatment based on products obtained from cows used in ayurvedic medicine and of religious significance for Hindus. Panchagavya is also used as fertilizers and pesticides in agricultural operations

Dasagavya: Dasagavya is an organic preparation made from ten products as in the form of panchagavya and certain plant extracts. “gavya” is the term given to cow’s products comprising of cow dung, cow urine, cow’s milk, curd and ghee, which have miraculous effects on plant growth when suitably mixed. The plants recommended for the taking plant extract are Neem (*Azadirachta indica*), Erukam (*Calotrophis)*, Kolingi (*Tephrosia purpurea*), Notchi (*Vitex negundo*), Umathai (*Datura metel*), Katamanaku (*Jatropha curcas*), Adathoda (*Adathoda vasica),* Pungam (*Pongamia pinnata), Leucas aspera* and *Lantana camera*. Since management of these can be made best use of in agriculture, as effective agents against certain pests and diseases.

Amirdhakaraisal: Amirdhakaraisal is an organic preparation made from products *viz.,* fresh cow dung (10 kg), cow’s urine (10 litres), country jaggery (1 kg) and water (100 litres).

General Indigenous Practices in Agriculture

1. Soil and Water Management:

a. For soil improvement in 'theri' lands of Tuticorin district, 200 tonnes to tank silt are applied per acre followed by 50 tonnes per year for the next few years (Farmers of Erode and Tuticorin District in Tamil Nadu).
b. Grassed water ways are adopted or vettiver *(Vetiveria zizanoides)* is planted along the bunds in red soils to check the soil erosion (Farmers in Karnataka, India)
c. Terracing is a traditional conservation method employed to prevent soil erosion particularly in steep areas (Fanners in Philippines).

2. Weed Management:
a. To control *Cyanodon dactylon,* harvested dried stalks of cumin crop are spread in the field. As the stalks decompose and mix with the soil, the weed is destroyed. (Farmers in Gujarat)
b. Manure made with mango leaves is applied in the fields to control *Cyperus rotundus*
c. Use of multivariate seeds (MVS) for mixed sowing navathaniyam as intercrops.

3. Pest and Disease Management:
a. To control pod borer *(Leucinodes orbonalis)* in vegetables, *Anethum sowa* plants are sown in rows along with the vegetables. The strong odour of the plant repels the insects (Farmers in Karnataka, India).
b. Mint and marigold are planted in the farm to repel insects (Farmers in Philippines).
c. To project the plants from the white ants, *Vetiveria zizanoides, Euphorbia tirucalli* and *Calotropis gigantea* are planted at intervals in the field (Farmers in Maharashtra).
d. A mixture is made with 1 liter of neem oil, 3 kg of fine sand and 3 kg of cow dung and heaped in shade covering with a moist sack for 3 days. On the fourth day, the mixture is dissolved in 150 lit. of water and sprayed to control all sucking pests (Farmers in Tamil Nadu).

4. Storage Pest Management:
a. Lime juice is mixed with grains and then sun dried before storage to prevent insect pests.
b. Seeds are safely stored in earthen pots after mixing with the leaves of neem and *Vitex negundo.*

Some Underutilized Fruit Crops of Meghalaya, India

Article ID: 10743

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Introduction

The state of Meghalaya from Northeast region, stretches between 25°30'N latitude and 91°36'E longitude with an altitude range from 150 m to over 1961 m above sea level, is an important part of the Indo-Burma biodiversity hotspots of the world. Several indigenous fruit crops which are rarely found in other parts of the world grow naturally along the foothills of the state due to suitable geo-climatic conditions which are primarily utilized by the tribal population of the region for nutrition and medicinal purposes. These fruit crops are termed as underutilized of the fact that these are neither grown commercially nor widely marketed. However, these fruits are majorly grown, traded, consumed locally, and the popularity and/or preference vary from crop to crop and from locality to locality of the region. These considerably wild, underutilized fruit crops exist through natural selection are easier to grow, hardy in nature and producing a crop even under adverse soil and climatic conditions hence can acquire many desirable traits against biotic and as well as abiotic stresses. Besides, these indigenous fruit crops have potential for nutritional and economic benefit as most of these fruits have become day to day diet for tribal people in these regions as life sustaining diversification of nutrient security all through the year (Table 1). And with the recent trend of the demand for healthy food and increasing health consciousness amongst the population it has renewed the interest for these underutilized fruit crops.

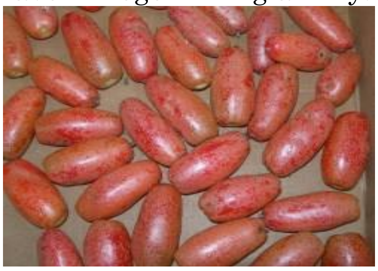
Popular Underutilized Fruit Crops

Some of the most popular underutilized fruits among the tribals of Meghalaya are described as mentioned below.

Padus napaulensis (Ser. ex DC.) Schneider [syn. *Prunus nepalensis* Hook., *Prunus nepalensis* (Ser. ex DC.) Steud.]

This belongs to the family Rosaceae. It is widely found growing in the Khasi and Jaintia hills of Meghalaya. It is locally called *Sohiong* (Khasi), *Slangi* (Jaintia) and is also known as Khasi cherry, as the tree is of low chilling type and resembling to the common cherry. Tree is found to grow well in forest openings and swamps, grows well at light sandy, medium loamy and heavy clay soils and prefers well-drained soil. It can also grow in nutritionally poor soil and can tolerate conditions like acidic to alkaline soil, dry to moist soil and drought conditions. This are evergreen trees growing up to 15 to 20 m high and matures after 7 to 8 years of planting (by seed) bearing fruits in the months of August to September after flowering in October to November. The fruits are purplish or blackish brown, round and smooth having characteristic colour, taste and unique flavour. Variation of two types is observed within the species for fruit size and quality, ranging from smaller to bigger fruit type as well as chemical contents of both the fruit types with bigger fruit type recorded higher content of acidity (3.32 %), ascorbic acid (58.38 mg/100 g), reducing sugar (4.44 %), total sugar (8.75 %), pectin (2.00 %), moisture (in fruit, 61.84 % and seed, 33.33 %) as compared to smaller fruit types. However, it was recorded that higher content of anthocyanin (358.86 mg/100 g), TSS (20.15 %), b-carotene (2.76 mg/100 g) and fibre (2.5 %) were in smaller fruit however, both the types have same nitrogen content. These fruits are consumed fresh or as processed products like jams, beverages and wine. The matured fruits have a characteristic deep purple colour owing to their high anthocyanin content which has growing interests, not just as a natural colorant but also due to their biological properties *viz.* anti-inflammatory, hepatoprotective, cardioprotective, neuroprotective and anti-aging. Locally, the leaves are used as diuretic agent to reduce edema. It is also reported to contain biochemical compounds which can provide therapeutic remedy as conducted in mice. Therefore, it is important to provide improvement on the storage to reduce post-harvest losses, maximise utilisation and commercialisation for its potential nutrients which can be beneficial both economically and therapeutically.

Eleagnus latifolia **L. (syn.** ***Elaeagnus javanica*** **Blume):** *Eleaegnus latifolia*, commonly known as Bastard Oleaster, is an edible plant belonging to the family Eleaegnaceae. The plant is common throughout Meghalaya and grows up to an altitude of 1500m and, it is commonly called *Soh-shang* (Khasi) and *Slangi* (Jaintia). This plant is a woody deciduous shrub, densely branched and expanding to 3m width with thorny, rusty-shiny scales. The tree bears hermoprodite flowers during September to December that bears dark pink oblong shaped fruits with single large seed having shiny silvery patches scattered on the skin that are harvested in the months of March to April. Studies recorded the fruit TSS (11.9°Brix), acidity (2.8 %), vitamin C (16–19.2 mg/100 g pulp), reducing sugar (4.0 %), total sugar (6.1 %), β-carotene (1.1 μg/100 g pulp), anthocyanin (16.2 mg/100 g pulp) and antioxidants (10.1 μg mol trolox/ g). Fruits are rich in minerals, vitamins, flavonoids, phenols and also contain essential fatty acids which are quite unusual in fruits. The fruits are eaten raw and also used for preparing value added products like jams, jellies, chutney, tarts and beverages. The tree is also reported to have nitrogen fixing ability.



Myrica esculenta **Buch.-Ham. ex D. Don (syn.** ***Myrica farquhariana*** **Wall.):** *Myrica esculenta* is belonging to the family Myricaceae and is commonly found cultivated in Hills of Meghalaya and is the income source of many locals. Around 97 species are found distributed globally in the tropical and sub-tropical regions and they favour a nitrogen-depleted soil and marginal land growing up to a height of 15-30 m and up to an altitude of 1300-2000. Its common name is Box myrtle and *Sohphie-bah* in Khasi, *Morella esculenta* is a newly accepted name of *Myrica esculenta.* Flowers appear between first fortnight of October to second fortnight of December and bear fruits from last week of March till last week of June. The analyzed quality parameters of fruit ranges from 15.21 to 23.4 g in big size, 8.37 to 8.70 g in medium size, while small size fruits showed the average 3.86 g fruit weight. Maximum pulp (86.7%) and juice recovery (80.44%) was obtained in big size yellowish green colour fruit and medium size fully pink coloured fruits, respectively. The maximum TSS (9.0 °Brix), reducing sugar (2.44%), total sugar (6.67%), β carotene (3.86 mg/100 ml) and anthocyanin (13.84 mg/100 ml) was recorded in small size fully pink coloured fruits whereas, maximum ascorbic acid (30.36 mg/100 ml) and minimum acidity (3.58%) was recorded in big size yellowish green and small size fully pink coloured fruits, respectively. The fruits are eaten raw at all stages and are also prepared as sparkling red colour refreshing drinks, squash, jam and pickles. The plant also has medicinal properties *viz.* bark is used as aromatic, stimulant for rheumatism, astringent, carminative, asthma, toothache, diarrhea, lung infection, fever, cough, bronchitis, dysentery, antiseptic indigenous medicine and also in the preparation of yellow dye.

Myrica nagi: In Meghalaya, three morphotype of the *Myrica* species are found *viz. Myrica nagi* , *M. esculenta*, and the third morphotype have been considered to be an intermediate of both the former morphotype. *M. nagi* is called as *Sohphie-nam* in Khasi. They are deciduous trees of 6 to 7.5 m. The fruits of *M. nagi* are relatively smaller than of the *M. Esculenta* which bears in the month of May. These fruits are small, seedy, brightly coloured, globose, drupe with hard endocarp. The fruits of *M. nagi* are said to have ravishing taste due to the preferable combinations of sugars, tannins and acids. The tree is of important medicinal value, which is safely and effectively used to treat various disorders in Ayurvedic system of medicines since ancient times. Myricitin is an important chemical compound found in *M. nagi*, previous findings reported its antioxidant, anti-inflammatory and anti-mutagenic activity.

***Docynia indica* (Wall.) Decne. (syn. *Docynia hookeriana* Decne.; *Malus docynioides* Schneid.):** *Docynia indica* is a wild fruit belonging to the family Rosaceae. It is found in growing naturally in Meghalaya and prefer moist soil. The species are deciduous, growing at a height of 9 to 12 m and are locally called as *Sohphoh* in Khasi. Leaves are ovate to oblong, lanceolate, acuminate, serrate and glabrous. Flowering occurs in the month of March to April, either solitary or arranged in fascicales of 2 to 3.

Fruits are pear or round shaped and greenish or yellowish coloured with red tinged pale green colour when ripe, maturing during August to November. Taste of the fruit varies with the genotypes, ranging from medium sweetness to acidic and astringency. Studies on chemical content of fruits showed that pH 3.25, moisture 80.31 to 85.14 %, vitamin C 14.8 to 17.5 mg/100 g pulp, antioxidant activity IC50 1657 to1731 μg/ml, protein 1.81 to 2.76 mg/100 g pulp, total sugar content 21.92 mg/100 g pulp, reducing sugar 1.05 to 4.31 mg/100 g pulp, potassium 140 mg/100 g, magnesium 20.60 mg/100 g and micro elements such as iron, copper, cobalt, manganese and zinc. Fruit is eaten fresh with salt, boiled with sugar, pickled or sundried. Slices of sundried fruits can be store for months and consumed during the off-season. Apart from these uses, plant is also used as rootstock for imparting semi-dwarfness in apple. Traditionally the fruits are used as remedy against infectious diseases, digestive problems and hypertension in adults. Studies shows the fruit extract having high alkaloid contents and functional phytochemicals, anti-oxidative, anti-inflammatory and anti-microbial activities.

***Baccaurea ramiflora* Lour. (syn. *Baccaurea sapida* Muell. Arg.):** *Baccaurea ramiflora* belongs to the Phyllanthaceae family. The species is found wild or semi- cultivated in Meghalaya and called *Soh-ramdieng* in Khasi. The evergreen tree grows up to a height of 5 m, the wood is pinkish-white, soft and even-grained having branches from near the ground, particularly when the stem is lalden with fruits. The wood is pinkish-white, soft and even-grained.

Flower is tomentose on short pedicels in simple bracteates speciform densely fascicled racemes borne below the old wood. Fruit is yellow, velvety, 2 to 3 cm in diameter, with leathery pericarp. Sometime, the yellowish ripe fruits turn into ivory to pinkish-buff or bright red. Pulp is aril with whitish and occasionally deep pink near seeds. Seeds are arillus, 3 in number per fruit, embedded in pale rose-coloured delicious pulp. Taste varies from acidic to sweet. Biochemical analysis of fruits revealed that TSS was 8.2 to 14.1 %, acidity 1.93

%, reducing sugar 5.10 % and total sugar 13.69 % besides, fruits are also rich in protein and iron. Arils of ripened fruits are eaten and very delicious with high market preferences among the tribal population.

Fruits are used for preparing wine, squash and jam. Fruits and leaf yield a chocolate-coloured dye that can be used as colorants for any processing products. The rinds of the fruits are occasionally used for making pickle. Traditionally, fruit juice is either stewed or used to prepare wine, and is also used for treatment of arthritis, abscesses and injuries.

Table 1. Some other underutilized fruit crops existing in Northeast region of India:

Scientific name	Common/ Local name	Family	Distribution in Northeast states
Actinidia strigosa	Wild kiwi	Actinidaceae	Sikkim
Actinidia callosa	Wild apple	Actinidaceace	Arunachal Pradesh
Baccaurea sapida Muell.Arg. *Baccaurea ramiflora Lour.*	Leketu (Assamese), *Soh-ramdieng* (Khasi)	Euphorbiaceace	Arunachal Pradesh, Assam, Meghalaya, Sikkim, Tripura
Averrhoea carambola L.	Carambola, Star fruit, *Soh Pyrshong* (Khasi)	Oxalidaceae	Assam, Meghalaya
Docinia indica *Docinia hookeriana* (*Eriolobus indica* Schn.)	Indian crab apple, Sohphoh Khasi	Rosaceae	Meghalaya, Sikkim
Emblica officinalis	Aonla	Euphorbiaceace	All NE states
Elaeagnus latifolia Linn. *Elaegnus pyrifolia*	Bastard Oleastar, Soh-shang (Khasi), Slangi (Jaintia), Muslerhi (Sikkim)	Eleagnaceace	Lower Assam, Meghalaya, North east frontier tracts
Garcinia lanceaefolia	*Thekera tenga* (Assamese)	Clusiaceae	Assam, Meghalaya, Mizoram, Nagaland
Myrica esculenta *Myrica nagi*	Soh-phie (Khasi)	Myricaceae	All NE hill region
Myrica fraquhariana	Soh-phie (Khasi)	Myricaceae	Khasi & Jaintia hill (Meghalaya), Naga hills, Sivasagar (Dikhow valley Assam)
Passiflora edulis var. flavicarpa	Passion fruit, Soh-rub (Khasi)	Passifloraceae	Manipur, Meghalaya, Mizoram, Nagaland, Sikkim
Padus napaulensis	Khasi cherry, *Soh-iong* (Khasi)	Rosaceae	Khasi and Jaintia hills (Meghalaya)
Pyrus pashia	*Soh-shur* (Khasi)	Rosaceae	Khasi & Jaintia hills (Meghalaya)
Dillenia indica	*Otenga* (Assamese)	Dilleniaceae	Assam, Meghalaya
Machilus edulis King. syn. *Percea fructifera* Kost.	*Pumsi* (Sikkimese)	Lauraceae	Arunachal Pradesh, Sikkim and some parts of NE region

(Deka *et al.*, 2012)

Conclusion

These fruit trees have potential to increase the sustainability of agriculture through the reduction in multi-agricultural inputs. Initiation of standardization strategies for the development of new commercial crops through domestication, crop improvement and benefit modern agriculture by providing plant breeders with a broad pool of potentially useful genetic resources for crop improvement. Interested researchers may accurately undergo assessment and improvement on their adaptability, nutritional value and physiological state as well as metabolite production.

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Nano Urea for Precision and Sustainable Agriculture

Article ID: 10744

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Introduction

Nano Urea (Liquid) contains nanoscale nitrogen particles which have more surface area (10,000 times over 1 mm Urea prill) and number of particles (55,000 nitrogen particles over 1 mm Urea prill) which makes it more impactful.

IFFCO developed nanotechnology-based Nano Urea (Liquid) fertiliser to address the imbalanced and excessive use of conventional Urea. This nanofertiliser has been developed indigenously, for the first time in the world at IFFCO - Nano Biotechnology Research Centre (NBRC) Kalol, Gujarat through a proprietary patented technology. Nano Urea (Liquid) is a source of nitrogen which is a major essential nutrient required for proper growth and development of a plant. Nitrogen is a key constituent of amino acids, enzymes, genetic materials, photosynthetic pigments and energy transfer compounds in a plant. Typically, nitrogen content in a healthy plant is in the range of 1.5 to 4%. Foliar application of Nano Urea (Liquid) at critical crop growth stages of a plant effectively fulfils its nitrogen requirement and leads to higher crop productivity and quality in comparison to conventional urea.

Technical Specifications

1. Nano urea prepared by nanotechnology contains nanoscale particles of Nano Urea.
2. Average physical size of Nano Urea particles is in the range of 20 -50 nm.
3. Nano Urea contains 4 % nitrogen by weight in its nano form.
4. Nitrogen present in Nano Urea effectively meets the crop nitrogen requirement.
5. It has better use efficiency than conventional urea.
6. Nano Urea is suitable for application as a source of nitrogen for most of the crops/plants.

Benefits of Nano Urea

1. Reduces the requirement of conventional Urea by 50% or more
2. Required less and produces more: Efficacy of one bottle of Nano Urea (500 mL) is equivalent to one bag of urea.
3. Environment friendly product, can improve Soil, Air & Water quality thus, helps in addressing the concerns of Global Warming and in meeting the UN SDGs.
4. Cheaper than conventional urea.
5. Reduce input cost to farmers, leads to increase in farmers' income.
6. Improves crop productivity, soil health and nutritional quality of produce.

Mode of Action of Nano Urea

When sprayed on leaves Nano Urea easily enters through stomata and other openings and is assimilated by the plant cells. It is easily distributed through phloem from source to sink inside the plant as per its need. Unutilised nitrogen is stored in the plant vacuole and is slowly released for proper growth and development of plant. Nano Urea (Liquid) does not involve any government subsidy and will be made available to farmers at a 10% lower price than a bag of subsidised Urea. Transportation would be easier and economical, as one 500 ml bottle would be equivalent to one bag of regular urea fertiliser.

Conclusion

In comparison to Urea the uptake efficiency of Nano Urea is more than 80 %. It is thus, required in lesser measure compared to the conventional urea fertiliser to fulfil plant's nitrogen requirement. All India efficacy trials have been conducted on 20 ICAR research institutes and State Agricultural Universities on 43 crops. At all India level 11,000 farmer field trials on 90 crops have been undertaken in supervision of Krishi Vigyan Kendras. It has been recorded in the trials that Nano Urea (liquid) increases crop productivity and can reduce the requirement of conventional Urea by 50%. Further, application of nano urea (liquid) improves yield, biomass, soil health and nutritional quality of the produce.

Nano Urea (liquid) has been tested for biosafety and toxicity as per the guidelines of Department of Biotechnology (DBT), Government of India and OECD international guidelines. Nano Urea (liquid) is completely safe for human, animals, birds, rhizosphere organisms and environment at the recommended levels of application. Ministry of Agriculture & Farmers Welfare, DAC & FW, Government of India, has notified IFFCO Nano Urea (Liquid) as a nanofertilizer under the Fertilizer Control Order (FCO).

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Farmers Producer Organization (FPO) for Addressing Agriculture Distress

Article ID: 10745

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Summary of Article

The government of India has envisaged doubling farmer's income by 2022, but this target is likely to be missed. This is because the efficiency, productivity, and economic viability of Indian agriculture are affected by many factors. Factors like poor supply chain management, lack of modernization, and the declining average size of farm holdings are some of the reasons for agrarian distress. Moreover, these factors affect the small farmers to a bigger magnitude.

Recognizing the problems of small and marginal farmers in India, the government is actively promoting Farmers Producer Organization (FPO). The aggregation of small, marginal, and landless farmers in FPOs has helped enhance the farmers' economic strength and market linkages for improving their income.

Introduction

Farmers Producer Organization" (FPO) are voluntary organizations controlled by their farmer-members who actively participate in setting their policies and making decisions. They are open to all persons able to use their services and willing to accept the responsibilities of membership, without gender, social, racial, political or religious discrimination. FPOs operatives provide education and training for their farmer-members, elected representatives, managers, and employees so that they can contribute effectively to the development of their FPOs. FPOs in Gujarat, Maharashtra and Madhya Pradesh, Rajasthan and some other states have shown encouraging results and have been able to realise higher returns for their produce. For example: tribal women in the Pali district of Rajasthan formed a producer company and they are getting higher prices for custard apples.

Benefits Emanating from FPO

1. Delining Average Land Holding Size: The average farm size declined from 2.3 hectares (ha) in 1970-71 to 1.08 ha in 2015-16. The share of small and marginal farmers increased from 70 per cent in 1980-81 to 86 per cent in 2015-16.

a. FPOs can engage farmers in collective farming and address productivity issues emanating from small farm sizes.

b. Further, this may also result in additional employment generation due to the increased intensity of farming.

2. Negotiating with Corporates: FPO can help farmers compete with large corporate enterprises in bargaining, as it allows members to negotiate as a group and can help small farmers in both input and output markets.

3. Economics of Aggregation: The FPO can provide low-cost and quality inputs to member farmers. For example, loans for crops, purchase of machinery, input agri-inputs (fertilizers, pesticides, etc.) and direct marketing after procurement of agricultural produce.

a. This will enable members to save in terms of time, transaction costs, distress sales, price fluctuations, transportation, quality maintenance, etc.

4. Social Impact: Social capital will develop in the form of FPOs, as it may lead to improved gender relations and decision-making of women farmers in FPOs.

Government's Effort for Promotion of FPO

1. Since 2011, it has intensively promoted FPOs under the Small Farmers' Agri-Business Consortium (SFAC), NABARD, state governments and NGOs.
2. The ongoing support for FPOs is mainly in the form of, one, a grant of matching equity (cash infusion of up to Rs 10 lakh) to registered FPOs, and two, a credit guarantee covers to lending institutions (maximum guarantee cover 85 per cent of loans not exceeding Rs 100 lakh).
3. The budget for 2018-19 announced supporting measures for FPOs including a five-year tax exemption while the budget for 2019-20 talked of setting up 10,000 more FPOs in the next five years.
4. One District One Product Cluster: The Ministry of Agriculture and Farmers Welfare on Tuesday reiterated the importance of FPOs which are to be developed in production clusters, wherein agricultural and horticultural produces are grown/cultivated for leveraging economies of scale and improving market access for members.
5. "One District One Product" cluster will promote specialization and better processing, marketing, branding and export.
6. Collective Farming: FPOs can be used to augment the size of the land by focusing on grouping contiguous tracts of land as far as possible. More focus should be on creating a supply chain and find new markets. Women farmers will play a major role in collective farming.

Way Forward

1. Adding More FPOs: Some studies show that we need more than one lakh FPOs for a large country like India while we currently have less than 10,000.

a. In this context, the government has taken several steps to promote FPOs.

2. Addressing Structural Issues: Many FPOs lack technical skills, inadequate professional management, weak financials, inadequate access to credit, lack of risk mitigation mechanism, and inadequate access to market and infrastructure.

a. The above issues such as working capital, marketing, infrastructure have to be addressed while scaling up FPOs.
b. Getting credit is the biggest problem. Banks must have structured products for lending to FPOs.
c. They have to be linked with input companies, technical service providers, marketing/processing companies, retailers, etc.
d. They need a lot of data on markets and prices and other information and competency in information technology.

Conclusion

In the last decade, the Centre has encouraged farmer producer organizations (FPOs) to help farmers. While incomes will rise because of the benefits flowing from FPOs, they may not still be adequate to give a reasonable income to small and marginal farmers.

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Food Additives - A Macro View

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Introduction

Food additives are chemicals added to foods to keep them fresh or to enhance their colour, flavour or texture. They may include food colourings (such as tartrazine or cochineal), flavour enhancers (such as MSG) or a range of preservatives. Most food additives are listed on the product label, along with other ingredients, in a descending order by weight (flavours are an exception and do not need to be identified). Sometimes, the additive is spelt out in full. At other times, it is represented by a code number: for example, cochineal may be listed as Colouring (120); sodium sulphite may be shown as Preservative (221).

Food Additives Serve Five Main Roles

1. Maintain product consistency: Emulsifiers provide a consistent texture and prevent products from separating. Stabilizers and thickeners provide a uniform texture. Anticaking agents enable substances to flow freely.

2. Improve or preserve the nutrient value: Fortification and enrichment of foods has made it possible to improve the nutritional status of population. For example, vitamins and minerals are added to many foods including flour, cereal, margarine, and milk. This helps to make up for vitamins or minerals that may be low or lacking in an individual's diet.

3. Maintain the wholesomeness and the palatability of foods: Â Contamination from bacteria can allow food-borne illnesses to occur. Preservatives reduce the spoilage that air, fungi, bacteria, or yeast can cause. Preservatives such as antioxidants help baked goods preserve their flavor by preventing the fats and oils from becoming rancid. They also keep fresh fruits from turning brown when exposed to the air.

4. Control the acidity and alkalinity, and to provide leavening: A Specific additives aid to adjustment of the acidity or alkalinity of foods to gain a wished taste, color, or flavor. Leavening agents that release acids when they are heated react with baking soda to help biscuits, cakes, and another baked goods rise.

5. Provide color and improve flavor: Certain colors improve appearance of foods. There are many spices and natural and synthetic flavors that bring out the best in the flavor of food.

Some food additives have more than one use. Food additives are listed according to their roles. Examples of the most common roles according to classes are:

6. Colorings add or restore color to foods: A Color retention agents keep or intensify the color of food. Preservatives help protect against deteriorations caused by microorganisms.

Safety Tests for Food Additives

1. Food Safety and Standards Authority of India (FSSAI) is responsible for the approval of which food additives are allowed in Australian foods. All food additives used in Australia undergo a safety assessment, which includes rigorous testing, before they are approved.

2. Toxicological tests on animals are used to determine the amount of the additive that is expected to be safe when consumed by humans. This is usually an amount 100 times less than the maximum daily dose at which 'no observable effects' are produced by an additive consumed over the test animal's lifetime.

3. If there is any doubt over the safety of an additive, approval is not given. If new scientific information becomes available suggesting that a food additive is no longer safe, the approval to use the food additive would be withdrawn.

4. Most food additives are tested in isolation, rather than in combination with other additives. The long-term effects of consuming a combination of different additives are currently unknown.

Effects of Food Additives

1. Some people are sensitive to particular food additives and may have reactions like hives or diarrhoea. This doesn't mean that all foods containing additives need to be automatically treated with suspicion. All foods are made up of chemicals and food additives are not always 'less safe' than naturally occuring chemicals.
2. Many of the food additives used by the food industry also occur naturally within foods that people eat every day. For example, MSG is found naturally in parmesan cheese, sardines and tomato in significantly greater quantities than the MSG present as a food additive. People with food allergies and intolerances are also often sensitive to chemicals found naturally in certain foods, such as nuts or shellfish.
3. Many people view food additives as a major food threat. However, in terms of health risk, food additives would come in at the end of the line, after food-borne microorganisms (like salmonella), inappropriate hygiene and eating habits, environmental contaminants and naturally occurring toxins.

Types of Food Additives

The different types of food additive and their uses include:
1. Anti-caking agents – stop ingredients from becoming lumpy.
2. Antioxidants – prevent foods from oxidising, or going rancid.
3. Artificial sweeteners – increase the sweetness.
4. Emulsifiers – stop fats from clotting together.
5. Food acids – maintain the right acid level.
6. Colours – enhance or add colour.
7. Humectants – keep foods moist.
8. Flavours – add flavour.
9. Flavour enhancers – increase the power of a flavour.
10. Foaming agents – maintain uniform aeration of gases in foods.
11. Mineral salts – enhance texture and flavour.
12. Preservatives – stop microbes from multiplying and spoiling the food.
13. Thickeners and vegetable gums – enhance texture and consistency.
14. Stabilisers and firming agents – maintain even food dispersion.
15. Flour treatment – improves baking quality.
16. Glazing agent – improves appearance and can protect food.
17. Gelling agents – alter the texture of foods through gel formation.
18. Propellants – help propel food from a container.
19. Raising agents – increase the volume of food through the use of gases.
20. Bulking agents – increase the volume of food without major changes to its available energy.

Food Additives and Processed Foods

1. There is a common misconception that processed foods automatically contain food additives. Foods like long-life milk, canned foods and frozen foods are all processed, yet none of them need extra chemicals.

2. If you are unsure whether or not a product contains an additive, check the label. However, some listed ingredients may contain food additives without mentioning them on the label. For instance, 'margarine' might be a listed ingredient and margarine contains food additives.

Some Food Additives Can Cause Reactions

1. For most people, additives are not a problem in the short term. However, 50 of the 400 currently approved additives in Australia have been associated with adverse reactions in some people. Some food additives are more likely than others to cause reactions in sensitive people.
2. It is often the additives that are used to give a food a marketable quality, such as colour, that most commonly cause allergic reactions. Some of these hypersensitive reactions include:
    a. Digestive disorders – diarrhoea and colicky pains.
    b. Nervous disorders – hyperactivity, insomnia and irritability.

c. Respiratory problems – asthma, rhinitis and sinusitis.
d. Skin problems – hives, itching, rashes and swelling.

Conclusion

The term does not include chance contaminants. An additive may be reactive or inactive; it may be nutritive or nonnutritive; it should be neither toxic nor hazardous. Additives are substances, or a mixture of substances, other than basic foodstuffs, that are present in food as a result of any aspect of production, processing, storage or packaging. Food additives has important role in the production of processed meats and sausages, where it solubilizes muscle protein, which contribute to meta binding, moisture and fat retention and the formation of desirable gel texture upon cooking.

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Food Processing Industry Present Scenario in India

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Introduction

With farm distress making headlines, the state government of Tamil Nadu unveiled its own food processing policy keeping an eye on increasing farmers' income, reducing wastage of food products and value addition of farm products, to ensure a healthy food processing industry. The objective is to encourage setting up of food processing industries by agro-entrepreneurs, availing financial assistance from Union.

What is Food Processing?

Food Processing includes process under which any raw product of agriculture, dairy, animal husbandry, meat, poultry or fishing is transformed through a process (involving employees, power, machines or money) in such a way that its original physical properties undergo a change and the transformed product has commercial value and is suitable for human and animal consumption.

It also includes the **process of value addition** to produce products through methods such as preservation, addition of food additives, drying etc. with a view to preserve food substances in an effective manner, enhance their shelf life and quality.

Status of Food Processing in India

1. India is the world's second largest producer of fruits & vegetables after China but hardly 2% of the produce is processed.

2. In spite of a large production base, the level of processing is low (less than 10%). Approximately 2% of fruits and vegetables, 8% marine, 35% milk, 6% poultry are processed. Lack of adequate processable varieties continues to pose a significant challenge to this sector.
    a. India's livestock population is largest in the world with 50% of the world's buffaloes and 20% of cattle, but only about 1% of total meat production is converted to value added products.
    b. More than 75% of the industry is in unorganized sector.
    c. Processing can be delineated into primary and secondary processing. Rice, sugar, edible oil and flour mills are examples of primary processing. Secondary processing includes the processing of fruits and vegetables, dairy, bakery, chocolates and other items.
    d. At present, India's agricultural exports predominantly consist of raw materials, which are then processed in other countries, again indicating the space to move up the value chain.

Food Processing Industry in India can be Segmented as Follows

1. Cereal/ pulse milling
2. Fruit & vegetable processing
3. Milk & milk products
4. Beverages like coffee, tea & cocoa
5. Fish, poultry, eggs & products
6. Meat & meat products
7. Aerated waters/soft drinks 8. Beer/alcoholic beverages
8. Bread, biscuits & other bakery products
9. Edible oil/fats.
10. Confectioneries.
11. Breakfast cereals, malt protein, weaning, extruded food products.

Problems in Food Processing Industries

At present most of the industries are in unorganized sectors. Some of the basic problems encountered by Indian food industries at different levels are given below:

Farm level problems	Distributors' problems	Processing industries problem
• Poor yield of farm produce and therefore low returns. • Lack of material resources necessary for development. • Primitive methods of farming. • No control on the quality of inputs and lack of finance to manage. • Vagaries of weather. • Unavailability of reliable handling and transportation system. • Lack of storage facilities at farm.	• Lack of modern transportation facilities and high cost • Inadequate cold storage faculties • Irregular quality and quantity of farm produce	• Financing • Higher import duties • Higher cost of raw material and packaging • Inadequate transport and cold storage facilities • Infrequent availability of refrigerated containers • Staggering advertising costs • Limited domestic market

Government's Initiatives

1. It has been the endeavor of the Government to promote food processing industry in the country to reduce wastage of agricultural produce and minimize post- harvest losses.

2. With the above in view, the Ministry of Food Processing Industries (MoFPI) is implementing **PMKSY (Pradhan Mantri Kisan SAMPADA Yojana)**.

3. Foreign Direct Investment (FDI) policy: FDI up to 100%, under the automatic route is allowed in food processing industries.

4. Agricultural and Processed Food Products Export Development Authority (APEDA)– an apex organization under the Ministry of Commerce and Industry – focusses on 'export' of scheduled products.

Conclusion

Food processing has numerous advantages which are specific to Indian context. It has capacity to lift millions out of poverty and malnutrition. Government should develop industry in a way keeping in mind the interests of small-scale industry along with attracting big ticket domestic and foreign investments. The entire food value chain in India is controlled by multiple ministries, departments and laws. A comprehensive policy will ensure that various initiatives across the departments are aligned to the overall goal of ensuring availability, awareness, affordability, access, quality and safety of food. The target of ensuring food security for more than a billion people requires a concerted effort by all stakeholders including government and the food processing industry. In addition to private players and government, industry bodies and academia will also have a crucial role in the success of these initiatives.

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Nanofertilizers: Applications and Future Prospects

Article ID: 10748

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Presentation

The worldwide populace is developing at a disturbing rate, which has expanded the interest for food persistently and is unsurprising to ascend by 70% up to 2050. As the worldwide populace is expanding, the interest for food is likewise expanding step by step, which has compelled the cultivators toward enormous scope utilization of manures. For taking care of these issues in crop creation nano-manures, pesticides and herbicides might be viable instruments in farming for better irritation and supplement the board. "Nano" signifies one-billionth, so nanotechnology alludes to materials that are estimated in a billionth of a meter (nm). The field of nanotechnology has brought about a few advances in science, physical science, drugs, designing, and science. The size of a nanomaterial is typically around 1 to 100 manometers. They can be normally happening or designed.

Nanofertilizers

Nano composts are incorporated or changed type of conventional manures, composts mass materials or extricated from various vegetative or regenerative pieces of the plant by various compound, physical, mechanical, or organic techniques with the utilization of Nano innovative apparatuses used to further develop soil richness, efficiency and nature of horticultural produces. Nanofertilizers work on the bioavailability of supplements inferable from high explicit surface region, scaled down size, and greater reactivity. The encapsulatio n of supplements with nanomaterials should be possible in three distinctive manners:

1. Entrapped/embodied inside the nanomaterials.
2. Coated with a layer of nanomaterials.
3. Delivered as nanoemulsions.

Nanofertilizers have been Ordered into Three Gatherings

1. Nan formulation of micronutrients.
2. Nan formulation of macronutrients.
3. Nutrients-stacked nanomaterials.

Macronutrient-Based Nanofertilizer

Nitrogen Nanofertilizers: Nitrogen is the above all else supplement fundamental for plant development as it is significant for energy digestion and protein blend. N nanofertilizer plans and tracked down a steady expansion in development, yield, quality, and supplement take-up in crop regarding regular urea. Nitrogen nanofertilizer which is based Zeolite not just demonstrated higher amassing of N in plants yet additionally the post-impact of utilization in soil displayed better pH, dampness, and accessible nitrogen than the customary compost.

Phosphorous Nanofertilizers: P is fundamental for shipping and putting away energy, photosynthesis execution, and natural compound arrangement. In customary composts edifices with iron, aluminum hydroxides, and calcium in the dirt or its immobilization with earth particles in the dirt limits its accessibility. Just 10–20% of the provided P manures are taken up by plants. Thus, to defeat these issues, a few analysts have planned and assessed nanotechnology-based methodology for phosphorus manures. For example, nanohydroxyapatite-based manure as for ordinary P composts. The utilization of hydroxyapatite NPs prompted improved plant development boundaries, synthetic substance, and anticancer movement of leaves in contrast with various wellsprings of P Nanofertilizers.

Potassium Nanofertilizers: The job of potassium incorporates guideline of water, transport of the plant's save substances, upgrade of photosynthesis limit, reinforcing of cell tissue, incitement of blooming, and amalgamation of starches and proteins. Nano-K was best in expanding the leaf region, grain yield, natural yield, gather record, potassium rate, and chlorophyll content, infection and irritation obstruction, and dry season resistance attributable to worked on supplement retention.

Calcium Nanofertilizers: Calcium assumes a critical part in different cycles, for example, cell divider adjustment, mineral maintenance in soil and their transportation, killing poisonous substances, and seed arrangement. Showering of nanofertilizer at a centralization of 500 mg/L brought about blooming around 15 days before control plants alongside 56.3% increment in the quantity of blossoms. Ca-nanofertilizer fundamentally decreased organic product breaking and expanded the yield.

Magnesium Nanofertilizers: Magnesium is an imperative component for plant development as it principal arrangement in the center of the chlorophyll particle, along these lines becoming essential for photosynthesis. It likewise goes about as a catalyst activator. Magnesium hydroxide nanofertilizer have likewise been investigated for their viability in seed germination just as in vitro and in vivo plant development advancement.

Sulfur Nanofertilizers: Sulfur adds to chlorophyll arrangement and builds nitrogen effectiveness just as plant guards. It was seen that sulfur Nanofertilizers diminished Mn take-up, upgraded S digestion, raised the water content of seedlings, and dispensed with physiological dry spell, showing that sulfur Nanofertilizers can restrict the harmful impacts of Mn stress.

Micronutrient-Based Nanofertilizers

Iron Nanofertilizers: Iron goes about as a significant cofactor for catalysts managing various organic cycles in plants. A promising way to deal with make iron accessible to plants is the utilization of exceptionally steady and moderate delivery nanoformulations. Iron chelate nanofertilizer is profoundly steady and gives moderate arrival of iron in a wide pH range. Iron nanofertilizer huge expansion in development boundaries, photosynthetic colors, and absolute protein substance.

Zinc Nanofertilizers: Zinc is significant for the synergist action of different metabolic compounds, cell division, tryptophan union, photosynthesis, protein union, and in the upkeep of film construction and potential. Utilization of zinc nanofertilizers to plants can be refined by different techniques, for example, by soil blending, foliar splash, as well as seed-preparing strategy. Out of these, the seed-preparing technique is straightforward, more productive, and financially savvy. Foliar utilization of zinc oxide nanofertilizers brought about improved petal.

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Forecasting and Prediction of Plant Disease Epidemics through Simulation Models

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The plant disease epidemics cause major loss in food production worldwide. Totally 14.1 per cent of crops are lost due to plant disease alone and these losses are in part responsible for the suffering of 800 million people who lack adequate food (Strange and Scott, 2005). So, it is necessary to have adequate, economic and environmentally acceptable strategies to manage the epidemic development of plant diseases through prediction and forecasting of plant disease epidemics using simulation models.

In epidemiology, modelling aims to understand the major determinants of epidemic development and their spatio-temporal dynamics. The simulation models are basically developed through mathematical and statistical tools and can be divided into three steps which includes, model development, model analysis and hypothesis testing. (VanmaanenandXu., 2003).

The EPIRICE model developed using different parameters which includes lesion size, relative rate of crop growth, epidemic onset, latent period, infectious period, infection rate, age, temperature and wetness effects to predict leaf blast and sheath blight diseases of rice. The level of agreement between the observed and simulated epidemics was high and the model was found to be valid according to the performance criteria.

Overall, the incidence of epidemics for both diseases was simulated to gradually decrease towards year 2100 based on RCP 8.5 scenario (Kim *et al.,*2015). Sharma *et al.* (2008) developed the three different linear cotton bacterial blight prediction models based on (A) current week weather parameters, (B) previous week weather and (C) previous week disease intensity in combination with weather variables.

The models were compared to improve disease forecasting of bacterial blight and validated with field data from year 1998-2005. Finally, model 'C' was considered as best model to predict the disease intensity one week in advance, providing sufficient time for contingency plan with plant protection inputs to restrict and manage the disease growth.

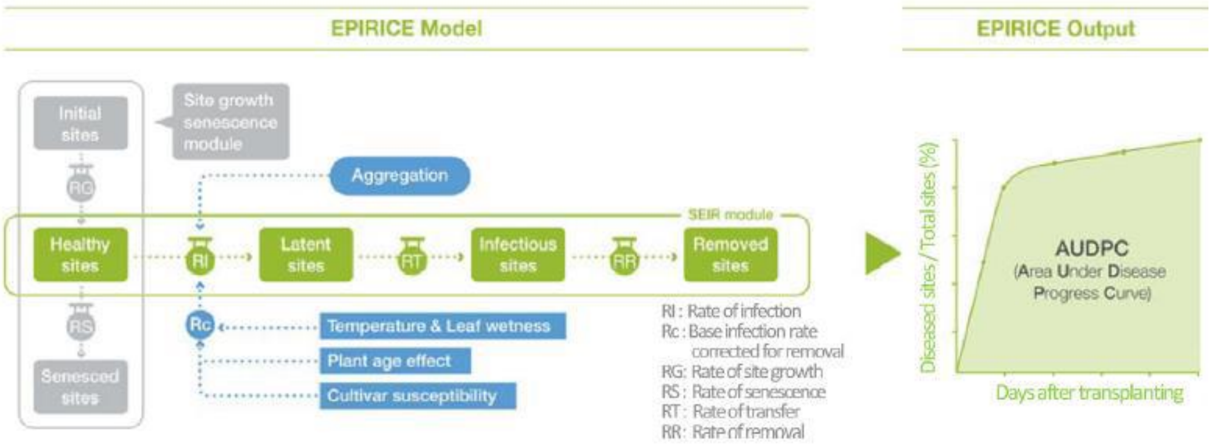
BYDV.PREDICTOR, a simulation model, was developed to predict and forecast aphid outbreaks and *Barley yellow dwarf virus* (BYDV) epidemics in wheat crop in the grain belt region of southwest Australia.

Sensitivity analysis of the model confirmed that, the combination of a high proportion of immigrants vectoring BYDV, early sowing of crops and early start to aphid arrival relative to sowing date led to the most BYDV spread and greatest yield loss (Thackray*et al.,*2009).

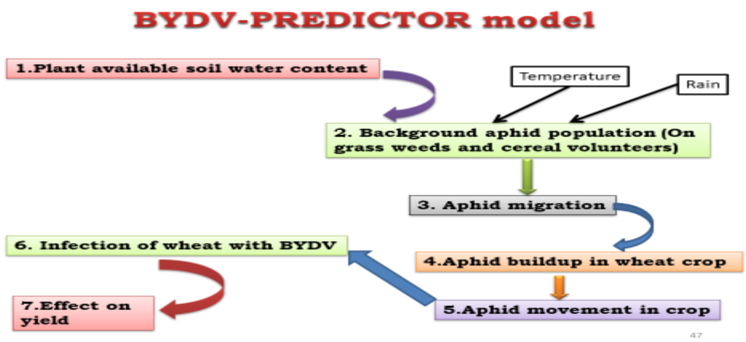
A sensitivity analysis using LB2004 version of LATEBLIGHT showed that, within the rangeof values observed empirically, LB2004 is more sensitive to changes in variables related to initial inoculum and sporulation rate.The level of agreement between the observed and simulated epidemics was high and the model was found to be valid according to the performance criteria (Piedra*etal.,* 2005).

The development of forecasting and predictive simulation models for epidemic diseases requires understanding of the interaction of the pathogen with biotic and abiotic environment. Models are valuable tool for designing sustainable practices for strategic and tactical management of diseases before occurance.

Recent advances in computer tools have made mathematical/statistical modelling more accessible and have led to the development of more complex models for many diseases. The incorporation of these simulation models into Decision Support Systems (DSS) made maximizing the utilization at farmlevel.



Structure of EPIRICE model



Structure of BYDV PREDICTOR model

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RNA Interference: A Powerful Innovation in Plant Pathology

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Plant diseases are threat to world agriculture. Significant yield losses occur due to attack of pathogens in most of the agricultural and horticultural crop species. More than 70 percent of all the major crop diseases are caused by fungi. It has been estimated that out of 36.5 percent average total losses, 14.1 percent by diseases 10.2 percent by insects, 12.2 percent by weeds.

Plant diseases are usually handled with applications of chemicals. For some diseases, chemical control is very effective; but it is often non-specific in its effects, killing beneficial organisms and may have undesirable effects on health, safety and cause environmental risks. Traditional plant breeding methods have been used to develop cultivars resistant to various diseases. However, this process is time consuming and limited availability of genetic resources.

So, in order to sustain high quality yielding and disease resistant plants, there is need to incorporate some biotechnological practices like gene silencing technologies to the breeding programmes (Wani *et al.*,2010). Gene silencing is a technique used to turn down or switch off the activity of genes. It directs a natural mechanism to degrade the RNA instructions of specified gene, preventing the gene from making its protein so it is called as RNA interference.

Genes are regulated at either the transcriptional level or post transcriptional level, therefore silencing can be induced either at transcriptional level or post transcriptional level (Mmeka*et al.*, 2014). RNA interference was first developed in 1998 by Andrew Fire and Craig Mello in the nematode *Caenorhabditis elegans* and later found in a wide variety of organisms, including mammals. It emerged as a method of choice for gene targeting virulence gene in fungi, virus, bacteria, insects, nematodes and parasitic weeds (Guo*et al.,* 2016).

Escobar *et al.* (2010) generated transgenic *Arabidopsis thaliana* and *Lycopersicon esculentum* plants that are highly resistant to crown gall disease development. In *in vitro* root inoculation bioassays with two biovar I strain of *A. tumefaciens*, transgenic *Arabidopsis* lines averaged 0.0–1.5 per centtumorigenesis, whereas wild-type controls averaged 97.5 percent tumorigenesis.

Similarly, several transformed tomato lines that were challenged by stem inoculation with three biovar I strain, one biovar II strain, and one biovar III strain of *A. tumefaciens* displayed between 0.0 percent and 24.2 percent tumorigenesis, whereas controls averaged 100 percent tumorigenesis. This mechanism of resistance, which is based on mRNA sequence homology RNAi-mediated oncogene silencing. Lindbo *et al.* (1993) transformed tobacco plants with the gene sequence of the tobacco etch virus (TEV) CP to provide TEV resistance.

They noted that TEV could initiate replication in transformed plants, producing the typical systematic symptoms of infection, but these plants were able to outgrow TEV infection approximately 3 to 5 weeks after the initial inoculation event, returning to a “recovered” healthy noninfected state. Recovered leaves did not support subsequent inoculations with TEV, but they did support replication of the unrelated virus *Potato virus X* (PVX).

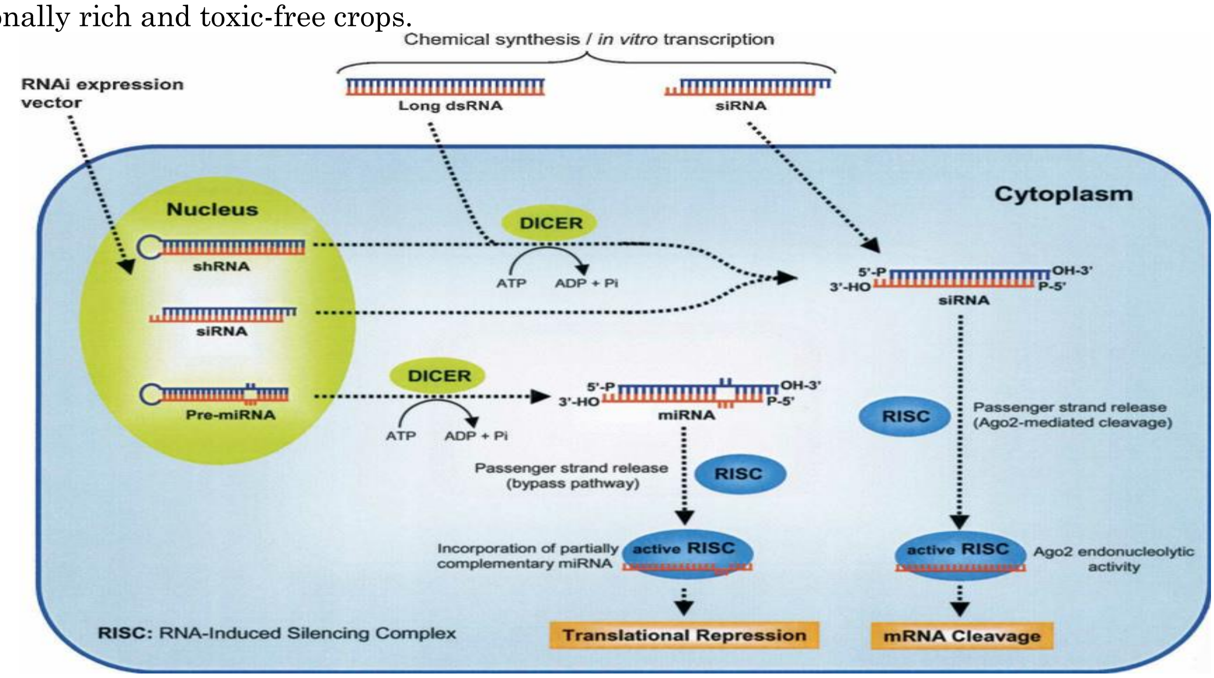
Molecular analyses of the recovered tissue showed that introduced TEV sequences were still actively transcribed, but corresponding mRNA failed to accumulate. These observations led them to speculate that the gene silencing or co-suppression initiated by the transgene and viral trigger was localized to the cytoplasm and occurred at the post transcriptional level. Thakare*et al.*, (2017) transformed maize plants with a kernel-specific RNA interference (RNAi) gene cassette targeting the aflC gene, which encodes an enzyme in the *Aspergillus* aflatoxin biosynthetic pathway.

After pathogen infection, aflatoxin could not be detected in kernels from these RNAi transgenic maize plants, while toxin loads reached thousands of parts per billion in non-transgenic control kernels. A comparison of transcripts in developing aflatoxin-free transgenic kernels with those from nontransgenic kernels showed no significant differences between these two groups.

These results demonstrate that small interfering RNA molecules can be used to silence aflatoxin biosynthesis in maize, providing an attractive and precise engineering strategy that could also be extended to other crops to improve food security. Hernandz*et al*., (2009) Amplified glutathione S-transferase gene from cDNA of *Nicotiana tobaccum* roots infected with *Phytophthoraparasitica var. nicotianae*.

The gene was cloned in sense and anti-sense orientation to an RNAi vector for induced gene silencing and reduced expression of the gene was detected by RT-PCR. A statistically significant increase in resistance *of N. tobaccum* to infection following gene silencing was found for glutathione S-transferase-silenced plants compared with control plants.

Current agricultural technology needs more and more molecular tools to reduce current crop loss and feed extra mouths, which will increase by two billion over the next 30 years. The RNAi technology describes one such powerful innovation to narrow the gap through production of disease, insect and virus resistant, nutritionally rich and toxic-free crops.



Mechanism of RNA Interference

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Insect Pests of Cucurbitaceous Vegetables and their Management

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Introduction

The various types of gourds cultivated in India include Bottle gourd, *Lagenaria siceraria*; Bitter gourd, *Momordica charantia*; Ash gourd, *Benincasa hispida* (L.); Ivy gourd, *Coccina grandis* (L.); Pointed gourd, *Trichosanthes dioida* (R.); ridge gourd, *Luffa acutagula* (R.). The terms cucurbits were coined by bailey. Cucurbits are manly use for both salad and vegetable's purpose. Many insect pests like the Red pumpkin beetle, *Raphidopalpa foveircollis* (L.) Cucurbits fruit fly, *Bactrocera cucurbitae* (C.); Flea beetle, *Phyllotreta cruiciferae* and Semilooper, *Plusia orichalcea* are infect the cucurbits crops and reducing the productivity and quality of products, among which fruit flies and red pumpkin beetles are important. The present article emphasis on the identification, life cycle, nature of damage and management of major insect pests of the cucurbit's crop.

Red Pumpkin Beetles, *Raphidopalpa foveircollis* (L.) (Gelerucidae: Coleoptera)

It is a most destructive pest of cucurbitaceous vegetables such as pumpkin, round gourd. cucumber and melon. Two specious of pumpkin beetle, Blue pumpkin beetle (*R. atripennis* F.) and Red pumpkin beetle (*R. foveicollis* L.) are common in north-western india.

	
Adult Red pumpkin beetles	**Infected Plant**

Identification and life cycle: Grub are freshly hatched dirty white and fully grown grub are creamy yellow in colour. Adult are 5-8 mm long and oblong. Their body (Dorsal) Surface is brilliant orange, red and ventral is black, being clothed in short white hair. The beetle is found in crevices of soil. They resume activity as soon as the season warm up and in the life span of 60-85 days. They lay oval yellow 300 eggs are single and in batches of 8-10 in the moist soil and near the base of the plants. The egg period is 6-15 days and grub remain below the soil surface feeding on roots. Grub is full grown in 13-25 days and pupate in thick-walled earthen chambers in the soil. The pupal stage lasts 7-17 days and the beetles, on emergence, being to feed and breed. The life cycle is completed in 26-37 days and there are five generation in a year (March – October).

Damage: Damage is caused by both grub and adult, grub damage the plant by boring in to roots and underground stem and adult are very destructive to vegetable particularly March- April when creepers are very young, adult feeds on leaf and flower.

Management:

a. Plough the field just after harvesting destroy the hibernating adults.
b. Collect and destroy adult beetles
c. Sow the crop in November to avoid damage by this pest.
d. Use of methyl eugenol trap to monitor fruit flies.
e. Poison bait can be used to kill fruit flies.

Apply 7.0 Kg carbofuran 3G per ha. 3-4 cm deep in the soil near the base of the plants just after germination or spray diamethoate 30 EC 500 ml/ha and 375 g of carbaryl 50WP in 250 liter of water per ha.

Fruit Fly, *Bactrocera cucurbitae* (C.) (Tephritidae: Diptera)

It is a commonest and most destructive pest of musk melon and other cucurbits throughout India. It's found in China, Pakistan, Japan, Australia, India and Hawaiian Islands.

	
Adult Fruit fly	**Infected Fruit**

Identification and life cycle: Eggs are laid single on fruit in clusters and larva is dirty white apodous maggot. The adult flies are reddish brown with lemon–yellow marking on the thorax and have fuscous areas on the outer margins of their wings. Flies is active throughout the year but life cycle is longest during winter season. In the morning hours, Adult emerge from pupae and mate at dusk. It takes a few days for the egg to mature inside the body of the female which starts laying them within 14 days, during winter, the pre-oviposition period is prolonged. The egg hatch in 1-9 days and the maggot bore into the pulp, forming galleries. The larvae are full grown in 3 days during summer and 3 weeks during winter. The mature larvae come out of the rotten fruit and move away in jumps of 12-20 cm. these are made possible by folding and unfolding the two ends of the elongated body.

Damage: The maggots pollute and destroy fruits by feeding on the pulp. The damage caused by this fruit fly is most serious in the melons and after the first shower of the monsoon, the infestation often reaches 100 per cent.

Management:

a. Collection infection and fallen fruits and burn in deep pits.
b. In endemic area, change the sowing date as the fly population is low in hot dry condition.
c. Use poison baiting in severe infestation.
d. Keep 5g of wet fishmeal in polythene bags with six holes.
e. Spraying the bait on the lower surface of the leaves of maize plants grown at distance of 8-10 cm as trap crop has been found to be effective as the flies have the habit of resting on such tall plants.

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Efficient Fertilization in Rainfed Maize through INM

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Introduction

India ranks first in rainfed agriculture globally in both area and the value of produce. Rainfed regions in India contribute substantially towards foodgrain production *i.e.,* 40%. Since green revolution, the food-grain production has more than quadrupled, but the yield gains are largely from the irrigated agroecosystems. Even after realizing the full irrigation potential, nearly 40% of the net sown area of 141 Mha will remain totally rainfed. Notwithstanding the increase in average productivity large yield gaps do exist for rainfed crops (Rao *et al* 2015).

Maize (*Zea mays L)* is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions. The productivity of maize mainly depends on its nutrient management **(**Kumar *et al.,*2007). Around 82 % of the total area under maize is in kharif season and 18% of that in rabi season. The production of kharif season is 70% of the total production and that of rabi season is 30%. Karnataka with the highest area under rainfed maize has 29%, 31%, and 7% of the area under N, P and K deficiencies respectively. So, there is vehement need to manage nutrient in rainfed maize.

Issues Related to Nutrient Management in Rainfed Maize

1. Introduction of hybrid varieties along with composite varieties has led to less factor productivity.
2. Degraded soil with high risks of accelerated erosion resulting in the loss of fertile surface soil.
3. Low soil organic carbon leads to less water and nutrient holding capacity.
4. The soil in rainfed area is subjected to a prolonged double exclusion *i.e.,* being unable to gain from chemical fertilizers and with less supply from fertility enhancing practices, resulting in continuous over mining of nutrients from soil and imbalance on the use of fertilizers.
5. Temperature is high, so ET losses are more & resulting in salinity problems.
6. India receives about 400 mha rainfall annually, most of which is received in 100 hours over a span of 25 non-consecutive rain days, resulting in leaching of the nutrients, depletion of major plant nutrients from soil and hence poor fertility.
7. Fertilizer use efficiency (FUE) is declining due to inadequate supply or even unavailability of fertilizer at the time of requirement due to inappropriate method of application and blind fertilizer use.
8. Data shows that about 89% of the rainfed soil is deficient in N, 80% for P, 50% K, 48% Zn, 12% Fe and Mg deficiency is also seen in maize in red and lateritic sandy soils.
9. In rainfed condition, there are areas that are practicing maize – maize cropping system also leading to more nutrient exhaustion from soil.

Strategy to Manage Nutrient in Rainfed Maize: INM

INM is a strategy by which soil nutrients are added to the system in organic form along with inorganic form. There is focus on nutrient recycling to minimize reliance on external inputs with regard to fertility building, apprehending the risk of addition of phyto, animal, and human toxic inorganics to the system. The conjunctive use of organic manure along with chemical fertilizers can augment the nutrient use efficiency. Hargilas, 2012, reported a significant buildup of soil fertility as organic carbon, available N, P and K with RDF + FYM. Biofertilizers have also emerged as an essential component of INM. The major attraction of using biofertilizers is their characteristic ability to convert unavailable or inert nutrients to a form which is readily available and easily accessible to the plants. Dhiman and Dubey, 2017, reported a significant effect of combined use of biofertilizers and inorganic fertilizers on grain yield of maize. Crop residues are good sources of plant nutrients and important component of INM. Ghuman and Sur ,2000, reported an improvement in soil health in terms of Soil organic carbon, bulk density and soil water retention with crop residue incorporation.

Conclusion

The potential productivity of maize in high rainfall regions under rainfed conditions is 8 Mg/ha and the national average yield of 2.1 Mg/ha, indicating an unbridged yield gap of 6 Mg/ha. The low-cost technologies like seed inoculation with *Azotobacter chroococcum* (N fixer) and *Aspergillus awamorii* (P. solubilizer) can be very productive. Use of legumes can supplement fertilizer N and improve soil health. Use of organic manure is beneficial, conserves soil moisture and supplies essential nutrients. Overall available research results suggest a large potential for improving productivity through adoption of INM.

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Effect of Biofertilizers Improving Fruit Quality in Guava

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Abstract

Biological fertilizer is a substance which contains living microorganisms which when applied to plants either on the surfaces or soil has the ability to colonize the rhizosphere or the interior of the plant. They promote growth by increasing the supply or availability of primary nutrients to the host plant. Biological fertilizer boosts the nutrient composition of soil through the processes of nitrogen fixation and solubilizing mineral ions and thereby stimulates plant growth through the synthesis of growth-promoting substances. The use of biofertilizer is expected to reduce the use of chemical fertilizer and synthetic pesticides. They accelerate microbial processes in the soil which augment the availability of nutrient in a form easily assimilated by plants which means that the microorganism present in the biofertilizer helps to restore the soil's natural nutrient cycle and build soil organic matter. Use of biofertilizer has become one of the important components of integrated nutrient management, as they are cost-effective and also a renewable source of plant nutrients to supplement the chemical fertilizers for sustainable agriculture. Additionally, it can provide healthy plant growth, while enriching the sustainability and the fertility of the soil.

Introduction

Guava (*Psidium guajava* L.) originated from tropical America is one of the most important fruit crops of India. It is considered *Apple of the Tropics* because of its high vitamin C and mineral content. Guava cultivated throughout the tropical and subtropical regions is fourth important fruit crop of India after mango, banana and citrus, covering around 3.3% of the total area under fruit crops and contributing 3.3% of the total fruit production in country, where it occupies an area of 27000 hectares with annual production of 4107000 metric tonnes. Allahabad region in Uttar Pradesh is reputed for the production of high-quality guava in India. In Punjab, guava is cultivated on large scale in all districts, occupying an area of 8022 hectares with an annual production of 160463 metric tonnes. The main guava producing districts of Punjab are Sangrur, Patiala, Amritsar, Ropar, Firozpur, Ludhiana, Bathinda, Muktsar, Hoshiarpur and Jalandhar (Anonymous, 2018), where the flowering in guava takes place twice or sometimes thrice in a year. Biofertilizers and biopesticides, which are microbial in origin, are viable alternatives to enrich the soil with beneficial microorganisms, mobilizing the nutritionally important elements from non-usable to usable form through biological processes, resulting in enhanced production of various fruit crops (Dey *et al*., 2005). Biofertilizers are most inexpensive, ecofriendly and sustainable inputs containing microorganisms capable of solubilizing and mobilizing the nutritive elements present in soil in insoluble form through biological processes. Increasing soil fertility and providing plant hormones, they upsurge plant growth and make the crops more productive with better fruit quality. It is the best way of achieving sustainability and simultaneously they act as biocontrol agents since they control many plant pathogens and harmful microorganisms present in the soil. Research evidences are uncourageous towards the integrated use of organic, inorganic and biofertilizers, which may improve the soil productivity and crop yield with better quality fruits (Singh *et al*., 2011). The beneficial effects of biofertilizers are now well established in many fruit crops (Ahmad *et al*., 2004), however, the information concerning the effect of biofertilizers on organic production of quality guava predominantly in north regions is scanty, therefore, the problem was formulated to find out the influence of biofertilizers on fruit quality of guava under Punjab conditions.

Role of Bio Fertilizers in Improving Soil Fertility and Crop Productivity

The bio fertilizer interaction with plant root determines crop yield and soil nutrient status as they provide numerical benefits like decomposition of organic matter, nutrient and water acquisition, nutrient recycling.

Azotobacter plays an important role in the nitrogen cycle, produce plant hormones indole acetic acid, gibberellins and cytokinins. The improvement in total soluble solids, reducing, non-reducing and total sugars, ascorbic acid and sugar to acid ration in guava fruits with combined application of biofertilizers might be due to the balanced absorption of macro- and micro- nutrients, which exerted regulatory role in important constituents of endogenous factors affecting the quality of fruits. The roots and stems carbohydrates reserves were drawn heavily, which might have resulted in higher total soluble solids and sugar contents in fruits. These findings corroborate the findings of earlier researcher Sharma *et al*. (2004) and Dey *et al*. (2005) in guava. This increase in total soluble solids, reducing, non-reducing and total sugars in guava fruits with the application of *Azotobacter* and PSB might be attributed to the quick metabolic transformation of starch and pectin into soluble compounds and rapid translocation of sugars from leaves to the developing fruits (Mishra and Tripathi, 2011).

Conclusion

Biofertilizers are ecofriendly inputs have tremendous potential for supplying nutrients which can reduce the chemical fertilizer dose by 25-50%. Biofertilizers increases the efficiency of nitrogen fertilizers, increase yield of guava and bring more profit to farmers. Also do not leave the residual effects like that of the chemical fertilizers. Hence the use of biofertilizers could be the proper option for sustainable agriculture.

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Entomophagy: A Loom Towards Food Security

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Introduction

Entomophagy is the practice of eating insects by human beings. The term entomophagy is derived from two Greek words 'entomon' (insect) and 'phagein' (to eat). Entomophagy is accepted and practiced by many cultures around the world and constitutes a major source of nutritious food for many people (Ramos-Elorduy and Pino, 2002). It is promoted as an alternative sustainable source of protein for humans and animals (Jongema, 2017). It has been estimated that entomophagy is practiced in at least 113 countries with over 2000 documented edible insect species and the United Nations has recommended the practice as a potential solution to the shortage of world food supplies (Dobermann *et. al*., 2017).

Status of Edible Insects

America recorded maximum number of edible insect species, contributes 39 per cent and Africa possess maximum number of countries consuming insects (van Huis, 2013). In India, 255 species of insects are taken as food by different tribes, most commonly in north eastern parts of India. Among the different states, Arunachal Pradesh recorded highest number of edible insects followed by Manipur, Assam and Nagaland (Chakravorty, 2014).

Edible Insect Orders

The most popular edible Coleopteran species include *Rhynchophorus phoenicis*, *R. ferrugineus* and *R. palmarum* (Ramos-Elorduy and Pino, 2002). Yellow mealworm (*Tenebrio molitor*), lesser mealworm (*Alphitobius diaperinus*) and superworm (*Zophobas morio*) of the family Tenebrionidae are some among the edible Coleopterans.

Among Lepidoptera, moths of the cutworm *Agrotis infusa* and silkworm pupae (Flood, 1980), mopane caterpillar (*Imbrasia belina*) (Ghazoul, 2006), larvae of *Cirina forda* and *Hemijana variegate* are being consumed (Badanaro *et. al*., 2014).

The larvae of yellow jacket wasps (*Vespula* and *Dolichovespula* spp.) and bee species such as *Apis dorsata, A. cerena indica* and *A. florea* are the edible hymenopteran members (Nonaka, 2009). The large Macrotermes species is the commonly consumed isopteran in southern Africa (van Huis, 2003). Locusts, grasshoppers and crickets constitute the edible groups under Orthoptera. The desert locust, migratory locust, red locust and brown locust are widely consumed in Africa (Ramos-Elorduy *et. al*., 2011).

Why Insects as Food?

Insects are a source of energy, protein, fat, minerals and vitamins (Rumpold and Schluter, 2013) and the composition vary across insect species and also within species depending on what the insects have fed on, stage of development, sex and environmental factors (Ramos-Elorduy and Pino, 2002; Finke and Oonincx, 2014). Protein is a significant component of edible insects, comprising between 30 and 65 per cent of the total dry matter (Dobermann *et. al*., 2017). In variegated grasshopper (*Zonocerus variegatus*), first instar nymph contains 18.3 g protein per 100 g fresh weight whereas, in adult, it contains about 21.4 g protein (Ademolu *et. al*., 2010). Witchetty grub of Australia possess high fat content (38 per cent) and very rich in oleic acid (omega-9 mono-unsaturated fatty acid) (Naughton *et. al*., 1986).

Ramos-Elorduy *et. al*. (2011) reported that Orthopterans can produce a very large value of energy (3319.3 - 5239.7 kJ) compared to all other conventional sources. Some insects are considered as a good source of micronutrient and the mopane caterpillar can supplement micronutrients such as Zn, Mn and Cu (Bukkens, 2005) and iron (Oonincx *et. al*., 2010). Vitamin content (Bukkens, 2005) and mineral composition (Ekpo, 2010), are also reported to be high in edible insects.

Insect Farming and Food Security

Practice of raising and breeding insects as livestock is termed as insect farming (Durst and Hanboonsong, 2015). Insects can be used as sustainable food source as these have high feed conversion ratio, high production potential, require very little land or energy to produce, and production can be possible throughout the year.

Rearing of edible insect species such as yellow mealworm (*Tenebrio molitor*), house cricket (*Acheta domesticus*), and migratory locust (*Locusta migratoria*) are advantageous over conventional livestock not only in terms of reduced greenhouse gas emission, but also, due to decreased ammonia production (Oonincx *et. al*., 2010). Feed conversion ratios (FCRs) are particularly important, as an increased demand for meat will cause a more than proportional demand for grain and high protein feeds (Smil, 2002).

Yellow mealworm and the lesser mealworm (*Alphitobius diaperinus*) are drought resistant, can be reared on organic side streams. Zoonoses, infectious diseases of livestock cause 50 per cent of the total loss in livestock sector. But insect farming is not likely to be affected by such infestations (Ramos-Elorduy and Pino, 2002).

Hurdles to Use Insect as Food

Although, a myriad of opportunities exists for entomophagy, there are significant hurdles to overcome as a result of the lack of research and the need for innovation within the sector. Major issues include the consumer acceptability, possibility that insects may contain antinutrient substances, concerns around food safety related to storage, allergic reactions and physical risks (Dobermann *et. al*., 2017).

Processing of Edible Insects

Processing of caterpillars include eviscerating, roasting, sun drying and packaging (Mbata *et. al*., 2002) whereas, baking, boiling and steaming are the processing methods followed for termites and lakeflies (Ayieko *et. al*., 2010).

Conclusion

Research to date indicates that insects could play an important role in addressing the impending protein supply crisis. Edible insects contain sufficient levels of protein, fats and micronutrients to contribute improvements in global health and food security, both through direct consumption and indirect use in feeds. Insects have a smaller environmental footprint and a higher economic value than other livestock protein sources and they are unlikely to pose significant microbial risks. The wider adoption of entomophagy could help alleviate growing pressure on the environment from food production and reduce malnutrition in both developed and developing countries.

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Honey Processing: A Prospective Livelihood Option in Bihar

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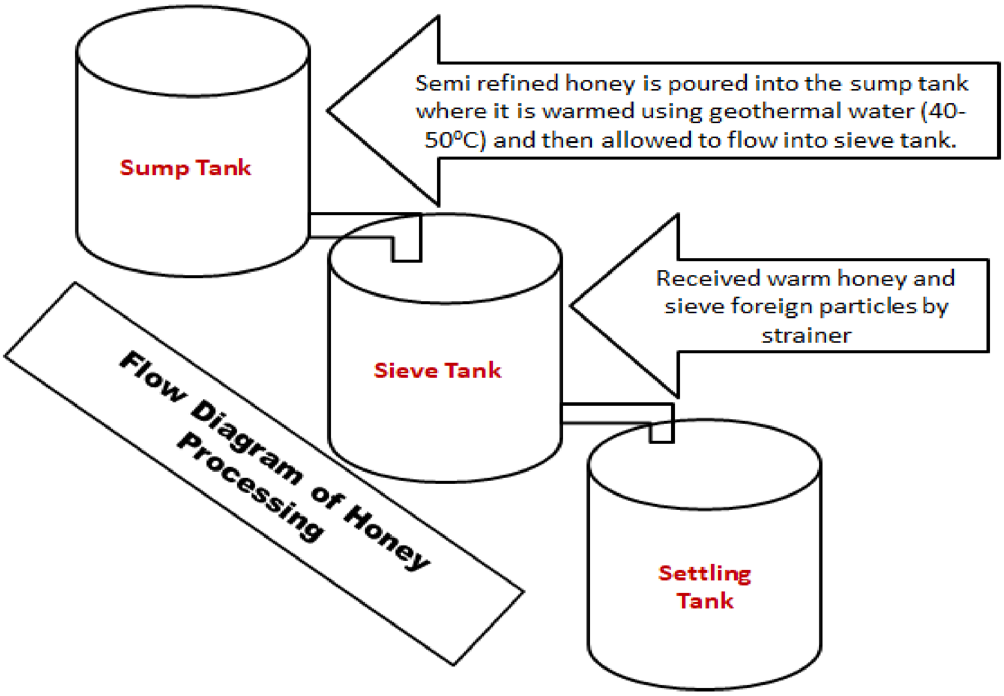
Bihar, located in the eastern part of the country, has been blessed with rich flora and ecological conditions favouring beekeeping having the high potentiality to produce beehive products as well. The weather conditions prevailing in the state are more conducive for beekeeping as the favourable temperature ranged between 25 – 35 ^{o}C throughout the year except a few weeks of May – June and December – January. The adverse weather conditions are easily overcome by proper management of colonies.

The state of Bihar is well known for its production of honey with stringent quality. The state ranked 11th in terms of honey production in India. This is because of its richness in bee pasturage like litchi, jamun, mustard, drumstick and several others. As the state is concern, till date there are about 860 number of registered bee keepers with 1, 60,451 number of bee colonies (NHB). According to this report, Bihar stands 4th in terms number of beekeepers after Uttar Pradesh, Punjab and Haryana, while it ranks at 5th position in terms of number of bee colonies. However, as per recent report, besides these registered bee keepers, there are around 8000 additional beekeepers present in the state. Bihar along with another three states such as West Bengal, Uttar Pradesh, and Punjab contributed about 61 % to the country's honey production. Hence, this state is categorized as "High Potential" honey producing state along with Punjab, WB, Kerala, Karnataka, UP, TN and Uttarakhand.

Even though, Bihar ranked 11th in honey production, there are lots of constraints faced by the beekeepers of the state. The key concerns are processing, storage and marketing. Owing to having such constraints, most of the beekeepers in state are forced to sell their honey in raw form at a low price. So, there is ample scopes for the migrants as well as the people of this state having little skill, to adopt bee keeping related activities like "Honey Processing" as an entrepreneurship which not only provides income but also generate employment thereby helps in overall upliftment of the society.

Honey Processing



It is a process in which the raw honey is allowed to pass through a series of filters one followed by another so as to get refined processed honey.

During this process the foreign materials along with excess of moisture present in raw honey are eliminated. The refined processed honey contains 78 – 80 % sugar and 18 – 20 % moisture along with some minerals, vitamins and enzymes.

The installation of honey processing plant is quite expensive for beekeepers at individual level. Because of this reason most of the bee keepers in this area were forced to sell their honey in raw form at a low price. As per report from the bee keepers, most of them sold their raw honey to different companies at Rs. 1,00,000 – 1,50,000 per tonne.

This may serve as a great opportunity for a skilled person having little knowledge about honey and its quality parameters to take honey processing as an entrepreneurship. The person can identify potential beekeepers of his own region, collects raw honey from them and brings raw honey to processing unit. After processing, he can sell these processed honeys at a handsome price.

Dr. Rajendra Prasad Central Agricultural University has two honey processing units, one located at Pusa campus and another at Piprakothi campus. The university charges at Rs. 7,000 per tonne as processing fees while the packaging charges are additional i.e., about Rs. 30,000 per tonne.

Depending upon the honey flow season, one can collect raw honey, bring to university for processing, packaging, sealing and labelling. After processing they can sell their honey with university registered trademark at Rs. 3,00,000 per tonne. The honey flow seasons in Bihar are given below.

Sl. No	Honey Flow Period	Bee Flora	Area	Honey extracted from an ideal apiary(q)
1	Nov-Jan	Mustard	Begusarai, Samstipur, Sitamarhi, Siwan, Saran	20
2	February	Khesari	Darbhanga, Madhubani	2
		Coriander	Nalanda boxur, ara, balia	2
		Drumstick	Ara	2
3	March-April	Litchi	Muzzafarpur, Samastipur, Begusarai	10
4	April-May	Sunflower	Purnia, Sehrosa, Katihyar Madhepura	5
5 5	May-June	Jamun	Darbhanga. Samastipur, Madhubani	5
		Sesame	All most all area	2
		Mung	All most all area	2
6	July-Oct	Dearth period		
Total				**50**
If properly managed, a beekeepers can harvest on an average of 50 q of raw honey from an ideal apiary (100 numbers hive) when favorable climate conditions prevails.				

Benefits From Honey Processing		
A	Collection of Raw Honey from beekeeper	1,00,000-1,50,000/tonne
B	Transportation (approximately)	10,000
C	Processing fees	7,000/tonne
D	Packaging fees	30,000/tonne
E	A + B + C + D	1,47,000-1,97,000
F	Selling price	3,00,000/tonne
G	Benefit (E-D)	1,03,000-1,53,000/tonne

Salient Features

1. Honey produced in Bihar has better taste, colour and flavour than that of other states due to variation in ecological conditions.

2. Most of the beekeepers sold their honey in raw form because of several constraints like processing, storage, marketing etc.
3. Ample scopes are there to take 'Honey Processing' as one of the feasible entrepreneurship options to the migrants of Bihar.
4. One can derive 1 – 1.5 lakhs of benefit per tonne of honey through processing.
5. Honey processing helps in overall upliftment of the society by generating income as well as employment opportunity.

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Impact of Covid-19 on Foreign Direct Investment of India

Article ID: 10756
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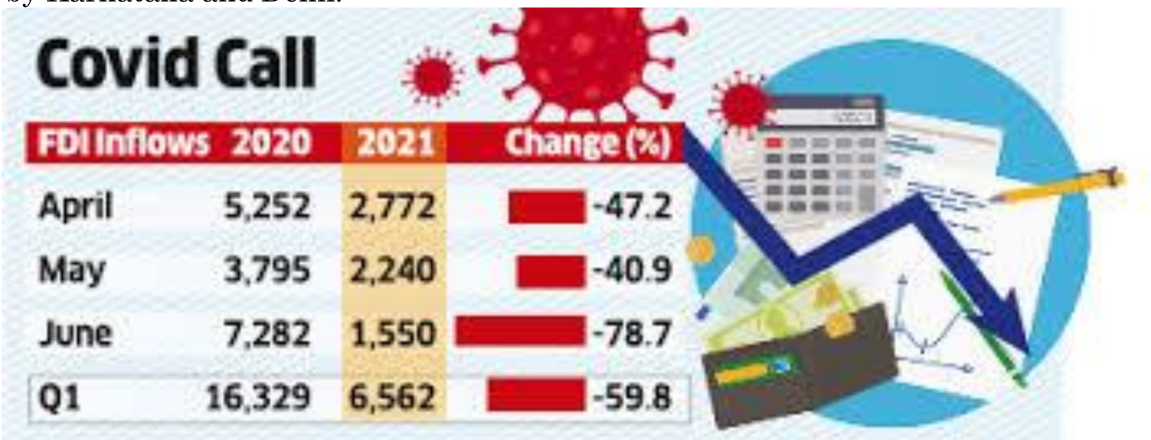
Introduction

India is the second well known nation on the planet after China. It is a fundamental for a nation like India to draw in more FDI for each area of the economy. The government of India in interview with RBI chose to pursue increasingly liberal disposition towards FDI in center divisions acknowledges guard area. Initially evaluation of information identifying with India's major monetary pointers recommend that India's financial presentation has improved significantly during the most recent 16 years of advancement time and much has been left to be accomplished in the years to come. Regularly Indian enterprises are inadequate in these imperative perspectives.

Immediate Effects

1. FDI has been stuck in the lockdown
2. The physical closure of places of business, manufacturing plants and construction sites to contain the spread of the virus causes immediate delays in the implementation of investment projects.
3. Among states, Maharashtra garnered the highest share of FDI at $1.16 billion in the April-June period followed by Karnataka and Delhi.



FDI Inflows	2020	2021	Change (%)
April	5,252	2,772	-47.2
May	3,795	2,240	-40.9
June	7,282	1,550	-78.7
Q1	16,329	6,562	-59.8

Source: Department for Promotion of Industry and International Trade, GoI

Short-Term Effects

1. There is tightening margins for reinvestment and new investment restrictions.
2. The vast majority of the top 5,000 largest multinational enterprises (MNEs) revised their earnings expectations for 2020 between February and May, with the average downward revision surpassing 35 per cent.
3. On the policy side, in parallel with temporary trade restrictions taken in some countries to prevent shortages of critical medical supplies during the pandemic, several governments have taken measures to avoid fire sales of domestic firms during the crises, introducing new screening requirements and investment restrictions.

Medium-Term Effects

1. Navigating a global economic recession.
2. Current expectations are for a modest and highly uncertain recovery of GDP in 2021 if economic activity picks up with the support of policy stimulus (IMF, 2020a).
3. A deep contraction of demand will have strongly negative effects on international production.

4. Over the two critical years 2020 and 2021, the demand shock will be the biggest factor pushing down FDI.
5. The demand contraction will hit FDI in 2020 and then fully unfold in 2021.

Long-Term Effects

1. Heading towards supply chain resilience and secure access to critical supplies.
2. The pandemic will drive MNEs to consider options to achieve greater supply chain resilience and could lead to a policy push for a higher degree of national or regional self-sufficiency in the production of critical supplies – which may extend to broader strategic industrial capacity.
3. Tighter restrictions on international trade and investment have already emerged as a result of the pandemic.
4. The trend towards rationalization of international operations, reshoring, nearshoring and regionalization looks likely to accelerate, leading to downward pressure on FDI.

Value Addition of Poultry Meat

Article ID: 10757

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Introduction

India is the second well known nation on the planet after China. It is a fundamental for a nation like India to draw in more FDI for each area of the economy. The government of India in interview with RBI chose to pursue increasingly liberal disposition towards FDI in center divisions acknowledges guard area. Initially evaluation of information identifying with India's major monetary pointers recommend that India's financial presentation has improved significantly during the most recent 16 years of advancement time and much has been left to be accomplished in the years to come. Regularly Indian enterprises are inadequate in these imperative perspectives.

Advantages of Value Addition

1. Adding value to chicken especially to meat and eggs increases its life span.
2. Increasing value increases the convenience to consumers.
3. It mitigates losses that happen when the meat turns stale.
4. Value addition creates a more significant market opportunity and can easily satisfy the demand for products.
5. You will be able to make money from simple things including feathers and chicken waste.

Chicken Products Fit for Value Addition

1. Eggs: Value is added to eggs by breaking them. The liquid then undergoes filtration, mixing, stabilization and is finally blended. After this, it is pasteurized to ensure that any pathogens are killed before being cooled into liquid form. After that, you can opt to dry it into powder form or freeze it. Egg powder can last up to four years. Bakers are increasingly embracing the use of powdered eggs in their trade.

2. By-products: You can get an extra coin by drying chicken feathers. They are a good fibre source and can be used to make pillows and cushions. Chicken excretions are a good source of manure. You will not miss a farmer or two who will buy the organic fertilizer from your chicken farm. You can dry chicken blood and make money from selling it as fish meal.

3. Chicken Meat Parts: Give your customers a wide range of choice. You can give them chicken parts including gizzards, drumsticks, necks, thighs, wings, and breasts. You can pack them and get them to the shelves as either fresh or frozen cut-ups

4. Semi-Cooked chicken: You can provide consumers many choices by putting semicooked chicken strips on the shelves. Just ensure that they are flavored and seasoned. Your market will include hotels, schools, hospitals, and supermarkets.

5. Fully cooked chicken.

6. Marinated chicken parts.

7. Boneless chicken products.

Value-Added Chicken Business Ideas

1. Chicken restaurants: You will have a direct market for your chicken all year round.

2. Hatchery: Instead of buying chicks from other hatcheries you hatch your own and even get to sell the day-old chicks. You can also decide to teach other farmers how to rear chicken.

3. Poultry parks: You can rear ducks, layers, and broilers and have people pay to come and see your poultry park. You can choose to venture into value-added chicken business or to add value to your chicken.

4. Large versus small scale units: Large scale processing of meat products with automatic processing equipment would find relevance to market products in metropolitan cities and for exports. However, a relevant approach for large scale development of processed meat sector in the country would be to promote a number of small-scale units across the country to meet the demand for products from a large number of consumers of varying socio-economic status and ethnic preferences.

Value Addition of Poultry Meat

1. Emulsion based meat products: Emulsion based products facilitate better utilization of meat from spent hens. Large variety of palatable products such as sausages, patties, nuggets, kababs, meat balls, meat pakoda, etc. could be produced from the same emulsion. Emulsion technology is more relevant in Indian situation with availability of tough meat and desire to incorporate a number of spices, condiments and non-meat extenders such as eggs, milk solids, potato, soya pulses, etc.

2. Combination of meats: Blends of mutton and chicken or chicken by-products (skin, gizzard and heart) or chicken fat results in highly acceptable products such as nuggets, patties and sausages. Eggs possess several functional properties, which may compliment meat proteins in meat products. Highly acceptable meat products of relatively lower cost are produced incorporating eggs up to 30% in the formulation.

3. Restructured products: The purpose is to effectively market fewer valuable carcasses (from spent or aged animals and of poor conformation) and carcass components. The basic processes include chunking, flaking, tearing, tumbling, pressing, slicing, cooking, etc. Tumbling, massaging and blade tenderization facilitate production of high-quality restructured products. The products include cutlets, roasts, rolls etc.

4. Enrobed products: Enrobing/coating of meat products with edible materials in the form of batter using flours, whole egg liquid and other additives is a method of value addition, which enhances the acceptability of meat products. Enrobing imparts the product a crispy texture and increases the pleasure of eating with more desirable colour. Products will be juicier as natural juices are retained.

5. Incorporation of vegetables in meat products: Incorporation of seasonal vegetables such as cabbage, cauliflower, carrot, bottle guard, pumpkin, etc. in meat products would be advantageous to reduce cost of meat products, to provide fibre and flavonoids in meat products, to facilitate consumption of vegetables and to provide balanced and healthful diet meat products. Meat products added with vegetables may find wide popularity among Indian consumers.

Economics of Value-Added Products

Availability of adequate raw materials at reasonable cost and distribution and marketing at minimum costs contribute favorably to the economics. Sale price depends on the economic status of consumers, the product aimed at. Low cost facilitates wide range of consumers. All efforts have to be made to keep production cost at minimum with selection of appropriate formulation, processing conditions and infrastructure facilities. A project appraisal on different aspects of the value-added products is necessary before going for starting a meat products venture. In place meat product units need to be assisted to upgrade their facilities and production practices to give a fillip to the development of value-added meat products sector.

Conclusion

Value addition of poultry meat is essential to generate more income from the enterprise which will eventually result in more profit for the farmers. Modern times demand processing and value addition of the produce in-order to double the farmers income.

Mealybug Infestations and their Management in Custard Apple in Dryland Areas

Article ID: 10758

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Introduction

The custard apple (Annona squamosa Linneus; Annonaceae) is a tropical fruit crop native to South America that is drought, salt, and saline irrigation water tolerant to a degree. It thrives in even the driest of soils. It also shades leave during stress periods to prevent moisture loss from the plant, making it the best fruit crop for arid areas. This fruit crop's plants are shrubs or small trees with a fairly stout and smooth trunk that grows to a height of 5 to 6 meters. Sitaphal, Sugar apple, Sweetsop, and Sharifa are some of the names given to this fruit.

The custard apple is a common table fruit. Its pulp is very delicious when combined with milk or ice cream. Custard apple leaves are therapeutic, and the oil extracted from its seed is used to make soap, while the cake is utilized as manure.

Custard apple is seen to cover more than 40,000 hectares in India. Andhra Pradesh, Madhya Pradesh, Tamil Nadu, Utter Pradesh, Bihar, Gujarat, and Maharashtra have the wildest populations. Year after year, the area under cultivation of this fruit crop expands. In India, the custard apple growing area and production totaled 44,000 ha and 3.6 million metric tonnes, respectively. Insect pests continue to be a serious constraint in the production of custard apples in India.

Mealy bugs, such as the Striped mealy bug, *Ferrisia virgate* (Cockerell), Pink mealy bug, *Maconellicoccus hirstus* (Green), and Citrus mealy bug, *Planococcus citri* (Risso), have been reported to attack the custard apple, with the Striped mealy bug, *Ferrisia virgate* (Cockerell), Pink mealy bug, *Maconellicoccus hirstus*.

Biology

1. Egg: The egg process takes between 28 and 32 days. Adult females and males have a life expectancy of 23 to 28 days, respectively. Pre-oviposition, oviposition, and post-oviposition periods are correspondingly 6-7, 8-9, and 1-2 days. Females and males have a total life span of 46-49 days and 23-29 days, respectively. The female laid an average of 155 eggs throughout the course of a lifetime and reproduced both sexually and parthenogenetically.
2. Nymph: The colour ranges from yellow to pale white. It possesses three to four nymphal instars and a 21 to 29-day nymphal phase.
3. Adult: Apterous females are long, slender, and covered in white waxy secretions. The mature female has a lifespan of 12-31 days.

Symptoms Caused by Mealybugs

Mealybugs cause yellowing of plants and deformity in affected areas by injecting poisons. Leaf growth is stunted, which is followed by indications of leaf and fruit falling. The honey dew released by mealybug attracts red and black ants. Later, the afflicted leaves develop a sooty mould fungus (Capnodium), which causes the leaves to dry out and kill the custard apple trees.

Reproduction

Mealy bugs are oviparous, which means each female lays 400 to 450 eggs. In about a month, their nymphs mature into adults. Adults survive for 30-60 days, depending on their surroundings. Adults migrate from one location to another in quest of food and mate. Mealybugs are usually found beneath the stem, on the underside of leaves, in leaf axils, flower buds, and fruits, and on roots quite infrequently. Alternate hosts include cotton, Jatropha, Guava, weeds Coleus, Parthenum, Redgram, and solanum sp.

Bio Control of Mealybug by Parasitoid (Wasp)

Biological control is the use of insect pests' natural enemies (parasites, predators, or pathogens) to manage them. Biological control helps in the maintenance of a population of many natural enemies that can keep pest populations under control without causing economic harm. Predators and parasites are the two main types of useful insects. Predators usually attack and eat other insects, either adults or larvae, or both. Parasites lay their eggs on or in the bodies of other insects. The developing parasite larvae feed on the host, usually from within, after the egg hatching process. Natural enemies are typically reared in large numbers before being put into custard apple plantations. The augmentative release system can ensure a sufficient quantity of natural enemies to control mealybugs. Female parasitoids lay eggs on mealybugs and reproduce by putting their ovipositor into the body of the mealybug. After the ovipositor (egg-laying mechanism) is inserted, the mealybug is startled, and it lifts its body upwards before returning to its normal position. After depositing eggs on mealybugs, the parasitoid cleans away secretion and waxy substances before moving on to find a new host.

Integrated Pest Management for Mealybugs

The population of mealybugs should be checked on a regular basis. Insect infestations can also be reduced by taking immediate precautions and applying insecticides on a spot basis. Spraying with a high volume of water and a surfactant is desirable. Pyrethroids, insecticide mixtures, and product combinations should be avoided. It's particularly effective to spray the undersides of leaves, fruits, flowers, stems, and soil. To achieve better control, the use of broad-spectrum pesticides can be lowered. To diminish mealybug populations, alternate weed hosts must be eradicated. Mealybugs are best managed by removing and killing the affected sections of the plant. Observing crawler emergence will aid in the early detection and implementation of effective control measures.

Management Using Cultural Control

Custard apple cultural techniques are critical for preserving current natural enemies of pests. Other plant management, tree skirting and trunk banding, and proper orchard hygiene are all important custard apple cultural practices. Tree health is important for pest and disease management; healthy trees can withstand pest attacks better than unhealthy trees.

Management Using Natural Enemies

Mealybugs are attacked by a variety of coccinellid beetles and hymenopteran wasps. Mealybugs can be seen and should be gathered in order to control them. Spalgisepius, lichened predator larval that feeds on several stages of mealy bugs and aids in the management of mealy bugs to some extent, is common in wild mulberry and morus sp. When natural enemy activity is high, deferring spraying is a good option. Fungi that are entomopathogenic to insects *Maconellicocus hirsutus*, the custard apple mealy bug, is extremely susceptible to *Lecanicillium lecanii* (Green).

Conclusion

Ground dusting with methyl parathion 2 percent dust at 24 kg/ha, stem spraying with methyl parathion 0.4 percent (40EC), and foliar application of quinalphos 0.05 percent (25EC) immediately after appearance of mealy bug crawlers on shoot, followed by spraying with triazophos (50EC) 0.05 percent after 15 days were the most effective chemical controls.

In addition, combinations of entomopathogenic fungi Lecanicillium lecanii @ 2.0 gm/l + profenophos 50 EC @0.5ml/1 and L.lecanii @2.0 gm/1 + flonikamid 50 WG @ 0.25g/l, as well as their combination with insecticides, were particularly efficient against the custard appl mealy bug, Maconellicoccus hirsutus (Green).

More effective combinations of botanical pesticides like Neem oil 2 percent or NSKE 5 percent, as well as fish oil rosin soap as a sticking agent at 25g/litre of water were discovered. Chlorpyriphos 20 EC 2ml/litre, Profenphos 50EC 2ml/litre, Dimethoate 30EC 2ml/litre, or Imidacloprid 17 SL 0.6 ml/litre are chemical insecticides for mealy bugs. After a fortnight, apply 1 ml teepol (sticking agent) to check the population of newly emerged crawlers. If necessary, a second spray can be used.

Mealybug infestations in Custard Apple

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Processing and Value Addition of Baby Corn

Article ID: 10759

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Baby corn (*Zea mayz* L.) is the small young ear before pollination and is an important vegetable product (Lekagul, 1994). Corn has wider adaptability, high yielding ability and fast-growing habit and hence emerged as a potential alternative crop to diversify sustainable agriculture. In India baby corn production and processing industries are still in early stage which needs to be developed through combined efforts of producers, processers and consumers.

Baby corn and its processed products are being exported from India to many other countries with Thailand and Taiwan being the largest exporters (Aggarwal and Kaur, 2010). Baby corn nutritive value is quite comparable to any other seasonal vegetable. Besides proteins, vitamins and iron, it is one of the richest sources of phosphorous and easy to digest. It is the "safest" vegetable to eat as it is almost free from residual effects of pesticides due to wrapping of young cob with husk and well protected from insects and diseases (Kawatra and Sehgal, 2007).

Baby corn is a young finger like unfertilized cob of maize with 2-3 cm emerged silk and husk removed. Corn, because of its wide adoptability, high yielding ability and fast-growing habit, has become a potential alternative crop used to diversify sustainable agriculture (Asaduzzaman et al 2014). Baby corn is a high nutritive value vegetable. In India, baby corn production and processing industries are beginning to be developed.

The nutritional quality of baby corn is at par or even superior to some of the seasonal vegetables. Besides proteins, vitamins and iron, it is one of richest source of phosphorous. It is a good source of fibrous protein and easy to digest. It is the "safest" vegetable to eat as it is almost free from residual effects of pesticides as the young cob is wrapped up with husk and well protected from insects and diseases (Kawatra and Sehgal ,2007). Baby corn may be consumed raw or cooked. Processing of baby corn into more usable and shelf stable products is important because as a fresh product it begins to degrade quickly after harvest; harvesting of young baby corn should be done within 2-3 days of silk emergence, otherwise it will start degrading after the harvest.

Baby Corn Nutritional Composition (Per 100 Gram)

Moisture	89.10 %
Sugar Starch	8.2 g
Protein	1.90 g
Fat	0.20 g
Calcium	28.0 mg
Phosphorous	86.00 mg
Iron	0.10 mg
Thiamine	0.50 mg
Riboflavin	0.08 mg
Ascorbic Acid	11.0 mg

Methods of Processing of Baby Corn

The different methods used for baby corn preservation are fresh storage, cold storage, freezing, drying, dehydration, preservation with sugar, salt vinegar etc.

Blanching

Prior to drying or processing in to any other product, exposing the baby corn to hot or boiling water - as a pre-treatment before drying is essential, as it has the following advantages.

1. It helps clean the material and reduce the number of micro-organisms present on the surface;
2. It preserves the natural colour in the dried products; for example, the carotenoid (orange and yellow) pigments dissolve in small intracellular oil drops during blanching and in this way, they are protected from oxidative breakdown during drying;
3. It shortens the soaking and/or cooking time during reconstitution. During hot water blanching, some soluble constituents are leached out: water-soluble flavors, vitamins (vitamin C) and sugars.

Use of Preservatives for Processing of Baby Corn

Preservation of baby corn by using low-cost viable technologies will go long way in preventing post-harvest losses of baby corn as well as to extend the shelf life of corns by the way of value addition. With the increasing demand for natural and ayurvedic preparations owing to health consciousness, the natural products like baby corn candy, murabba, brined baby corn, canned baby corn and dehydrated baby corn products have good market potential.

Preservatives are used to improve the colour and keeping qualities of the final product for vegetables. Preservatives include items such as sulphur dioxide, ascorbic acid, citric acid, salt and sugar and can either be simple or compound solutions.

Preservation of Baby Corn Using Brine Solution

1. Salt solution: The baby corns blanched for 4 min with 0.5% KMS and 0.5% Citric acid and 8% salt solution had excellent shelf life without much affecting its sensory quality parameters such as color, taste, odour, appearance and types of spoilage up to 12 months indicating that the combination of preservatives is better compared to single once in extending the shelf life of the baby corns.

2. Vinegar: The baby corns blanched for 4 min with 0.5 % KMS and 0.5% Citric acid and 5 % vinegar solution had excellent shelf life without much affecting its sensory quality parameters such as color, taste, odour, appearance and types of spoilage up to one year.

3. Preservation of baby corn by dry salting: The baby corns blanched for 4 min with 0.5% KMS and 0.5 % citric acid followed by addition of 5 % salt was considered best for long time storage with good retention of colour. The product-maintained quality in terms of color, odour and appearance up to 12 months.

4. Dehydration of baby corns: Baby corns are blanched for 4 min in hot water followed by steeping in 0.5 % KMS for 40 min and washing in good quality water followed by air drying. The product was dried at 50ºC for 9 hours to final moisture content 4.3 % with rehydration ratio of 1:2:2. (Ranganna, 2001). Most vegetables like corn should be dried so they are brittle enough that they would shatter if hit with a hammer. Depending on humidity levels this can take 8-12 hours. Allow corn to cool thoroughly before storing in airtight jars. Store in airtight containers in a cool, dry, dark place for up to one year

5. Froozen corn: Freezing is a quick and convenient way to preserve vegetables at home. Baby corn is a popular, easy and excellent vegetable to freeze. Baby corn can be stored for long by following simple, basic procedures for freezing vegetables.

a. Husk is removed from ears and silk is removed.
b. Bring 6 to 8 quarts of water to a boil.
c. Submerge ears at a time in water.
d. Blanch the ears for 4 minutes.
e. Cool in ice water for 4 minutes.
f. Drain excess water
g. Package the corn in freezer containers, leave one-half inch headspace.
h. Seal and freeze at zero degrees F or below.
i. For best quality, eat within 3-6 months of freezing.

Value Addition to Baby Corn

Baby corn recipes can be easily prepared at house hold level includes baby corn pakoda, pickle, chutney, manchoori, jam, soup, halva, murabba and such others using dehydrated, frozen, brined or dried corn.

Required Ingredients for Baby Corn Pakoda

Maize flour	50 g
Gram flour	50 g
Baby corn	10
Coriander	2
Curry leaves	2 leaves
Corn flour	2 teaspoons
Green chilly	2

Procedure for Making Baby Corn Pakoda

Washed baby corns are boiled in water for 5 to 10 minutes with salt. Maize flour and gram flour are mixed and ingredients listed were added after cutting into small pieces. Add 2 tea spoons of heated oil, water and mix to get required consistency. Baby corns were added to the mixture and deep fried.

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Baby corn (*Zea mayz* L.) is the small young ear before pollination and is an important vegetable product (Lekagul, 1994). Corn has wider adaptability, high yielding ability and fast-growing habit and hence emerged as a potential alternative crop to diversify sustainable agriculture. In India baby corn production and processing industries are still in early stage which needs to be developed through combined efforts of producers, processers and consumers.

Baby corn and its processed products are being exported from India to many other countries with Thailand and Taiwan being the largest exporters (Aggarwal and Kaur, 2010). Baby corn nutritive value is quite comparable to any other seasonal vegetable. Besides proteins, vitamins and iron, it is one of the richest sources of phosphorous and easy to digest. It is the "safest" vegetable to eat as it is almost free from residual effects of pesticides due to wrapping of young cob with husk and well protected from insects and diseases (Kawatra and Sehgal, 2007).

Baby corn is a young finger like unfertilized cob of maize with 2-3 cm emerged silk and husk removed. Corn, because of its wide adoptability, high yielding ability and fast-growing habit, has become a potential alternative crop used to diversify sustainable agriculture (Asaduzzaman et al 2014). Baby corn is a high nutritive value vegetable. In India, baby corn production and processing industries are beginning to be developed.

The nutritional quality of baby corn is at par or even superior to some of the seasonal vegetables. Besides proteins, vitamins and iron, it is one of richest source of phosphorous. It is a good source of fibrous protein and easy to digest. It is the "safest" vegetable to eat as it is almost free from residual effects of pesticides as the young cob is wrapped up with husk and well protected from insects and diseases (Kawatra and Sehgal ,2007). Baby corn may be consumed raw or cooked. Processing of baby corn into more usable and shelf stable products is important because as a fresh product it begins to degrade quickly after harvest; harvesting of young baby corn should be done within 2-3 days of silk emergence, otherwise it will start degrading after the harvest.

Baby Corn Nutritional Composition (Per 100 Gram)

Moisture	89.10 %
Sugar Starch	8.2 g
Protein	1.90 g
Fat	0.20 g
Calcium	28.0 mg
Phosphorous	86.00 mg
Iron	0.10 mg
Thiamine	0.50 mg
Riboflavin	0.08 mg
Ascorbic Acid	11.0 mg

Methods of Processing of Baby Corn

The different methods used for baby corn preservation are fresh storage, cold storage, freezing, drying, dehydration, preservation with sugar, salt vinegar etc.

Blanching

Prior to drying or processing in to any other product, exposing the baby corn to hot or boiling water - as a pre-treatment before drying is essential, as it has the following advantages.

1. It helps clean the material and reduce the number of micro-organisms present on the surface;
2. It preserves the natural colour in the dried products; for example, the carotenoid (orange and yellow) pigments dissolve in small intracellular oil drops during blanching and in this way, they are protected from oxidative breakdown during drying;
3. It shortens the soaking and/or cooking time during reconstitution. During hot water blanching, some soluble constituents are leached out: water-soluble flavors, vitamins (vitamin C) and sugars.

Use of Preservatives for Processing of Baby Corn

Preservation of baby corn by using low-cost viable technologies will go long way in preventing post-harvest losses of baby corn as well as to extend the shelf life of corns by the way of value addition. With the increasing demand for natural and ayurvedic preparations owing to health consciousness, the natural products like baby corn candy, murabba, brined baby corn, canned baby corn and dehydrated baby corn products have good market potential.

Preservatives are used to improve the colour and keeping qualities of the final product for vegetables. Preservatives include items such as sulphur dioxide, ascorbic acid, citric acid, salt and sugar and can either be simple or compound solutions.

Preservation of Baby Corn Using Brine Solution

1. Salt solution: The baby corns blanched for 4 min with 0.5% KMS and 0.5% Citric acid and 8% salt solution had excellent shelf life without much affecting its sensory quality parameters such as color, taste, odour, appearance and types of spoilage up to 12 months indicating that the combination of preservatives is better compared to single once in extending the shelf life of the baby corns.

2. Vinegar: The baby corns blanched for 4 min with 0.5 % KMS and 0.5% Citric acid and 5 % vinegar solution had excellent shelf life without much affecting its sensory quality parameters such as color, taste, odour, appearance and types of spoilage up to one year.

3. Preservation of baby corn by dry salting: The baby corns blanched for 4 min with 0.5% KMS and 0.5 % citric acid followed by addition of 5 % salt was considered best for long time storage with good retention of colour. The product-maintained quality in terms of color, odour and appearance up to 12 months.

4. Dehydration of baby corns: Baby corns are blanched for 4 min in hot water followed by steeping in 0.5 % KMS for 40 min and washing in good quality water followed by air drying. The product was dried at 50ºC for 9 hours to final moisture content 4.3 % with rehydration ratio of 1:2:2. (Ranganna, 2001). Most vegetables like corn should be dried so they are brittle enough that they would shatter if hit with a hammer. Depending on humidity levels this can take 8-12 hours. Allow corn to cool thoroughly before storing in airtight jars. Store in airtight containers in a cool, dry, dark place for up to one year

5. Froozen corn: Freezing is a quick and convenient way to preserve vegetables at home. Baby corn is a popular, easy and excellent vegetable to freeze. Baby corn can be stored for long by following simple, basic procedures for freezing vegetables.

a. Husk is removed from ears and silk is removed.
b. Bring 6 to 8 quarts of water to a boil.
c. Submerge ears at a time in water.
d. Blanch the ears for 4 minutes.
e. Cool in ice water for 4 minutes.
f. Drain excess water
g. Package the corn in freezer containers, leave one-half inch headspace.
h. Seal and freeze at zero degrees F or below.
i. For best quality, eat within 3-6 months of freezing.

Value Addition to Baby Corn

Baby corn recipes can be easily prepared at house hold level includes baby corn pakoda, pickle, chutney, manchoori, jam, soup, halva, murabba and such others using dehydrated, frozen, brined or dried corn.

Required Ingredients for Baby Corn Pakoda

Maize flour	50 g
Gram flour	50 g
Baby corn	10
Coriander	2
Curry leaves	2 leaves
Corn flour	2 teaspoons
Green chilly	2

Procedure for Making Baby Corn Pakoda

Washed baby corns are boiled in water for 5 to 10 minutes with salt. Maize flour and gram flour are mixed and ingredients listed were added after cutting into small pieces. Add 2 tea spoons of heated oil, water and mix to get required consistency. Baby corns were added to the mixture and deep fried.

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Orphan Tuber Crops

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Introduction

Orphan crops are crops that have been neglected or underutilised, and are not at the forefront of research or international trade. Tuber crops, especially cassava and sweet potato are considered as the energy sources next to cereals in Asian and African countries. Tuber crops as staple foods have the advantage of being able to adapt to a wide range of environmental conditions and farming systems with minimal agricultural inputs. However, there are several minor tuber crops which are still abandoned but are a treasure of healthy compounds. These are normally called orphan tubers and need special attention to fully explore their health benefits. Aerial yam/potato yam, lesser yam, African yam, xanthosoma and minor tuber crops like yam bean, winged bean and Jerusalem artichoke *etc*. are examples of orphan tuber crops and are feeding many local communities around the world. These crops are important for food security, nutrition, and income generation in many developing countries, but they have not been significantly investigated and researched. They are often well-adapted to local growing conditions and satisfy the social and economic needs of local people, and are often tolerant to many biotic and abiotic stresses compared to the world's major crops (Tadele, 2018).

Orphan Tuber Crops

Yam, any of several plant species of the genus *Dioscorea* (family Dioscoreaceae) grown for their edible tubers. This includes aerial yam, lesser yam, African yam *etc*. Aerial yam (*Dioscorea bulbifera*), also called as potato yam/bulbil-bearing yam in English and '*adathap*' in Malayalam. This is a climber, which twines anticlockwise and may climb up to 8 m. This is characterized by the profuse production of large bulbils located at the base of the petioles and hence called aerial yam. The Lesser yam (*Dioscorea esculenta*) is a typical tropical crop grown for its carbohydrate rich underground tubers. These spindle shaped tubers are mainly consumed after boiling and peeling. The African yam (*Dioscorea rotundata*), also known as white yam, is a crop species introduced from Nigeria. It is also an important edible yam which is widely consumed in some parts of Asian and African countries as it is a dependable source during food scarcity periods. *Dioscorea* tubers have a nutritional advantage over other root and tuber crops as they contain a good source of essential dietary supplements such as protein, essential amino acids and many dietary minerals (Baah *et al*., 2009).

Xanthosoma sagittifolium, commonly known as tannia/cocoyam, is another important orphan tuber crop which needs to be explored in detail. It comes under the Araceae family and is also called elephant ear. Xanthosoma has superior nutritional value in terms of protein digestibility and mineral composition (calcium, phosphorus and magnesium). Therefore, these tubers can be effectively used for the manufacturing of diversified food products for different food industries (Boakye *et al*., 2018).

There are numerous minor tuber crops that are consumed by local communities in several regions, generally belonging to the Cyperaceae, Fabaceae, or Asteraceae families. Yam bean/Mexican turnip (*Pachyrhizus erosus*), also called as 'Mishrikand' in Hindi, is a leguminous tuber crop and is mainly cultivated for its large tuberous roots. It is a starchy root crop with a comparatively high sugar content and a moderately good source of ascorbic acid. The pods are poisonous due to the presence of rotenone and related toxic compounds, but the young immature pods can be used as vegetables. Winged bean (*Psophocarpus tetragonolobus)* is another minor tuber crop in the Fabaceae family. The tuberous roots are a good source of energy in the form of starch, and they contain 8–10% protein (Allen, 2013). The Jerusalem artichoke (*Helianthus tuberosus*) is a species of sunflower in the Asteraceae family and is also called 'sunroot' or 'sunchoke'. Tubers are one of the finest sources of dietary fibre, especially high in oligo-fructose inulin, which is a soluble non-starch polysaccharide. The tubers are also a rich source of levulose, used as a sweetening agent for diabetic patients. Chinese water chestnut (*Eleocharis dulcis*) is another important minor tuber crop from the Cyperaceae family that grows as a marginal weed in water bodies and can be exploited for its potential. The tubers (corms), rich in starch, are crispy and slightly sweet, making them a good ingredient in vegetable salads. Apart from their fresh, delicate taste and mild flavour, water chestnut are a good source of nutrients, vitamins and minerals.

Conclusion

As humans are more concerned about health and gaining nutritional security, it is important to choose a variety of foods from each food group. So, cultivation and consumption of these nutrient rich minor tuber crops also provide diversity in our food habits. There are still a lot of root and tuber crops yet to be investigated in detail, so that they can be efficiently utilized to mitigate the food and nutritional security problems around the world.

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Concepts in Intellectual Property Rights

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Intellectual property rights are the rights given to persons over the creations of their minds. They usually give the creator an exclusive right over the use of his/her creation for a certain period of time.

Types of Intellectual Property Rights

The TRIPs provide the standards and norms on the forms of IPRs as:
1. Patents
2. Copyrights and related rights
3. Geographical indications
4. Industrial designs
5. Trademarks.
6. Layout designs of integrated circuits.
7. Trade secrets (undisclosed information).

Dimensions of Intellectual Property Rights

Patents: Patents are the protection accorded by a government to an inventor for a fixed number of years during which period he will hold full rights to exclude others from exploiting. In return for this right, the inventor discloses details of his innovation to the people. In most countries, patent protection is being given for twenty years from the date of filling. Three basic criteria to be fulfilled for obtaining a patent are novelty, non-obviousness and utility.

According to WTO, 1995, a patent is a statutory privilege granted by the government to the inventors and other persons from manufacturing, using or selling a patented product or from utilizing a patented process or method.

Paten table inventions in accordance with the definition of the term, 'invention' has been defined in section 2 (j) of patents Act, 1970, which means any new and useful:
1. Art, process method or manner of manufacture.
2. Machines, apparatus, or another article.
3. Substance produced by manufacture.

Therefore, in order to be patent able, an invention must possess the characteristics viz:

a. It should relate a manner of manufacture.
b. The manner of manufacture should be novel.
c. It should be outcome of inventive activity.
d. It should have utility.
e. It should not be contrary to law and morality.

Industrial Design

An industrial design is an outcome of inventive activity, initially, mentally conceived and then put on a drawing board, followed by the mechanics of giving a concrete shape to the basic new idea in the design and then finally contriving a method for mass manufacturing the same to put forth a product in the market for the benefit of the consumer. A new design thus conceived or invented is, therefore, an intellectual property. "Design", as defined in the 'Designs Act, 1911, related only to the features of shape, configurations, pattern or ornamental decoration applied to an article by any industrial process or means. Whether manual, mechanical or even chemical, separate or combined, which in the finished article appeal to and are judged solely by the eye.

Trade Mark

Trade mark have been defined as any signs, or any combination of signs capable of distinguishing the goods or services of one undertaking from those of other undertakings. Such distinguishing marks constitute protectable subject matter under the provisions of the agreement. The agreement provides that initial registration shall be for a term of not less than seven years and the registration shall be renewable indefinitely. Compulsory licensing of trademarks is not permitted. The Indian Trademark Act is in the process of being amended in response to our own requirements. The proposed amendments, if approved, would also bring our trademark law completely in line with our obligation in the TRIPs Agreement. It may be pointed out that by and large the amendments being made in the context of the TRIPs agreement are marginal; the main amendments are in the nature of clarifications and procedural specifications.

Copyright

Copyright means all the rights conferred by the Act upon its owner in respect of his literary, dramatic, musical or artistic work or in respect of cinematographic film or record. It does not only mean the right to do something but also the right to exclude others from committing those acts, which are protected under the copyright act. In short, 'copyright' in a work means the exclusive right to do the things specified in it. Thus, copyright secures form of expression and not the ideas or information or opinions. The subject matter of one's imagination or thinking cannot be protected as such. Apart from its form of existence copyright offers protection to original works of authorship in any tangible medium of expression.

Layout Designs of Integrated Circuits

The obligation in this area is to comply with the Washington Treaty on layout designs. India is a signatory to the Washington treaty. The main obligations of this treaty which are also incorporated in TRIPs Agreement are the protection of the intellectual property in respect of layout and designs that are original in the sense of feeling the result of their creator's own intellectual efforts and national treatment of foreign right holders. The term of protection is ten years and the rules in respect of compulsory licensing are the same as in case of patents. India would need to enact legislation to give protection to layout design.

Trade Secrets

Trade secrets are defined as "a formula, pattern, device or compilation of information used in one's business and given an opportunity and advantage over competitors who do not know the use of it." The agreement requires the members to protect the undisclosed information and data submitted to governments or governmental agencies. It also provides that natural and legal persons shall have the possibility of preventing information lawfully within their consent in a manner contrary to honest commercial practices. Further, parties are required to protect against unfair commercial use Undisclosed or other data obtained as a condition of approving the marketing of pharmaceutical or of agricultural chemical products. In India there is no separate legislation dealing with trade secrets.

Geographical Indications

Typical examples of GI are basmati (India & Pakistan), scotch whisky (Scotland) and Champagne (France). These are the products identified as typical to a geographical region. This gives the right to producers only from these regions to name the produce by these names. Produce from any other region cannot be named similarly.

The agreement contains a general obligation that parties shall provide the legal means for the interested parties to prevent the use of pay means in the designation or presentation of good that indicated or suggests that the good in question originates in a geographical origin of the good. There is no obligation under the agreement to protect geographical indications which are not protected in their country of origin or which have fallen into disuse in the country.

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An Overview on Medicinal Value of Minor Tuber Crops

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Root and tuber crops play a key role in human diet. They have an immense potential as functional food and nautraceutical ingredients to be explored in disease risk reduction and wellness. They play a key role in providing a substantial part of the world's food supply and are considered as an important source of animal feed and processed products for human consumption and industrial uses. There are many numbers of root and tuber crops grown in our country. Some of them are grown commercially throughout the country or within a geographical region whereas some of them are grown in few pockets within some locality. Till date, many of them are not yet explored fully for their health and nutritional benefits. Here we discussed some of the minor tuber crops that will be need for further exploitation in future.

Ararrot (*Maranta arundinacea*)

It is a tropical starchy root vegetable native to Indonesia. It is usually processed into a powder, also called arrowroot flour. The powder is extracted from the plant's rhizome, an underground stem with multiple roots that is rich source of starch and energy. As nutritional composition is concern, a cup of arrowroot flour contains 16 g carbohydrates, 2 g fiber, 5 g protein with no fat and 78 calories. It is highly proteinaceous in nature as compared to other tuber crops, comprising 5 grams of protein per cup while that of yam is 2.3 grams per cup. Besides that, it also provides over cent per cent of vitamin B_9 (folate), which play an important role during pregnancy and during the process of DNA formation. Low levels of this vitamin are associated with an increased risk of birth defects and chronic diseases like cancer. Besides above, it offers significant amounts of phosphorus, iron, and potassium. Aside from its high nutritional value in term of protein, vitamin and minerals, it acts as an ideal food for childs and older adult as it is very easy to digest. It may aid in weight loss, may fight from diarrhoea and boost our immune system. As it is naturally gluten free, may be used as substitute for wheat flour.

Aerial Yam (*Dioscorea bulbifera*)

It is a species of yam and widely distributed around the world in tropical and subtropical regions. It contains protein 7.47%, moisture 14.74%, ash 2.56%, fiber 0.35%, and carbohydrate 73.62%. It also shows the presence of some minerals like, Ca, Mg, K, P, and Na with some phytochemical analysis like saponin, tannin, flavoured and alkaloids. It is primarily used as food in many parts of the world and is cultivated as an agricultural crop. The plant has been using as a flock medicine like anhalgesic aphrodisiac, diuretic and rejuvenate tonic. Because of lower glycenic index, it provides more sustained form of energy and better protection against obesity and diabetics. It also used for the treatment of leprosy and tumors in many parts of the world. The roots are used as a remedy of sore throat and for struma by the people of republic China. The plant is used as an infusion to apply on cuts and stores, both for human and animals in Zembabwe. In India, the bulbs are used to treat piles, dysentery syphilis and are applied to ulcers, pain and inflammation. It also has anti-cancer prosperities (Jiang 1978).

Katchu (*Helianthus tuberosus*)

Helianthus tuberosus, the Jerusalem artichoke, is popularly known as katchu that emerged in eastern North America and is now widely distributed in the Middle East. It is 2–3 mm in length with superficial leaves and plump tubers. The tuber contains about 2% protein, no oil, and little starch. It is rich in the carbohydrate inulin (8 to 13%), which is a polymer of the monosaccharide fructose. Tubers stored for any length of time convert their inulin into its component fructose. Jerusalem artichokes have an underlying sweet taste because of the fructose, which is about one and a half times as sweet as sucrose. It has been established that this species exhibits several medical activities, such as purgative, diuretic, and bowel tonic effects, and has been used as a folk medicine for managing bone fractures and cutaneous wounds, and even for relieving pain. Various studies have also found that *H. tuberosus* compounds have antioxidant, anti-inflammatory, antimicrobial, antifungal, anticancer, antipyretic, and analgesic effects. Jerusalem artichoke is rich in fatty acids such as palmitic acid, which resemble those present in the sebaceous glands in the skin. These fatty acids in this plant have been reported to possess potent antimicrobial–disinfectant properties in the skin. It has also been reported as a folk remedy for diabetes: since inulin is not assimilated in the intestine, it doesn't cause a glycemic spike as potatoes would. Temperature variances have been shown to affect the amount of inulin the Jerusalem artichoke can produce. It makes less inulin in a colder region than when it is in a warmer region.

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NTFPs as Tools for Rural Development and Climate Change Mitigation Option in India

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Introduction

Human activities have accelerated the warming of our planet's climate at a rate unprecedented in at least 2,000 years. Climate change is causing a slew of changes across the globe, all of which will increase with further warming. Unless there are immediate, rapid and large-scale reductions in greenhouse gas emissions, limiting warming to close to 1.5°C or even 2°C will be beyond reach (IPCC, 2021). Forests are important in reducing the consequences of environmental degradation and serving as a carbon sink for the terrestrial ecosystem.

Forests and trees play an important part in limiting atmospheric carbon emissions and slowing climate change by sequestering and storing carbon in the atmosphere. Non-timber forest products (NTFPs) have been identified as a critical component of long-term forest management and economic development. It is an important source of income for forest fringe communities all around the world. It has become increasingly aware of its role in ensuring food security, diversifying income streams, and providing ecosystem services.

The storage of carbon within trees is the most promising contribution of NTFPs that has recently become important. NTFPs are any forest-produced product or service that is not timber. Fruits and nuts, vegetables, fish, medicinal herbs, resins, gums, essences, and a variety of barks and fibres including bamboo, rattans, and a variety of different palms and grasses are among them. It is taking major role in carbon sequestration as NTPFs trees are not cut by the rural communities instead they are conserving for extraction of the products.

Livelihood and Economic Contribution

In India, NTFPs contributes to the livelihoods of about 50 million populations of poor rural communities and forest dwellers. They harvest fruits, fuelwood, leaves, fibers, gums, dyes, honey, wax, etc., for selling to the market or home consumption.

NTFPs have been shown in numerous studies in India to give significant inputs to the livelihoods of forest-dwelling populations, many of whom have limited non-agricultural income options (Chandrashekaran, 1994). NTFPs alone account for around 40% of overall forest revenues, 55% of forest-based employment and 70% of forest-based export earnings (Behera, 2009). About lac, approximately 30.0 per cent of farmers earn up to Rs. 5,000 per year from lac, while 3.3 per cent earn more than Rs. 20,000 per year from lac in Ranchi and Khunti districts, Jharkhand (Pal et al., 2013).

NTFPs give 40-63 per cent of total yearly income in rural Madhya Pradesh (Tewari and Campbell, 1995), whereas NTFPs collecting provides 17-50 per cent of rural household income in West Bengal (Malhotra et al., 1993). In Karnataka's Western Ghats region, the estimated value of NTFPs collected ranged from Rs. 1233 to Rs. 3445 per household (Murthy et al., 2005).

Impact of Climate Change on NTFPs

Climate change in India, such as rising temperatures and shifting rainfall patterns, is expected to influence the country's livelihood and biodiversity significantly. Climate change has had a major impact on forest ecosystems, resulting in changes in vegetation types, phenology, and reproductive biology of a variety of trees, shrubs, and herbaceous plant species, as well as changes in the frequency, intensity, duration, and timing of the fire, drought, insect, and pathogen outbreaks. Aside from these scientific findings and projections, many indigenous people have reported a decline in the number and quality of NFTPs, as well as changes in phenology.

The NTFPs species' production and regeneration capability have been harmed by erratic rainfall and temperature changes, which have also impacted total biodiversity. The study done in Madhya Pradesh's Mandla district highlights villagers' observations of a substantial change in the phenology of local mahua since 2005, a progressive shift in fruiting and blooming season from mid-March to mid-February on phonological alterations in mahua (Sushant 2013).

There have been reports of reduced lac yield by 8% per year from 2007-11, due to changing temperature (Jaiswal and Singh, 2011). Reduced availability of forest products such as food, fuel, medicinal plants, and herbs appears to deprive the rural poor of a supplementary source of income, food, and healthcare (Basu, 2009).

Role of NTFPs in Ameliorating Environment

Economic growth is predicted to drive annual increases in emissions. The loss of forest area in India is primarily due to changes in land-use systems for developmental purposes and the conversion of forest into agricultural land. In the framework of development, resource use and environmental protection are always two opposing processes.

NTFPs, on the other hand, have been highlighted as an important part of long-term forest management and economic growth. Aggarwal and Chauhan, 2014 assessed the carbon sequestration of three extensively used medicinal tree species of *Emblica officinalis* (Amla), *Terminalia belerica* (Bahera), and *Terminalia chebula* (Harar) in the state of Sikkim.

The findings of this study suggest that the selected species of Amla, Bahera, and Harar have significant carbon sequestration rates of 1, 2.64, and 1.42 tC ha^{-1} yr^{-1}, respectively. Annual CO_2 sequestration (tCO_2/ha/yr) of NTFPs bunds and block plantation were 6.6 and 8 respectively (Gera et al., 2011).

Conclusions

The NTFPs plays a major role in mitigation of climate while enhancing rural livelihood. Despite the fact that falling NTFPs productivity is a major issue for forest communities and biodiversity, NTFPs regeneration has received little attention. Various afforestation programmes in India primarily focus on timber plantation and assign an ambitious mission to the forest service to enhance the country's forest cover.

As a result, large-scale cultivation of fast-growing timber-producing species remains a top priority. Slow-growing NTFPs, on the other hand, do not receive the necessary attention. The quantity of forest produce has decreased due to forest land being diverted for agriculture and development projects like roads and dams. Forest degradation caused by shifting cultivation has reduced the NTPFs population. Monocultures of commercial species such as teak, sal, eucalyptus, and others, planted under various plantation programmes to improve forest cover, have limited NTFPs availability.

Way Forward

1. Recognizing NTFPs as a possible adaptation and mitigation approach for dealing with climate change and increasing resilience in resource-poor tribal communities.
2. Mass plantation and regeneration of NTFPs species in the forest area under various afforestation programs.
3. Infrastructure support for value addition and market link, processing and storage.
4. Plantation of NTFPs species in the community land and integrating them onto an agroforestry system.
5. More scientific research on the effects of climate change on biological diversity and the livelihoods of forest-dependent populations should be encouraged.

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Impact Analysis of Front-Line Demonstrations on Sesame (*Sesamum indicum* L.)

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Abstract

The present study was undertaken to assess the performance of Front-Line Demonstrations on sesame was conducted at ten villages of Eastern Uttar Pradesh during *kharif*-2020. Total 25 farmers were selected on the basis of their socio-economic conditions. Front line demonstrations on sesame were conducted from seasons *Kharif*-2020 at various farmers' field's locations under front line demonstration during this period 25 demonstrations were organized of 0.4 ha /each using short duration improved varieties *i.e.,* Shekhar & RT-351. The main objective of the FLDs to improve the socio-economic condition of the farmers in Eastern Uttar Pradesh region, increasing the sesame cultivated area during *kharif* season in Eastern Uttar Pradesh region and also utilization of the *kharif* fellow land for cultivation of sesame crop. Looking to the better performance of Front-Line Demonstration, farmers of the region were highly benefitted and satisfied with improved practice in comparison to their own traditional practices. The average yield of sesame was recorded 440 kg per hectare and 600 kg per hectare from farmers practices and Improved practices, respectively. The average net returns from farmers & Improved practices were 27,560 & 44,920 Rs/ha, respectively. The significant average cost: benefit ratio of *kharif* sesame variety Shekhar were recorded 1.9 & 2.5 from both farmers & improved practices, respectively. The significant average cost: benefit ratio of *kharif* sesame variety RT-351 were recorded 2.0 & 2.5 from both farmers & improved practices, respectively.

Introduction

Sesame (*Sesamum indicum* L.) is labeled as the queen of oilseeds because of its high oil content, delicious nutty aroma, and flavor and is traditionally categorized as a health food in Asian countries. Sesame (*Sesamum indicum* L.) is the oldest indigenous oilseed crop, with longest history of cultivation in India. Sesame or gingelly is commonly known as til (Hindi, Punjabi, Assamese, Bengali, Marathi), tal (Gujarati), nuvvulu, manchi nuvvulu (Telugu), ellu (Tamil, Malayalam, Kannada), tila/pitratarpana (Sanskrit) and rasi (Odia) in different parts of India. Area, production & productivity of sesame in the world were 11.7 mha, 6.01 mt & 512 kg/ha, respectively and in India it was cultivated in an area, production & productivity of 17 mha, 7.46 mt & 431 kg/ha, respectively.

Source: Food & Agriculture Organization Statistical Databases (FAOSTAT, 2020).

Resources & Methodology

In the present study performance of improved technologies of sesame against local check was evaluated through front-line demonstrations conducted at farmer's field during *Kharif* season-2020. A total of 25 demonstrations were laid on 10 ha area in 10 villages namely; Saah, Saiganpurwa & Narora in Kanpur Nagar District, Prempur & Naugaon in Kanpur Dehat District & Apsari, Vanprwa, Sohramau & Gangoli in Unnao District of Eastern Uttar Pradesh during *kharif*-2020. The soils of the study area are mostly sandy loam to clay loam in texture with low nitrogen, medium phosphorus and high in available potassium. The improved technologies include improved varieties viz. Shekhar & RT-351, recommended dose of fertilizer and plant protection chemicals were supplied free of cost to the farmers. Crop was sown after receiving sufficient rainfall, between second week of June to last week of July will crop geometry of 30 x 20 cm and seed rate of 05 kg/ha. The total amount of phosphorus and potassium was applied as basal dose along with half dose of nitrogen and remaining dose of nitrogen was top dressed in two equal splits at 30 and 60 days after sowing. Hand weeding was done once at 20-30 days after sowing. The total number of 25 beneficiary farmers were associated under this FLDs programme for maximize the production and double your income as per the suggestions of our Hon'ble Prime Minister Shri Narendra Modi Ji. The FLDs techniques was used as ***"Improved practices vs. Farmers practices (local check)"***. The demonstrations of improved technologies were taken in an area of 0.4 ha of each farmer. In each demonstration one control plot was kept where farmers practices were carried out. The critical inputs such as seed, fertilizers and pesticides were supplied to the farmers free of cost for demonstration purpose. Adoption of improved technology by the farmers and guidance was ensured through regular visits by the Chandra Shekhar Azad University of Agriculture & Technology, Kanpur scientists to the demonstrations field. Field days and group meetings/ farmers training/ kisan gosthi were organized at the site of demonstration to provide the opportunities for other farmers to see the benefit of demonstrated technologies. The feedback from the farmers were utilized for further improvement in research and extension programme. The crop was harvested between first and second week of October. Data were collected from the FLD's farmers and analyzed with statistical tools to compare the performance of farmer's field and FLD's field. Total 25 farmers were selected on the basis of their socio-economic conditions and also on the basis of their own choice for conducted Front Line Demonstrations on sesame during *kharif*-2020 in Eastern Uttar Pradesh. The details of the farmers are given below in the table-1.

Table-1: Details of farmers selected for conducted FLDs on sesame in *kharif*-2020:

S.No.	Farmers name	Villages	Blocks	Districts
1.	Sri. Ram Sanker	Saah	Bhitargaon	Kanpur Nagar
2.	Sri. Ram Bhajan	Saah	Bhitargaon	Kanpur Nagar
3.	Smt. Rajani	Saah	Bhitargaon	Kanpur Nagar
4.	Sri. Babu Ram Yadav	Tons	Sarsoul	Kanpur Nagar
5.	Sri. Ratiram	Tons	Sarsoul	Kanpur Nagar
6.	Sri. Shiv Balak	Tons	Sarsoul	Kanpur Nagar
7.	Sri. Babu Singh Kushwaha	Saiganpurwa	Sarsoul	Kanpur Nagar
8.	Sri. Om Prakash Kushwaha	Narora	Sarsoul	Kanpur Nagar
9.	Sri. Mahesh Yadav	Prempur	Amroandha	Kanpur Dehat
10.	Sri. Mahendra Yadav	Prempur	Amroandha	Kanpur Dehat
11.	Sri. Praveen	Prempur	Amroandha	Kanpur Dehat
12.	Sri. Raj Narain	Prempur	Amroandha	Kanpur Dehat
13.	Smt. Sunita Devi	Prempur	Amroandha	Kanpur Dehat
14.	Sri. Shiv Kumar	Naugaon	Maitha	Kanpur Dehat
15.	Smt. Shyama Devi	Naugaon	Maitha	Kanpur Dehat
16.	Sri. Amrendra Bhadur Singh	Apsari	Purwa	Unnao
17.	Sri. Vinay Singh	Apsari	Purwa	Unnao
18.	Sri. Fool Chandra	Apsari	Purwa	Unnao
19.	Sri. Anand Verma	Vanprwa	Purwa	Unnao
20.	Sri. Anil Kumar Patel	Sohramau	Purwa	Unnao
21.	Sri. Bij Bhan Singh	Gangoli	Sikandraapur	Unnao
22.	Sri. Mahavir Pasi	Gangoli	Sikandraapur	Unnao
23.	Sri. Satendra Pratap Singh	Gangoli	Sikandraapur	Unnao
24.	Sri. Manoj Tiwari	Gangoli	Sikandraapur	Unnao
25.	Sri. Vishnu Kori	Gangoli	Sikandraapur	Unnao

Results & Discussion

The results were revealed that the performance of crop stand was good with healthy crops. The average yield production of *kharif* sesame variety Shekhar were recorded 440 kg per hectare and 600 per hectare, respectively from farmers and improved practices and the yield of variety RT-351 were recorded 445 kg/hectare & 625 kg/ha, respectively from farmer's and Improved practices.

The average gross returns of *kharif* sesame variety Shekhar were recorded 60,760 Rs per hectare and 40,180 Rs per hectare, respectively from farmers and improved practices and the average gross returns of variety RT-351 were recorded 42,140 Rs per hectare & 62,720 Rs per ha, respectively from farmer's and Improved practices. The average net returns of *kharif* sesame variety Shekhar were recorded 27,160 Rs per hectare and 42,96 Rs per hectare, respectively from farmers and improved practices and the average net returns of variety RT-351 were recorded 27,560 Rs per hectare & 44,920 Rs per ha, respectively from farmer's and Improved practices.

Results are given in below table-2 & Fig.-1. The significant average cost: benefit ratio of *kharif* sesame variety Shekhar were recorded 1.9 & 2.5 from both farmers & improved practices, respectively. The significant average cost: benefit ratio of *kharif* sesame variety RT-351 were recorded 2.0 & 2.5 from both farmers & improved practices, respectively.

Results are given in below table-3 & Fig.-2. The significant differences were recorded from farmers practices and improved practices in several points such as variety, seed rate, seed treatment, time of sowing, method of sowing, fertilizers management, water management, plant protection, threshing, harvesting & marketing, etc.

Table-4 & Fig.-3 revealed that the maximum & minimum rainfall were recorded in the month of July (446.6 mm) and October (0 mm), respectively. Maximum and minimum number of rainy days were recorded in the month of August (11 days) and October (0 days), respectively. Maximum and minimum temperature were recorded in the month of July (34.4° C) and November (11.8° C), respectively.

Maximum and minimum sunshine hours were recorded in the month of July (5-6 hr) and September (2-3 hr), respectively. Maximum and minimum Relative Humidity (RH %) were recorded in the month of July (87 %) and October (38.0 %), respectively.

Fig.-1: Seed distribution of Shekhar & RT-351 variety of sesame under FLDs on Sesame during *kharif*-2020.

Table-3: Average cost of cultivation, average net of returns & B: C ratio of FLDs on sesame during *kharif*-2020:

Sl. No.	Variety	Average cost of cultivation		Average net returns		B: C ratio	
		FP	IP	FP	IP	FP	IP
1.	Shekhar	13,600	17,8800	27,160	42,960	1.9	2.5
2.	RT-351	13,600	17,800	27,560	44,920	2.0	2.5

Table-4: Meteorological data recorded during the *kharif*-2020 season:

Weather Parameter	July.2020	Aug. 2020	Sep. 2020	Oct. 2020	Nov. 2020
Rainfall (mm)	446.6	353.3	62.6	0	34.4
No. of Rainy days.	11	14	6	0	1
Maximum Temperature OC	34.4	34.8	33.9	31.4	28.2
Min. Temperature OC	26.8	26.0	25.6	17.6	11.8
Sun Shine Hours	5.9	3.2	2.2	2.8	3.6
Relative Humidity Maximum (%)	87	80	65.8	83.8	77.2

Relative Humidity Minimum (%)	71	55	48.0	38.0	39.2

Fig.-2: Standing sesame crop in the field under FLDs on sesame during *kharif*-2020.

Conclusion and Way Forward

The Farmers with or without resources keep their land fallow in *Kharif* and cultivate wheat, gram, linseed and lentil in *Rabi*. Here we found *Kharif* sesame a promise crop to increase Cropping intensity in Eastern Uttar Pradesh region. With majority of population living in villages under studied area were economically isolated. Those were below poverty line and their livelihood dependent solely on agriculture and livestock rearing the Plan seems to be boon for uplifting their status.

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Machineries for Crop Residue Management

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Introduction

Crop residues are natural resource of nutrients, about 25% of nitrogen, 25% phosphorus, 50% of sulphur and 75% of potassium uptake by cereal crops are retained in residues. Crop residue management is the practice of removing the plant materials left in the field after harvest include burning of residue and conservation tillage practices such as no-till and mulch till and other conservation practices that provide sufficient residue cover to protect the soil surface from the erosive effects of wind and water. Management of crop residue is the challenging task for the farmers because of high cost of removing the residues and unavailability of labor.

Crop Residue Burning

Usually, farmers are practicing burning of crop residues to clear the harvested field easily and quickly for next crop production. The main reasons for crop residue burning - It clears land quickly from residues; It facilitate timely planting of following crop; It kills soil born pests and pathogens; Low-cost management of crop residues. Burning of crop residues produce soot particles and smoke causing human health problems, emission of greenhouse gases causes global warming, loss of plant nutrients (N, P & K), adverse impacts on soil properties and wastage of valuable organic carbon and energy rich residues.

Machineries

There are several alternatives for crop burning using on-farm machines for managing of crop residues. These machines perform baling and removing of straw, shredding and surface retention or mulching, shredding and incorporation and resource conservation technologies like no-tillage seeding.

1. Baler: Baling machines collect the straw from harvested fields, compress it and make it into rectangular or round bales; these straw bales are used as fodder, fuels for industries, bio-fuel production. There are two types of balers namely rectangular baler and round baler. Rectangular baler (Fig. 1) collects harvested and threshed straw from the field through pickup and fed into the baling chamber where the straw is compressed by plunger which moves in and out in the chamber.

Fig.1 Rectangular baler

Due to the movement of plunger inside a rectangular chamber a predetermined size of rectangular straw bale is formed. When the correct length of bale is achieved, a mechanism wraps the bale with twine or wire and ties it securely. Round baler (Fig. 2) collects straw from the land by pickup and fed into the bale chamber through auger. Bale chamber consist of roller and 6-8 number of rubber belts. These belts are tightly held by hydraulic system when the hay enters into the chamber it wraps over itself due to belt tension and roller action. The hay exerts force upon the belts, which is in turn monitored by the hydraulic system. Once a predetermined pressure is reached, bale is automatically wrapped with twine or protective sheeting. After wrapping, the tension on the belts is released and the entire rear portion of the baler is opened by hydraulic cylinders. The bale then simply rolls out onto the ground (Manjunath *et al.*,2015).

Fig.2 Round baler

2. Straw reaper/straw combine: Straw combine cut the left-over wheat straw after cut by combine harvester is recovered, threshed and blown into the netted trolley or directly on to the field (Fig. 3). The straw thrown and stubble left by the grain combine is cut by reciprocating type cutter bar and delivered to the cylinder-concave section through feeding auger. At cylinder-concave section (brushing unit) the straw is chopped by serrated saw blades mounted on brushing cylinder and counter bar. Straw, which passes through the concave, is aspirated by a blower and fed into a trolley on rear side covered by a wire net. Recovered wheat straw is used as cattle feed. The capacity of machine on an average is 0.4 ha/h and straw recovery is about 55-60%. There is an additional grain recovery of 50-100 kg/ha (Anon., 2010).

Fig.3 Straw combine/straw reaper

3. Rotary shredder: A rotary shredder has straight blades rotating in a horizontal plane with direction of travel. The straight blade used for shredding and it has mounted on disc in straight. The Rotary shredder gear box receives 540 rpm from tractors PTO; which converted in to 1200 rpm by suitable gear drive. When it is passed over the plants due to high rotation and impact force of the blades on plants cut it into smaller pieces and left over the field (Fig. 4). Shredding efficiency of this machine is about 89% with cost of operation 2800 Rs/ha (Sridhar and Surendrakumar, 2017).

Fig.4 Rotary shredder

4. Super Straw Management System (super SMS): It is a device attached behind the combine harvester. The Super SMS cuts the straw into small pieces and spread it around behind the tail of the combine (Fig. 5). Super SMS consists of a shredding unit and spreading unit. Shredding unit having a cylinder or rotor on which number of serrated knives are mounted in zig-zag manner, this cylinder rotates against fixed serrated knives.

The threshed paddy/wheat straw in the combine harvester is passed between rotor and fixed serrated blades due to shearing effect exerted by rotation of rotor (1600 rpm) and fixed serrated blades, straw cuts into small pieces and spread over the field uniformly by flail type straw spreader. The cost of operation is 2800 Rs/ha. Using of this machine makes harvesting and crop residue management is done in single pass (Zang *et al.* 2017).

Fig. 5 Super SMS.

5. Sugarcane trash shredder: It is a trailed type tractor PTO operated machine (Fig. 6). It chops the dried and semi-dried sugarcane leaves after harvest of the sugarcane. The machine consists of two units namely suction and shredder unit. The suction unit has four wings are in arc shape. The shredding unit consists of cylindrical drum and counter bars. The drum consists of eight bars mounted on circular disc rotating at 1188 rpm. Serrated blades are mounted on these bars at fixed spacing. There are three counter bars which are fixed to upper casing of drum. When sugarcane leaves enter between drum and counter bars due to impact and shearing action it cut into smaller pieces of 8 – 12 cm by serrated knives and the cut material is left over the field as mulch or for incorporation. The cost of operation is 2015 Rs/ha with 90.40 % shredding efficiency (Mukesh and Rani, 2017).

Fig.6 Sugarcane trash shredder

6. Cotton stalk shredder: Cotton stalk shredder (Fig. 7) cut and chops the stalks after harvest of the cotton. It consists of converging unit, cutting unit, chopping unit and spreading unit. The converging unit guides the cotton stalks towards the cutting unit. Cutting unit consist of serrated drums which are having sharp edged circular disc at its bottom which cut the cotton stalks easily. The cut stalks are conveyed by 2 feeding rollers to the shredding unit which consists of a flywheel on which 6 numbers of blades are mounted. Flywheel rotates continuously at 1600 rpm so that it chaffs the stalks into smaller pieces of size 1 – 5 cm and spread over the field. The cost of operation is 3000 Rs/ha with shredding efficiency 85-90 % (El-Atty *et al.* 2017).

Fig.7 Cotton stalk shredder

7. Happy Seeder: It is used for sowing of wheat seeds without any burning of Crop residue in paddy or wheat fields. In this machine a mulching unit is attached at front of seeding unit (Fig 8). When the machine is passed over the combine harvested paddy or wheat field the mulching unit cut the stubbles into smaller pieces and left over the soil surface as mulch. This machine can be operated with 45 hp and above powered tractor and can cover 0.3 ha/h. cost of operation of this machine is 2300 Rs/ha. The seeding unit opens the furrow, places the seeds at uniform depth and covered with soil. Direct sowing with happy seeder helps in reducing soil disturbance, enabling it to retain more nutrients, moisture and organic content. It also saves money as less time is needed on carrying out field operations, which in turn reduces fuel and labour costs (Singh *et al*., 2009).

Fig.8 Happy seeder

8. Super seeder: It consists of rotavator unit and seeding unit (Fig 9) which incorporate the standing paddy stubble into soil and sow wheat seed simultaneously in a single operation after the harvesting of the paddy with combine harvester. The rotavator unit having J-type blades which are rotating at 300 rpm which results in cutting and incorporation of paddy stubble into soil and it also make a clean bed for sowing. The seeding unit opens the furrow by double disc type furrow opener the place seeds and fertilizer in the furrow at uniform depth and covered with soil. The average field capacity is 0.35 ha/h with field efficiency of 77%.

Fig.9 Super seeder

9. Zero-till drill: Zero-till farming is a way of growing wheat / other crops without tillage or disturbing the soil in paddy/other crop harvested fields. Zero till drill consist of seed and fertilizer box, seed metering mechanism, seed tubes, inverted T-type furrow openers and power transmission wheel (Fig 10). The inverted T-type furrow opener opens a slit type furrow with less soil disturbance, places the seeds into the furrows at uniform depth and covered them with soil by a covering device. Size of the implement ranges from 9 to 11 number of furrow openers spaced 200 mm with provision for changing the row spacing. Average field capacity of this implement with 9 number of furrow openers is 0.35ha/h with field efficiency of 80% and cost of operation is 665 Rs/ha. Using of this machine helps in reduces labor for sowing, saves time of tillage of land, saves fuel, traps soil moisture and reduces soil erosion (Druwe and Victor, 2019).

Fig.10 Zero-till drill

Conclusion

Removing of crop residue is the major problem for the farmers after harvesting of succeeded crop. By using of machineries like balers, straw combine, super SMS, shredders and no or minimum tillage machines the burning of crop residue can be avoided and incorporation of organic matter into the soil is the better utilization of crop residue which improves the soil fertility, reduces soil moisture evaporation and soil erosion when crop residue is chopped and left over the field. Efficient use of these machines saves the labour, time, energy and cost of operation as well as cost of crop production.

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Housing of Sheep Under Temperate Climate

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Introduction

Sheep are an important component of rural living especially in hilly areas where other species of livestock find it difficult to survive. Sheep production is less capital intensive because of less land requirement, less operational costs and less initial investiment. Unlike cattle and buffalow, sheep don't require an elaborate housing system and low cost readily available materials often suffice. However, under temperate climate some sort of confinement is necessary especially for the newly born lamb/kids as their thermoregulatory mechanism is not fully developed during the immediate post-natal life.

Factors to be Considered for Selection of Site

For construction of farm buildings selection of site is most important. Before selecting a site, the following points are to be considered:

1. Soil type and topography:

a. Soil must be suitable for strong foundation.

b. Clay, sandy, rock soils are not suitable.

c. The buildings should be at a higher elevation than the surrounding ground to offer a good slope for rainfall and drainage for the wastes of the dairy to avoid stagnation within.

d. Any pollution norms and other legal formalities with regard to construction at a particular site should be taken into consideration well in advance.

2. Availability of land:

a. There should be vast area to construct all building with area demarcated for paths, paddocks. There should also be a scope for future expansion.

b. An adult sheep should be allotted a minimum covered floor area of 10-12 square feet with almost double uncovered area in the paddock for exercise.

c. In addition to this, there must be cultivable land available for fodder production so as to reduce the feeding expenses in the absence of which cost of production will be very high.

3. Availability of water and electricity: Plenty of water is needed for farm operations like washing, fodder cultivation and for drinking purpose. This necessitates round the clock availability of clean water at the farm premises. Electricity is a necessity at the farm. It is needed for any machinery work like shearing machines besides the general illumination of animal sheds and farm premises.

4. Protection from wild animals and industrial noises/wastes:

a. One of the basic motives of animal housing is to ensure protection from wild animals. Sheep in particular are highly vulnerable to predator attacks. This should be considered before planning a construction. Besides this a strong fencing around the farm will prevent the predator attacks to a large extent.

b. The site selected for construction should be far away from industrial area as numerous noises are generated in such areas. Besides this, the industrial wastes may find their way in the water bodies and pollute the surroundings which may be detrimental for animals.

5. Market facility and road connectivity: The selected site should to near to the market so as to reduce the transport costs of farm inputs and produce while being moved in and out of the farm. For this, road connectivity is must.

Housing System

Season dependent fodder availability in temperate regions largely determines the system of housing followed for sheep. While as close confinement (intensive) with stall feeding becomes inevitable during winter, other systems of rearing may be practiced in other seasons of the year wherein animals are not confined in sheds or confined to a lesse extent.

Table-1: Season dependent rearing systems for sheep in temperate regions:

Month	Rearing system
April to June	Semi-intensive/extensive
July to Sept.	Extensive
Sept. to Nov.	Semi-intensive
Nov. to Dec.	Intensive
Dec. to Feb.	Intensive
Feb. to April	Intensive

During winter season, close confinement of animals in houses is practized. This system is labour and capital intensive in nature. Although high initial investiment may be a demerit but the system ensures better management and supervision. Further as this system does not involve grazing but cut and carry system, it is economically feasible only when atleast some part of the fodder is raised by the farmer himself. If whole of the fodder is to be purchased, then the cost of production considerably increases. Thus, in areas with low land holding, this system may be high on cost unless some other fodder options are not available.

Table-2: Floor space requirement per animal (BIS standard):

Types of animals	Minimum floor space per animal (m2)
Ram (in group)	1.8
Ram (individual)	3.2
Lambs (in group)	0.4
Weaners (in group)	0.8
Yearling	0.9
Ewes (in group)	1.0
Ewe with lamb	1.5

Various types of sheds/ confinements may be utilized for the purpose of winter protection of animals which include kuccha type sheds, pucca type cement concrete buildings or wooden confinements. However, a scientifically managed sheep farm ensures that different age groups of the animals are reared separately keeping in view their separate nutritional requirements. This necessitates separate compartments for each age group which have been discussed below.

1. General flock shed (Ewe shed): Major part of the flock at the farm is constituted by the breedable female stock which are to be housed in ewe sheds of standard dimensions 15 m x 4m x 3m for 60 ewes. If the number of breedable ewes is more, the number of ewe sheds rather than the size should be increased. The choice of construction material may depend upon the economic feasibility, availability besides other factors.

2. Ram shed: The recommended dimensions of the ram shed are 4m (l) ×2.5m (w) ×3m (h) which can accommodate about 3 rams. The shed should be partitioned lengthwise to form three equal compartments. The number of such sheds is far less in comparison to other compartments because a single male can be used to breed as high as 30 females and as such only 3-4 breeding males may be required for 100 breedable females. Some farmers may not even keep any breedable male and as such may not require a ram shed. However, this requires breeding services from other farms which may be a source of infection to the farm unless the source is reputed.

3. Lambing shed: Since these sheds are to accommodate ewes along with their new born lambs for some time, they should ensure a floor space of more than 1 square metre meant for the ewe alone. The dimensions of the shed should be 1.5m (l)×1.2m (w)×3.0m (h), A manger, hay rack and a bucket for keeping water should be provided in the shed.

4. Lamb shed: This shed is meant for housing lambs from weaning upto attaining maturity at the rate of about 25 animals per shed. However, suitable partitions can be made in this shed to house unweaned, weaned but immature and nearby maturity lambs separately. On larger farms however, three separate sheds may be constructed to house three categories of lambs. The shed shall have a size of 7.5m (l) ×4m (w) ×3m (h) to accommodate not more than 75 animals.

5. Sick animal shed: Sick animal sheds should be 3m (l) ×2m (w) × 3 m (h) and the number of such sheds should be proportionate to the size of the flock. Approximately 5 such sheds/compartments should be constructed for every 100 of flock size. Since such sheds are meant for housing sick animals, they have been constructed away from other sheds to avoid spread of diseases to healthy animals.

6. Shearing and storeroom: Shearing and storeroom are usually constructed in the same shed as two separate compartments with a dividing wall. The room used for shearing may be 6m (l) x 2.5m (w) x 3m (h). It should have damp proof and easy to clean floor.

7. Attendant's room: This room is meant for the caretaker and should preferably be 6m (l) X 4m (w) X 3 m (h). It should be located at a convenient place in the yard preferably where almost all the sections of the farm are visible to the caretaker.

Table-3: Dimensions of different sheds in a sheep and goat farm:

Name of the shed	Lx w x h (m)	Max. animals/shed
Ewe shed	15 x 4 x 3	60
Ram shed	4 x 2.5 x 3	3
Lamb shed	7.5 x 4 x 3	75
Lambing shed	1.5 x 1.2 x 3	1
Isolation shed	3 x 2 x 3	1
Shearing shed	6 x 2.5 x 3	1
Shepherd house	6 x 4 x 3	-
Milch doe shed	1.2 x 0.8 x 3	1

Table-4: Feeding and watering space requirement:

Type of animal	Space per animal (cm)	Width of manger/ water trough(cm)	Depth of manger/ water trough (cm)
Adult sheep	40 - 50	50	30
Lamb	30 - 35	50	20

Highland Migration

Highland migration of sheep during summer months (June-September) is an important component of sheep rearing in temperate regions. The animals are moved to highland during this period as these are rich in good quality fodders which suffice the nutritional requirements. The animals are grazed in these areas without any housing arrangement which essentially represents an extensive or free-range system. However, this system cannot be followed throughout the year and the animals are to reared intensively during winter because of severe cold and non-availability of fodders.

Conclusion

Sheep have the resilience to thrive under adverse climatic conditions. The system of rearing of sheep in temperate regions is largely influenced by season. However, close confinement of animals is needed to protect them from extreme cold during winters.

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Nuts for Nutrition (N4N): Composition and Health Benefits

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Introduction

Nuts generally are fruits that have a hard outer shell that doesn't crack open naturally. Most nuts are seeds, but not all seeds are nuts. Nuts are extremely nutrient-dense. They provide generous amounts of calories, fats, complex carbohydrates, protein, vitamins, minerals and fiber. Trace minerals like magnesium, zinc, selenium and copper are important but may be under-consumed in today's largely processed Western diet, and even in some plant-based diets. Nuts are reliable and delicious source of these essential nutrients. Plus, more than just a way to meet basic nutrient needs, nuts have been shown to protect against disease. Research has shown that regular nut consumption as part of a healthy diet does not promote weight gain, and can protect against chronic diseases such as heart disease and diabetes.

Biochemical Composition of Nuts

1. Macronutrient composition:

Name of Nut	Water (G)	Energy (Kcal)	Protein (G)	Fat (G)			Carboh-Ydrate (By Difference) (G)	Fiber (G)
				SFA	MUFA	PUFA		
Pistachio	1.85	572	21.05	5.645	24.534	13.346	28.28	10.3
Almond	2.41	598	20.96	4.092	33.076	12.955	21.01	10.9
Cashew nut	5.2	553	18.22	7.783	23.797	7.845	30.19	3.3
Walnut	4.07	654	15.23	6.126	8.933	47.174	13.71	6.7
Peanut	1.81	587	24.35	7.723	26.181	9.773	21.26	8.4
Brazil nut	3.42	659	14.32	16.134	23.879	24.399	11.74	7.5

Table 1. Macronutrient composition of different nuts. (Source: USDA food data central) *amounts are calculated per 100g of food sample. (SFA= Saturated Fatty Acids; MUFA= Monounsaturated Fatty Acids; PUFA= Polyunsaturated Fatty Acids)

Nuts are high in calories and fat. But when eaten in moderate amounts, they provide a big health boost. From the above table, it is clear that the nut which contain the highest of fat, yield highest calorie. This is due to the fact that 1g of fat yields 9 kcal of energy while 1g of protein or carbohydrate yields 4 kcal of energy. Among the nuts, Brazil nut contains the highest amount of fat and calories. So, it must be consumed in proper amount in order to stay healthy.

Water content of cashew nut is the highest among the nuts. High water content results in low calorie density. Foods with low calorie densities have been shown to help with weight loss by promoting fullness and reducing appetite. Protein is necessary for bone and muscle development. It also increases feelings of fullness, helping one stay satisfied and energized. Like most legumes, peanuts provide a lot of plant-based protein. In fact, peanuts have the highest protein content out of all commonly consumed nuts.

Carbohydrate (by difference), i.e., the residual weight after subtracting amounts of water, protein, fat, and ash found by analysis; this moiety includes sugars, starches, fibre, and small amounts of other organic compounds. Nuts are known for being high in healthy fats and plant-based protein while being low in carbohydrates. Cashew nut contains the highest carbohydrates while Brazil nut contain the lowest. The percent daily value (%DV) for fiber is 28g per day, and one-ounce portion (a handful) of high fiber nuts provide between 5-35% of that daily value. Almond has the highest fiber content among nuts, especially the soluble fibers, which reduces blood sugar and improves other blood markers linked to heart disease, including “bad” LDL cholesterol.

Although high in fats, nuts are good sources of healthy fats such as monounsaturated and polyunsaturated fats, and they are low in (unhealthy) saturated fats. This combination of fats makes them heart healthy, as polyunsaturated and monounsaturated fatty acids help reduce low density lipoprotein (LDL) cholesterol, or the ‘bad’ cholesterol which causes atherosclerosis and coronary heart disease. MUFA and PUFA are also known as essential fatty acids (EFAs) as our bodies cannot manufacture them, so they must be included in the foods we eat.

Omega-3 FAs (one category of EFA) have a wide spectrum of potential health benefits including the prevention of some cancers, anti-inflammatory properties, and cardiovascular health, as well as supporting the maintenance of cognitive functions during aging. As the table above illustrates, nuts such as almonds, brazil nuts, cashew nut, pistachios, etc., may be especially good source of monounsaturated FAs and unaltered omega-6 FAs. Walnuts are particularly good choices because of their high omega-3 FAs.

2. Micronutrient composition (Minerals and Vitamins):

Minerals	Pistachio	Almond	Cashew nut	Walnut	Peanut	Brazil nut
Calcium (Ca)	107 mg	268 mg	37 mg	98 mg	58 mg	160 mg
Iron (Fe)	4.03 mg	3.73 mg	6.68 mg	2.91 mg	1.58 mg	2.43 mg
Magnesium (Mg)	109 mg	279 mg	292 mg	158 mg	178 mg	376 mg
Phosphorus (P)	469 mg	471 mg	593 mg	346 mg	363 mg	725 mg
Potassium (K)	1007 mg	713 mg	660 mg	441 mg	634 mg	659 mg
Sodium (Na)	6 mg	3 mg	12 mg	2 mg	410 mg	3 mg
Zinc (Zn)	2.34 mg	3.31 mg	5.78 mg	3.09 mg	2.77 mg	4.06 mg
Copper (Cu)	1.293mg	1.099mg	2.195mg	1.586mg	0.428mg	1.743mg
Selenium (Se)	10 µg	2 µg	19.9 µg	4.9 µg	9.3 µg	1917 µg
Vitamins						
Vitamin C (mg)	3	0	0.5	1.3	0	0.7
Thiamine (mg)	0.695	0.077	0.423	0.341	0.152	0.617
Riboflavin (mg)	0.234	1.197	0.058	0.15	0.197	0.035
Niacin (mg)	1.373	3.637	1.062	1.125	14.355	0.295
Vitamin B-6 (mg)	1.122	0.136	0.417	0.537	0.466	0.101
Folate (µg)	51	55	25	98	97	22
Choline (mg)	71.4	52.1	50.4	39.2	64.6	28.8
Vitamin A (µg)	13	0	0	1	0	0
β Carotene (µg)	159	1	0	12	0	0
Vitamin E (mg)	2.17	23.9	0.9	0.7	0	5.65
Vitamin K (µg)	13.2	0	34.1	2.7	0	0
Lutein + Zeaxanthin (µg)	1160	1	22	9	0	0

Table 2. Micronutrient composition of different nuts. (Source: USDA food data central) *amounts are calculated per 100g of food sample.

Compared to other common foods, nuts have an optimal nutritional density with respect to healthy minerals, such as calcium, magnesium, and potassium. Like that of most vegetables, the sodium content of raw or roasted but otherwise unprocessed nuts are very low, ranging from undetectable in walnut to 410 mg/100 g in peanuts. A high intake of calcium (from almond), magnesium (from brazil nut) and potassium (from pistachio), copper (from cashew nut, brazil nut and walnut) together with a low sodium intake, is associated with protection against bone demineralization, arterial hypertension, insulin resistance, and overall cardiovascular risk.

Obviously, the advantage of the low sodium content of nuts is lost if they are consumed as a salted product. Brazil nuts are one of the best food sources of selenium, an essential mineral that supports thyroid health and protects the body from infection as well as a strong oxidant which helps in fighting cancer. Just one Brazil nut (5 grams) has almost 175% of the DV (Daily Value) for selenium. However, one should not overconsume brazil nuts as high amounts of selenium are toxic to the body. The human body does not store zinc, so a person has to get enough from their daily diet. Nuts especially cashew nut, brazil nut and almond serve as a good source of zinc, which is essential for immunity, fetal development, reproductive health and wound healing. About 20% of women, 50% of pregnant women, and 3% of men do not have enough iron in their body. The solution, in many cases, is to consume more foods high in iron like cashew nut, pistachio, almond and walnut. Having vitamin C rich food increases absorption of iron. Iron deficiency can cause anaemia and lead to symptoms like fatigue. Menstruating women who don't consume iron-rich foods are at a particularly high risk of deficiency. Nuts contain significant amounts of folate, a B-vitamin necessary for normal cellular function. High folate containing nuts include walnut and peanut. Nuts are also rich sources of antioxidant vitamins (e.g., tocopherols) and phenolic compounds, necessary to protect from oxidative stress. Almonds in particular are especially rich in α-tocopherol (23.9 mg/100g), while walnuts contain significant amounts of its isomer γ-tocopherol, which is rare but have relevant antiatherogenic properties. Remarkably, in all nuts most of the antioxidants are located in the pellicle or outer soft shell, and 50% or more of them are lost when the skin is removed. Peanuts contain negligible number of tocopherols due to lack of consumption of outer shell while walnuts are an exception because they are almost always consumed as a raw, unpeeled product. Pistachio has high B6 vitamins and is the only nut that contains a substantial number of carotenoids that benefit eye health. Peanuts are also one of the best food sources of biotin, a vitamin that helps convert food into usable energy in the body. Choline in the diet is associated with lower risk of certain chronic health conditions. Individuals with the highest choline levels had 28% lower risk of fatty liver disease (Yu et al., 2014). This is likely because of choline's role in the transport and metabolism of fats in the liver. Getting enough choline during pregnancy has also been associated with lower risk of neural tube defects in children (Shaw et al., 2004). All the nuts have significant amount of choline with pistachio having the highest content. Availability of vitamin C in nuts is very limited with pistachio and walnut having relatively higher amounts. Vitamin A, found only in pistachios is important for normal vision, the immune system, and reproduction. Vitamin K, found mostly in cashew nuts and pistachios, is an important nutrient that plays a vital role in blood clotting and bone and heart health.

Nut phytochemicals have been associated with numerous bioactivities known to affect the initiation and progression of several pathogenic processes. Phytochemicals include carotenoids, phenols, and phytosterols. α- and β-Carotene, β-cryptoxanthin, lutein, and zeaxanthin are found in microgram/100 g amounts in some nuts but at 1-3 mg/100 g in pistachios and none at all in Brazil nut and peanuts. Lutein and zeaxanthin are powerful antioxidants as protect us from free radicals which damage the cells and contribute to aging. Pistachio contains the highest amount of these carotenoids. Walnuts are particularly rich in total phenols with 1625 mg gallic acid equivalents/100 g. The stilbene resveratrol is found in peanuts and pistachios.

Conclusion

Nuts are energy dense and contributes to a healthy lifestyle. Combining nuts with low-energy dense foods (such as vegetables) is a good way to enhance vegetable-based meals.

		
Pistachio	**Peanut**	**Brazil Nut**

		
Almond	**Walnut**	**Cashew Nut**

They are a good substitute for meats, fish and eggs but more than 30 grams of nuts a day may be needed to ensure adequate protein. Salted nuts, however, are not recommended as an everyday choice due to the higher sodium content. This is particularly important for people having high blood pressure. Inspite of all the benefits of nuts, they have the potential to trigger allergic reactions (anaphylaxis) in people with a nut allergy, particularly, peanut allergy. While the number of nuts per serving varies by type, a typical serving is 1 oz or about 1/4 cup or a small handful (palm of the hand only). Rather than focussing on one nut, people must include a variety of nuts in their diet.

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Role of Intermediary in Agricultural Marketing

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Introduction

An agent assumes the part of a delegate in a dispersion or exchange chain who works with association between the elaborate gatherings. Mediators work in performing critical exercises engaged with the buy and offer of merchandise in their stream from makers to a definitive purchaser. They regularly don't deliver everything except have broad information available, in this manner charging a commission or an expense for their administrations.

The agent is also called intermediary or middleman. The intermediary may be a individual or organization which facilitate the forwarding function of any activity. Indian agriculture is holding majority of the farmers who are capable of negligible or no bargaining power.

It is because of small holding and the primary motive of farming is subsistence purpose. Later the introduction of technology and research development transforms the agriculture to commercial mode.

When India become fully self-sustained in the food production, struggling to uplift the income of the farmers which is still lying-in darker side. When technology innovation got success in the sector, it takes years together to reach the farmers.

Once farmer starts adopting the technology and producing the higher yield, market absorb the major share of the profit. Farmers are facing a lot of problems to sell their produce.

Middleman malpractices is also one of the major constraints in major cases of marginal and small farmers. At the same time, middlemen are resource person to link the farmers to market and facilitating the organized marketing function. The increasing demand and fluctuating supply of agricultural commodities must require the middlemen. This article aims to explore the role and functions of various categories of intermediaries such as wholesalers, retailers, brokers, traders and merchants.

Major Functions of Intermediaries in Distribution

1. Looking out purchasers and venders, coordinating with products to the prerequisites of market.
2. Offering products as collections or bundles.
3. Convincing and affecting the imminent purchasers to support a specific item and its market.
4. Carrying out valuing strategies in such a way that would be worthy to purchasers.
5. Giving input data, promoting insight and deals determining administrations for the districts to their providers.
6. Taking care of the course of dispersion were fundamental.
7. Taking part effectively in the creation and foundation of a business opportunity for another item.
8. Offering pre and after deal administrations to customers.
9. Imparting the utilization of strategy of the item to the clients.
10. Offering credit to retailers and purchasers.
11. Hazard holding on for reference to stock holding/transport.

Different Categories of Middlemen

As Merchants: Person who take title to the products they handle. They purchase and sell all alone and acquire or lose, contingent upon the distinction in the deal and buy costs. Wholesalers and retailers are very well-known examples in this category.

Wholesaler purchase huge amounts of produce where it origins and sell into wholesale or retail basis. They may even sometimes go for grading, value addition and labelling instead of selling as such what they procured during their marketing. They normally have large storage godowns which are their main strength in business.

They have sound knowledge of the entire market and well-developed logistics system. Their procurement fluctuates based on the demand from various traders across the country. Retailers are small shop owners and closely connected with the consumers. They purchase the goods from wholesalers at wholesale price and sell it as small units at retail price with fixed margin.

Petty traders who move from one town to another, and straightforwardly buy the produce from the cultivators are known as Nomad or Itinerant Traders. Town vendors or Village Merchants buy the product of ranchers who have either taken money from them or the individuals who can't go to the market. Mashakhores are known popularly as huge retailers or little wholesalers and used to bargain just in a couple of foods grown from the ground. They usually offer to the mass purchasers like lodgings, little retailers/sellers in heaps of around 5-10 kg each

As Agents: They are little special rather than merchant middlemen are entirely different from agent middlemen. They act as only agent of their customers and they never possess the item. They simply arrange marketing activities in between two groups. They offer administrations to their directors and not the merchandise or wares. They get pay as commission or financier.

There are two sorts of people under this category such as Commission Agents and Arhatias and Representatives or brokers. Commission Agents are individuals working in the discount market who goes about as the delegate of either a vender or a purchaser.

They go for physical treatment of the produce, organizes its deal, gathers the cost from the purchaser, deducts his costs and bonus, and dispatches the equilibrium to the dealer. They act as investors of the ranchers.

They provide storage and advance advances against the saved up to 75% of its worth. Brokers **r**ender individual administrations to their customers on the lookout. Unlike the commission specialists, they don't have actual control of the item. They render important support of the forthcoming purchasers and dealers, for they have total information available – of the amount accessible and the overall costs and charge for their service as brokerage.

As Speculative or Theoretical Persons: These are the men who takes title to the item with the end goal of making a benefit on it. It could not be a customary purchasers or merchants of produce. They are specialized in hazard – taking and buys produce at low costs when appearances are generous and auction in the – season when costs are high. They make benefit from short-run just as since quite a while ago run value variances.

As Processors: Mostly an industry who **c**arry on their business either all alone or on custom premise and utilize specialists to purchase for them in the delivering regions, store the produce and interaction it over time on ceaseless premise. They engage in promoting movement to drive an interest for their handled items.

As Facilitative Persons: They do not accept and sell straight forwardly however aids the showcasing cycle. Efficiency in marketing framework increments when they take part in business and they receive their pay as expenses or administration charges from the individuals who utilize their administrations.

Other Facilitators: Hamals or Laborers are most important workers or labours who physically move the merchandise in commercial centre. Their work starts from dumping from and the stacking on to bullock trucks or trucks, assists in gauging the sacks.

They also perform cleaning, sieving, and topping off positions and line the packs. Weighmen in the market facilitates the right weighmen of the produce. Graders who sort out the item into various grades, in light of some characterized qualities, and organize them available to be purchased.

Carriers assists in the development of the produce starting with one market then onto the next. Modern and improved logistics are result of privatization and liberalization economy. Communication is most significant in large and complex unit.

Communication organization helps in the correspondence of the data about the costs winning, and amount accessible, on the lookout. Publicizing Agency enables imminent purchasers to know the nature of the item and choose about the acquisition of wares. Newspapers, the radio, TV and Internet are the primary media for commercials.

Conclusion

Though the intermediaries are acting as bridge between farmers and consumers in many aspects, there is a need of second thought of their existence in the system. It is all because of hiking marketing cost of the produce in the distribution channel and lead to hike in price before it reaches the consumers. No faithlessness, black marketing, selling duplicate, charging more, poor service with the motive of gaining profit rather seeing the wellbeing of the society. The new electronic era brings down the middlemen and introduces transparency in each step of marketing. It helps to farmers producers as well the consumers. The government should fasten the policy making and implementation of middlemen lessen or free marketing.

Energy Efficient Cropping Systems

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Energy is ability to do work. Neither it can be created nor can be destroyed but can be changed from one form to another form for use. The productivity and profitability of agriculture depends upon energy consumption as their existence has close relationship between production and energy. Energy demand in agriculture can be divided into direct and indirect energy. Direct energy is required for land preparation, irrigation, harvest, processing and transportation. While indirect energy is used in the form of fertilizers, pesticides etc. Energy appears in a variety of forms. It appears as chemical energy, as molecular & atomic energy, as electromagnetic energy, as electrical energy and as mechanical energy (movement with potential and kinetic energy) as well as thermal energy.

Non-Renewable energy is the available energy before the anthropogenic energy transformation. These include fossil fuels such as various coals, crude oil, natural gas, and in the case of nuclear energy the resources uranium or thorium. And renewable energy includes solar energy, the surrounding temperature, the kinetic energy from water or wind-power, the energy content of bio-mass, the energy content from ocean waves and tides, the temperatures of ocean water levels and the energy of the Earth magma.

There exists more non-renewable form of energy (73.2%) than renewable form of (26.8%) in all the crops. Furthermore, non-renewable form of energy is utilized for cultivating rabi crops as compared to kharif. Among the kharif crops the energy ratio varied from 3.4-7 with cotton having the highest energy ratio 7, however among the rabi crops mustard is found most profitable (Singh et al., 2003).

The crop yield can be co-related with energy input in the form of a second-degree polynomial i.e., $Y=\beta 0 + \beta 1\ x + \beta 2\ x2$ where, Y is the crop yield and x are the energy input (Singh et al., 2003). Both renewable and non-renewable energy are used for crop production. With increase in population and demand of food, efficient cropping system in terms of less input energy is preferred for higher system productivity & enhancing cropping intensity in present day agriculture in India.

Kachroo et al. (2012) reported that in a diversified rice based cropping system of Jammu region the highest energy input value of 65.5 x 103 MJ/ha was used for rice-potato-maize+greengram cropping system to produce energy output 261 x 103 MJ/ha, Specific energy (2.59 MJ/kg) was also highest in this system followed by rice-wheat system (2.23 MJ/kg). It means these two systems require higher input to yield a unit of produce.

Brar et al. (2011) worked with Rice (Basmati) -wheat cropping sequence in Punjab, where transplanted basmati rice gave 4.3 and 2.8% higher energy output than direct seeded basmati rice, irrespective of crop sowing method in succeeding wheat. Energy use efficiency was maximum in zero till sown wheat because of lowest energy input under zero till sown than conventional and bed planting method in wheat.

Seven different cropping sequences in Rajasthan tried by Jat et al. (2011) and observed groundnut-wheat was the best cropping system based on productivity and profitability but maximum energy intensiveness was from sorghum-chickpea (13.13 MJ/Re) and minimum from green gram-wheat (2.66 MJ/Re). This was due to lower productivity and lower net return of the cropping system. Soil health was not much affected by the influence of different cropping sequences; however, it was better with pulse (groundnut-green gram)-wheat cropping system and hence it was found to be biologically efficient and economically profitable replacement to conventional pearl millet-wheat crop sequence for semi-arid ecosystem of Rajasthan.

Another seven set of rice based cropping systems were reported from Varanasi region where Yadav et al. (2013) found that rice-potato-onion significantly recorded highest production efficiency 97.5 kg/ha/day, land utilization efficiency 91.4%, economic efficiency Rs 738/ha/day, energy input 61.08 x 103 MJ/ha and energy output 187.09 x 103 MJ/ha. Further it was found most energy efficient at application of RDN through organic source.

In tarai region of Himalayan foothill at Pantnagar, Singh et al. (2010) worked on maize-wheat and showed that maize and wheat was affected by different tillage practices with maximum energy use efficiency of 7.29 and 6.58 for both the crops on permanent raised beds and minimum energy use efficiency of 5.21 and 4.77 were obtained for both the crops from conventional tillage.

In an experiment conducted in agro-climatic situation of Ranchi (Jharkhand), Puran (2013) reported that maximum specific energy in maize-wheat cropping system was 3951.43 MJ/t under conventional tillage practice, while minimum was recorded in narrow bed tillage practice 3115.36 MJ/t.

At Almora, five pigeon pea based cropping systems were compared with rice-wheat cropping system, where Tuti et al. (2013) observed that system net energy return was maximum from pigeon pea-lentil cropping system (93.7 x 103 MJ/ha) and minimum from pigeon pea-barley cropping system (41.1 x 103 MJ/ha). More net energy in return was due to less input energy and more output energy in NW Himalayas therefore they recommended pigeon pea-lentil cropping system for rainfed farming in the region.

Conclusion

The performance of cropping system differs with combination of component crops. Agro-climatic conditions (mainly rain-fed, irrigated, etc.) help to result into an efficient cropping system. Therefore, the efficiency of a cropping system depends on its suitability for higher system productivity, profitability per unit area and time and energy productivity in a region.

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Precision Farming

Article ID: 10771

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Precision farming is a key component of the third wave of modern agricultural revolutions. The first agricultural revolution came along during the advent of increased mechanization, from 1900 to 1930. Each farmer produced enough food to feed about 26 people during this time. The 1990s prompted the Green Revolution with new methods of genetic modification, which led to each farmer feeding about 155 people. It is expected that by 2050, the global population will reach about 9.6 billion, and food production must effectively double from current levels in order to feed every mouth. With new technological advancements in the agricultural revolution of precision farming, each farmer will be able to feed 265 people on the same acreage.

The first wave of the precision agricultural revolution will come in the forms of satellite and aerial imagery, weather prediction, variable rate fertilizer application, and crop health indicators. The second wave will aggregate the machine data for even more precise planting, topographical mapping, and soil data.

Precision agriculture aims to optimize field-level management with regard to crop science by matching farming practices more closely to crop needs (e.g., fertilizer inputs); environmental protection by reducing environmental risks and footprint of farming (e.g., limiting leaching of nitrogen); economics by boosting competitiveness through more efficient practices (e.g., improved management of fertilizer usage and other inputs). Precision agriculture also provides farmers with a wealth of information to build up a record of their farm, improve decision-making, foster greater traceability, enhance marketing of farm products, improve lease arrangements and relationship with landlords, enhance the inherent quality of farm products (e.g., protein level in bread-flour wheat)

Precision agriculture (PA), Precision farming, satellite farming or site-specific crop management (SSCM) is a farming management concept based on observing, measuring and responding to inter and intra-field variability in crops. The goal of precision agriculture research is to define a decision support system (DSS) for whole farm management with the goal of optimizing returns on inputs while preserving resources. The practice of precision agriculture has been enabled by the advent of GPS and GNSS. The farmer's and/or researcher's ability to locate their precise position in a field allows for the creation of maps of the spatial variability of as many variables as can be measured (e.g., crop yield, terrain features/topography, organic matter content, moisture levels, nitrogen levels, pH, EC, Mg, K, and others). Similar data is collected by sensor arrays mounted on GPS-equipped combine harvesters. These arrays consist of real-time sensors that measure everything from chlorophyll levels to plant water status, along with multispectral imagery. This data is used in conjunction with satellite imagery by variable rate technology (VRT) including seeders, sprayers, etc. to optimally distribute resources.

Singh *et al.* 2018 concluded that maize yield was higher at BAU, Ranchi as compared to the yield with RDF and at farmer's field.

Singh *et al* 2007 reported that application of N fertilizer through LCC reading was less than the N applied by the farmer but had almost equal yields. Singh *et al* 2010 observed that application of N fertilizer through LCC reading suggested that the grain yield and nutrient uptake was higher in LCC reading based recommendation as compared to blanket application at farmer's field.

Through SPAD values it was concluded by Singh *et al* 2002 that SPAD value of <37.5 gave the maximum grain yields of rice cultivars PR 106 and PR 111.

Soil moisture tension of 24 ± 2 had the minimum irrigation water applied and irrigation water saving of 46.1% as observed by Kukal *et al* 2010.

According to Annual Report, AP Cess Fund, the laser land leveled gave grain yield of rice as 8.22 t/ha and 8.31 t/ha and water productivity of 0.48 and 0.52 kg/m^3 as compared to unlevelled with grain yield of 7.76 t/ha and water productivity of 0.52 kg/m^3.

Conclusion

Precision farming can play an important role in: Efficient nutrient management (SSMZ, LCC, SPAD. Savings to the tune of 16-23% N. Efficient water management (drip irrigation, tensiometer, laser land leveler) Saving up to 25-49% of irrigation water. Making agriculture eco-friendly and reducing cost of production. Technologies like SPAD meter, drip irrigation, tensiometer etc. can act as foundation stone of the precision farming.

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Mushroom: - A Vegetable for Current Era

Article ID: 10772

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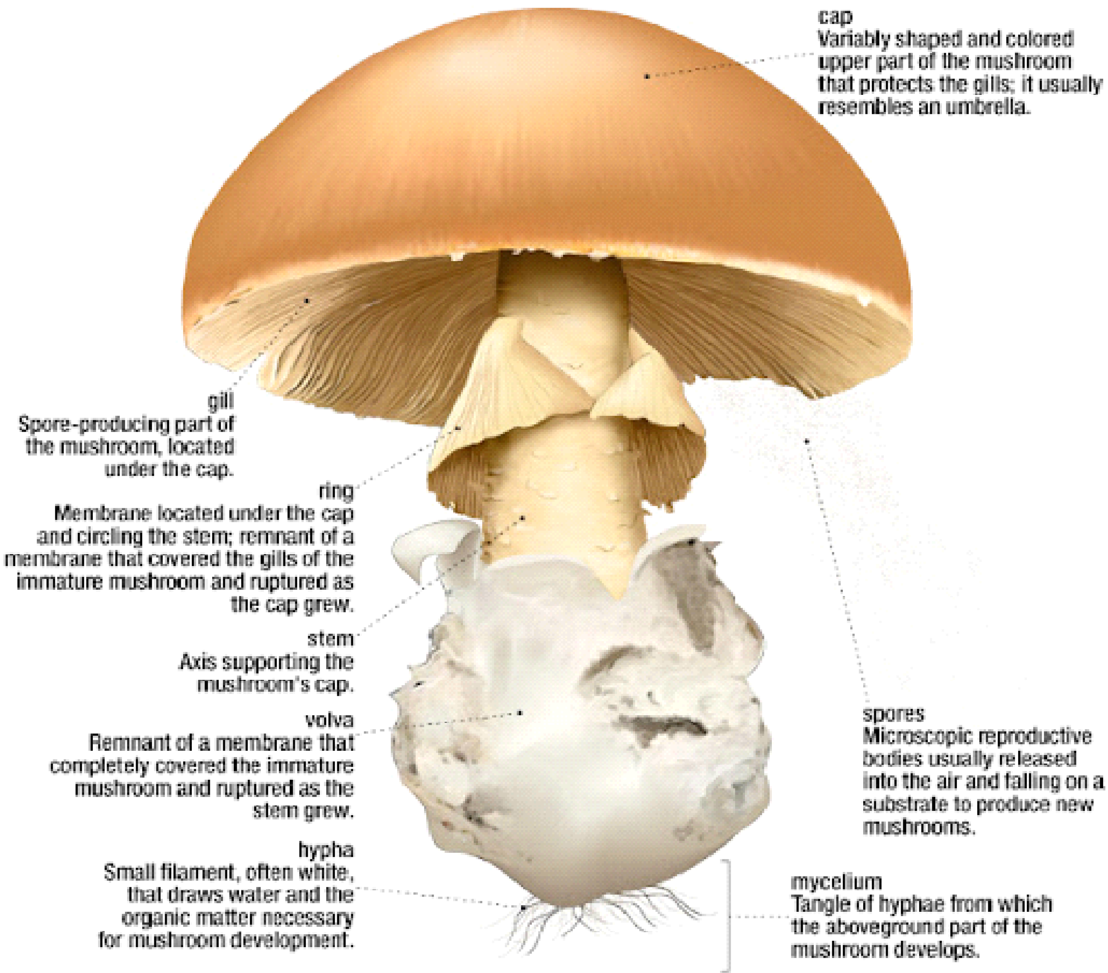
Introduction

Now a day's everyone is becoming more conscious towards their health. Mushrooms are consumed by us as a part of our diet. These are considered as a vegetable for future because of their nutritional and medicinal properties and are mainly cooked as vegetables. They are good substitutes of meat for vegetarians and are low in calories, carbohydrates, fats. They also act as antibacterial agents and are good for our immune system.

Indian diet is primarily based on cereals which lead to problems of malnutrition and various other diseases. In order to feed such a large population with proper nutritious diet we must go for various alternatives such as non-green resolution which is commonly known as mushroom farming. These are grown on waste material and can be cultivated with ease without requiring an extra land.

Morphology

Generally, a mushroom as a root cap, roots, stem semi opened umbrella shaped fleshy fruiting body typically belong to phylum Basidiomycete's order Agaricales and also of some other groups.



Medicinal and Health Benefits of Mushroom

Mushrooms are valued not only for their nutritional value but also for their medicinal properties. It has antibiotic, anti-viral, anti-diabetic, anti-microbial and also a good source of antioxidants. Mushroom is a complete food suitable for all age groups. Including mushroom recipes to Indian diet will bridge the gap of protein and improve overall health status.

Mushrooms are rich in proteins, dietary fibers, vitamins (B, C, D) and minerals (K, Na, P). These are low in calories with no cholesterol. The carbohydrate profile of mushroom includes starches, hexose, pentose and disaccharides. These also contain Ergosterol a precursor of vitamin D.

1. Improves Heart Health: Mushrooms are low in fat content with no cholesterol, low calories. Thus, it is good for cardiovascular patients.

2. Control Blood Pressure: Mushrooms contains low level of sodium and high level of potassium which enhance salt balance and thus control blood circulation.

3. Prevents Cancer: As per some studies mushroom contains certain compounds which restricts tumor activity.

4. Good for Diabetic patients: As mushroom are low in calories, little fat, no cholesterol thus ideal for diabetic patients.

5. Strengthens Immunity: Mushrooms contains minerals, vitamins, antioxidants which help us to develop a good immune system. Specific antioxidants 'Ergohioneine' found in mushroom are good for eye health, kidney, liver and skin.

6. They are also great source of selenium.

Nutritional Facts

Every 100 of edible white mushroom has:
1. 22 kilocalorie energies.
2. 0.3g Fats.
3. 3.3g Carbohydrates.
4. 3.1g Proteins.
5. 92g water.
6. Minerals and Vitamins.

Commonly Grown Mushrooms in India

Various types of mushrooms are grown in India such as:
1. Button Mushroom [*Agaricus bisporus]*
2. Paddy Straw Mushroom [*Volvariella volvacea]*
3. Oyster Mushroom *[Pleurotus ostreatus]*
4. Milky Mushroom *[Calocybe indica]* Shiitake Mushroom *[Lentinula edodes]*

Scopes of Mushroom Production in India

As in production of mushroom in India mostly agriculture product residues are used so it budgets friendly and eco-friendly. But, due to lack of awareness about cultivation techniques and health benefits of mushroom it is not grown widely in India.

Mushroom production provides a good opportunity to earn along with employment to the youth. There are several varieties of mushroom which is edible but the most commonly edible in our country are oyster mushroom and button mushroom.

Punjab, Haryana, Himachal Pradesh, Uttar Pradesh, Rajasthan, Jammu & Kashmir are major producing states. Punjab is the leading mushroom growing state with 50% of total production.

Conclusion

Mushrooms are delicious sources of food found all over the world and its consumption is increasing day by day. After knowing the importance and nutritious value of mushroom people are including it as a source of diet but, excess consumption of mushrooms can cause some physical uneasiness and, in some cases, it might cause panic attack like vomiting. Mushrooms can be used as a supplementary food item in Indian diet which is mainly cereal based and can fill up the gap of protein and improves health of people. Bringing awareness on mushroom cultivation, it's nutritional and medicinal values, improves the livelihood through nutritional and economical contributions. Therefore, selection and consumption of mushrooms of good quality for dietary consumption may be helpful. Being an immune system booster mushroom might also help us to fight pandemic situations like COVID-19.

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Importance of Iron Folic Acid in Woman

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Introduction

Our body is like a complex machine it required about 50 different nutrients for growth, repair and regulation of vital body functions. These nutrients can come only from a healthy balanced diet. The adult human body contain 3-4 g of iron, 60-70% of this is present in the blood as circulating iron while the rest forms storage iron.

Roman soldier added iron filing to their wine before going into battle to increase their energy. Iron we need for building healthy RBC. RBC contains haemoglobin haem is the iron part and globin are the protein part. Iron transports the oxygen in the blood stream. Iron containing haemoglobin as the vehicle that picks up the oxygen from the lungs and carries it to every cell in the body. Cell need a regular supply of oxygen to burn the food we eat and release energy.

We would survive without water or food for several days but not without oxygen. Body requires adequate iron stores to fight infections and defend against foreign organisms. Women daily loss of iron 1mg during menstruation 2mg/day 40 to 50 mg every month. Also, women have smaller iron store than men. Pregnant and lactating women have an increased iron requirement.

Moreover, iron is linked with the learning ability in children. It builds neurotransmitters which in turn regulate the brains' ability to pay attention. Iron is a key mineral for growth and optimal brain function in children and adolescents.

Folic acid is called folate or vit. B9 and is one of the light water-soluble B-vitamins. All the B vitamins help the body to convert carbohydrate into glucose which is burned to produce energy. These B- vitamins open referred to as B-complex vitamins are essential in the breakdown of fats and protein also in maintaining muscle tone along the lining of the digestive tract and promoting the health of the nervous system, skin, hair, eyes, mouth and liver.

Folic acid is crucial for growth and maintenance of cells. It also supports for proper brain function and plays an important role in mental and emotional health. It aids in the production of DNA and RNA in the body. genetic material especially during periods of high growth such as infancy, adolescence and pregnancy, Folic acid also works closely with vitamin B12 to regulate the promotion of RBC and to help iron functions properly in the body. First four week of pregnancy is important when the baby's brain and spine are forming.

When a woman knows that she is pregnant it is often too late to consume folic acid and so she should take it before being pregnant. Folic acid also closely with vit. B 12 to regulate the formation of RBC and to help iron function properly in the body.

Iron Rich Foods

1. Iron rich food include liver, red meat, fish, green leafy vegetables, dried fruits, beans, legumes. However, plant sources of iron are poorly absorbed by the body. Only 2 to 5 % absorbed in blood stream. Because plant sources contain inhibitors/barriers like Phosphates, Phytates, Oxalates which interfere with absorption.
2. Vit. –C rich fruits like citrus fruits, Tomatoes and green vegetables. Vitamin C rich diet helps in absorption of iron.

Folic Acid Rich Diet

It includes lean meat, liver, dark green leafy vegetables, Kidney beans and whole grains.

Iron Requirement

Children and adolescent: Iron is a key mineral for growth and optimal brain function in children and adolescents. Iron need more in adolescence due to increase in lean body mass, blood volume and haemoglobin and to replace menstrual losses in adolescent girls. Moreover, iron is linked with the learning ability to pay attention.

Elderly persons: Elderly persons need extra iron either due to low intake or due to gastrointestinal problems.

Athletes: Athletes required more iron due to the skipping meals, poor diets and blood loss through trauma and injury.

Vegetarians: Insufficient iron rich food in vegetarian diet and poorly absorbed forms of iron in plant food required more iron. It is not easy to get iron from the diet. In the plant sources contains inhibitors like phosphate, phytates, oxalates which interferes with absorption. Vitamin -C rich food increases iron absorption.

Deficiency of Iron

Iron deficiency is one of most common nutritional disorders in the world. 4 to 5 billion people in the world, 66-80 % of population may be iron deficient. WHO & UNICEF now recommend routine iron supplementation of young children, adolescent, and women of child bearing age and pregnant woman.

In children low iron levels causes attention deficit disorder symptoms may include of hyperactivity, inattention, boredom, learning disabilities, lack of motivation and loss of interest in families and friends. Iron deficiency causes anaemia.

It is a condition where a person has inadequate amount of iron to meet the body's demands. RBC are smaller paler and fewer in number. Symptoms are pale skin colour, fatigue, irritability, dizziness, weakness, shortness of breath.

Folic Acid Requirement

Birth defects: Women have more folic acid requirement because it can protect against serious birth complications and birth defects during pregnancy. Inadequate intake of folic acid slows down the growth of foetus and increase the risk of neural tube defects and brain damage in new-born babies.

Osteoporosis: Keeping bones healthy depends on getting specific vitamins and minerals i.e., phosphorous, magnesium, boron, copper, zinc, folic acid and vit. –c.

Elderly and folic acid: Between 15 to38 % have low folic acid people will have depression. It is an important factor for elderly people.

Heart disease and folic acid: Folic acid can help to protect the heart through several methods. Risk factors like cholesterol and homocysteine by diminishing this damage, folic acid helps the blood vessels function better improves blood flow to the heart. It prevents the cardiac pain and heart attack and reduces the risk of death. The Americans heart association recommends iron folic intake regularly.

Deficiency of Folic Acid

It can cause poor growth, tongue inflammation, gingivitis, loss of appetites, shortness of breath, diarrhoea, irritability and mental sluggishness. A recent study shows that birth defects in new-born babies in the US has decreased since FDA authorized the fortification of foods with folic acid.

Conclusion

Who and UNICEF have declared the combinations of iron and folic acid as the most rational combinations? The two complement each other, aid in better and faster absorption by the body and together help to supplement your diet and maintain good health.

It is also good to take folic acid with a multivitamin because other B vitamins are needed for effective folic acid activation. Make iron and folic acid supplements a part of our family's healthy lifestyle. Iron increases a healthy immune system and adequate energy.

WHO and UNICEF now recommends routine iron supplementation of young children, adolescents, women of child bearing age and pregnant woman?

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Paddy Leaf Roller

Article ID: 10774
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Introduction

Paddy is a very important and chief staple crop of India (Mandeep et al., 2017). It's production in India is carried out on a very large scale in our Country due to its favorable environmental conditions. It requires high rainfall and irrigation if sufficient rain is not available. Thus, it can be grown in most of the tropical areas. It is also subjected to a lot of pests and thus requires high pesticide applications. Out of all the common pests, Paddy Leaf Roller or Rice Leaf folder is also a common pest of Paddy having the ability of causing huge economic loss. Its botanical name is *Cnaphalocrocis medinalis* belonging to family Pyralidae. Its infestations are seen when the temperature and humidity increase thus if not controlled timely, it can cause yield loss. Its spread can be seen in almost all the Paddy cultivated areas (Gangwar et al., 2015).

Biology

1. The adult Paddy Leaf Roller has yellow feathers having grayish brown strips at the margins (Gangwar et al., 2015).
2. Their females can lay eggs either singly or in groups having incubation period of about 4 days.
3. After completing the incubation period, the larvae of the Paddy Leaf Roller emerge out.

4. The larva is slightly greenish to yellowish in colour.
5. The larva undergoes about 6 nymphal period and then enters into its pupation stage for which they roll the Paddy leaves vertically around them using their saliva.
6. The pupal period is completed within 1 week and after that the adult Paddy Leaf Roller emerges out.

Damage Symptoms

1. The most damaging stage of Paddy Leaf Roller is its larval stage (Gangwar et al., 2015) as they rolls the leaf around them decreasing the area of photosynthesis and feeds on it internally due to which the leaves appear transparent (Padmavathi et al., 2012).
2. Their larva scratches the greenish portion of Paddy making them colourless and dry which also reduces the photosynthetic ability of leaves thus affecting yield (Ankit et al., 2016).
3. Infected leaves are rolled vertically having larva in between the folded leaves.
4. In case of heavy infestation almost all the leaves are folded due to which the field shows scorched appearance.

Management

1. If the infestation is on small level, then, pluck the infected leaves and destroy them.
2. The application of Nitrogen should be reduced in the infected Paddy fields as it encourages the rapid growth of Paddy crop providing matured leaves as a favourable condition for the infestation of the Paddy Leaf Roller.
3. Weeding at a regular interval must be performed to discontinue the life cycle of the pest.
4. In order to control the pest by natural predators any egg parasitoid like Trichogramma sp. or larval parasitoid like Apentales sp. etc. should be released into the infected fields (Rani et al., 2007).
5. Low plant density in the field should be preferred to reduce the yield losses.
6. Installation of light traps in the infected fields will attract the adult Paddy Leaf Roller.
7. To control the pest chemically, Pests like Alpha-cypermethrin, Chloropyriphos 20 EC, Fipronil 200SC, Lambda cyhalothrin (Sulagitti et al., 2017), Azadirectin etc. should be sprayed in the field.

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Recent Trends in Poultry Farming

Article ID: 10775

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Introduction

Indian poultry industry is one of the fastest growing segments of the agricultural sector today in India Today India is world's third largest egg producer and the eighteenth largest producer of broilers. The Indian poultry industry has grown largely due to the initiative of private enterprises, government intervention and very considerable indigenous poultry genetics capabilities and support from the complementary veterinary health, poultry feed, poultry equipment, and poultry processing sectors. The organized sector of Indian poultry industry is contributing nearly 70% of the total output and the rest 30% in the unorganized sector. Broiler industry is well dominated by the southern states in our country with nearly 60-70% total output coming from these states.

Feeding Systems in Poultry

1. Most of the poultry rations first for formulated were used to supplement locally produced cereal grains on the average small farm. Thus, feeding a formulated feed which is balanced in all the essential nutrients needed for normal growth and production of birds is called complete feed.
2. Complete feed does not require any supplementation.

Different Feeding System for Feeding of Poultry are Given here Under

1. Adlibitum feeding: This system also called as free choice feeding. In this system feed is always available and the birds can eat at will. Adlibitum feeding is practiced in broiler chicken where maximum body weight is the ultimate goal for rearing the birds. Feed can be supplied for several days at a time and need no monitoring or supervision of the bird's daily intake.

2. Control feeding: (a) Forced Feeding: It is sometime attempted for a short while in first week when turkey poultrys do not learn or try to pick up their feed. Forced feeding may be employed in other species if feed and water are denied for more than 36 hours to prevent body dehydration. Mash water mixture, sweetened milk, skim milk etc. should be fed.

3. Restricted feeding: Restricted feeding during the growing period means an actual reduction of nutrient intake below minimum requirement of birds. Feed intake is reduced either by limiting feed offered to 85-90% of normal fed intake or by diluting the conventional feed with fibrous material of low nutrient density or following skip a day feeding. In skip a day feeding feed is provided on the first day at 85-90% level of the 2 days ration; on the 2nd day birds are not given any feed and some whole grain may be spread on litter. Feed restriction is recommended until 21 or 22 weeks of age up to 5% egg production level.

4. Phase feeding: Followed during laying phase. Phase feeding refers to change in the protein level of laying diet during normal production cycle. Such changes are designed to regulate the intake of dietary protein meet more closely the hen's requirement at various stages of egg production. Reduce feed cost and also to help to maintain the egg size.

Some Modern Poultry Farm House Innovations

1. Automated public access control: With showers, concrete flooring between houses to reduce vegetation, pad cooling with easy cleaning and disinfecting even when birds are present.

2. Chain-feeder technology: It promotes efficient food distribution by accurately measuring feed and providing uniform nutrition for every birds.

3. Fluid LED light: Its level control, flicker free lighting system, with multiple light level settings.

4. Air quality: It monitor is designed to sample the air within the building every two minutes and display the following air quality information CO_2/ Ammonia/ Humidity/ Temperature.

5. Water system: It designs to keep water uncontaminated by preventing dirt, faeces and other pollutant from entering the automatic drinking system.

6. Innovative waste management methods: Manure belts systems in egg production, pelletization of dried manure further stabilizers the materials, reducing dust. Some countries are using Black Soldier Fly (BSF) larvae are an alternative system for manure treatment.

7. Remote Access Livestock Monitoring: Our Livestock Monitoring system allows poultry farmers the ability to view their broiler sheds internally from their smartphones, tablets and personal computers, in greater detail they can view feed and drinker lines, hoppers, birds spread, all without the need to enter the houses as regularly as they normally would.

Scope with Value Added Products

1. Whole egg powder, brined and pickled eggs, egg roll, egg strips, egg cutlet, egg crepe and waffle, albumen flakes/rings, yolk powder, natural yellow pigment from yolk, lecithin and avidin from eggs used in pharmaceutical industry.

2. Lysozyme, di-calcium phosphate from shell and membranes, cured and smoked chicken patties, intermediate moisture diced products with long self-life, battered, chicken soup, chicken essence, kababs, marinated breast fillet, frankfurters etc.

3. Giblets, liver and liver extract, deboned meat for airline industry, chicken gizzard pickle, feather meal, poultry by-product meal from inedible portions as a source for poultry feed etc.

4. High demand for various forms of egg powder and hatching eggs including Specific Pathogen-Free (SPF) Eggs.

Top Leading Companies

Leading broiler integrators in India are as follows:
1. Venkateswara Group, Pune.
2. Suguna Poultry Farms Ltd, Coimbatore.
3. Pioneer Poultry Group, Coimbatore.
4. Godrej Agrovet Ltd, Mumbai.
5. Sky Lark Group, North India.
6. Jafa Com Feed

Strategy for Organized Sector

1. Intensify education and awareness about nutritive value of egg and poultry through various platform like World Egg Day etc.
2. Develop Marketing Intelligence domestically and internationally in collaboration with ICAR and other Department/ Agencies.
3. Formulating Package of Good practices where central poultry Development Organizations along with ICAR can help devising region or even state-specific practices.
4. Facilitate Industry- Academic partnership so as to enable transfer of technology at the grassroots level. A regular interface with ICAR and Universities is ensured through various technical committees. An industry DADF state Government Interface Committee is also constituted.

Conclusion

India has technically qualified manpower, a strong private poultry sector and financial credit institutions. There is a considerable scope in investments in all aspects of poultry namely breeding, feeding, Housing and management, health control and processing and marketing of products both for domestic as well as export market. Hence the poultry farming is a good source of earning income for farmers and new entrepreneurs as a business.

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Introduction

Azolla is a floating fern which resembles the algae. Normally azolla is grown in paddy fields or shallow water bodies. Azzola Multiplies very rapidly. Azolla an aquatic fern is regarded as "Live Nitrogen Manufacturing Factory" because, it harbors nitrogen fixing Cyanobacteria. It has been extensively used both as biofertilizer and green manuring for rice cultivation in the South East Asian countries. More than 50 % nitrogen can be supplemented when Azolla dual cropped with rice.

Azolla as Fodder/ Feed

Rich in proteins, essential amino acids, vitamins (vitamin A, vitamin B12 and Beta- Carotene), growth promoter intermediaries and minerals like calcium, phosphorous, potassium, ferrous, copper, magnesium. Dry weight basis, it contains 25 - 35 percent protein, 10 - 15 percent minerals and 7 - 10 percent of amino acids, bio-active substances and bio-polymers. Livestock easily digest it, owing to its high protein and low lignin content. Azolla can be mixed with concentrates or can be given directly to livestock Can also be fed to poultry, sheep, goats, pigs and rabbits.

Azolla Production

The soil in the area is first cleared of weeds and leveled. Bricks are lined horizontally in a rectangular fashion. A UV stabilized silpauline sheet of 2mX2m size is uniformly spread over the bricks in such a way as to cover the margin of the rectangle made by the bricks. 10-15 kg of sieved soil is uniformly spread over the silpauline pit.




Slurry made of 2 kg cow dung and 30 g of Super Phosphate mixed in 10 liters of water, is poured onto the sheet. More water is poured on to raise the water level to about 10 cm. About 0.5- 1kg of pure mother azolla culture seed material is spread uniformly over the water, after mild stirring of soil and water in the azolla bed. Fresh water should be sprinkled over the azolla immediately after inoculation to make the azolla plants upright. In a week's time, the azolla spreads all over the bed and develops a thick mat like appearance. A mixture of 20 g of Super Phosphate and about 1 kg of cow dung should be added once in 5 days in order to maintain rapid multiplication of the azolla and to maintain the daily yield of 500 g can also be added at weekly intervals to enhance the mineral content of azolla. About 5 kg of bed soil should be replaced with fresh soil, once in 30 days, to avoid nitrogen build up and prevent micro-nutrient deficiency 25 to 30 percent of the water also needs to be replaced with fresh water, once every 10 days, to prevent nitrogen build up in the bed. The bed should be cleaned, the water and soil replaced and new azolla inoculated once every six months. A fresh bed has to be prepared and inoculated with pure culture of azolla, when contaminated by pest and diseases.

Harvesting

Azzola will grow rapidly and fill the pit within 10 - 15 days. From then on, 500 - 600 g of azolla can be harvested daily. Can be done every day from the15th day onwards with the help of a plastic sieve or tray with holes at the bottom. The harvested azolla should be washed in fresh water to get rid of the cow dung smell.

Alternative Inputs

1. Fresh biogas slurry may also be used.
2. Waste water from bathroom and cattle shed can also be used to fill the pit.
3. In areas where there is a problem of fresh water availability, the water left after washing clothes (after the second rinsing) can also be used.

Environmental Factors for the growth

1. Temperature 20°C - 28°C.
2. Light 50% full sunlight.
3. Relative Humidity 65 - 80%.
4. Water (standing in the tank) 5 - 12 cm.
5. pH 4-7.5.

Points to be Noted During Cultivation of Azolla

Washing in a net will be useful as it will allow small plantlets to get out, and they can be poured back in to the pond. Care should be taken to retain the temperature below 25°C. Shade nets can be used to cut the light intensity. The azolla biomass should be removed daily to avoid overcrowding.

Azolla Rice Dual Culture

Field Method for Azolla Multiplication

1. Prepare and level the field.
2. Uniformly Divide the field into 20x5m providing suitable bunds & irrigation channel.
3. Maintain 10 cm water depth.
4. Add 10 kg cowdung+8kg.
5. Azolla+100 gm SSP /plot.
6. Harvest after 15 days.

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Educational Institute World Wide is Under the Influence of Global Lockdown

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Abstract

Education is at its core a process of socialization. Whenever the nature of society changed, there was talk of change in the nature of education as well. Today, in the era of Corona crisis, the proposal for change in the form of education through online education is being strongly proposed by the position.

In such a situation, it is necessary to see that what is such a fundamental change in the structure and purpose of society that it is being described as inevitable After Independence, is the model of universal education with nationalism based on freedom, equality and fraternity no longer word while has socio-economic-political equality been achieved? With online education, the new Education policy that the government is moving towards, which socialization of education are the future objective policy makers.

Has socio-economic-political equality been achieved? With online education, the new education policy which the government is moving towards, which socialization of education is the future objective? Online education is not just technology but a new process of socialization through which the policy and intention of government and policy makers can be understood and it needs to be seen in the same way.

It is one thing to use technology for education by maintaining physical distance in corona crisis. Anyway, with the development of technology, it has also been used in education. It also has to be. Changing technology from blackboard to smart board was used to make classroom teaching strong and interesting. Digitalization of the library is a form of the same process. Recording lectures of professors and making them available online is also the use of technology. The process of socialization was increased through education using these techniques.

Keywords: Education, Global, Influence, lockdown.

Introduction

Corona virus, which has emerged as the biggest problem or period in 21st century, has shaken the entire world today. Developing countries of the world, as well as developed countries, have been caught in the virus. This virus has not only attacked the health of the people of a country. Rather, it has severely affected the economy, education, defense and health departments that are considered to be the backbone of a country. At the time of lockdown, online education is now being used on a large scale, where it is good in developing countries like India; there are also the consequences of online education and examination. In the last few years, there has been an increase in data theft and leaks of examinations. The field of online education is at the forefront. Everyday fake news and cybercrime in social media has reduced the importance of online education and examinations.

It is not that the problem of cybercrime exists only in our country. This is also a big problem in developed countries of the world. The leak of the UP-Board 10th Examination for Social Science, SSE, Junior Engineer Recruitment Examination Question Paper of Railway Recruitment Board (RRB) and important examinations for technical posts of Indian AIFF shows its biggest drawback and negligence. Some of the wrong people of the country, even the app "PM Cares Fund", created by the common man for cooperation with the corona, even made a fake account. In such activities, the confidence and confidence of countrymen and examinees is broken.

Where students are benefiting from online classes and education facility provided by the government So at the same time, a large number of students are also present in the country that does not have any medium like phone. A large section of India is living below the poor line. In such a situation, there is no relation or benefit for him from online classes and books online. Online resources are very expensive, which very few families are unable to buy. In such a situation, it is just a dream for them to get online education. There are many such poor families in the country.

Those who were living before working, in such a situation, all the sources of income have become due to the closure of business. Due to which the children of many poor families can be deprived of education from the poverty of the family. There is also some material in online education which is not favorable or beneficial for children. In such a situation, it works by tying the online system to a boundary.

Global Impact of Lockdown on Education/ Learning Based Field

1. Corona virus epidemic has also changed the way millions of people worldwide are educated. Schools have been closed due to the declared or enforced lockdown in 39 countries, affecting more than 421 million children. In addition, 22 other countries have also announced partial "localized" closure.
    a. The corona virus is spreading rapidly in Asia, Europe, the Middle East and the United States; these countries have taken rapid and decisive action to reduce the development of a fully developed epidemic. In the last two weeks, there have been several announcements to suspend the attendance of students in schools and universities.
    b. These decisions, aimed at overcoming the crisis, caused temporary 'home schooling' conditions for millions of students, especially in countries such as China, South Korea, Italy and Iran, which corona virus Causes include the most affected countries. These changes have certainly caused inconvenience, but they have also introduced new examples of educational innovation.
    c. To help slow down the spread of the virus, students in various parts of the world including India started reading and learning at home through interactive apps. Most have access to learning materials through live television broadcasts.
    d. After 5G technology has become more prevalent in countries like China, America and Japan, learners and solution providers adopt particular forms of digital education concept of "learning anywhere, anytime, any time". Will move towards new methods of learning will replace traditional in-person classroom learning - from live broadcasts to "educational influencers" and virtual reality experiences. Teaching will become a habit that will adjust to the daily routine of the daily routine.

2. Educational associations and alliances can take shape with diverse stakeholders - including governments, publishers, education professionals, technology providers and telecommunications network operators - who come together to use digital platforms as temporary solutions to the crisis. In emerging countries where education has been predominantly provided by the government, it can become a prevalent and consequential trend for future education.

3. This pandemic has also come as a chance for students to make our decisions in this unpredictable world by making informed decisions, solving a problem in a constructive manner and most importantly adaptability such as skill learning. To ensure that these skills become primary for all students, flexibility must be developed in our educational systems.

There is a lot of malfunctions in India's education system and students are unable to follow their regular academic routines. In the wake of this emergency and keeping in mind the safety of students and their academic concerns, most institutions have taken the initiative to make telecommunications, Skype calls, zoom calls and other virtual options accessible to bridge the learning gap. It is training students and teachers using technology to facilitate virtual classrooms and information exchange. Undoubtedly, this is a very important time for students. Therefore, the move aims to reduce the pressure on students and help them use their time in a beneficial way without any compromise with quality.

Influence of Global Lockdown

1. The way the new education policy and online education is being talked about today, it has nothing to do with it. It is related to the model of privatization of education.

2. It is natural that there was a difference in outlook as well. For the first time, the education sector was recognized as a multi-billion-dollar global market. It has been suggested that this sector should be declared a business or profit-making business.

3. The field of education was under the state, which was changed during the Emergency and brought to the concurrent list and now it is being centralized in the new education policy. The participation of the state governments in policy formulation is minimal.

4. The role of academics in it has also been reduced in such a way that they will remain as mere symbols. Those whose role has been enhanced in this are business houses and political intervention.

5. Now these managers will be the policy makers of education and will decide the rules. This will decide what will be the purpose of that educational institution! Now the same governors will also decide the conditions of service of teachers and employees. Everything from promotion to suspension will be decided here. This will be the creator of fate.

6. The definition of teacher and student has changed in this new education policy. The definition of teacher and student was coined in the education policy of modern India by eliminating the tradition of Ekalavya of medieval guru-disciple.

7. Along with this, part of this proposal is to reduce costs by resorting to technology. In place of permanent teacher, a general arrangement for contractual appointments is being made, so that the cost can be reduced several times.

8. Along with this, the work is being done to drastically reduce the cost through online content. The funny thing is that by advertising it, high fees are being charged from the students on the other side.

9. If you look at the advertisement of all the private institutions, you will also get proof of this. The current government's policy of pushing the imperative of online using the Corona crisis needs to be understood in this perspective.

For schools and colleges to reopen, educational institutions will have to re-evaluate their current standard operating procedures for dealing with the issue of public health. It is important for students to return to the classroom gradually, though with all precautions to maintain the quality of knowledge sharing, which is only possible with face-to-face interaction as well as peer-to-peer learning.

The lockdown has stimulated more and more students to study from home, affecting concentration and productivity. However, for schools and colleges to reopen, educational institutions will have to re-evaluate their current standard operating procedures to deal with the issue of public health and adopt new safety solutions to protect the overall institution as these places hold approximately 50 people. have been co-shared with. on time. The health safety risk cannot be ignored and needs immediate attention. Educational institutions can adopt both physical and health protection measures that will help get students back to attend classes on campus, as well as reassure them and their parents. Today India is one of the largest markets for education. The Indian education sector is expected to reach US$ 1.96 billion by 2021 with around 9.5 million students. According to the new education policy, India is a major destination for attracting students from abroad to study in the universities here. Hence, it becomes important for the educational institutions and the leaders of these institutions to ensure complete safety of the students and teaching faculty working out of the campuses once they reopen after the lockdown. The key factors that will play a key role in the post-pandemic revival are ensuring the health safety and security of workers on campus and introducing new solutions to help the entire sector re-boot. Here are some techniques that can be adopted by schools and colleges to optimize their surveillance and security to ensure public health safety.

a. Adoption of contactless technologies – One of the key points to keep in mind while reopening educational institutions is to reduce human touch points at all intersections and avoid large number of assemblies. This can be done by adopting new techniques of surveillance and sanitation. Schools and colleges can use turnstile hand sanitizer dispenser with thermal scanner for body temperature in place of manual tracking at the main entrance of the campus. These thermal scanners can help teachers to check students' health and eliminate students at high risk for their safety. It will also help streamline entry and access to a particular area and ensure that all students, staff are sanitizing their hands before entering the campus.

b. Enhanced surveillance to monitor social distancing – On checking at the time of admission, institutions will have to keep a constant check on students and others on campus without disturbing them during class hours. A clever way of doing this is by deploying surveillance cameras at various points that enable the administration to survey the parameters of the premises and ensure that people are practicing social distancing within the premises, including cafeterias, water coolers , maintaining distance at different places like field. , laboratories, etc. It can be managed with ease of human intervention and monitoring while protecting the privacy of the students. Adoption of new generation surveillance cameras can help to comply with all protocols

c. Optimization of structure and design – In order to accommodate new security solutions, schools as well as colleges must undergo structural and design changes. Space and storage management can help students as well as teachers to contract infections less from surfaces and objects. After the lockdown, educational institutions should consider adapting their existing structures and facilities to streamline classrooms, halls and other common areas. The new design changes are to be made in such a way that students can work, study and do other activities comfortably.

d. Dividing class time – Classrooms have always been structurally designed to accommodate safety. Most classes can be suitable for about 50-80 students on a one-time basis in the campus area. After the lockdown many educational institutions may consider optimizing their class timings by conducting classes in different batches to suit the needs of the students. This will ensure that classrooms that require a lab or PT can move around as well as ensure that too many people do not have to congregate for long periods of time in a particular area, while also maintaining a distance of six feet.

e. Medical personnel on campus – While most campuses have medical staff to deal with emergency issues and concerns for students, it is now mandatory to have medical personnel to test and treat students with infectious diseases or any communicable diseases. Trained staff can eliminate students who are at risk and provide good medical advice to students to care for their illnesses.

f. Self and surface cleaning – Deploying turnstile sanitizer is an easy way to ensure that people in these locations are constantly sanitizing their hands, but at the same time using hygiene items/equipment to avoid the spread of diseases It is very important to do. from surfaces. Cafeterias can start using paper-based disposable cutlery and plates for students and staff. Cleanliness of surfaces and daily classroom equipment is important for teachers and teaching members. Classrooms, as well as teacher's lounges, can be equipped with UV sanitization boxes to store notebooks, test papers, stationery so that they can be sanitized before use. To be extra vigilant after the pandemic, schools and colleges should also adopt UV technology-enabled UV cases, which can be used to bring any item from outside like phones, masks, wallets etc.

Medical researchers, pharmaceutical companies and scientists around the world are working on active vaccines to help us fight this pandemic. There have been many breakthroughs to develop a cure for COVID-19, but when the greatest minds are at work, we as individuals need to ensure our safety. It is important for the country to follow the guidelines and for the betterment of the students across the country, educational institutions should help the students to return to the campuses without constantly going insane. Not just students, parents will also be comfortable sending their kids back to campus with the right safety guidelines. All educational institutions will have to make a one-time investment that assures their students, helps the campuses get back to business as usual, and ultimately helps the economy recover from the slowdown. Adoption of new technologies and techniques will go a long way in ensuring linear growth for all sectors and in turn the economy.

Conclusion

Online education may be 'necessary under compulsion' in times of present crisis, but quality education may not be an option at all. Some people are seeing social discrimination in online education. He argues that backward classes do not have smart phones, computers, data, etc., so they will be deprived of the benefits of online. This concern is true. This is a situation arising from the immediate problem of the corona crisis. If we see the difference between the cost of Smartphone, computer, data, etc. and the cost of classroom education, then it will be understood that using this logic, the Dalit-backward sections are being excluded from quality education.

They are being pushed towards online. The government is talking about giving the option of online education to the poor Dalit backward through these technical facilities. They are giving him the name of cheap education and quality education. Massive Open Online Courses (MOOCs) are being emphasized for this reason. After independence, educational institutions were built according to the need of the country. The study of law etc. along with doctor, engineer was taken into consideration. There was a sense of building a citizen in all these. A citizen who has a critical conscience with liberal values like freedom, equality and fraternity This was also the moral value. It was a policy to create these moral values through literature and social science. Today, that whole policy is being described as wrong. The policy of establishing the moral values of Indianness which is being implemented on the pretext of attacking 'secularism' are communal moral values. Who tolerates any kind of critical conscience cannot do. Therefore, the new policy that only states vocational education is the need of the nation. The Liberal attacks universal values by calling them Macaulay's education policy and calling them Western values. Its alternative is the non-equal Brahmin cal value of Indians. That is why instead of the creation of universal liberal values, they are emphasizing 'communalization through moral values' and 'commercialization education' rather than critical conscience building. In such a situation, there is an attempt to increase 'New Nationalism' by eliminating nationalism born of universal value.

The role of education in nation building now means such vocational education which is only aimed at generating employment. Employment is directly related to the economy and not just vocational education. Today, technology is being described as the option of science and skill means skill is the option of education. The real purpose is the same and that is to make education a profitable business and to eliminate all the obstacles that come in it. For those who will have so much money in their pockets that they can get quality education, for them there will be a few institutions like Asoka and Jio whose fees will be in lakhs. For the rest, the system of vocational education is being done through the privatization and commercialization of various institutions. It is the policy of the government to provide cheap online facilities for the remaining exploited dalits, backward, poor and women. This is the pain from farming to all small businesses. On the one hand, large business capital is trying to destroy them, on the other hand they cannot be organized in any way - the effort is on. Labor law is being changed. Along with increasing the working hours, the rule of forming a trade union is also being scrapped. A rule is being made to ban students and teachers from forming any kind of union. Today 70% of the society have reached the position of going below the poverty line. The rate of unemployment increases due to the Corona crisis. The Corona crisis is facing a challenge in the face of the Indian economy already going towards economic recession. People's purchasing power is at the lowest level. So, where the alternative is to strengthen the field of public health and public education, increase government investment so that the capacity and competence of the citizens can be increased, their purchasing capacity can be increased, the economy can be put on track! But the government's intention is completely different. She is pursuing Birla-Ambani's capitalist policies only on the basis of the crisis. It is said that a friend is identified only at the time of crisis. The identity of the present government can also be seen during this corona crisis.

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Effect of Climate Change in Management Plant Diseases

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Introduction

The occurrence and severity of several plant diseases are get probably influenced by change in climate in many ways. It also affects crop production and also imparts great deviations in farming practices. The variations in temperatures and humidity affect the diversity and responsiveness of several plant diseases and also affect disease management with regard to timing, preference, efficacy of chemical, physical, biological control measures along with their utilization under integrated pest management strategies. Under such situations, weather-based disease monitoring, time to time monitoring of inoculum for air and soil borne plant pathogens and utilization of rapid diagnostics tools would play an important role. Besides, integrated disease management strategies should be developed to decrease utilization of fungicides. Other approaches include selection of healthy seeds with durable disease resistance, intercropping systems, monitoring and early warning systems for forecasting of disease epidemics, use of botanical pesticides and plant derived soil amendments can help in mitigation of climate change since it helps in reduction of nitrous oxide emission by nitrification inhibitors like nitrapyrin and dicyandiamide (Pathak *et al.*, 2010). Some of the following major strategies to be mentioned under climate change regimes are:

1. Adaptation strategies: The recent predictions and estimations of increased frequency of global climate extremes as well as changes in ecoclimatic zones might be an indication of global warming (Milly *et al.*, 2002). However, adaptation strategies vary with the agricultural systems, location and scenarios of global climate change also. At higher levels of adaptation, the cropping systems and types of crops could be changed altogether along with the field management adjustments or cultivation areas could shift geographically (Reilly *et al.*, 2003). In addition to these, land management systems could be adapted to climate change. Shifts from rainfed to irrigated agriculture are the simplest way, but issues of water availability, cost and competition are needed to be considered (Rosenzweig *et al.*, 2004). However, some adaptations would tend to be successful such as change in planting dates to avoid heat stress but some adaptations such as changing varieties, changing the crop rotations and development of new agricultural areas, may not be always effective in overcome the negative effects of changing climate on crops. Moreover, there may be some gains from fewer frosts, altered precipitation patterns, CO_2 fertilization, and longer growing seasons (Chakraborty, 2005). For horticultural crops, the effect of global warming favours the use of soil solarization techniques, which are reported to be highly effective in managing soilborne pathogens such as *Verticillium dahliae* and *Fusarium spp*. (Strand, 2000).

2. Mitigation strategies: Disease management strategies are needed to change with the changing climate since it will cause alterations in geographical and temporal distributions of several plant diseases and consequently control measures will have to be adapted to climate change scenarios. Moreover, changes in temperature and high precipitation can also alter fungicide residue dynamics. The several modes of action of fungicide like penetration, translocation *etc.* can be affected with the changes in plant morphology or physiology due to high concentration of CO_2. Besides, changes in plant growth and development can alter the period of higher susceptibility to pathogens that can determine a new fungicide application (Pritchard and Amthor, 2005). Therefore, some others important mitigation strategies for managing plant diseases in respect to climate change should include as reported by Gupta *et al.* (2018):

a. Selection of resistant cultivars/varieties under elevated temperature.
b. New molecules with higher efficacy at increased temperature for disease management.
c. New forecasting model for prediction of disease appearances like Down-scaling climate models and focus on variability in disease epidemiology.
d. Changes in date of sowing to avoid cause of epidemic.
e. Efficient tillage practices for disease management.

f. Selection of bio-agents having wide range of temperature adaptability.
g. Integrated disease management by integration of all the existing technologies.

The vulnerability of biological control agents will be higher under climate change, since more difficulties on their survival and activity of applied antagonists has been imposed (Garrett *et al.* 2008). Accordingly, the more diverse, flexible and more resilient crop production systems will be needed in future that can readily deal with changing environmental condition.

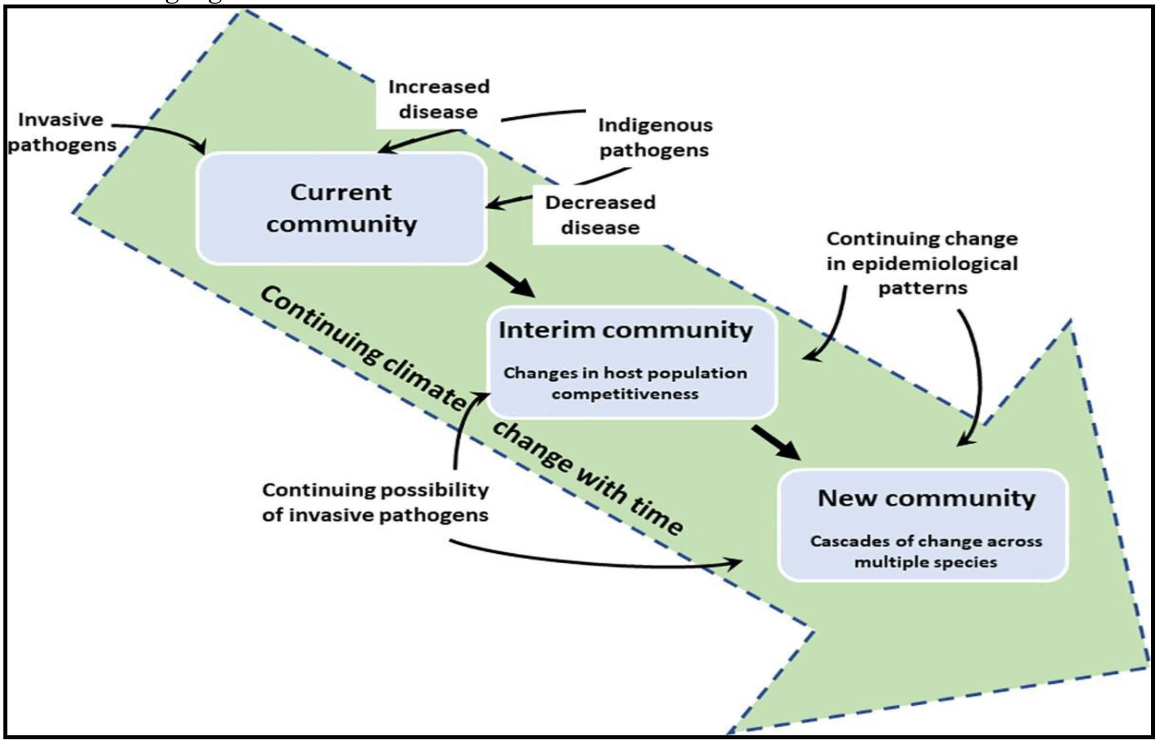

Fig 1. Picture showing ways in which climate change may affect wild plant community structure as increased or decreases in disease or invasion of new pathogens leads to either positive or negative changes in host (Courtesy: Jeremy, J. Bourdon)

Case Study

1. Extinction of local pathogen due to rising temperature: A study on metapopulation of about 230 *Filipendula ulmaria* host patches in northern Swedish archipelago has determine the effect of climate change on disease epidemiology (Zhan *et al*., 2018) where host is infected by rust pathogen (*Triphragmium ulmariae*) which varies in incidence and severity from year to year and patch to patch.

Their finding has demonstrated a strong correlation in between an increased rate of local extinction of pathogen with a steady rise in summer temperature.

2. Viral diseases under climate change: Viral diseases transmitted by whiteflies and appearance of tomato yellow leaf curl disease, cassava mosaic disease, cucurbits virus diseases, tomato chlorosis *etc*. has increased with changing climate (Navas-Castillo *et al.,* 2011).

Potato leaf roll virus and Potato yellow vein virus which are best adapted to warmer regions has shifted to higher elevations with cooler climates in hilly regions while some viruses adapted to cooler regions like Andean potato latent virus and Potato mop top virus are adapted in higher elevations in hilly regions (Jones, 2016). Likewise, Soil Borne Wheat Mosaic Virus and Wheat Spindle Streak Mosaic Virus are adapted to temperate conditions and mostly occur in cooler parts of Europe, Asia, North America, and New Zealand are likely to expand to higher latitude areas (Cox *et al.,* 2014).

3. Bacterial diseases under climate change: Plant pathogenic bacteria such as *Acidovorax avenae* subsp. *aveane, Ralstonia solanacearum* and *Burkholderia glumea* which are high temperature tolerant have emerged as serious problem worldwide under climate change (Schaad 2008). Huot *et al.* (2017) reported that with rise in temperature the susceptibility of Arabidopsis to *Pseudomonas syringae* pv. tomato (Pst) has significantly increased.

4. Wheat diseases under climate change: The changes of future Fusarium head blight risk in South America (Fernandes *et al*. 2004), future karnal bunt risk in Europe (Dumalasova and Bartos 2009), future worldwide changes in rust diseases (Chakraborty *et al.* 2011), future septoria tritici leaf blotch risk in France (Gouache *et al*. 2012), and future changes of different wheat diseases in Punjab, India (Kaur *et al*. 2008).

For example, due to temperature and humidity changes, the importance of stripe rust and Karnal bunt in Punjab, India is assumed to be reduced in the future (Juroszek and von Tiedemann, 2013). On contradictory, the importance of leaf rust, stem rust, foliar blights and Fusarium head blight may increase in Punjab in the future with rise of temperature (Kaur *et al.* 2008). Another example which is the incidence of Fusarium head blight mainly in southern England during wheat anthesis is projected to become more severe by 2050s due to increase in temperature as reported by Madgwick *et al*. (2011).

5. Maize diseases under climate change: Research on impacts of climate change on maize diseases has been limited, but studies have indicated that climate change could changes in rates of pathogen development, modification in host resistance potential, which ultimately lead to changes in physiology of host pathogen interactions. It is hypothesized that climatic changes could directly affect maize yield and quality (Bender and Weigel, 2011), due to long term trend towards higher temperatures, greater evapotranspiration and an increase in the frequency of extreme weather events such as heat spells and temporary droughts (Juroszek and Tiedemann, 2013).

An analysis by Lobell *et al.* (2011) has suggested that the past climate change, especially between 1980 and 2008 may have reduced the potential global maize production by about 3.8% already, countervailing the yield gains. Therefore, changes in temperature, humidity, and rainfall patterns have increased infection of fungi such as *Aspergillus* and *Fusarium* species, responsible for maize ear rot and the related risk of mycotoxins contamination.

6. Diseases of vegetables crops under climate change: Under temperate region of Indian hill areas, earlier the late blight disease appeared at the temperatures ranging from 10-25°C but nowadays it started appearing at a wider temperature range from 14-27.5°C during November in the northern part and during February in the eastern part contributing yield losses of about 40-85% every year (Luck *et al* 2012).

Thus, major losses due to late blight of potato have acquired with changing climate leading to yield loss and use of pesticides in huge quantities (Duveiller *et al.* 2007). In Deccan Plateau of India, an outbreak of Phytophthora blight of pigeonpea (*Phythophthora drechsleri* f.sp. *cajani*) was reported due to unpredictable and heavy rainfall (>300mm in 6-7 days) leading to temporary flooding (Pande *et al*., 2011). Foliar diseases like Ascochyta blights, Stemphylium blights and Botrytis gray mold can become a serious threat in pulses (Priyanka *et al*., 2020).

7. Diseases of fruits crops under climate change: Bebber (2019) reported that a significant increase of black sigatoka of banana disease across the banana growing regions of Latin America and the Caribbean, increasing by a median of 44.2% per pixel from 1960s to 2010s and this increase in risk was caused by climate change. In mango, if temperatures exceed 35^{o}C sun burning in fruits are very common while anthracnose and powdery mildew decreases since the presence of sunlight, low humidity and extreme temperature of about below 18°C or greater than 35°C, rapidly inactivate spores (Alfonso *and* Brent, 2014). A questionnaire survey conducted by Basannagari *et al.* (2013) at low hills areas of Himachal Pradesh has indicted that 72% of farmers believed that the decline in fruit size, quality, occurrence of apple scab, cankers are considered as the indicators of climate change mainly rise in temperature.

Research Challenges and Priorities

Disease risk analysis based on host pathogen interactions should be managed and research on host response and adaptation should be focus, so, the following points would be considered:

1. The risk of diseases must be analyzed in order to determine the geographical distribution and modification of diseases under climate change regime. Large scale projections of disease risks analysis based on different climatic conditions could be major priorities for research.
2. Development of more advanced mathematical models of quantitative analysis to understand the interactions among weather, crop and disease variables.
3. Climate change prediction with higher resolution on spatial and temporal scales.

4. Development of new crop varieties that are more productive in harsh environments.
5. Assessing the current existing management strategies and proposing of alternatives for the next decades which will make mitigation measures a more adaptable to climate change.

Future Prospects

In addition to the strategies discussed above, we need to emphasize on future line of research for combating plant diseases under climate change regimes. Some of these are:
1. Strengthening of survey and surveillance of plant diseases.
2. Evolvement of temperature tolerance strains of biocontrol agents.
3. Development of advanced weather and disease forecasting models such as simulation models, downscaling models, early warning systems/decision support systems.
4. Sensitization of stakeholders about the impacts of climate change.
5. Farmers' participatory research for enhancing adaptive capacity of strategies.
6. Promotion of precision and resource conservation technologies.

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Strategies for Improvement of Feed and Fodder Production and Utilization for Enhancement of milk and Meat Production

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Introduction

India is endowed with most fabulous diverse livestock wealth in the world. This huge livestock population needs special attention of nutritionists for supplying sufficient nutrients not only to fulfil their hunger but also to maintain the optimum productivity potentials. In India the area under fodder production has remained static at around 4% of cultivable land area for the last Three decades. There is little hope to increase the cultivated area under green forage or to regenerate the degraded pasture through intensive management. Crop residues have special importance in livestock feeding as they constitute a major portion of roughages. Milk and Meat is an important component of diets for all humans as it is high in essential amino acids that are most likely to be deficient in Diets. Improving milk, meat production is an important tool for improving the quality of life particularly for rural people in developing countries.

Issues in Forage Resources Development in India

1. India faces critical imbalance in its natural resources base with about 18% of human 15% of livestock population of the world being supported only by 2.4% geographical area, 1.5% of fodder and pasture land 4.2%.
2. Non-commercial nature of crops and production of forage with minimum inputs from degraded land and marginal land has led to huge gap in fodder availability and requirements.
3. Presently, the country faces a net deficit of 35.6 % of green fodder, 10.95% dry crop residues and 44% conc. Feed ingredient.
4. In Case of forage, the regional and seasonal deficiencies are more important than the national deficiencies at it not economical top the transport the forages over long distances.
5. The available forage are poor in quality and deficient in available energy, protein and minerals.
6. Farmers as maintain large herds of animal to compensate for the low productivity.

Availability of Green Fodder

The area under permanent pasture and other grazing land in India is only 3.3% against the recommendation of 8% of total cultivable area. The Small farmers of developing countries have limited recourses available for feeding to their ruminant livestock. Available feed straw and other crop residues and agriculture by-products which are generally low in protein.

Availability Vs Requirements of Animal Products

In the last 25yr the proportion of dietary calories coming from livestock products (Milk, Meat and Eggs) in India has increase from 6-10% and the other countries constant proportion 20% of animal products. Production potential of livestock in India is very low as compare to livestock in developed world. The most important one is inadequacies of feed and fodder recourses.

Feed Supply System for Livestock

Feed is an important input for milk and meat production. And constituent 50-70% of total cost of livestock products. While milk production in India is increasing fast (India is largest producer of milk in the world with 105 million metric tonnes, FAO 2006), the feed and fodder resources are deleting very fast. Due to increase in human population, urbanization and pressure on land to grow cereal crops.

Strategies for Improved Feed & Fodder Production

1. Strategies to increase forage production per unit area.
2. Encouraging forage production in mixed crop livestock farming system.
3. Putting to good use of waste land denuded, degraded marginal and sub marginal land for the development of pastures and agro -forestry system.
4. Strategies for efficient utilization of locally available resources like crop residues, AIBP and NCFR.
5. Representing to the government for augmentation of feed and fodder resources.

Strategies to Increase Forage Production Per Unit Area

Evolving intensive fodder production system with efficient utilization of plant and other farm inputs for maximum forage production. Identifying improved fodder verities on the basis of high production potential, better quality traits, adaptability to different agro climatic zones. Utilizing state agriculture university farms, AH department and progressive farmers for production of quality seeds and for distribution. Taking up fodder production on tank beds in summer season. Taking fodder production on problematic soil.

Improved Varieties of Fodder Crops

BERSEEM
(*Trifolium alexandrinum*)
Variety :- Wardan

LUCERN
(*Medicago sativa*)
Variety :- CO-2

GUNIYA GRASS
(*Pannicum maximum*)
Variety- CO-2

MAIZE
(*Zea mays*)
Variety- J-1006

Encouraging Forage Production in Mix Farming System

By growing short duration forage crops in the gap period of main crop. In increasing the production of crops which provide forage as by products like sugar cane, sunhemp, cowpea. By growing suitable fodder crops in fruit orchards for fodder as well as enriching the soil fertility. eg. Mango, Citrus, Guava, Orchards.

Strategies for Efficient Utilization of Available Resources Like Crop Residues

General proper storage of crop residues and NCFR i.e., protecting then from rain and exposure to sun will prevent wastage improve utility to an extent of 10-15%. Chaffing green dry fodder will prevent wastage and improve utility to extent 20-60%. Harvesting the green fodder at optimum stage to retain maximum nutrient. Conversion of fodder during lush season and judicious uses of crop residues at farm level.

Use of Non-Conventional Feed Supplements

Antimicrobial substances, Enzymes, Organic acids, Probiotics.

Use of New Technology

Development of simple and economically viable and sustainable technology for increasing nutritive value of low-quality feed. Urea treatment of cereal straw 4% Urea + 50 lit water + 100 Kg feed 7-21 Days incubation.

Use of urea-molasses-mineral block:
1. By Pass Nutrient Technology.
2. Use of Biotechnology Products.

Conclusion

1. There is need to improve and increase quality forage production per unit area of available land growing high yielding forage crops in mixed crops feeding system.
2. Available crop residues and other are properly utilized by harvesting crops at right time, bye proper storage processing and conservation.
3. The efficiency of feed utilization enormously improved if the rumen of the animal has healthy microbial population adequately supplemented by providing a molasses urea block which often increase the intake basal diet.

Hyperspectral Imaging: A Tool for Sensory Analysis

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Introduction

The sensorial attributes of food, such as its flavor, texture, and appearance, are the first food impressions. Optical properties like color, luster, and uniformity; physical characteristics like size; surface properties, and presentation style, including food packaging, all contribute to the overall appearance of a food product. Furthermore, the texture is aimed at the senses that are automatically perceived after it appears. Finger feeling, including softness, juiciness, hardness, and mouth feeling such as chewiness, gumminess, grainy, and floury, are the two categories for determining the texture. Moreover, the insight of different tastes (e.g., bitter, salty, sour, sweet, and umami) gives food flavor. Aside from these characteristics, physical and mechanical defects may lead to various sensory characteristics. Consumers tend to purchase foods that guarantee overall acceptability and satisfaction, so sensory evaluation of food items receives much attention in the food industry. The need to create a rapid and accurate sensory evaluation is evident as consumers become increasingly conscious of sensory attributes like flavor, color, and texture. The food industry must assess the accessibility of food and recognize its critical sensory characteristics. Conventionally, trained panelists have assessed the sensory qualities of food products; however, trained panel assessment is subjective and not appropriate for immediate implementation as required. Instrumental methods such as texture analyzer, colorimeter, and GC-MS for flavor compounds are also available. However, they are inefficient and disparaging.

On the contrary, different imaging and spectroscopical techniques have arisen as substitute approaches for the food industry. Hyperspectral imaging (HSI) technology, in particular, has gained considerable popularity in recent years as a fast and non-invasive approach. However, no study focusing on a wide variety of sensory properties of food products evaluated by HSI is currently available (Özdoğan *et al.,* 2021). As a result, the current article aims to provide brief information on HSI technology in the sensory assessment of food products.

Scope and Approach of HSI Technology

HSI technology is a blend of imaging and spectroscopy. This technology is used to get both spectral and spatial information in a solitary system. HSI produces a 3D hypercube with 2D spatial data and 1D spectral data in the form of a stack. The 3D hypercubes possess three sensing approaches, namely interactance, reflectance, and transmittance. The interactance approach gives essential data about the food. The reflectance approach evaluates the physical food properties. The transmittance approach measures the internal parameters of the food. Hence, the acquisition mode for analysis should be chosen based on food product properties. In the HSI image acquisition, images can be produced in various modes. These modes are area scanning, line scanning, point scanning, and single shoot mode. The point scanning mode is used in the food industry due to its scanning approach in one direction. An HSI system comprises a software-loaded monitor, a camera, a spectrograph, and an illumination unit (Özdoğan *et al.,* 2021). The hypercubes are processed in three main steps as follow:

1. Image acquisition and pre-processing – in this stage, the instrumental systems are adjusted, followed by image acquisition and wavelength calibration. The instrumental setup involves the type of detector used and the sensing mode. The pre-processing can be done using filtering, Fourier transform, standard normal variate, and multiplicative scatter correction. These pre-processing methods eliminate the redundant data and decrease the noise.

2. Data extraction – this can be done using edge-based segmentation and thresholding. The image selection is made at a specific wavelength.

3. Data modeling and post-processing involve principal component analysis, partial least squares regression (PLSR), Fisher's discriminant analysis, multi-linear regression, and artificial neural network. The post-processing of data calculates the root mean square for calibration, cross-validation, and prediction.

HSI for sensorial analysis measures the textural characteristics (e.g., chewiness, cohesiveness, and hardness) and appearance. Additionally, the sensory evaluation assures the food quality. Thus, HSI as a sensory analysis tool attracts research attention. The main principle for sensorial analysis using HSI is based on chemometric analysis that forms a relation among the wavebands and molecular bonds (Özdoğan *et al.,* 2021).

Application of Hyperspectral Imaging Technology in Food Sensory

HSI is widely used for texture analysis of food products like meat and fruits. Some of the applications of HSI in the sensory analysis of foods are outlined in Table 1.

Table 1. Application of hyperspectral imaging for sensory analysis of food products (Özdoğan *et al.,* 2021):

Food Products	Sensorial attributes	Wavelengths (nm)	Models
Beef	Marbling	400–1000	PLSR
Fish	Hardness, Cohesiveness, Springiness, Gumminess, Chewiness, Freshness	900–1700	PLSR
Pork Sausages	Color (L* a* b*)	380–1000	PLSR
Egg	Freshness	400–1000	support vector machine
Banana	Firmness, Color (L* a* b*)	380–1023	PLSR
Apple	Bruise	400–1000	random forest
Pomegranate	Visual maturity	720–1050	partial least square discriminant analysis
Hard Cheese	Sensorial maturity	1000–2400	PLSR

Color, a critical sensorial attribute related to the appearance of the food product. This attribute plays a substantial part in the consumer likeness of food. Instruments like Hunter color Lab measures the L* (lightness), a* (red-green), and b* (blue-yellow) values. In contrast, this color estimation technique is not appropriate for non-homogenous food products. Previous research has demonstrated the utility of the HSI technique in estimating the color of food products. Chilling injury caused due to low temperature affects the textural attributes of the fruits. The HSI technique in a 400-1000 nm spectral range has been employed to detect chilling injury in fruits like bell pepper (Babellahi *et al.,* 2020) and peaches (Sun *et al.,* 2017).

Bruising, a mechanical defect caused during the harvesting and transporting of fruits and vegetables, affects its flavor and texture. HSI technique has been employed to detect the bruising effect in potatoes (Ji *et al.,* 2019), peaches, and apples (Keresztes *et al.,* 2016). Textural attributes of food products affect consumer preference regarding food acceptability. Based on food products, the textural qualities of food vary. Chewiness, hardness, gumminess, juiciness, and tenderness are terms used to explain the textural property of food. Instruments like texture profile analyzers are generally used to estimate the texture of food products. The texture profile analyzer measures the food product's adhesiveness, cohesiveness, chewiness, springiness, gumminess, hardness, and other textural parameters. Presently, HSI has been used to assess these textural attributes of different food products. HSI technique has also been used for analyzing the level of marbling in meat products. Marbling refers to the quality characteristic of meat involving fat distribution with lean muscle, directly related to tenderness and juiciness of meat products. Other parameters like the flavor of food products can also be estimated by using the HSI technique. Earlier, gas chromatography-mass spectroscopy was used to detect the flavor of food products. Techniques like HSI have been reported to detect the other flavor components such as astringency, sweetness, and pungency in food products (Özdoğan *et al.,* 2021).

Conclusion

The HSI technique's spectral range is 400-1000 nm for sensory evaluation using linear regression models. The use of HSI technology in estimating sensorial properties of food products has been validated as a quick and non-invasive sensory analysis tool. This technique is costly. Thus, novel technological development in combination with HSI is required to minimize its cost. Additionally, combining hypercube spatial and spectral data may produce better results. Moreover, research has advocated for the use of real-time HSI in the food industry.

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Success Story of an Oil Seed Farmer

Article ID: 10781

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Sesame is one of the oldest oilseed crops known to mankind for its seeds. The main reason for their popularity is that they have many health-promoting nutrients and elements. The world produces about 3 million tons of sesame seeds every year. Myanmar, India, China, Sudan, and Tanzania are the key producers accounting for 70% of the total production. Sesame is a warmer weather crop, which is mostly grown in tropical and subtropical areas. These conditions require specific plant performance which makes it capable of thriving despite the challenging environment.

1. Sesame is a versatile crop with unique attributes to fit almost any cropping system
2. It achieves more profit when grown with limited resources and offers more return for less cost (less risk) than any other crop
3. It doesn't require additional farming equipment than that used for cereal farming
4. It has excellent disease and insect tolerance
5. Sesame in a crop rotation reduces nematodes in the soil
6. Deep taproot may reach and utilize nutrients and moisture below the root zones of other crops
7. Sesame adds beneficial residue within the whole soil profile, resulting in improved tillage and topsoil properties
8. Excellent drought and heat tolerance – it thrives where other crops fail.

Mr. Shekar (39) from Laxmipoor village of Jagtial rural mandal in Jagtial district of Telangana state, India. He completed his intermediate and owns 9 acres of land. He started diversified farming on his land comprising various combinations of field crops such as cereals, oilseeds, commercial crops and fruit cultivation. He also had drip irrigation system installed for cultivation of crops to aid judicious use of irrigation facilities.

JCS 1020 was released through SVRC on the name of Jagtiala Til 1 during 2019, a white seeded variety with 85-90 days duration. RARS, Polasa, Jagtial conducted awareness programmes to the farmers regarding the yield superiority which amounts to 1050-1100 kg/ha during *summer* under irrigated and 700-750 kg/ha during *Late kharif* with lifesaving irrigations and it is moderately resistant to shattering. Its multi-capsular nature favour to exploit maximum returns under favourable crop management. In addition, the variety also suitable for export with free fatty acids, palmitic acid (10.37%), steric (6.52%), oleic (41.99%), linoleic (40.39%), eicosenoic (0.68%).

He has cultivated Jagtial Til 1 variety in summer, 2020 in turmeric fallows and reaped good results. The sowings were completed at 01.02.2021 with seed rate of 3 kilograms per acre of land. As 1st dose, the farmer applied 25 kilograms of urea and 15 kilograms of potash after 20 days of sowing and it was followed by weeding. At the time of flowering, he again applied 15 kilograms of urea and 10 kilograms of potash by drip system. Irrigations were given at an interval of eight to ten days. Neem oil was sprayed to control sucking pest infestation. The harvesting of the crop completed on 30.04.2021 and yielded 4.5 quintals per acre for which the farmer was extremely happy about the guidance provided from RARS, Jagtial.

Costs and Returns of Jagtiala Til 1(JCS 1020) Sesame Variety

S. No.	Component	Cost (Rs./A)
I.	Cost of cultivation	
A.	Operational costs	
1	Human labour	10100 (49.69)
2	Machine labour	1500 (7.38)
3	Seed	600 (2.95)
4	Fertilizers	816 (4.01)
5	Plant protection chemicals	400 (1.97)
6	Miscellaneous	120 (0.59)

7	Interest on working capital	947.52 (4.66)
	Total operational costs	14483.52 (71.26)
B.	Fixed costs	
1	Rental value of owned land	5000 (24.6)
2	Depreciation	650 (3.2)
3	Interest on fixed capital	565 (2.78)
	Total fixed costs	6215 (30.58)
	Total cost	20698.52 (101.84)
II.	Returns	
A.	Yield (q A-1)	4.50
B..	Market price (Rs q-1)	9000
C.	Gross returns (Rs A-1)	40500.00
D.	Net returns (Rs A-1)	19801.48
E.	Returns per rupee spent	1.96

Note: Figures in parenthesis indicates per cent to total cost.

The total cost incurred for cost of cultivation was accounted to Rs. 20698.52 per acre and the yield was 4.5 quintals per acre. The market price was Rs. 9000 per acre. Hence, the total gross returns were accounted to Rs. 40500.00 per acre. The net returns were accounted to Rs. 19801.48 per acre and returns per rupee spent was 1.96. This clearly indicates that farmer is benefitted with the cultivation of sesame variety JCS-1020 which may be given wide publicity among the farming community for increasing economies of scale.

Conclusions

Cultivation of the Jagtial Til 1 sesame variety was beneficial to the farming community and hence the farmers are advised to cultivate variety in turmeric fallows to increase the net returns.

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Jungle Jalebi- An Ignored and Underutilized Fruit

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Introduction

India is one of the largest fruits producing countries where many varieties of fruits are being cultivated. In addition to major fruits, many underused fruits are also grown. These underutilized fruits are those which are neither cultivated in farming system nor processed by commercial methods. Majority of these fruits are rich sources of nutrients like minerals, vitamins and many phytochemicals, having the capacity to prevent and cure different diseases. Consumption of these underutilized fruits can be an alternative way to overcome nutritional disorders. Jungle jalebi is one of the underused fruits ignored by many people although it has many medicinal properties and health benefits.

Jungle jalebi (*Pithecellobium dulce*) tree is evergreen, growing up to 20 meters height, branches bearing thorny spines and deciduous leaves making the tree look rich and vibrant green. Jungle jalebi is an exotic Indian fruit known by different names in different localities like Seema Chintakaya in telugu, Vilayati Imali or Jungle Jalebi in Hindi, Manila tamarind or Monkey pod or Madras thorn in English, Kodukka puli in Tamil and Ingraji chinchu in Marathi.

Taxonomic Classification

Domain	Eukaryota
Kingdom	Plantae
Phylum	Spermatophyte
Subphylum	Angiospermae
Class	Dicotyledonae
Family	Fabaceae
Genus	Pithecellobium

Species	Pithecellobium dulce

Nutritional Information

According to Nutritive Value of Indian Foods provided by the National Institution of Nutrition (NIN), 100g of jungle jalebi or manila tamarind contains.

Nutrients	Composition
Energy	342 KJ
Moisture	74.54 g
Carbohydrates	13.54 g
Protein	3.56g
Fats	1.14g
Dietary fiber	4.40 g
Calcium	8.51 mg
Vitamin C	55.78 mg

Health Benefits

People usually do not consume it due to lack of awareness, though it has several health benefits. Health benefits of jungle jalebi are as follows

1. Promotes weight loss: the dietary fiber in this helps in controlling the cravings and regulate appetite. According to a recent study, consuming a glass of lemon water infused with pod of jungle jalebi helps in shedding off extra kilos and maintains healthy body weight.

2. Manages diabetes: pod extract of this is known to have anti-hyperglycemic properties. Due to this, it can reduce blood sugar levels in diabetic person.

3. Treats Gut problems like diarrhoea: the pods of this plants are rich in antioxidants such as flavonoids, quercetin etc. These effectively eliminate the harmful free radicals and toxins present in the body, thereby reduces and cures diarrhoea and dysentery.

4. Maintains bones health: the pods are rich in calcium and phosphorus which plays important role in maintaining strong bones.

5. Boosts Immunity: jungle jalebi pods contain high amount of vitamin C content. Vitamin C is a beneficial antioxidant and has role in enhancing immunity.

6. Promotes oral health: The three important minerals in bone fortifying are calcium, magnesium and phosphorous. Pods of this fruit are packed with these minerals, that strengthen teeth enamel. Besides this, the fruit possess antimicrobial agents and antioxidants which aids in treating mouth ulcers and other oral diseases

7. Relieves anxiety and depression: fruits of this tree are loaded with tannins, flavonoids, alkaloid antioxidants and phytonutrients. These phytonutrients possess powerful bioactive traits, which enhances memory, cognition, brain power, besides reducing symptoms of anxiety, depression and influencing positive moods.

8. Other health benefits: works as antiseptic, lightens skin tone, prevents hair loss, treats oily scalp, good for pregnant women, cures bilious disorders, treats fever and jaundice, regulates blood circulation, prevents cancer, eliminates pigmentation and other skin diseases, remedy for indigestion, cures constipation etc.

Along with fruit pods other parts like bark and leaves are also being used as traditional medicine for treating and preventing many disorders, as these possess antibacterial, anti-inflammatory, antidiarrheal, antiulcer, antioxidant, cardioprotective and hypolipidemic properties.

Conclusions

Jungle jalebi is a fruits pod possessing many health benefits and several medicinal properties. Incorporating this nutrient dense fruit in regular diet helps in treating, preventing many disorders and maintain sound health. Though it has various benefits it does promote few side effects. So, it has to be consumed in moderate amount. Topical application of this tree extracts should be performed with caution since it may irritate skin and eyes sometimes.

		
Pickel	**Potato jungle jalebi curry**	**Colada**

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Integrated Management of Foot and Leaf Rot Disease of Betelvine *(Piper betle* Linn.)

Article ID: 10783

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Introduction

Betelvine is the most important and useful asexually propagated cash crop having various cultivars. It belongs to piperaceae family and is a shed loving plant. It has a perennial creeper and bears leaves that are 4–7 inch long and 2–4 inch broad. It bears both male and female flowers. It is originated from Malaysia but is distributed extensively in South and Southwest China. This plant is economically, medicinally and traditionally important in the whole world. The cultivation of betelvine is hindered by a number of fungal and bacterial diseases resulting in heavy loss in leaf yield every year.

Phytophthora parasitica var. *piperina* a perpetual menace to the crop of betelvine, cause leaf and leaf rot diseases. The extent of losses varies from 5-90 per cent (Dasgupta and Sen. 1999). Low temperature, high humidity and diffused light, a prerequisite for vine growth that prevail inside the borojes, favoures the pathogen. The disease appears at the onset of monsoon and remains in high intensity throughout the rainy season. It wanes during the winter and very rarely occurs in the off-season.

Symptoms

The fungus attacks the vines at all stages of crop growth. Initial symptom is sudden wilting of vines. The affected vines show yellowing and drooping of the leaves from tip downwards. The leaves become dull due to loss of lustre. The affected plant dries up completely within 2 or 3 days. The succulent stem turns brown, brittle and dry as stick. The lower portion of the stem near the soil level shows irregular black lesions upto second or third internode. The diseased intermodes undergo 'wet rot' and the tissue become soft, slimy with a fishy odour. The roots of the affected plants also show extensive discolouration and rotting.

In the young crop, the fungus produces 'Leaf rot' symptoms. The leaves near the soil region show circular to irregular water-soaked spots, often starting from the edge. The spots rapidly enlarge and cover a part or whole of the leaf blade, which shows rotting. The leaves turn brown to dark brown or dirty black and defoliation occurs. The leaves within 2-3 feet height of the vine show the leaf rot symptom.

The fungus produces hyaline, non-septate mycelium. The sporangia are thin walled, hyaline ovate or learn shaped with papillae, measuring 30-40 X 15-20um. Zoospores, which are liberated from the sporangia, are kidney-shaped and biflagellate. Oospores are dark brown, globose and thick walled. September to February months with high atmospheric humidity and low night temperature (23˚C and below) are highly favorable. The fungus is soil-borne and survives as facultative saprophyte in the infected plant debris and in the soil as oospores and chlamydospores. The fungus mainly spreads from field to field through irrigation water. The secondary spread is through sporangia and zoospores disseminated by splash irrigation and wind-borne rains.

Foot rot disease of betelvine

 

Leaf rot disease of betelvine

Management Practices

1. Select were matured (more one year old) seed vines from fields.
2. Soak the seed vines in Streptocycline 500 ppm + Bordeaux mixture 0.05 per cent solution for 30 minutes.
3. Bordeaux mixture (4 drenches + 8 sprayings at monthly and fortnightly intervals, respectively) Bordeaux mixture 1 % as soil drench and 0.5% as foliar spray.
4. Apply 150 kg N/ha/year through neemcake (75 kg N) and 100 kg P_2O_5 through Super phosphate and 50 kg Muriate of potash in 3 split doses, first at 15 days after lifting the vines and second and third dose at 40-45 days interval.
5. Apply shade dried Neem leaf or *Calotrophis* leaves at 2t/ha in 2 split doses and cover it with mud.
6. Collect and destroy the infected vines and leaves.
7. Drench the soil with 0.5 per cent Bordeaux mixture at 500 ml/hill during the cool weather period (October-January) at monthly intervals.
8. Drenching of *Trichoderma viride* four times+four sprays *of Trichoderma viride*@5ml/Lt water in the months of Dec. to January after 10 days interval.

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Invasive Pest in India and Means to Combat them

Article ID: 10784

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Introduction

Indian agriculture faces two major challenges i.e., production of sufficient food to feed the growing population, and prevention of environmental degradation. Damage by crop pests which include insects, diseases, nematodes and rodents, is one of the major constraints to increasing food production. Globally, up to 30% of agricultural yields are affected by pests and diseases despite intensive chemical pesticide use. Apart from these elements, the agricultural economy in India is vulnerable to threat from invasive pests/exotic pests/diseases which act as the bottleneck in reducing yield. Therefore, the management of invasive insect pests is the obvious strategy for increased food supply.

What is Invasive Insect Pest?

Invasive species, alien species, exotic pests, or invasive alien species, are common names that categorize non-native animals, insects, microbes, diseases, or plants that are pests. These pests are not native in areas in which they cause problems and they are considered "invasive" because they invade and establish populations in new areas and the resulting uncontrolled population growth and spread cause economic or environmental problems.

Some of the alien species become invasive when they are introduced deliberately or unintentionally outside their natural habitats into new areas where they express the capability to establish, invade and outcompete native species. According to the International Union for Conservation of Nature (IUCN) an Invasive alien species is an alien species that becomes established in natural or semi-natural ecosystems or habitats, is an agent of change, and threatens native biological diversity.

India in the past has witnessed continuous pest invasions leading to a severe imbalance to crop and human ecosystems. Invasive species appear to have specific traits or specific combinations of traits that allow them to outcompete native species. In India documentation of insect invasive is beginning to be systematically recorded. Zoological Survey of India (ZSI) for the first time compiled a list of alien invasive animal species, totalling 157. This number excludes invasive microbe species of the total 157 listed species by ZSI, 58 are found on land and in freshwater habitats, while 99 are found in the marine ecosystem. India occupies only 2.4% of the world's land area and contributes about 8% to the world's species diversity. With the rapidly increasing global commerce, the chances of accidental introduction of alien species have increased more.

Growing invasive pest numbers in India, the invasive pest species pose a substantial threat to biodiversity, but they may also increase evolutionary diversification due to various factors.

Table 1. Invasive insect pests in India:

S. No.	Name of insect pest	Scientific name	Introducing year& place	Origin
1	San Jose scale	*Quadaraspidiotus perniciosus / (Comstock) (Hemiptera: Diaspididae)*	1879 1921 Kashmir	China
2.	Woolly apple aphid	*Eriosoma lanigerum* (Hausmann)	1889 Coonoor, Tamil Nadu/ 1909 Uttarpradesh	China / America

		(Hemiptera: Aphididae)		
3.	Potato tuber moth	Phthorimaea opercullela Zeller (Lepidoptera: Gelechiidae)	1906 (East Bengal-Now in Bangladesh)	Italy
4.	Cottony cushion scale	*Icerya purchasi* Maskell (Hemiptera: Margarodidae)	1920 Tamil Nadu	Australia
5.	Pine woolly aphid	*Pineus pini* (Macquart) (Hemiptera; Adelgidae)	1970/ Nilgiris, Tamil Nadu	Western & Central Europe
6.	Subabul psyllid	*Heteropsylla cubana* Crawford (Hemiptera: Psyllidae)	1988 Tamil Nadu & Bangalore	Central L America
7.	Coffee berry borer	*Hypothenemus hampei* Ferrari (Coleoptera: Curculionidae)	1990 Gudalur, Tamilnadu	Northeast Africa
8.	Serpentine leaf miner	*Liriomyza trifolii* (Burgess) (Diptera: Agromyzidae)	1991 Hyderabad, Telangana	Florida (U.S.A.)
9.	Spiralling white fly	*Aleurodicus disperses* Russell (Hemiptera: Aleyrodidae)	1993 Kerala	Central America
10.	Coconut Eriophid mite	*Aceria gurreronis Keifer* (Arachnida: Eriophyidae)	1997 Enakulam, Kerala	Mexico
11.	Eucalyptus gall wasp /Blue gum chalcid	*Leptocybe invasa* Fisher & La Salle (Hymenoptera: Eulophidae)	2001 Karnataka/ Tamil Nadu	Australia
12.	Erythrina gall wasp	*Quadrastichus erythrinae* Kim (Hymenoptera: Eulophidae)	2006 Kerala	Tanzania, East Africa
13.	Cotton mealy bug	*Phenococcus solenopsis* Tinsley (Hemiptera: Pseudococcidae)	2006 Gujarat	Central america
14.	Papaya mealy bug	*Paracoccus marginatus* Williams and Granara de Willink	2007 Coimbatore, Tamil Nadu	Mexico

		(Hemiptera: Pseudococcidae)		
15.	Jack Beardsley mealybug (Banana)	Pseudococcus jackbeardsleyi Gimpel and Miller.	2012 Karnataka	America
16.	Madeira mealybug (Hibiscus)	*Phenacoccus madeirensis* Green (Hemiptera: Pseudococcidae)	2012 Karnataka	Neotropical
17.	South American tomato pinworm/ Tomato leaf minor	*Tuta absoluta* (Meyrick, 1917) (Lepidoptera: Gelechiidae)	2014 Pune, Maharashtra	South America
18.	Coconut Spindle infesting leaf beetle	Wallacea sp. (Coleoptera: Chrysomelidae)	2014/2015 Andaman Islands	Oriental region - Australia
19.	Rugose spiraling whitefly (coconut)	*Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae)	2016 Tamil Nadu	Central America
20.	Fall armyworm (Maize)	*Spodoptera frugiperda* (JE Smith) (Lepidoptera: Noctuidae	2018 Karnataka	America
21.	Nesting whitefly (Coconut)	*Paraleyrodes Iaccarino minei* (Hemiptera: Aleyrodidae)	2018 Kerala	Syria
22.	Bondar's Nesting Whitefly (Coconut)	*Paraleyrodes bondari* Peracchi (Hemiptera: Aleyrodidae)	2018 Kerala	Central America
23.	Neotropical Whitefly (Coco) nut	*Aleurotrachelus atratus* Hempel (Hemiptera: Aleyrodidae)	2019 Mandya/ Bangalore	Brazil

Reference (Alfred Daniel, J., Ashok, K., Pavithran, S., & Ranjith, M. (1921). A REVIEW ON INVASIVE INSECT PESTS IN INDIA AND THEIR PREDATORS AND PARASITOIDS.).

The import of agricultural products is governed by the Destructive Insects and Pests Act, 1914. The country has 108 plant quarantine centres located at major airports, seaports and transborder railway stations. The check posts at these quarantine centres are under the control of the Central Board of Indirect Taxes and Customs (CBITC), which works in close coordination with DPPQS.

If the product has not been given a phytosanitary certificate, the foreign government is obliged to inform India, in which case DPPQS fumigates the product with methyl bromide and issues a phytosanitary certificate. The fumigation is for two to 48 hours and depends upon the volume and quality of the product, and the country of origin. The company is charged for the fumigation. MAFW has also prepared lists of plants whose import is allowed, restricted or banned. There is also a list of weeds that should not enter the country with any impor.

Prevention of Invasive Species

The first step of prevention is to identify the invasive insect pests that may become invasive and therefore require special attention. These may be put on a "blacklist" and prohibited entry under national legislation. Species cleared for introduction through passing a risk assessment analysis can reasonably be declared as safe (put on a "white list"), though monitoring is still required to ensure that the prediction remains accurate over time. The potential invasiveness of the majority of the world's species is unknown and they should be placed on a "grey list".

Type of organism, Population size, Biology, Pest status, Available mitigation options:

1. Identification: Invasive insect pests should be correctly identified by the expert.

2. Risk assessments: First determine the level of risk, the invasive insect pests possess for the area. Study the biology of the organism, its distribution locally and worldwide? status of the Pest, Mitigation options, Window of opportunity for action.

3. Eradication programme: If the risk possessed by the pest is high then eradication of the invasive species should be done widely. The other extension activities should be carried out to educate the people about this pest.

4. Risk assessment review: The knowledge about the invasive species is necessary, the rate of the level of risk for that organism in a new environment.

The information on biology, its distribution, economic importance and management option.

5. Monitoring: For successful eradication of the programme, the survey data for most organisms for two years or two generations is considered.

Management Strategies Against Invasive Insect Pests

1. There is a need to study the biology and ecology of known insect pests and their natural enemies.
2. Study ecology and genetic makeup of the Invasive insect pest.
3. Tracking of the geographical distribution of pest.
4. Developing cultivars resistant to insect pests.
5. Judicious use of insecticides to prevent resistance and resurgence development.
6. To identify, conserve and augment natural enemies of invaded insect pests.
7. Modify crop management practices.
8. Develop suitable integrated pest management programmes.
9. Phytosanitary regulations to prevent or limit the introduction of risky insect pests.

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Bihar Hairy Caterpillar and their Management

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Introduction

Bihar hairy caterpillar *(Spilosoma oblique)* is the serious polyphagous insect pest that come under the order Lepidoptera of class consisting of chewing type of mouthpart which is confirm to the oriental region known to cause damage to several crops of agricultural and horticultural importance. both species of cultivated jute crop (*Corchorus oblitorus* and *C. capsularis*) are highly susceptible to *S. obliqua* particularly during the active growth season.in jute yield loss up to 30%.it is the regular pest of jute causing defolination and crop damage extensively.

Damage

1. The caterpillar invasion on holes on leaves, the caterpillar is herbivorous thus they devour any green matter fast. Leaves are the first culprits then target fresh buds and the result is wilting bud and crop.
2. Leaf yellowing-young larva feed gregariously on chlorophyll mostly on the under surface of leaves, due to leaves look like brownish yellow in colour, later the larva eats the leaves from the margin the leaves of plant give an appearance of net or web.
3. Irregular holes- the caterpillar chop weed leaves with no regular pattern at all.
4. Stem damage- the caterpillar eats up the stem insects start digging holes into the stem.




Bionomics

Egg periods: Adult female lay egg on the lower surface of leaves; freshly laid egg is the creamy white. Incubation period range is the 5-6 days.

Larval period: The caterpillar moulted five times and six larval instars. The total larval periods range is 20-21 days.

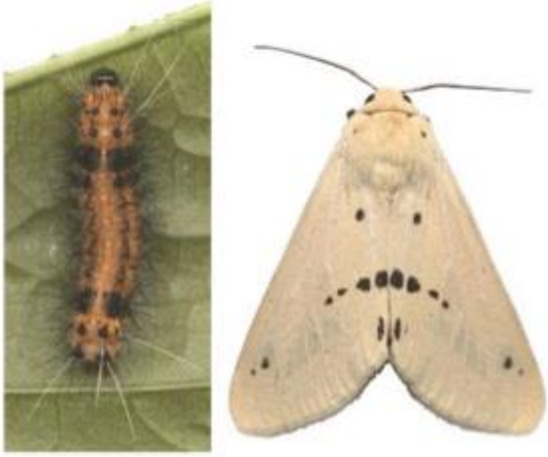
Pupal periods: Pupation take place in the soil. Obtect pupa, the total pupal periods are 8-9 days.

Adult: The adult are medium brown moths and had pink abdomen. Wings pinkish with numerous black spots.

The male moths are almost similar to the female but it was smaller than female in size. The abdomen is sharply tapered compared to female.

The female moth bigger than male. The abdomen of female was blunt while abdomen of male was narrow and pointed.

Total life span: Total life span male and female ranged from 32 to 42 days. Several generations in the year.



Larva and adult of Bihar hairy caterpillar

Management

1. Deep summer ploughing.
2. Avoid pre mansoon sowing
3. Use the optimum seed rate.
4. Use of the adequate plant spacing.
5. Intercrop soyabean either with (early maturing) pigeon pea variety or maize or sorghum in the sequence of 4:2 should be practiced.
6. Collect and destroy infested plant part, egg masses and young larvae.
7. Field sanitation.
8. Light trap: install one light trap (200W mercury vapour lamp) per hecter to catch the adults of some nocturnal pest such as hairy caterpillar.
9. Spraying of bacillus thuringiensis Krustaki @ 750 g/ha in 500-700 lit water. Grow trap crop like cowpea, castor and jatropha on field bunds to attract the caterpillar.

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Managing Nematode Infestation in Banana

Article ID: 10786

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Plant-parasitic nematodes are one of the major limiting factors to banana production which causes toppling or tip over or black root rot disease. Burrowing nematode (*Radopholus similis*), the root-lesion nematode (*Pratylenchus coffea*), spiral nematode (*Helicotylenchus multicinctus*) and root knot nematode (*Meloidogyne incognita*) are the four major nematodes associated with banana. They cause extensive root and corm damage leads to 20 - 50 % yield loss. In addition, root infestation by nematodes makes the banana plants highly susceptible to the panama wilt fungal disease caused by *Fusarium oxysporum* f.sp. *cubense*. Nematodes acts as predisposing agent for the entry of *Fusarium* fungus and both pathogens cause destructive disease complex in banana. The commercial banana cultivars such as Nendran, Robusta, Grand Naine, Ney Poovan, Poovan and Rasthali were frequently infected by the nematodes.

Symptoms of Damage

1. The caterpillar invasion on holes on leaves, the caterpillar is herbivorous thus they devour any green matter fast. Leaves are the first culprits then target fresh buds and the result is wilting bud and crop.
2. Leaf yellowing-young larva feed gregariously on chlorophyll mostly on the under surface of leaves, due to leaves look like brownish yellow in colour, later the larva eats the leaves from the margin the leaves of plant give an appearance of net or web.
3. Irregular holes- the caterpillar chop weed leaves with no regular pattern at all.
4. Stem damage- the caterpillar eats up the stem insects start digging holes into the stem.

Bionomics

1. The infected roots and corm show characteristic reddish-brown lesions.
2. Root knot nematodes produce small galls on fibrous roots and often lead to splitting and cracking of roots.
3. The root damage or malformation due to nematodes makes the plants do not respond to fertilizer and irrigation which result in reduced bunch weight.
4. Where root damage is severe, plants are poorly anchored and under the weight of a maturing bunch of fruit may be uprooted, especially during wet and windy weather.
5. The above ground part symptoms are characterized by leaf chlorosis, dwarfing, reduction in pseudostem girth, yellowing and drying of leaves with small bunches.

While diagnosis of nematode infestation, the aboveground symptoms always confuse with other soil-related plant growth suppressing factors such as drought or nutritional disorders. To confirm nematode infection, it is necessary to dig out the root systems and examine them for the presence of root lesion or root gall.

Typical gall formation in Root-knot nematode affected banana roots

Lesion nematode affected banana roots showing characteristic reddish brown lesions

Management

Chemical control:

a. Pare the corm and sprinkle 40 g of Carbofuran 3G over the corm (Before sprinkling, corm should be dipped in mud slurry).
b. Pare and dip the corm into 0.75% (15 ml/lit water) Monocrotophos solution; shade dry and plant.
c. If pre-treatment is not done, apply 40 g of Carbofuran in planting pits. For Tissue culture banana, split this into two i.e 20 g at planting followed by remaining 20 g at 3 months after planting.
d. Carbofuran application was found to take care of rhizome weevil management apart from reducing nematode population.

Nematode management using intercrops:

a. Growing Sunhemp in and around the basin of plants and incorporate their biomass one month later.
b. Growing marigold (*Tagetes erecta*) in and around the basin in banana and incorporate their bio-mass before they flower.

Organic amendments: Press mud application @ 15 t per ha (5 kg/pit) (or) neem cake 1.5 t per ha (500 g/pit) during planting.

Biological control:

a. Paring of corms and coating (Pralinage) with *Bacillus subtilis* (BbV 57) and *Pseudomonas fluorescens* each at 10 g/corm followed by soil application @ 1.25 kg each/ha.
b. Application of the bio-agent *Paecilomyces lilacinus* at 10 g/plant along with Farm yard manure (500g/plant).
c. Apply *Pseudomonas fluorescens* (Pf1) liquid formulation @ 4 lit/ha at 2nd, 4th and 6th MAP through drip system to manage panama wilt and nematode complex.

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Tomato: Common Pests, Diseases and Physiological Disorder

Article ID: 10787

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Introduction

Tomatoes are among the world's most cultivated crops, and given proper conditions and regular maintenance, they are relatively easy to grow. They are far from trouble-free, however, being prone to a host of production problems and pathogens, especially when conditions and maintenance are less than ideal.

As prevention is the best medicine, it helps to have some familiarity with the threats that you and your plants may face. To help acquaint you with the most common and damaging problems that may arise we developed this Guide to Common Tomato Pests, Diseases & Physiological Disorders. Many tomato problems closely resemble each other and are continually evolving; therefore, we always recommend seeking professional assistance from your cooperative extension for definitive identification of disease and pests. This guide will provide a starting point toward understanding some of the most common issues that may arise, and their causes, while also helping you to select varieties resistant to specific diseases.

Physiological Disorder and its Management

Sl. No	Physiological Disorder	Symptoms	Management
1.	 **Blossom end rot**	• Common and destructive disorder • Lesion appear at blossom end of fruit while it is green • Water-soaked spots appear at the point of attachment of the senescent petals • Affected portion becomes sunken, leathery and dark colored • This mainly due to reduced soil moisture supply and high rate of respiration at the time of fruit development. • Deficiency of calcium also causes this disorder	• Balanced irrigation and staking • Foliar spray of calcium chloride 0.5% at fruit development stage • Balanced irrigation, cultural practices to conserve soil moisture
2.	 **Fruit cracking**	• Fruit cracking is caused both by genetic and environmental factors. Following four types of cracking are noticed tomato. • Radial Cracking: Usually seen at ripe stage and crack	• Irrigate the crop lightly at proper intervals to maintain proper moisture in the field. • Soil application of

		radiate from pedicel end to stylarend. • Concentric cracking: Seen around shoulder of fruit even at greenstage. • Cuticular: Seen on outer skin offruit. • Burst: Burst occurs at certain points on shoulder offruit • Boron deficiency is one of the causes of cracking in Tomato fruit. • A long spell of drought followed by sudden heavy irrigation may cause cracking. • Wide variation in day and night temperatures and high humidity also cause fruit cracking.	10-20 kg of borax/ha during soil preparation.
3.	 **Blotchy ripening**	• Severe water stress, poor potassium uptake and distribution in plants • Irregular ripening, green blotches over red skin	• Regulated water supply during fruit development • Foliar sprays of 0.5% potassium chloride
4.	 **Sun scald**	• Green or near green of fruits exposed to sun light • The tissues have blistered, water-soaked appearance • Rapid desiccation leads sunken area on ripe fruits	• To grow cultivars with heavy foliage, provide protection to fruits
5.	 **Cat face**	• The fruit gets distorted at the blossom end • The fruits have ridges, furrows, indentations and blotches • The cells at blossom end of the ovary die and turn black and forms leathery blotch.	• Grow varieties free from this distortion • Grow tomatoes in the ample growing conditions

		• Unfavourable climatic condition during flowering causes distortion of growth of the pistil cells	
6.	 **Puffiness**	• Low or high temperature • Lack of pollination and fertilization • The outer wall continues to develop normally, But the growth of internal tissues is retarded	• Maintaining optimum soil moisture • Avoid over irrigation
7.	 **Gold flake**	• Higher supply of calcium and phosphate fertilizers • Excess calcium oxalates • Tiny yellow spots appear on the fruits surface around the calyx and fruit shoulder	• Apply recommended dose of calcium and potassic fertilizers • Provide shade during summer season
8.	Vascularbrowning	• When the stem is cut from the centre the vascular portion of the affected plants looks brown in colour and tissue is killed at a later stage. • It is caused due to the magnesium deficiency.	• Using 1.5% Magnesium Sulphate as foliar spray at the time when the symptom appears

Pest, Disease and its Management

Sl. No	Disease	Symptoms	Management
1.	 **Bacterial wilt**	• Deadly disease of tomato. • Wilting, stunting, yellowing of the foliage and finally collapse of the entire plant. • The lower leaves may droop first before wilting occurs. • The vascular system becomes brown.	• The pathogen is soil-borne • very difficult to control. • Crop rotation with Cruciferous vegetables is recommended. • Use resistant variety (ArkaRakshak, Arka Samrat) or tolerant variety (NS 501, & 538 etc.) • Chemical control is not available for this disease. • Soil pH having 6.2-6.5

		• If a segment of the lower stem is cut and squeezed it yields bacterial ooze. • Development of adventitious roots from the stem is considerably enhanced. • In tomato, limits the production from 4.24 to 86.14 per cent while in hot and humid climate, the disease can cause up to 100% losses	
2.	 **Fusarium wilt**	• Clearing of the veinlets and chlorosis of the leaf. • Soon the petiole and leaves droop and wilt. • The younger leaves may die • Dark brown or black discoloration of the vascular tissues. • Fungus survives saprophytically in soil.	• Use resistant Variety • pH 6.5 to 7.0 • Keeping tomato plants weed-free. • Avoid activity in wet plantings • Use nitrate-based nitrogen fertilizer, such as calcium nitrate, rather than an ammonia-based nitrogen fertilizer. • Seed treatment with 4 g Trichoderma viride formulation or 2.5 g Carbendazim per kg seed is effective.

3.	 **Anthracnose**	• Fruit may be infected when green and small, but symptoms do not appear until it begins to ripen. • Symptoms first appear on ripe fruits as small, slightly depressed circular lesions. • 12 mm Lesions and become more sunken, with concentric ring markings. • Centre is usually tan, and as the lesion matures becomes dotted with small black specks. • Surface of the mature lesion remains smooth and intact. • Small, circular, brown lesions surrounded by yellow halos characterize leaf infections	• Use resistant plants, or buy healthy transplants. • Plant your plants in well-drained soil. • Water your plants with a drip sprinkler. • Don't touch the plants when they are wet. • Keep ripening fruits from touching the soil • Remember to rotate your plants every 2 to 3 years. • Seed Treatment at 122∘F (50 ∘C) for25mints. • Spraying Mancozeb 2.5 g/l, chlorothalonil or Carbendazim 1 g/l gives effective contro

4.	 **Bacterial spot**	• Small circular to irregular water-soaked areas showing as definite spots on the lower leaf surface. • A narrow yellow halo may surround the spots. • When the spots are too many, the interveinal tissues become dry and brown. • If the spots are at the edge, they may break away. • Annual production loss due to this disease is 10– 20%, which may rise to 80% in some cases	• Use of pathogen-free certified seeds • Treat seeds with dilute bleach, hydrochloric acid, or hot water • Field sanitation and crop rotation reduces the disease incidence. • minimize overwatering • Spraying the plants with a mixture of Streptocycline 200 ppm and Copper oxychloride 3g/l
5.	 **Early Blight of Tomato**	• Leaf spots and blight on the foliage. • The disease first becomes visible as small, isolated, scattered pale brown spots on the leaf. • Spots are irregular, brown to dark brown in colour, and with	• Use pathogen-free seeds & resistant cultivars (ArkaRakshak&Arkasamarat). • Use crop rotation, eradicate weeds • test the garden soil annually and maintain a sufficient level of potassium. • Mancozeb (0.175%), chlorothalonil or copper fungicides (0.125 %). • Hot water Treatment of seeds for 25 mints at 50°C.

		concentric rings inside the spot. • Often several spots coalesce to form large patches resulting in the leaf blight. • Lowest leaves are attacked first and the disease progresses upwards	
6.	 **Late Blight**	• Especially damaging during cool, wet weather. The fungus can affect all plant parts. • Young leaf lesions are small and appear as dark, watersoaked spots. • Complete defoliation (browning and shriveling of leaves and stems) can occur within 14 days from the first symptoms. • Infected tomato fruits develop shiny, dark or olive-colored lesions, which may cover large areas.	• Keep foliage dry. Locate your garden where it will receive morning sun. • Allow extra room between the plants, and avoid overhead watering, especially late in the day. • Purchase certified disease-free seeds and plants. • Destroy volunteer tomato and potato plants and nightshade family weeds, which may harbor the fungus. • Spraying Mancozeb 2.5 g/l, chlorothalonil or Carbendazim 1 g/l gives effective control.

		• yield losses reaching up to 100% because of LB infection	
7.	 **Leaf Curl of Tomato**	• The leaf curl is characterise d by severe stunting of the plants with downward rolling and crinkling of the leaves. • Partial or complete sterility of the plant is also common. • Newly formed leaves show chlorosis. The older, curled leaves become leathery and brittle. • Plants are stunted due to shortening of the internodes. • Diseased plants look pale and produce more lateral branches resulting in bushy growth. • The disease is transmitted by the whitefly, Bemisiataba ci. • Total losses are in	• Use resistant variety Lycopersicon perurvianum, Akara Ananya, AkaraRakshak, Akara Samrat. • Do not smoke near field. • Use of systemic insecticide such as Dimethoate (0.05 %) as spray or Carbofuran or Phorate granules (50 kg / ha) as soil application are useful in vector control and reducing the disease

		between 17.6% to 99.7%. • 92.3% loss when infection occurred at 30 days after transplanting. • The yield reductions were 94.9, 90.0, 78.0, and 10.8% when plants got infected in 2, 4, 6, and 10 weeks after planting	
8.	 **Tomato fruit borer (Helicoverpaarmigera)**	• The larvae cause damage to flowers and bore into fruit. Often, large entry holes in the fruit are evidence and extensive rotting occurs.	• Shaking of theplants. • Ploughing upto depth of 10 cm before the end of august reduces the survival of over wintering pupae and reduces the startingpopulation • Spraying of dimethaote @ 1.5ml/litre ofwater.
9.	 **Aphid (*Myzuspersicae, Aphis* spp.)**	• Yellowish and black mould appear in leaves.	• Apply phorate @ 1 kg/hac as application/earthing up followed by one spray of Rogor750ml/hac/750lit. of water. • SprayImidacloropid 17.8 SL @ 1ml/lit.
10.	 **Cut worm *(Agrotis segetum, Agrotisipsilon)***	• Cutting young plants, holes in tubers.	• Sort out cut worm dam infection in thestores age tubers to avoid secondary • Use Chlorpyriphos 20 EC @ 500g/ha against cutworms.

Conclusion

The salient success factors can be enumerated below 1. Multiple disease resistant hybrids (TLCV, TMV, Verticillium, Fusarium and of late even bacterial wilt tolerance) have made it possible to grow tomato throughout the year (extended sowing window). 2. Long distance transportability because of breeding for very firm fruits has helped growers to not be restricted to selling in local markets thereby increasing their flexibility to sell. 3 Use of IPM technology with African marigold as a trap crop in tomato, Trichoderma for the management of the major fungal disease, use of chemical insecticide like Imidacloprid, Prophenophos, cypermethrin etc for fruit borer and leaf miner Management. 4 Root dipping of tomato seedlings in COC, Carbendazim and physical removal of TLCV-affected plants has been found effective.

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Common Mycotoxins and their Harmful Effects in Poultry: Measures to Combat Mycotoxin Infections in Poultry Feeds

Article ID: 10788

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Introduction

Mycotoxins are toxic secondary metabolites produced by some fungal species. The fungi produce the mycotoxins in certain favourable conditions in field before harvesting the crop, during transport and storage of crop. Environmental factors like excessive moisture in the field and storage place, extreme temperature and humidity, insect infestations also influence the extent of mycotoxin contamination in the crop. Drought and excessive rainfall may also cause mould growth. Mycotoxicosis is a disease caused in livestock and poultry due to ingestion of feeds contaminated with mycotoxins. The common mycotoxins present in feedstuffs are aflatoxin, zearelenone, ocharatoxin. The major mycotoxin producing fungi are Aspergillus, Fusarium and Penicillium.

Common Mycotoxins in Poultry

The common mycotoxins affecting poultry species are aflatoxin, ocharotoxin, fumonisin and trichothecenes.

Aflatoxin

Aflatoxin is produced by two major species of Aspergillus flavus and Aspergillus parasiticus. The secondary metabolites of fungi i.e., Aflatoxins contaminate different variety of feedstuffs especially maize. Aflatoxins are fluorescent compounds chemically called as diflurocomorolactones. The major aflatoxins produced in animal feedstuffs are Aflatoxin B_1, B_2, G_1 and G_2. Among these, the aflatoxin B_1 is the most potent and toxic carcinogen affecting liver.

Aflatoxin affects all poultry species. They cause mortality in birds when ingested at higher doses, lower doses of aflatoxin are detrimental to poultry on continuous ingestion of aflatoxin contaminated feed. Ducks and turkey are more susceptible to aflatoxicosis. The permissible level for ingestion of aflatoxin is 20 ppb.

Harmful Effects of Aflatoxins in Poultry

1. Dullness with high morbidity and mortality percentage in flocks.
2. Reduced feed intake and feed efficiency in birds.
3. Reduced weight gain, egg production, egg weight and discolouration of eggs.
4. Reduced serum protein levels, increased liver fat and liver damage.
5. Deficiency of fat-soluble vitamins.
6. Hepatotoxic effects (liver reddened due to necrosis and congestion).

Ocharotoxin

Ocharotoxins are produced by species of aspergillus, fusarium including Aspergillus ocharaceous and Aspergillus niger. Among the Ocharotoxins, the Ocharotoxin A is the most important toxin. Ocharotoxin is hepatotoxic, neurotoxic, teratogenic and immunotoxic. Environmental factors favouring ocharotoxicosis are similar to aflatoxicosis. Young poultry are more susceptible to infection compared to adults. Ducks are more susceptible than chickens. They are rapidly excreted in liver. It causes economic losses in poultry and significant health problems in poultry.

Harmful Effects of Ocharotoxins in Poultry

1. Causes severe economic losses in poultry.

2. Causes weakness and anaemia.
3. Decreased feed consumption, reduced growth rate.
4. In laying birds delayed sexual maturity, decreased egg production, egg weight and egg quality and decreased hatchability is often noticed.
5. Causes poor feathering and high mortality.

Fumonisin

They are group of metabolites caused by fungal metabolites. The chemical structures of fumonisins are fumonisin B1, FB1 and fumonisin B2 and FB2. The poultry species are less susceptible to fumonisin toxicity compared to swine. Among the poultry species turkey are more sensitive than broilers and layers.

Harmful Effects of Fumonisins in Poultry

1. The fumonisin FB1 has hepatotoxic effect in poultry.
2. They have a major impact on the immune system causing immunosuppressive effects such as reduced thymus weight, decreased total white blood cell count, reduced immunity against new castle disease and increased susceptibility to Salmonella gallinarum infection.
3. They have negative impact on the gastrointestinal tract causing increased incidence of intestinal pathogen.

Trichothecenes

Trichothecenes are fungal metabolites produced by fusarium species in climatic conditions. Trichothecenes include T-2 toxin, diacetoxyscirpenol (DAS), and deoxynivalenol (DON). Among them, the most important trichothecene is DON.

Harmful Effects of Trichothecenes in Poultry

1. Toxic effects of trichothecenes in poultry include oral lesions, growth retardation, decreased egg production and egg shell quality.
2. They cause decreased feed intake, reduced growth, reduced feed conversion ratio
3. Trichothecenes also cause immunosuppressive effects in poultry
4. Poor feathering, occurrence of oral and dermal lesions such as crust on the beak, ulcers in oral cavity
5. Other common symptoms include diarrhoea, abnormal pigmentation, anemia, and rickets effects, including severe fragility and bending of long bones and shanks, soft and bending of beak.
6. In laying birds, they cause decreased egg production, poor egg shell formation, reduced egg size.
7. In breeder stocks, trichothecenes caused decreased fertility and hatchability.

Management of Mycotoxins in Feeds

The following methods are being followed to salvage the harmful effects of mycotoxins in feeds.

Increasing the amino acid content of the feeds: Supplementation of amino acids in feeds can decrease the effect of mycotoxins in feeds. The amino acid methionine when supplemented at 30 to 40 per cent levels in feeds may detoxify the aflatoxins faster and overcomes the effects caused by mycotoxins in poultry.

Physical treatment to remove mycotoxins in feeds: Physical treatment mainly heat treatment will destroy the toxins produced by mycotoxins. The mycotoxin Ocharotoxin is also affected by heat treatment. Sunlight destroys some of the aflatoxins in feeds. Hence, drying feeds in sunlight is one of the ways of reducing mycotoxin contamination. Autoclaving at 120 ^{0}C and 15 lbs psi pressure causes detoxification of ground nut cake and cottonseed meal contaminated with mycotoxins.

Chemical treatement to remove mycotoxins in feeds: Commercial detoxification of mycotoxins to destroy aflatoxins is done by gaseous ammonia treatment. Extraction of mycotoxins using organic solvents of calcium chloride can detoxify the mycotoxin contaminated feeds.

Other methods: Addition of mould inhibitors, mycotoxin binding agents and antioxidants may reduce the effects of mycotoxins in feeds. Formic acid and propionic acid are the mould inhibitors that are effective against fungal growth and toxin production. Mycotoxin binding agents such as activated charcoal, east cell wall products and synthetic zeolites may combat the effects of mycotoxins in feeds. One of the recent techniques for decontamination of mycotoxins is the use of enzymes such as esterase and epoxidase.

Microbial detoxification can be done by *Clostridium sporogenes* which breaks the harmful Ocharotoxin A into nontoxic metabolite. The aflatoxins in feeds can be destroyed by *Aspergillus repens* and *Flavobacterium multivorum*.

Conclusion

Mycotoxins are group of chemicals causing harmful effects in Poultry species. Alteration of favourable environmental conditions such as reducing the moisture content in feeds and effective control measures such as increasing the amino acid content in Poultry feeds can be followed to combat mycotoxin infections in Poultry.

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Machineries for Crop Residue Management

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Introduction

Crop residues are natural resource of nutrients, about 25% of nitrogen, 25% phosphorus, 50% of sulphur and 75% of potassium uptake by cereal crops are retained in residues. Crop residue management is the practice of removing the plant materials left in the field after harvest include burning of residue and conservation tillage practices such as no-till and mulch till and other conservation practices that provide sufficient residue cover to protect the soil surface from the erosive effects of wind and water. Management of crop residue is the challenging task for the farmers because of high cost of removing the residues and unavailability of labor.

Crop Residue Burning

Usually, farmers are practicing burning of crop residues to clear the harvested field easily and quickly for next crop production. The main reasons for crop residue burning - It clears land quickly from residues; It facilitate timely planting of following crop; It kills soil born pests and pathogens; Low-cost management of crop residues. Burning of crop residues produce soot particles and smoke causing human health problems, emission of greenhouse gases causes global warming, loss of plant nutrients (N, P & K), adverse impacts on soil properties and wastage of valuable organic carbon and energy rich residues.

Machineries

There are several alternatives for crop burning using on-farm machines for managing of crop residues. These machines perform baling and removing of straw, shredding and surface retention or mulching, shredding and incorporation and resource conservation technologies like no-tillage seeding.

1. Baler: Baling machines collect the straw from harvested fields, compress it and make it into rectangular or round bales; these straw bales are used as fodder, fuels for industries, bio-fuel production. There are two types of balers namely rectangular baler and round baler. Rectangular baler (Fig. 1) collects harvested and threshed straw from the field through pickup and fed into the baling chamber where the straw is compressed by plunger which moves in and out in the chamber.

Fig.1 Rectangular baler

Due to the movement of plunger inside a rectangular chamber a predetermined size of rectangular straw bale is formed. When the correct length of bale is achieved, a mechanism wraps the bale with twine or wire and ties it securely. Round baler (Fig. 2) collects straw from the land by pickup and fed into the bale chamber through auger. Bale chamber consist of roller and 6-8 number of rubber belts. These belts are tightly held by hydraulic system when the hay enters into the chamber it wraps over itself due to belt tension and roller action. The hay exerts force upon the belts, which is in turn monitored by the hydraulic system. Once a predetermined pressure is reached, bale is automatically wrapped with twine or protective sheeting. After wrapping, the tension on the belts is released and the entire rear portion of the baler is opened by hydraulic cylinders. The bale then simply rolls out onto the ground (Manjunath *et al.*,2015).

Fig.2 Round baler

2. Straw reaper/straw combine: Straw combine cut the left-over wheat straw after cut by combine harvester is recovered, threshed and blown into the netted trolley or directly on to the field (Fig. 3). The straw thrown and stubble left by the grain combine is cut by reciprocating type cutter bar and delivered to the cylinder-concave section through feeding auger. At cylinder-concave section (brushing unit) the straw is chopped by serrated saw blades mounted on brushing cylinder and counter bar. Straw, which passes through the concave, is aspirated by a blower and fed into a trolley on rear side covered by a wire net. Recovered wheat straw is used as cattle feed. The capacity of machine on an average is 0.4 ha/h and straw recovery is about 55-60%. There is an additional grain recovery of 50-100 kg/ha (Anon., 2010).

Fig.3 Straw combine/straw reaper

3. Rotary shredder: A rotary shredder has straight blades rotating in a horizontal plane with direction of travel. The straight blade used for shredding and it has mounted on disc in straight. The Rotary shredder gear box receives 540 rpm from tractors PTO; which converted in to 1200 rpm by suitable gear drive. When it is passed over the plants due to high rotation and impact force of the blades on plants cut it into smaller pieces and left over the field (Fig. 4). Shredding efficiency of this machine is about 89% with cost of operation 2800 Rs/ha (Sridhar and Surendrakumar, 2017).

Fig.4 Rotary shredder

4. Super Straw Management System (super SMS): It is a device attached behind the combine harvester. The Super SMS cuts the straw into small pieces and spread it around behind the tail of the combine (Fig. 5). Super SMS consists of a shredding unit and spreading unit. Shredding unit having a cylinder or rotor on which number of serrated knives are mounted in zig-zag manner, this cylinder rotates against fixed serrated knives. The threshed paddy/wheat straw in the combine harvester is passed between rotor and fixed serrated blades due to shearing effect exerted by rotation of rotor (1600 rpm) and fixed serrated blades, straw cuts into small pieces and spread over the field uniformly by flail type straw spreader. The cost of operation is 2800 Rs/ha. Using of this machine makes harvesting and crop residue management is done in single pass (Zang *et al.* 2017).

Fig.5 Super SMS

5. Sugarcane trash shredder: It is a trailed type tractor PTO operated machine (Fig. 6). It chops the dried and semi-dried sugarcane leaves after harvest of the sugarcane. The machine consists of two units namely suction and shredder unit. The suction unit has four wings are in arc shape. The shredding unit consists of cylindrical drum and counter bars. The drum consists of eight bars mounted on circular disc rotating at 1188 rpm. Serrated blades are mounted on these bars at fixed spacing. There are three counter bars which are fixed to upper casing of drum. When sugarcane leaves enter between drum and counter bars due to impact and shearing action it cut into smaller pieces of 8 – 12 cm by serrated knives and the cut material is left over the field as mulch or for incorporation. The cost of operation is 2015 Rs/ha with 90.40 % shredding efficiency (Mukesh and Rani, 2017).

Fig.6 Sugarcane trash shredder

6. Cotton stalk shredder: Cotton stalk shredder (Fig. 7) cut and chops the stalks after harvest of the cotton. It consists of converging unit, cutting unit, chopping unit and spreading unit. The converging unit guides the cotton stalks towards the cutting unit. Cutting unit consist of serrated drums which are having sharp edged circular disc at its bottom which cut the cotton stalks easily. The cut stalks are conveyed by 2 feeding rollers to the shredding unit which consists of a flywheel on which 6 numbers of blades are mounted. Flywheel rotates continuously at 1600 rpm so that it chaffs the stalks into smaller pieces of size 1 – 5 cm and spread over the field. The cost of operation is 3000 Rs/ha with shredding efficiency 85-90 % (El-Atty *et al.* 2017).

Fig.7 Cotton stalk shredder

7. Happy Seeder: It is used for sowing of wheat seeds without any burning of Crop residue in paddy or wheat fields. In this machine a mulching unit is attached at front of seeding unit (Fig 8). When the machine is passed over the combine harvested paddy or wheat field the mulching unit cut the stubbles into smaller pieces and left over the soil surface as mulch. This machine can be operated with 45 hp and above powered tractor and can cover 0.3 ha/h. cost of operation of this machine is 2300 Rs/ha. The seeding unit opens the furrow, places the seeds at uniform depth and covered with soil. Direct sowing with happy seeder helps in reducing soil disturbance, enabling it to retain more nutrients, moisture and organic content. It also saves money as less time is needed on carrying out field operations, which in turn reduces fuel and labour costs (Singh *et al.*, 2009).

Fig.8 Happy seeder

8. Super seeder: It consists of rotavator unit and seeding unit (Fig 9) which incorporate the standing paddy stubble into soil and sow wheat seed simultaneously in a single operation after the harvesting of the paddy with combine harvester. The rotavator unit having J-type blades which are rotating at 300 rpm which results in cutting and incorporation of paddy stubble into soil and it also make a clean bed for sowing. The seeding unit opens the furrow by double disc type furrow opener the place seeds and fertilizer in the furrow at uniform depth and covered with soil. The average field capacity is 0.35 ha/h with field efficiency of 77%.

Fig.9 Super seeder

9. Zero-till drill: Zero-till farming is a way of growing wheat / other crops without tillage or disturbing the soil in paddy/other crop harvested fields. Zero till drill consist of seed and fertilizer box, seed metering mechanism, seed tubes, inverted T-type furrow openers and power transmission wheel (Fig 10). The inverted T-type furrow opener opens a slit type furrow with less soil disturbance, places the seeds into the furrows at uniform depth and covered them with soil by a covering device. Size of the implement ranges from 9 to 11 number of furrow openers spaced 200 mm with provision for changing the row spacing. Average field capacity of this implement with 9 number of furrow openers is 0.35ha/h with field efficiency of 80% and cost of operation is 665 Rs/ha. Using of this machine helps in reduces labor for sowing, saves time of tillage of land, saves fuel, traps soil moisture and reduces soil erosion (Druwe and Victor, 2019).

Fig.10 Zero-till drill

Conclusion

Removing of crop residue is the major problem for the farmers after harvesting of succeeded crop. By using of machineries like balers, straw combine, super SMS, shredders and no or minimum tillage machines the burning of crop residue can be avoided and incorporation of organic matter into the soil is the better utilization of crop residue which improves the soil fertility, reduces soil moisture evaporation and soil erosion when crop residue is chopped and left over the field. Efficient use of these machines saves the labour, time, energy and cost of operation as well as cost of crop production.

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New Technologies in Soil Fertility Management

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Introduction

Soil fertility is the ability of soil to sustain plant growth and optimize crop yield. This can be enhanced through organic and inorganic fertilizers to the soil. Nuclear techniques provide data that enhances soil fertility and crop production while minimizing the environmental impact. Advancing food security and environmental sustainability in farming systems requires an integrated soil fertility management approach that maximizes crop production while minimizing the mining of soil nutrient reserves and the degradation of the physical and chemical properties of soil that can lead to land degradation, including soil erosion. Such soil fertility management practices include the use of fertilizers, organic inputs, crop rotation with legumes and the use of improved germplasm, combined with the knowledge on how to adapt these practices to local conditions.

Soil Fertility Management

The key physical, chemical, and biological components of soil fertility maintenance are the following:

1. Control of erosion: All the available techniques for controlling soil losses have been applied for many years, even hundreds of years, often in a very successful way and often alongside practices that are examples of what not to do. Sound stewardship of the soil, however, is not a universal goal; the needy and the greedy often have no interest in long-term and often low-payoff investments. In general, practical soil erosion control programs have been initiated by governments, for example, the U.S. Soil Conservation Service (SCS). Traditional moldboard plowing is an effective means of controlling weed, insect, and disease problems, and so the shift to reduced tillage practices tends to necessitate the use of more chemical pesticides. Fertilizer placement becomes more critical and thus leads to an increased demand for innovations in product and application equipment. One of the key components of erosion control is the rapid establishment of ground cover in order to reduce rainfall impact on the soil surface; thus, the selective encouragement of weed growth combined with a sound herbicide application program is a practical proposition in some areas.

2. Organic matter: In the natural uncultivated condition, the regular addition of plant detritus that is incorporated into the soil-by-soil organisms leads to the development of higher levels of soil organic matter (humus), which, in turn leads to improved soil structure and improved plant nutrient and water holding properties and greatly increased storage of soil nitrogen (N). The final level of organic matter in a soil is a characteristic of a particular soil; generally, higher rainfall increases the level while higher temperatures decrease the level. Once a soil is cultivated, the level of the soil organic matter declines. In turn large quantities of inorganic N are initially liberated, the physical stability of the soil is reduced, and its capacity to act as a reservoir for plant nutrients and soil moisture is diminished, and, of course, large quantities of nutrients are removed in the harvest. These are facts that account for the serious destruction of structurally fragile soils, however, for most of the productive soils of the world, these facts have been of little interest to the farmer because improved cultivation techniques combined with improved crop varieties and fertilizer use have achieved major increases in yields despite soil and organic matter losses.

3. Soil physical properties: Historically, maintaining the soil's physical properties has been of prime concern for the farmer, and the timing of tillage operations to match optimum soil moisture contents for good results is a skill all farmers have to learn. Organic manures and correct crop residue management and rotations all improve soil physical structure. Various synthetic soil conditioners are being marketed for agricultural use; Krillium (Monsanto), a synthetic organic soil conditioner, was available in the 1950s. The improvement of soil physical conditions is essentially controlled by the farmer's skills and by the equipment manufacturer bringing in innovative developments such as the high flotation equipment to lessen soil compaction.

4. Avoidance or the reduction of the effect of toxicities: The classic toxicity problems are the acid nature of many upland soils and the salinization of arid soils. acid soils are treated with various basic materials and, particularly, crushed limestone. Most national liming programs have been subsidized because farmers in the 1930s and 1940s were reluctant to spend money on liming. The increasing use of soil acidifying nitrogenous fertilizers has always concerned agronomists who have developed sound liming programs for most farm situations. It should be noted that attempts to develop the use of neutral or less acidifying fertilizers have been overtaken by the development of low-cost technologies for urea production. It is appropriate here to draw attention to the fact that soil acidification can be a serious problem even where nitrogenous fertilizers are not used. The acidification of ley pastures in Australia caused by the mineralization of biologically fixed nitrogen in the soil is well documented.

5. Integrated nutrient management: It thus embraces soil, nutrient, water, crop, and vegetation management practices, tailored to a particular cropping and farming system, undertaken with the aim of improving and sustaining soil fertility and land productivity and reducing environmental degradation. Integrated Plant Nutrient Management aims to optimize the condition of the soil, with regard to its physical, chemical, biological and hydrological properties, for the purpose of enhancing farm productivity, whilst minimizing land degradation. INM would include the use of farmyard manures, natural and mineral fertilizers, soil amendments, crop residues and farm wastes, agroforestry and tillage practices, green manures, cover crops, legumes, intercropping, crop rotations, fallows, irrigation, drainage, plus a variety of other agronomic, vegetative and structural measures designed to conserve both water and soil. The underlying principles on how best to manage soils, nutrients, water, crops and vegetation to improve and sustain soil fertility and land productivity and their processes are derived from the essential soil functions necessary for plant growth.

Conclusions

The balanced fertilization along with manures improved the soil aggradation process as well as biological activity of soil and maintained soil quality and sustainability of productivity. The maintenance of soil organic matter levels and the optimization of nutrient cycling are essential to the sustained productivity of agricultural systems. Crop production worldwide has generally resulted in a decline in soil organic matter levels and, consequently, in a decline of soil fertility. Integrated nutrient management improve and sustain soil fertility and land productivity.

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Soil Heavy Metal Pollution and Soil Ecology

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Introduction

Farmers are using higher doses of inputs like fertilizers, pesticides and insecticides to get higher production and profit but they are unaware about losses of cost and biological fertility (microbial activity) of their soils. The functioning of the soil as a vital system and the support on its biological productivity depends to a higher extent on the soil microflora activity. The microbial population of the soil depends on various factors such as chemical and physical environment surrounding rhizosphere environment. heavy metal contamination could influence conversion or mineralization of various nutrients *viz*, P, S, Zn, Fe, Cu and Mn of the soil. The changes in soil microbial equilibrium can serve as an "early warning" for negative alterations in the soil conditions long before they could be detected by soil pollution.

Effect of Heavy Metals on Soil Ecology

There is number of microbial factors which are influenced by heavy metals:

1. Decrease in microbial respiration rate: According to Shi and Ma (2017) there is continuous decrease in microbial activity have been observed due to of heavy metal contaminated of soil which is indicated by reduction in respiration rate which dependent on the type of the soil. He also reported that toxicity of heavy metals decreased due to microbial complexing with heavy metals. The decrease in respiration rate take place when concentration increase above a certain level.

2. Decrease in enzymatic activity: There is continuous decrease in various enzymatic activities *viz;* catalase, soil urease, amylase which indicates the lower mineralization of nutrients in soil and lower microbial growth.

3. Low soil organic carbon, total N, C/N ratio and DNA: Chen *et al,* (2013) reported a decline in soil organic matter total N and C/ N ratio due to lower microbial activity in the rhizosphere zone.

4. Lower biomass carbon, fungal and bacterial population in contaminated soil was observed by Chen *et al,* (2013).

Remedial Measure of Heavy Metals in Soil

Here some remedial technologies have been giving which are economically suitable for farmers:

1. Excavation: Excavation and physical removal of the soil is perhaps the oldest remediation method for contaminated soil.

2. Stabilizing Metals in the Soil: This consists of adding chemicals like phosphate fertilizer to the soil that cause the formation of minerals (pyromorphite) that contain the heavy metals (lead in case in of Phosphate fertilization) a form that is not easily absorbed by plants, animals, or people. This method is called in situ (in place) fixation or stabilization (Lambert *et al*., 1997).

3. Phytoremediation or Use of Plants Growing plants: It has the advantage of relatively low cost and wide public acceptance. It can be less than a quarter of the cost of excavation or in situ fixation. Phytoremediation has the disadvantage of taking longer to accomplish than other treatment. Plants can be used in different ways. Sometimes a contaminated site is simply revegetated in a process called Phyto stabilization.

4. Phytoextraction: Some of the plant species like Indian mustard can take up heavy metals and concentrate them in their tissue thus contaminated plant material disposed of safely. Sometimes soil amendments are added to the soil to increase the ability of the plants to take up the heavy metals.

5. Rhizofiltration: In this method, heavy metals are removed directly from water by plant roots. The plants are grown directly in water or in water rich materials such as sand, using aquatic species or hydroponic methods. In field tests sunflowers on floating rafts have removed radioactive metals from water in ponds. Metal absorption and immobilization, Nejad *et al*, 2018.

6. Use of organic inputs: Use of more organic or renewable sources also reduces the heavy metals in the soil.

Conclusions

The soil pollution caused by heavy use of synthetic fertilizers and chemicals is unconcerned by the most of the farmers which restrict the biological ecology of the soil and farmers production after use of all inputs. Therefore, an awareness about disadvantage of heavy use of these inputs should be spread among farmers will give better and long-term yield benefits over current system of farming.

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Disposal and Utilization of Animal Waste

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Introduction

Dairy cattle produce an average amount of 18-30 kg of dung and urine of about 17-45 ml per kg live weight in a day. As dairy farms increase milk production with more confined housing, manure production becomes more significant as a factor which must be considered by the farm operator in planning and operation. Pollution can also occur from milking parlours and wash rooms which is allowed to run directly into a stream. All wastes from a dairy farm are potential pollutants if not disposed or utilized in a proper manner. Manure disposal is the removal of manure from an area where its presence is undesirable. Manure utilization is the removal of manure from an undesirable area in such a way so as to realize some return. Animal wastes include livestock and poultry manure, bedding and litter, even waste feed and water. It replaces significant amounts of chemical fertilizers. Good hygiene around the farmstead is an aid to control diseases. Compost is rich in N, P, K and fair amount of Zn, Cu and Fe. It increases crop production up to 10 – 15 per cen.

Objectives of Animal Waste Management

1. To eliminate the threat of diseases.
2. To convert wastes into commodities of economic value like biogas.
3. Modify the wastes to harmless gases for release into the atmosphere (protect the environment).
4. To cut greenhouse gas emissions.
5. To stop offensive odour.
6. Prevention of sub-surface water pollution.
7. To destruct the pathogenic organisms and weed seeds.
8. To eliminate fly and mosquito breeding.

Waste Disposal System

1. Direct disposal: Manure is taken directly to the agricultural fields by directly conveying manure from byre to the fields and stationing the animals in the field with suitable protection.

Advantages:

a. It directly add nutrient in the soil.
b. It nourishes the living organisms present in soil.
c. Direct disposal of manure in soil improves soil fertility as well as productivity.

Disadvantages:

a. Loss of plant nutrients.
b. Problem of pathogens.

2. Indirect disposal: Manure is temporarily stored in manure pit for a period during which time most of the organisms' ova and larva will be destroyed by natural fermentation. This method is more hygienic and safer. In Loose houses two alternative methods follows:

a. Collecting solid and liquid manures separately.
b. Flushing out both manures together with plenty of water through hose pipe (It is more suitable for Buffalo farms and heavy rainfall areas).

Techniques for Effective Utilization of Animal Wastes

1. Composting.
2. Aerobic oxidation in ditches.
3. Direct application in field.
4. Biogas production (Anaerobic fermentation).

5. Insect repellent from cow's urine.

Composting

The process of decomposing organic wastes like organic biomass, cow dung or biogas slurry is called as composting.

Methods of Composting

1. Indore method - Pit Method.
2. Bio dung - Heap Method.
3. Bio-digested slurry - Biogas Plant.
4. Vermicompost - Earthworm composting.
5. Bangalore method - Anaerobic composting.
6. Coimbatore method - Semi aerobic compost.

NADEP Compost Tank method

Shifting the Heap above Two Weeks

Compost in Four Weeks

Making Compost (Organic Fertilizer)

Vermicompost

Vermicompost is the excreta of earthworm which is rich in humus. Vermiculture means farming of earthworms through bio-degradable material. The best manure worms are *Eisenia foetida*, as it works everywhere, in the indoor as well as outdoor. Physically they are crushers and grinders, due to action of their gizzard.

Advantages of Vermicompost

1. Eco-friendly natural fertilizer.
2. Improves soil aeration, texture, tilth and water retention capacity of soil.
3. Improves nutrient status of soil both macro and micro nutrients.
4. Promotes better root growth and nutrient absorption.
5. It does not have any adverse effect on soil, plant and environment.

Aerobic Oxidation

Slurry can be disposed by keeping in the shallow ditches. Biological Oxygen Demand (BOD) is generally 20 per cent for proper oxidation. Periodically solid sludge has to be removed. Water is used for irrigation after mixing with fresh water directly.

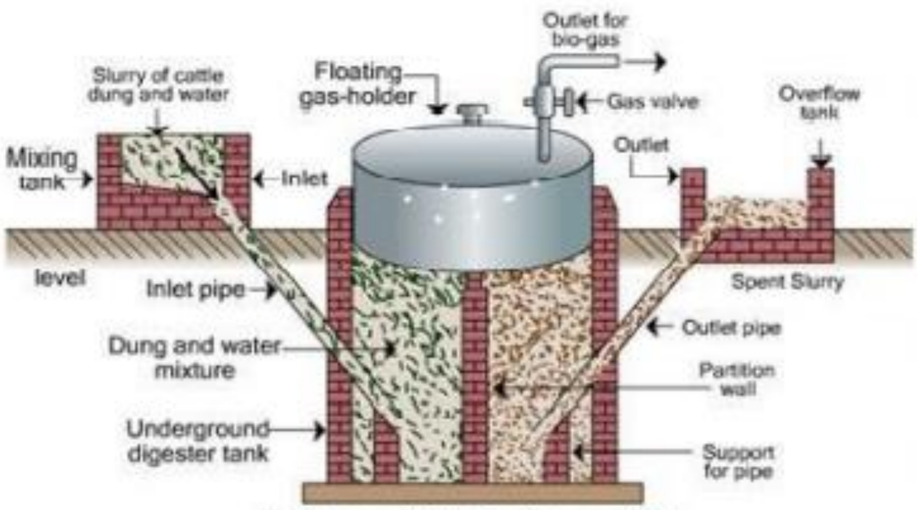
Direct Application in Field

Organic / Biomanure: It contains micro and macro nutrients such as Nitrogen, Phosphorus, Potassium and fair amount of Zn, Cu and Fe. It increases the microbial activity in soil. It improves soil structure, water holding capacity, seed germination and reduction of soil erosion. It is extremely essential for better crop productivity and maintaining the fertility of soil to ensure sustainable production.

Farm Yard Manure: Decomposed mixture of cattle dung and urine with straw and litter used as bedding material and residues from the fodder fed to the cattle. The waste material of cattle shed consisting of dung and urine soaked in the refuse of the shed is collected daily and placed in trench about 7m long, 2m broad and 1m deep. Each trench is filled up to a height of about 0.5m above the ground level. The heap is to be made dome shaped and plastered over with cow dung earth slurry. It becomes ready to apply after 3-4 months. 7-8 cu.m of manure (5-6 tones) per year per head of cattle. Well rotten FYM contains - N_2= 0.4-1.5 %, P_2O_5 = 0.3-0.9 % and K_2O =0.3- 1.9 %.

Biogas Technology

What is Biogas: It is a gas made from anaerobic digestion of agricultural and animal waste. The gas is a mixture of 65 per cent methane, 30 per cent CO_2 and 1 per cent H_2S. The technology is particularly valuable in agriculture, waste treatment or animal processing units where there is excess manure (e.g., cattle, pig, chicken) or farm waste. Small scale farmers having zero grazed pigs or 10 dairy cows for installing household biogas unit.



Floating gas-holder type bio-gas plant

Uses of Biogas

Cooking.
Lighting.
Motive power – can be produced by linking the Gobar gas to a fuel engine specially designed for Gobar gas for running:

a. Pump set.
b. Chaff cutter.

Produce electricity. Digested slurry is good organic manure for crops and fish ponds. Improves the sanitation and reduce the high incidence of diseases.

Insect Repellent from Cow's Urine

Cow's urine is a strong repellent for insects which normally inhabit the common crops. The repellent activity of cow's urine is enhanced by mixing some plant extracts with it. e.g Neem *(Azadirachta indica),* Custard apple *(Annona squamosa)* etc. These insect repellents are harmless for humans.

Conclusions

Proper disposal of animal waste is important for clean milk production, preservation of animal health and prevention of diseases. It improves fertilizing quality of the manure, urine and other wastes. Biogas technology and organic recycling is important to solve global problems such as food and energy shortage, desertification and pollution control. Organic manure is used for better crop production, maintaining the soil fertility to ensure sustainable production. It also necessary in livestock sanitation to dispose the animal manure in a simple and practicable manner.

Production Technology of Phyllanthus

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Phyllanthus amarus (syn. *P.niruri*) of the family Euphorbiaceae, is an important medicinal plant found growing as a weed in the rainy season in India and commonly known as Bhuamalaki, Nelanalli, Hazardana or Jaramala.

P. amarus possesses various groups of organic compounds including alkaloids, steroids, flavoids, lignans, terpenoidsniranthin, nirtetralin and lipids, etc. Among these compounds, lignans, tanrins and terpenoids are the most abundantly present. The main compounds that occur are lignans like phyllanthin and hypophyllanthin. The total phyllanthin content in the herb may range from 0.4 to 0.5 per cent. The roots contain kaempferol, rhamnopyranoside and eridityol rhamnopyranoside.

The herb is bitter, astringent, diuretic and antiseptic. It is employed in treating dyspepsia, colic, diarhoea and dysentery. It is also used in leprosy and diseases of the urino-genital system. The plant is said to be useful in Hepatitis B and jaundice, intestinal infection, diabetes, etc. It the traditional systems of medicine, it is one of the essential ingredients of many indigenous polyherbal formulations used in the treatment of bronchitis, leprosy, anaemia, asthma and hiccoughs. In the Unani system, the fruits are useful for tubercular ulcers, wounds; sores, bruises, scabies and ringworm.

An infusion of the root is a good tonic. The fresh roots or a decoction of the plant in a cup of milk or the dried leaves in powder are widely used in the treatment of jaundice. The roots and leaves are mixed with rice-water for application on oadema and ulcers. A decoction of the stem and leaves dyes cotton black it is sometimes used as a substitute for ink.

Origin and Distribution

There is still a stalemate about its nativity and taxonomic distribution. Now, it has been accepted that it is an American plant and occurs widely in China, Philippines, Cuba, Nigeria, Guam, West, Africa, and many other humid tropical countries.

The plant is commonly found growing throughout India during the rainy season, in many parts of the country like. Punjab, Uttar, Pradesh, Maharashtra, Karnataka, Tamil Nadu and Sikkim.

Description of the Plant

The plant is an erect annual herb, generally 30-70 cm tall, quite glabrous, often branched at the base, with numerous, sub sessile leaves. The stem is branched at the base, with numerous, sub sessile thick, very short petioles; the flowers are yellowish, numerous, axillary and monoecious. The capsule is oblate and smooth; the seeds are light brown, 0.9-1.0 mm 0.7-0.8 mm radially and tangentially.

Varieties

A selection named 'Navyakrit' from CIMAP, Lucknow, has been found superior in terms of high herbage yield (980 kg dry herbage/ha) and 40% more phyllanthin content.

Soil and Climate

It is found to grow well on a wide range of soils, varying from clayey to loamy soils in different parts of the country, at a soil pH ranging from 5.5 to 8. The plant has also been found to grow satisfactorily in well-drained calcareous soils. It is a tropical weed and survives under tropical and high rainfall conditions. However, when it is grown in dry or alpine temperate conditions the results are poor. The plant tolerates temporary water-logging.

Land Preparation

The field should be well ploughed 2-3 times and brought to a fine tilth. About 10 tonnes of FYM/ha is applied to the soil at the time of the last ploughing. Finally, plots of convenient size are made in the field along with irrigation channels.

Cultivation

Propagation: The plants are propagated sexually by seeds; the seed is photoblastic in nature. They are collected by allowing the plants to dry and the fruits to dehisce on paper. To raise seedlings, the seeds are sown in well-prepared nursery beds. Completely decayed FYM should be incorporated while preparing the beds. The seeds should be mixed with dry sand or soil to achieve uniform distribution, as they are very small in size. The months of April-May have been found excellent for raising the nursery. In order to get good germination and adequate herb yield. Appropriate moisture is maintained till the commencement of seed germination, which starts within 4-6 days of sowing. Approximately 1 kg of seeds is enough to get sufficient seedlings for transplanting an area of 1 ha.

Transplanting: Usually 35–40-day-old seedlings of 10-15 cm height are transplanted into the field at 15 X 10 cm spacing, out a wider spacing of 20 X 15 cm is also recommended to get a higher biomass yield. A light irrigation immediately after transplanting ensures the good establishment of the seedlings.

Manures and Fertilizers: At the time of the last ploughing, 10 t/ha FYM is applied. A does of 100: 50: 50 kg of NPK/ha is optimum to obtain better growth and herbage yield. Half the doses of N and the full does of P_2O_5 and K_2O should be applied at the time of transplanting and the remaining half of N is applied when plant attain 40-45 cm height.

Irrigation: In areas which get frequent rainfall during the growing period there is no need for any irrigation. However, if the rains are scanty or there are long dry spells, the fist irrigation should be provided immediately after the transplanting and later as when required. However, during the dry spell, the crop requires irrigation for its proper growth.

Weeding: Since the plant is herbaceous and tender, regular hand-weeding at monthly intervals is recommended. The application of herbicides is not recommended, because it affects the crop adversely by leaving residues in the crude drug.

Pests and Diseases: It is a very hardy crop and is not affected by many diseases except powdery mildew during its growth period. Powdery mildew can be effectively controlled by applying sulphur-containing fungicides like Sulphur @ 0.25%. Some insect pests like the leaf-eating caterpillar and stem weevils have also been reported and they can be controlled by spraying Nuvacron @ 0.2%.

The crop is ready for harvest after 3 months of transplanting, when the plants are greenish in colour and herbaceous. As the crop grows, there is an Increase in biomass, but the quantity of the leaves is reduced due to the fall of the lower leaves. Since the major active ingredients are confined to the leaves the production of maximum leaf biomass is the aim of harvesting at an appropriate time. Under Bangalore conditions the month of September has been found to be the optimum harvesting time for a high drug yield. The herb is dried in the shade for 3-4 days with constant raking with sticks. After drying, the material is stored in gunny (jute) bags and kept in a cool dry place.

The yield of the herb varies very much with the spacing of the plants. By adopting a spacing of 15 X 10 cm and average yield of 2000 kg of dry herb per hectare can be obtained.

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Prospects of GM Rubber in India

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The world's first genetically modified (GM) rubber plants have been set up for field trial in Assam, India during June 2021. It is the second GM crop which started field trial in India next to Bt cotton. GM rubber is developed by Rubber Research Institute of India, Kottayam, Kerala, and is developed exclusively for North Eastern States. The genetically modified rubber trees are expected to survive better and yield more in the climatic conditions prevailing in that area.

Introduction

Rubber plant is a native of warm humid Amazon rain forests and suited for tropical areas. It requires a temperature above 25°C, humid climate, annual precipitation above 200 cm. and rich, well drained soils. In NE India, growth of young rubber is retarded due to extreme winter climate when temperature falls to around 10°C, when the soil also gets dried up. During monsoon, the reduced light intensity also limits crop growth. Lack of adequate water during summer also leads to osmotic stress. As a result, yield is reduced and maturity time is prolonged by over a year in the NE India compared to Kerala, the predominating rubber tract of India, which has a more tropical climate. Genetic modification (GM) implies transfer of desired genes for specific traits between species using laboratory techniques. The GM rubber is produced by inserting additional copies of MnSOD (manganese containing superoxide dismutase), an enzyme encoding gene. Multiple copies of MnSOD gene enable the GM rubber to surmount extreme climatic stress like hot and cold temperatures, drought conditions etc. Hence, the new rubber clone is also expected to reduce maturity period leading to early yield and reduced payback period, thereby enhancing the returns.

Function of MnSOD Genes

Superoxide dismutases (SODs) are metallo-enzymes that catalyze the conversion of superoxide molecules to hydrogen peroxide and molecular oxygen, acting as cell's defense mechanisms against oxidative stress. Manganese containing superoxide dismutase (MnSOD) is an enzyme located in the mitochondria, the power house of cell. MnSOD is a nuclear encoded antioxidant enzyme that maintains normal mitochondrial functions by removing superoxide anion radicals generated in mitochondria and thus protects the cells from oxidative damage (Holley *et al.*, 2011).

The MnSOD gene eliminates toxic oxygen accumulation in cells during extreme temperatures. Genomic DNA analyses of rubber have revealed the presence of MnSOD genes in several rubber tissues including leaf, root, latex and intact plants (Miao and Gaynor, 1993). These MnSOD genes were amplified using bio-techniques and reinserted into rubber plant cells in laboratory, which was further developed into rubber plants for field trial. Over-expression of MnSOD genes in GM rubber enhances the survival of rubber plants by reducing the oxidative damage of cells during physiological stress conditions.

Background of GM Rubber

Genetic Engineering Appraisal Committee (GEAC), Ministry of Environment, Forest and Climate Change, Government of India, the country's apex biotechnology regulatory body had granted permission to start field trials of GM rubber as early as 2010 in Kerala. However, owing to the policy that Kerala preferred to remain a State free of GM crops, field level experiments were not undertaken in Kerala. The Rubber Board proceeded with the mission for climate tolerant GM rubber for NE India and succeeded by launching the field trial of GM rubber in Assam almost after a decade.

Prospects of GM Rubber in North East India

India is currently the sixth largest producer and second largest consumer of natural rubber globally. The unique position of rubber in framing the economy of nation is undisputable. So is its unparalleled role in maintaining the oxygen balance acting as a potential carbon sink in a predominantly fossil fuel consumer society. National Rubber Policy of India also promotes extensive cultivation of rubber to address strategic issues relating to climate change concerns and carbon market.

According to reports of Rubber Board, since there are no plant species in India that breeds with rubber trees in natural habitats, there is no risk of genes flowing from GM rubber into any other species, which is a concern often raised by environmental groups against GM plants. The apprehension of antibiotic resistance genes from GM rubber was also overruled as these genes would never come into contact with disease causing microbes. Field trials were also initiated by adopting all mandatory biological safety measures applicable to field trials involving GM crops.

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Immunity Boosting Vitamins and Minerals

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Summary
Currently, the world is in the grip of a pandemic of corona virus disease (COVID-19), caused by the SARS-CoV-2 virus that has mutated to allow human-to-human spread. Fever, dry cough, fatigue, severe pneumonia, respiratory distress syndrome can be caused by infection. Nutrition is, undoubtedly, a key determinant of maintaining good health. Key nutritional ingredients, such as vitamins C, D, E, zinc, selenium, and omega-3 fatty acids, have well established immune modulatory effects with infectious disease benefits. Also, some of these nutrients have been shown to have a potential role in COVID-19 management.

Introduction
Vitamins are vital organic nutrients in our meal that are utilized for the development and growth of our body and importantly prevents us from diseases thus improves immune system efficacy. The immune system helps in preventing the active tissues of the body from agents that lead to diseases. (Ibrahim and sayed 2015)

Vitamin C: Vitamin C can help prevent or shorten the duration of infections. Citrus fruits are a highlight, kale, bell peppers, Brussels sprouts, strawberry and papaya are two other good sources. (Furuya *et.,al* 2008)This vitamin stimulates the role of different immune cells and increases their capacity to defend themselves from infection. Cell death, which helps keep your immune system safe by wiping out old cells and replacing them with new ones, is also important. (Maggini *et.,al* 2007).Vitamin C also acts as a potent antioxidant, defending against oxidative stress-induced damage that occurs with the accumulation of free radicals known as reactive molecules. It has been shown that supplementation with vitamin C decreases the length and severity of upper respiratory tract infections, including the common cold.

Vitamin D: It's one of the most essential and strong nutrients for helping the immune system, known as the sunshine vitamin. The sources of food are small, but they include. Vitamin D is a fat-soluble nutrient that is important to your immune system's health and functioning. The pathogen-fighting effects of monocytes and macrophages that are essential parts of your immune defense are strengthened by vitamin D. This reduces inflammation, which helps promote immune responses. (Huang *et.,al* 2020)Other studies note that vitamin D supplements can improve the response of people with certain infections, including hepatitis C and HIV, to antiviral treatments. Somewhere between 1,000 and 4,000 IU of supplemental vitamin D per day is adequate for most people, depending on blood levels, although those with more severe deficiencies frequently need far higher doses.

Vitamin A: Rich sources of vitamin A are dark green leafy vegetables, carrots and pumpkin. It is an infection-fighter and comes in two forms: preformed, for example, from animal foods such as fish, meat and milk, or from carotenoids from plants. Tuna is an excellent source of pre-formed vitamin A. (yuan *et.,al* 2019).

Vitamin E: Almond, peanut, sunflower, hazelnuts have abundant Vitamin E. It can be an effective antioxidant that helps your body combat infection, just like vitamin C. This essential vitamin portion of your body's nearly 200 biochemical reactions is key to how your immune system works. Think of high-fat plant foods such as high-fat plant foods to get your vitamin E. (Morra *et., al.*2008)

Folic Acid: Folate is the natural form and the synthetic form is folic acid, often added to foods due to its health benefits. On a regular basis, add more beans and lentils to your plate, as well as leafy green vegetables, to get more folate. Another delicious resource is avocado.

Zinc: Meat, beans, nuts, seafood are packed with zinc. It is a mineral commonly applied to vitamins and other health items such as lozenges to improve the immune system. Zinc is a mineral. This is because zinc is essential for the functioning of the immune system. The period of the common cold can also be shortened by added zinc to your diet.

Iron: Iron, which allows the body to bring oxygen to cells, plays a role in many of the processes of the immune system. It comes in various types. Heme iron can be processed more quickly by the body. Meat, poultry, seafood, shellfish, legumes, nuts, beans, crunchy vegetables and dried fruit are iron-rich foods.

Selenium: It plays a major role in the immune system's health. This antioxidant allows the body to lower oxidative stress, which decreases inflammation and increases immunity. Studies have shown that elevated levels of selenium in the blood are related to an improved immune response. (Seale *et.,al* 2020)

Keeping in view the above benefits, incorporation of vitamin and mineral rich diet in your food is of paramount importance.

Conclusion

Adequate intake of nutrients especially vitamins and minerals are required and considered mandatory for healthy immune system and its functionality. Immunity is the natural defence mechanism in biological system to fight against diseases, infection and other autoimmune diseases.

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Carbon Farming and Agriculture

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Carbon farming could be a collection of agricultural practices or land uses designed to market carbon sequestration in soil and plants while lowering gas emissions from livestock, soil, and vegetation. The aim of carbon farming is to sequester more carbon and reduce greenhouse gas emissions in response to climate change.

Why Carbon Farming is Important to Agriculture

Land management is one of the most significant causes of global warming. Agriculture accounts for 18 per cent of India's total greenhouse gas emissions, with 2,299 million tonnes of carbon di oxide (CO_2) generated in 2018 as reported by the International Energy Agency. Common agricultural activities such as tractoring, tilling the soil, overgrazing, application of nitrogen and fossil fuel-based fertilisers, insecticides, herbicides, and animal manure to the soil, nitrogen leaching and run-off from fertilisers and manure, returning crop residues to the soil, and anaerobic rotting of organic matter during flood irrigation have the capacity to produce significant amounts of CO_2. On the other hand, agricultural ecosystems have the capacity to store a large quantity of soil carbon, up to 1 GT per year (Abdullahi *et al.*, 2018), which would offset roughly 10 per cent of yearly GHG emissions of 8 to 10 GT per year. No other human managed activity except agriculture has the capability to shift from a net CO_2 emitter to a net CO_2 sequesterer (The Carbon Cycle Institute, 2021). Carbon can be beneficially stored in soils for a long time through the process of soil carbon sequestration, collectively known as carbon farming.

Carbon Farming Options

1. Claying: The carbon sequestration potential of the majority of soils is limited, and depends on soil type, climate, and land use. Clay soils have the potential to hold more carbon in the form of soil organic carbon (SOC). Claying is a technique for incapacitating soil water repellence on light-textured, sandy soils where, the dry coatings of hydrophobic material on soil particles or aggregates, along with hydrophobic organic matter including fungal filaments and decomposing plant material, create water repellence in the soil. Claying water repellent sands enhances potential SOC storage due to the property of clay in shielding SOC from microbial degradation and also due to the increased plant biomass production.

2. Green and brown manuring: Green manuring is the process of cultivating green plant debris into soil using an offset-disc plough and trying to control seed set and kill weeds while increasing soil organic matter and nitrogen levels. Leguminous green manures will improve soil fertility by enhancing buffering ability to attenuate pH shifts and increasing SOC and nutrient status. Brown manuring is the practice of using a non-selective herbicide to desiccate the crop and weeds in bloom rather than cultivating the soil, where tillage is not adopted and hence the amount of organic matter in the soil increases. Through green or brown manuring, plant materials can be returned to the soil, which helps to increase soil organic matter, improve soil fertility, and minimize weeds.

3. Liming: Acid soils, with surface and subsurface pH below 5.5 and 4.8 respectively, restrict plant growth and biomass output. As a result, the accumulation of SOC is limited. Liming alleviates an acid-soil constraint on plant growth, resulting in increased biomass and SOC, and is a cost-effective way too. Liming decreases N_2O fluxes from a wheat–wheat rotation and increases CH_4 uptake from a wheat–wheat rotation (Barton *et al.,* 2013).

4. Composting: Compost sequesters carbon in a stable form. Ryals and Silver (2013) reported that an increase of 25-70% carbon storage was noticed by compost in grassland.

5. Liquid bio-fuel: Producing and using biofuel as a substitute for fossil fuels allows farmers to diversify their income, cut costs, and contribute to the reduction of global greenhouse gas emissions, particularly carbon dioxide, methane, and nitrous oxide. When biofuels are used to replace fossil fuels, almost all of them create fewer greenhouse gas emissions.

6. Stable ecological planting:

a. Reforestation, afforestation, revegetation and rangeland restoration.

b. Seaweed farming: Ocean afforestation through large scale seaweed farming could sequester huge amounts of carbon (Duarte *et al.*, 2017). The carbon sequestration potential is higher for wild seaweed as the dissolved particles of organic matter are transported to deep ocean seafloors and become buried and remain there for longer periods (Froehlich, 2019).

7. Biochar: Biochar is the stable, carbon-rich form of charcoal, produced by the process of pyrolysis, where biomass is heated at temperatures greater than 250°C with little or no oxygen. Biochar can reduce carbonic acid released into the atmosphere because pyrolysis traps the carbon within the biochar, which otherwise would be released through decomposition or burning of the material. Biochar has the potential to cut back on fertilizer requirements while crop productivity is maintained, or increase crop yields at lower rates of fertilizer use because of reduced leaching. Based on the type of biochar used and the soil's characteristics, the advantages may vary. Sandy soils showed more pronounced productivity improvements and the benefits include increased nutrient retention and reduced leaching, increased cation exchange capacity, improved soil structure and water-holding capacity, decreased soil acidity and increased habitat for microbes.

Conclusion

Carbon farming is an agricultural management approach that encourages the land to gather and store more greenhouse gases rather than emitting them into the environment. The aim of carbon farming is to sequester more carbon and reduce greenhouse gas emissions in response to climate change. Carbon farming can benefit in a variety of ways, including enhanced agricultural output, higher profitability, and satisfying national goals.

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Applications of Quantitative Trait Loci (QTL) Mapping

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Introduction

The development of saturated linkage maps with DNA markers facilitated to locate the genes of both simple and complex traits. The role of DNA markers in crop improvement, especially to understand the genetic architecture of complex plant traits is noteworthy. QTL analysis is essentially a "black box" approach to dissect the complex phenotypes. QTL approach allows us to identify individual loci showing a statistically significant association with phenotypes of interest. QTL studies suggest chromosomal regions where genes controlling quantitative characters are believed to reside. Researchers started exploring the possibilities of applying the QTL mapping in practical plant breeding and related areas. The three major areas where the knowledge of QTL mapping can be employed include: 1) genetic analysis, 2) marker assisted selection (MAS) and 3) introgression breeding.

Genetic Analysis

Marker based QTL analysis remains as an important tool in modern day plant breeding to find out the number of genes responsible for the expression of trait and locate them on specific linkage groups. It also helps to detect the nature of gene action, linkage or pleiotropy, epistasis, transgressants and their genetic basis, genetic basis of heterosis and genotype x environment interaction.

Marker Aided Selection (MAS)

In plant breeding, selecting the best genotype from the variety of genotypes remains the primary objective. Various selection methods were employed by the breeders involving biometrical, mutational and cytogenetical approaches. To the present-day breeders, molecular markers are going to be the best tool of selection opening up ways for a separate field of study, the molecular breeding.

In MAS, the tight linkage of marker to a gene is exploited for indirect selection of traits in a breeding programme. Two pre-requisites for adopting MAS in breeding programmes are: 1) a tightly linked marker to the gene of interest and 2) a population which is polymorphic for the marker and the gene which are in extreme linkage disequilibrium. In plant breeding, two distinct methods are followed: 1) for germplasm improvement (recurrent selection) and 2) for cultivar or hybrid development.

There are three possible approaches to applying MAS in plant breeding: 1) selection based on markers alone with no measurement of phenotype, 2) simultaneous selection on markers and phenotype and 3) two stage selection, the first stage involving use of markers to select among the genotypes and second involving phenotypic selection among the selected genotypes. The potential efficiency of MAS depends on the heritability of the trait, proportion of genetic variance explained by the markers and the selection method.

In plant breeding, markers can be applied for the identification of QTLs for trait that is under the control of small number of major genes with large environmental variance, a large number of minor genes with small effects or a mixture of the two.

Introgression Breeding

Introgression breeding is used to transfer the favourable genes from the wild relatives to the cultivated species. Cytological approaches were adapted to identify the lines having the introgressed segments, but the tediousness in the method made the process less amenable.

The ability to manipulate genes responsible for quantitative traits is a prerequisite for sustained improvement of crop plants. With the availability of recent molecular marker-based QTL analysis, breeders can make their attempt to transfer the favourable QTLs from wild species to cultivated varieties. Advanced

Back Cross-QTL analysis (AB-QTL analysis) method is used for the discovery and transfer of valuable QTLs from unadapted germplasm into elite breeding lines.

Conclusion

Many complex traits are under the control of multiple genetic factors, the effects of which are influenced by the environment. Because of these multiple influences, mapping the genetic basis (quantitative trait loci or QTL) for the variation in continuous traits is seldom easy. The advent of molecular marker technology and its potential use in QTL mapping made several aspects of crop breeding – marker aided selection for complex traits, marker aided introgression of favorable QTLs from unadopted germplasm and tracing the orthology among crop groups into reality. QTL mapping has tremendous application in plant breeding for the development of many promising lines.

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Participatory Guarantee System of India (PGS-India)

Article ID: 10798

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Introduction

The country situated to the north of the sea and the south of the Himalayas is known as Bharat and its progeny is known as Bharati. Such exceptional geographical location capacitates our nation to produce various crops organically because of its different agro-climatic conditions. In a few pieces of the country, the acquired custom of natural cultivation is an additional benefit. According to the available statistics, India's place is eighth in terms of the World's Organic Agricultural land and first in terms of the total number of producers as per 2020 data (FiBL & IFOAM Year Book, 2020). Among all the states, Madhya Pradesh has covered the largest area under organic certification followed by Rajasthan, Maharashtra, Chhattisgarh, Himachal Pradesh, Jammu & Kashmir and Karnataka. To further develop the trade of organic produce in domestic markets some form of certification is required and third-party certification is excessively exorbitant for India’s marginal and small farmers. Participatory Guarantee System (PGS) is designed to reduce costs to farmers and provide a satisfactory level of assurance to local consumers (Hill, 2016).

As per the International Federation of Organic Agriculture Movements (IFOAM), the Bonn-based global umbrella organization for organic agriculture, (2008) official definition "Participatory Guarantee Systems are locally focused quality assurance systems. They certify producers based on the active participation of stakeholders and are built on a foundation of trust, social networks and knowledge exchange". Key stakeholders (producers, consumers, retailers, traders and others such as NGOs, PGS-facilitators and service providers) are helping in capacity building and making farmers aware in group formation, system operation, decision making and integrity management. In the operation of PGS, stakeholders (including producers) are involved in decision making and essential decisions about the operation of the PGS itself.

In 2021 over 23,56400 Indian farmers were certified organic under the PGS banner (PGS, 2021). ‘Operational Manual for Domestic Organic Certification’ has been published in 2015 by the National Centre of Organic Farming, Ghaziabad, under the Ministry of Agriculture and Farmer’s Welfare, Department of Agriculture and Co-operation, PGS is a “quality assurance initiative that is locally relevant, emphasize the participation of stakeholders, including producers and consumers, and operates outside the framework of third-party certification”.

Guiding Principles for PGS-India

Under the global inclination and IFOAM's PGS Guidelines, the PGS-India programme is also based on a participatory approach, a shared vision, transparency and trust. As a unique feature PGS-India programme gives PGS movement the National recognition and institutional structure without affecting the spirit of PGS. Likewise, PGS-India also addresses the concerns of individual farmers that are unable to form groups or fall short of minimum numbers and the producers located in traditional/ default organic areas.

Therefore, to keep addressing the need for different categories of stakeholders PGS-India guiding principles are divided into three categories:

1. Groups.
2. Individual producers/ processors/ handlers.
3. Traditional default organic areas.

Guiding Principles for PGS Groups

1. Participation: Participation is an essential and dynamic part of PGS. Key stakeholders are engaged in the initial design and then in the operation of the PGS and decision making. The idea of participation exemplifies the principle of collective responsibility for ensuring the organic integrity of the PGS. This collective responsibility is reflected through:

a. Shared ownership of the PGS.
b. Stakeholder engagement in the development process.
c. Understanding of how the system works.
d. Direct communication between producers and consumers and other stakeholders.

2. Shared Vision: Comprehensive liability regarding execution and decision making is driven by a common shared vision. All the key stakeholders and even the State Governments support the guiding principles and goals, PGS is striving to achieve. This can be accomplished initially through their participation and support in the design and then by joining it. This may include a commitment in writing through signing an application that includes the vision.

3. Transparency: Transparency is created by having all stakeholders, including producers and consumers, aware of exactly how the guarantee system works to include the standards, the organic guarantee process with clearly defined and documented systems and how decisions are made. Public access will be ensured to documentation and information about the PGS groups, such as lists of certified producers and details about their farms and non-compliance actions.

At the grassroots level transparency is maintained through the active participation of the producers in the organic guarantee process which can include:
a. Information sharing at meetings and workshops.
b. Participation in internal inspections.
c. Involvement in decision making.

4. Trust: The reliability foundation upon which PGS are assembled is established in the initiative that producers can be trusted and that the organic guarantee system can be an expression and verification of this trust. The manners in which this trust is pondered may depend altogether on factors that are culturally or socially specific to the PGS group.

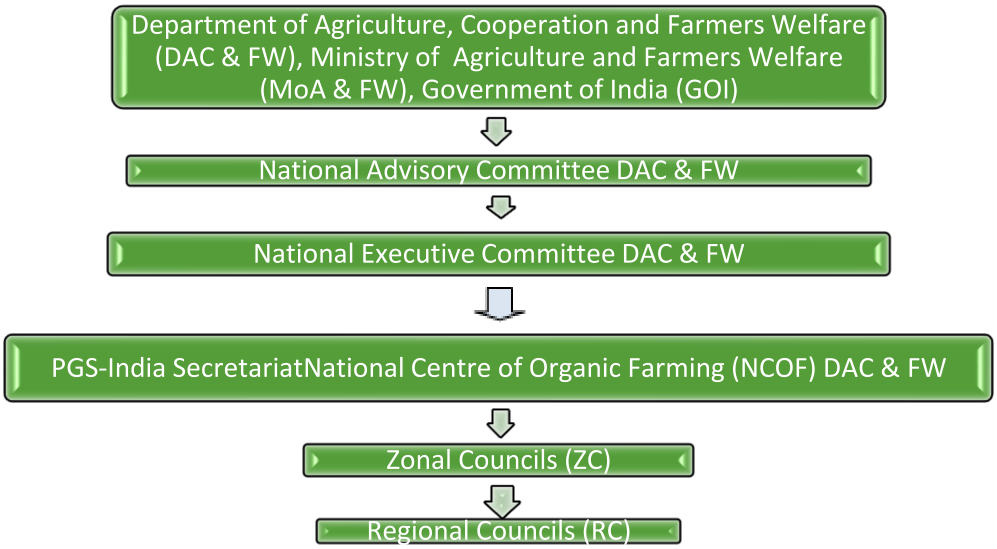
The idea of 'trust' assumes that the individual producer commits to protecting nature and consumer's health and well-being through organic production systems defined under "PGS-India standards".

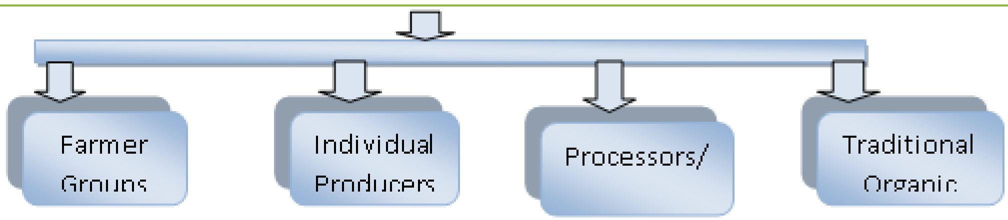
Mechanism to articulate trustworthiness includes:
a. Declaration (a producer pledge) via a witnessed signing of a pledge document.
b. Written collective undertaking by the group to abide by the norms, principles, standards of PGS-India and uphold trust for their peers.

5. Horizontality: The PGS India is anticipated to be non-hierarchical at the group level. This will reflect in the overall democratic structure and through the collective responsibility of the PGS group with sharing and rotating responsibility, by engaging producers directly in the peer review of each other's farms and by transparency in the decision-making process.

Operational Structure

The schematic operational structure of the PGS India is given below:





Certification Process by Local Group (LG)

Step 1- Structure a group involving at least five farmers (if possible, belonging to one village or close by villages with the contiguous territory). Collect registration and farm history sheet from all the members. All members need to modify their practices to comply with the requirement of PGS-India standards and ensure continued compliance. Prepare Local Group operational manual detailing requirement of documents to be maintained by farmers, peer appraisal methodology and checkpoints to be assessed, based on the broad guidelines of PGS-India norms. Register the group online on PGS Website and generate a user ID and password. Request RC to grant registration.

Step 2- To follow the PGS guidelines on group meetings, key field training and knowledge sharing. Ensure that all members abide by the standards in their production process. If member farmers are using or propose to use off-farm inputs then verify their organic status, discuss in group meetings and endorse or prohibit their use. Utilization of such inputs without the group's approval shall be treated as non-compliance.

Step 3- Complete peer review of all the farms at least once in each season. Ensure that all farms have been reviewed objectively. Segregate farmers who have fulfilled all the requirements and consider them for grant of certificate. Denial of certification or exclusion of members from the group to be endorsed by the whole group and should be informed to the defaulting member.

Step 4- On approval of yields by RC, a group can sell its produce as PGS certified produce and can generate Transaction Certificate (TC) online. TC can be issued for every farmer member separately. PGS certified products can be sold with the PGS-India logo as per prescribed terms and conditions for use of the logo.

Step 5- In case if RC returns the decision with reasons of return, the LG need to undertake corrective actions and resubmit the revised decision in fifteen days. In case of certificate denial by RC, if not satisfied LG can appeal to their respective Zonal Council with an intimation of PGS Secretariat for decision review.

Grant of Logo and Unique Certificate ID Code

On getting approved from Regional Council, Local Group can use scope certificate for publicity, trade enquiry or for putting into trade literature and also can use the granted PGS logo. Scope certificate will have a unique number, identifying the RC and Local Group along with the farmers. Each certificate will also list out the area, crops and products certified during the year as Annexure. The packets or containers of PGS certified products can be printed with the PGS logo with the UID code.
Two separate logos will be granted for PGS organic and PGS under conversion as follows:

1. PGS-India Green: Products under in-conversion to organic and granted with PGS-Green certification shall use the PGS-Green logo. It requires three years for conversion. Such products shall not be claimed as organic and only the indication "Under Conversion to Organic" can be used.

2. PGS-India Organic: Products acquired from the agriculture fields which are completely converted into organic. The certification mark certifies that the organic food product conforms to the NSOP (National Standards for Organic Production).

Marketing and Distribution of Organic Produce

Most probably it is seen it very challenging for the farmers to sell their grown organic produce and they are trapped by the middle man as well as the unable to fetch the right price. So, overcome such problems those farmers registered under the PGS procedure are connected with jaivikkheti.in portal, where farmers can themselves generate an ID and password and can sell their produce by desired value to it.

To harness the advantages of organic farming and to build up soil health and ensuring quality food free from pesticide residue, the Government of India has been promoting organic farming under the scheme

Parampragat Krishi Vikas Yojana (PKVY). Under PKVY state-wise PGS certifications are provided and through the help of cluster formation this process is being carried out since 2016.

Advantages

1. The procedures are straightforward, documents are basic, and local language is used for a better understanding of farmers.
2. All individuals live near one another and are known to each other. As practising organic farmers, themselves, they comprehend the processes well.
3. Since peer appraisers live in the same village, they have better access to surveillance.
4. It is cost-effective in nature.
5. There is Mutual acknowledgement and support between regional PGS groups which make sure better networking for processing and marketing.
6. Disparate the group certifications, PGS even provides every farmer individual certificate and the farmer is free to market his produce independent of the group.
7. Farmers can themselves sell their produce through jaivikkheti.in portal, which makes PGS ideal for local direct sales and direct trade between producers and consumers.

Limitations

1. PGS certification is for those farmers that can organise and perform as per the PGS guidelines.
2. Proper maintenance of documents, the farmers need to maintain their farm register properly, including all information regarding inputs and farm activities date time.
3. PGS ensures traceability until the product is in the custody of the PGS group.
4. Basic knowledge of online operations to use portal is required for online selling and marketing.

Conclusion

Participatory Guarantee Systems are locally focused quality assurance systems, built on a foundation of trust, social networks and knowledge exchange. PGS is a process in which people in similar situations assess, inspect and verify the production practices of each other and collectively declare the entire holding of the group as organic. We can understand as “Sabka saath, sabka vikas & sabka vishwas” is the key to the wholesome development of our farmers and in this way doubling of income can be achieved through quality production.

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Broccoli: An Neutraceutical Vegetable

Article ID: 10799

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Introduction

Broccoli (*Brassica oleracea* var. *italic*), belongs to family Cruciferae, is a member of Cole group. The species originated in the Mediterranean region. It is possessing abundant fleshy green flower heads arranged in a tree-like fashion on branches sprouting from a thick, edible stalk. The large mass of flower heads is surrounded by leaves. The curd found generally green, purple and white colour. Broccoli also provides many health-promoting properties owing to its content of antioxidant and anticarcinogenic compounds. It is composed of polyphenols, glucosinolates, sulforaphane and selenium.

Calabrese Broccoli

Sprouting Broccoli

Romanesco Broccoli

Purple Broccoli

Chinese Broccoli

Figure 1. Different type of Broccoli

Nutritional Value of Broccoli

Broccoli cultivation has become increasingly popular with Indian growers for the last couple of years obviously due to its multifarious use and great nutritional value. It is a rich source of vitamins, minerals and proteins, etc. Broccoli has 130 times more Vitamin A contents than cauliflower and 22 times more than cabbage. It is beneficial and more nutritious than any other vegetables of the same genus (Table 1).

Table (1): Nutrient, Minerals and Vitamins Database for broccoli:

Nutrient	value per 100 g	Minerals & Vitamins	value per 100 g
Protein	2.82 g	Calcium	47 mg
Carbohydrate	6.64 g	Iron	0.73 mg
Energy	34 kcal	Phosphorus	66 mg
Total lipid (fat)	0.37 g	Potassium	316 mg
Fiber	2.6 g	Vitamin A, RAE	31 µg
Sugars	1.7 g	Vitamin A, IU	623 IU
Water	89.3 g	Vitamin C	89.2 mg

Cancer Prevention

Cancer is a group of diseases involving abnormal cell growth with the potential to invade or spread to other parts of the body. Its main characteristics are uncontrolled growth of the cells in the human body and the ability of these cells to migrate from the original site and spread to distant sites. Isothiocyanates, which are the major active compound of many cruciferous vegetables, inhibits tumor growth by generating reactive oxygen species, or by inducing cycle arrest leading to apoptosis. Broccoli is a rich source of sulphoraphane, a compound associated with reducing the risk of cancer. It is also containing carotenoid compounds lutein and zeaxanthin. This is an anti-oxidant which helps in treating different types of cancers like bladder, colo-rectal etc. Bioactive GLS hydrolysis products, such as isothiocyanates (ITCs) and indole-3-carbinol (I3C), which may contribute to reduce risk of Renal cell carcinoma (RCC). ITCs can compound sulforaphane, which may help prevent cancer by enhancing the elimination of potential carcinogens from the body and increasing the transcription of tumor suppressor proteins.

National Cancer Institute (NCI) studies in experiments with and identified several potential ways in which these compounds may help prevent cancer:
1. They help protect cells from DNA damage.
2. They help inactivate carcinogens.
3. They have antiviral and antibacterial effects.
4. They have anti-inflammatory effects.
5. They inhibit tumor blood vessel formation and tumor cell migration.

NCI also mentioned that a concentrated form of sulforaphane (SPN) found in broccoli has been shown to reduce the number of acute lymphoblastic leukemia cells and prevent therapeutic properties in solid tumors.

Diabetes Prevention

Broccoli is one among the few vegetables that claims to possess anti-diabetic properties. Broccoli is mainly attributed to high concentration of sulforaphane; studies demonstrate that SPN reduces oxidative stress through the activation of antioxidant response pathways. Previously, we reported that broccoli sprouts supplementation with standard dose of SPN, in type 2 diabetic patients, significantly decreased lipid peroxidation and increased total antioxidant capacity. Broccoli contains many bioactive compounds, including flavonoids, phenols, carotenoids, antioxidant vitamins such as vitamin C and E, selenium, and several glucosinolates. It is a main source of bioactive components, especially sulforaphane (SPN), has been proposed as an effective supplement for diabetes management and prevention of its long-term complications.

Asthma Prevention

Asthma is most common chronic diseases it’s a long-term problem in the tubes that carry air into your lungs that can make it hard for you to breathe. Consumption of broccoli led to a two to three-fold increases in level of antioxidant enzymes linked to the protection of human airways against oxidative tissue damage, which leads to inflammation and respiratory condition like asthma. Sulforaphane promote antioxidant enzyme gene expression in airways, suggesting that ingestion of these foods could improve the anti-oxidant capacity of airways among asthmatics, thereby reducing airway inflammation, and ultimately improving clinical features of the disease.

Neurological Benefits

Broccoli contain Sulforaphane has been shown to protect brain cells from the damaging effects of reactive oxygen species (oxidants) including superoxide anion radicals, hydrogen peroxide, hydroxyl radicals, and peroxynitrite. Oxidative stress is likely a key component involved in the development of many neurological disorders including ALS, Parkinson’s disease, Alzheimer’s disease, and multiple sclerosis.

Conclusion

Therefore, the several phytochemicals or compounds that are present in broccoli have been proved to reduce the risk of several major diseases including cancers, asthma, neurodegenerative disorders and diabetes etc.

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Important Diseases of Cole Crop and their Management Practices

Article ID: 10800

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Cole crop consist of a large group and belonging to the family Cruciferae is a temperate, subtropical and cool season vegetable crop. Most of the cultivated forms originated in Mediterranean region. The commercially important crop of this group is cabbage, cauliflower, knol khol and broccoli etc. The crop is attacked by number of diseases of which White rust, Damping Off, Club rot, Black rot, Powdery mildew and Downy mildew are most serious causing substantial reduction in crop growth and yield. In the present document the causal organism, symptoms, survival and spread, environmental factors, disease management and various disease management practices have been discussed to save the crop from diseases.

Damping Off

1. Causal organism: *Pythium aphinidermatum, Rhizoctonia sonali*

2. Disease Symptoms: Damping off of occurs in two stages, *i.e.,* the pre-emergence and post-emergence phase.

a. In the pre-emergence phases the seedlings are killed just before they reach the soil surface.
b. The young radical and plumule are killed and there is complete rotting of the seedlings.
c. The post-emergence phase is characterized by the infection of the young and juvenile tissues of the collar at the ground level.
d. The infected tissues become soft and water soaked. The seedlings topple over or collapse.

3. Survival and spread:

a. Primary: Seed, Soil and Water.
b. Secondary: Conidia through rain splash or wind.

4. Environmental Factors: High temperature (25-29^{o}C) with high level humidity (80%) favours fast spread of the disease. The disease is more serious, when the minimum and maximum temperature are 18 and 25^{o}C, respectively, along with high level humidity and heavy rainfall.

5. Disease Management:

a. Provide good drainage.
b. Drench the nursery soil with 0.3% solution of Captan or Thriam @ 5 liter of water/m^{2}area.
c. Treat the seeds before sowing with Captan or Thriam @ 2.5 g/kg seed.
d. After seed germination drenches the seedlings with Bavistin (0.1%) or Dithane M- 45(0.2%).

Club Rot

1. Causal organism: *Plasmodiophora brassicae*

2. Disease Symptoms: Especially found in temperate region. It affects the underground portion but symptoms on above ground portion are apparent only in advance stages.

a. Stunting and yellowing of infected plants.
b. Leaves become yellowish and wilt on hot days.
c. Club like swelling of root and root lets.
d. Club root is particularly prevalent on soils with a pH below 7, whereas it has been observed that the disease is often less serious on heavy soils and on soils containing little organic matter.

3. Survival and spread:

a. Primary: Soil borne resting spores, which survive for longer periods in soil.
b. Secondary: Resting spores or zoospores carried through irrigation water or by root contact.

4. Environmental Factors: It occur at a temp. range of 12 - 27 °C and High soil moisture with acidic soils condition (5-7pH).

Disease Management:

a. Raise the soil pH of by liming.
b. Raise the crop in well-drained soil with pH slightly above neutral.
c. Sterilize the nursery beds.
d. The most practical control measure is crop rotation.

Black Rot

1. Causal organism: *Xanthomonas campestris* pv. *campestris*

2. Disease Symptoms: It is seed borne disease which affected both nursery and field condition.

a. The plant may be affected at any stage during its growth.
b. Infected leaves show yellowing at margins and the necrosis towards the centre of the leaf, forming V-shaped area.
c. The veins become brown or dark and vascular regions of the main stem discoloured.
d. Leaves fall prematurely due to formation of abscission layer.

3. Survival and spread:

a. Primary: Internally seed borne and soil borne.
b. Secondary: Bacterial cells dispersed through irrigation water and rain splashes.

4. Environmental Factors: Relative humidity > 90%. High soil moisture. Frequent rains

5. Disease Management:

a. Follow long crop rotation of at least 3-5 years.
b. Treat the seed with hot water at 52˚C for an hour.
c. Protective spray with Indofil M-45 @100ppm and repeat at least 8-10 days interval.
d. Small rotten area on the curd may be cut with knife and painted with Bordeaux mixture @ 4: 4: 50.

Alternaria Leaf Spot

1. Causal organism: *Alternaria brassicae*

2. Disease Symptoms: V-shaped lesions appear along the tips of the leaves, with the point of the V directed toward a vein.

a. The spots appear as small dark-coloured areas, which expand rapidly to form circular lesion up to 1.0 cm dia.
b. The enlargement of spots may be in concentric circles.
c. In some conditions, the cauliflower curd also show browning, beginning at the margins of flower clusters.

3. Survival and spread:

a. Primary: Mycelium persisting in the seed or as spores on seed or from debris.
b. Secondary: Through Wind or insect.

4. Environmental Factors: Soil temperature of around 30 C. High humidity or persistent dew. Moist weather with intermittent showers.

5. Disease Management:

a. Plant pathogen-free seed.
b. Crop rotation for 3 years.
c. Bury plant debris.
d. Eliminated volunteers and weeds.
e. Depending up on infection, 2-4 sprays of Indofil M-45, Difolatan at 0.2%, or Blitox @ 0.5- 0.75% at 15 days interval are effective.

Precision Agriculture -Technology to Increase the Resilience of Agriculture Production to Climate Change

Article ID: 10801

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Introduction

Precision Agriculture become and more an accepted way of crop production and helps to achieve a sustainable agriculture. It provides a new solution using a system approach for today agriculture issue, namely the need to balance productivity with environmental concerns. The potential of this technology has already been demonstrated, but in practice, machinery for delivering difficult as it need large scale application to realize the benefits. Precision agriculture technology for production and scope for suiting over to modern agriculture leaving the traditional over by utilizing the researches in right time and management, which results an environmentally friendly suitable agriculture.

Climate Change and Indian Agriculture

Climate change impacts on agriculture are being witnessed all over the world, but countries like India are more vulnerable in view of the huge population dependent on agriculture, excessive pressure on natural resources and poor coping mechanisms. The warming trend in India over the past 100 years has indicated on increase of 0.60̊ C. the projected impacts are likely to further aggravate field fluctuations of many crops thus impacting food security. There is already evidence of negative impact on yield of wheat and paddy in parts of India due to increased temperature, water stress and reduction in number of rainy days. Significant negative impacts have been projected with medium-term (2010-2039) climate change, e.g., Yield reduction by 4.5 to 9 % depending on the magnitude and distribution of warning. Since agriculture makes up roughly 15% of India's GDP, a 4.5 to 9% negative impact on production implies cost of climate change to be roughly at 1.5% of GDP per year. In the absence of planned adaptation, the consequences of long-term climate change could be severe on the livelihood security of poor (Mand, 2013).

Adaption to Climate Vulnerability

Planned adaptation is essential to increase the resilience of agricultural production to climate change. Several improved agricultural practices evolved over time for diverse agro-ecological regions in India have potential to enhance climate change adaptation, if deployed prudently. Management practices that increase agricultural production under adverse climatic conditions also tend to support climate change adaptation because they increase resilience and reduce yield variability under variable climate and extreme events. Some practices that help adapt to climate change in Indian agriculture are soil organic carbon build up, in-situ moisture conservation, residue incorporation instead of burning, water harvesting and recycling for supplemental irrigation, growing drought and flood tolerant varieties, water saving technologies, location specific agronomic and nutrient management, improved livestock feed and feeding methods.

Precision Agriculture

Precision agriculture is generally defined as an information and technology-based farm management system to identify, analyze and manage variability within fields for optimum profitability, sustainability and protection of the land resource. In this mode of farming, new information technologies can be used to make better decisions about many aspects of crop production. Precision farming involves looking at the increased efficiencies that can be realized by understanding and dealing with the natural variability found within a field. 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. Precision agriculture is helping many farmers worldwide to maximize the effectiveness of crop inputs. Precision agriculture often has been defined by the technologies that enable it and is often referred to as GPS (Global Positioning System) agriculture or variable rate farming. As important as the devices are, it only takes a little reflection to realize that information is the key ingredient for precise farming. Farmers who effectively use information earn higher returns than those who don't. Precision agriculture 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.

Need for Precision Agriculture

The potential of precision agriculture for economic and environmental benefits could be visualized through reduced use of water, fertilizers, herbicides and pesticides besides the farm equipment. Instead of managing an entire field based upon some hypothetical average condition, which may not exist anywhere in the field, a precision agriculture approach recognizes site-specific differences within fields and adjusts management actions accordingly (Goovaerts, 2000).

Farmers usually are aware that their fields have variable yields across the landscape. These variations can be traced to management practices, soil properties and/ or environmental characteristics. Soil characteristics that affect yields include texture, structure, moisture, organic matter, nutrient status and landscape position. Environmental characteristics include weather, weeds, insects and diseases.

In some fields, within-field variability can be substantial. In one field, the best crop growth was observed near waterways and level areas of the field. Side slopes where erosion depleted topsoil showed moisture stress and reduced plant stands. In another farm, it was observed that the variation in yield levels for corn and soybean was typically 2 to 1. Seeing this magnitude of variation prompts most farmers to ask how the problem that is causing the low yields can be fixed.

There is no economically feasible method of "fixing" the depleted topsoil areas in this field, so the management challenge is to optimally manage the areas within the field that have different production capacities. This does not necessarily mean having the same yield level in all areas of the field. A farmer 's mental information database about how to treat different areas in a field required years of observation and implementation through trial-and error. Today, that level of knowledge of field conditions is difficult to maintain because of the larger farm sizes and changes in areas farmed due to annual shifts in leasing arrangements. Precision agriculture offers the potential to automate and simplify the collection and analysis of information. It allows management decisions to be made and quickly implemented on small areas within larger fields. Management decisions to be made and quickly implemented on small areas within larger fields.

Why Precision Agriculture

1. To enhanced productivity in Agriculture.
2. Prevent soil degradation in cultivable land.
3. Reduction of chemical use in crop production.
4. Efficient use of water reservoir.
5. Discrimination a modern farm practice to increase quality, quantity and reclined cost of production with environmental degradation.

Advantages

Agronomical perspective -Use agronomical practices by level of perspective requirement of crop.
Technical perspective - Allow efficient time management.
Environmental perspective - Eco friendly income.
Economical perceptive - Increase crop yield and reduce cost of cultivation by efficient use of farm inputs, labors, water etc.

How can Precision Technology be Part of the Climate Change Solution?

1. Lower fuel and energy use will mean less carbon dioxide is produced.

2. Optimizing nitrogen fertilizer use will help reduce the amount of nitrous oxide released from the soil.
3. By locating and correcting local soil structural damage, crop performance and yield can be optimized, maximizing efficient use of inputs.
4. By reducing waste.
5. Improving productivity can reduce the greenhouse gas emissions per kg grain, milk or meat produced
6. By being better prepared for climate change, for example by using water more efficiently or improving soil structure.

Village Level Interventions Towards Climate Resilient Agriculture

Building resilience in soil: Soil health is the key property that determines the resilience of crop production under changing climate. A number of interventions are made to build soil carbon, control soil loss due to erosion and enhance water holding capacity of soils, all of which build resilience in soil. Mandatory soil testing is done in all villages to ensure balanced use of chemical fertilizers. Improved methods of fertilizer application, matching with crop requirement to reduce nitrous oxide emission.

Adapted cultivars and cropping systems: Farmers in the villages traditionally grow local varieties of different crops resulting in poor crop productivity due to heat, droughts or floods. Hence, improved, early duration drought, heat and flood tolerant varieties are introduced for achieving optimum yields despite climatic stresses. This varietal shift was carefully promoted by encouraging village level seed production and linking farmers decision-making to weather based agro advisories and contingency planning.

Water saving technologies: Since climate variability manifests in terms of deficit or excess water, major emphasis was laid on introduction of water saving technologies like direct seeded rice, zero tillage and other resource conservation practices, which also reduce GHG emissions besides saving of water.

Farm machinery (custom hiring) centers: Community managed custom hiring centers are setup in each village to access farm machinery for timely sowing/planting. This is an important intervention to deal with variable climate like delay in monsoon, inadequate rains needing replanting of crops.

Crop contingency plans: To cope with climate variability, ICAR/CRIDA has developed district level contingency plans for more than 400 rural districts in country. Operationalization of these plans during aberrant monsoon years through the district/ block level extension staff helps farmers cope with climate variability.

Livestock and fishery interventions: Use of community lands for fodder production during droughts/floods, improved fodder/feed storage methods, feed supplements, micronutrient use to enhance adaptation to heat stress, preventive vaccination, improved shelters for reducing heat/ cold stress in livestock, management of fish ponds/ tanks during water scarcity and excess water are some key interventions in livestock/ fishery sector.

Weather based agro advisories: Automatic weather stations at KVK experimental farms and mini-weather observatories in project villages are established to record real time weather parameters such as rainfall, temperature and wind speed etc. both to issue customized agro advisories and improve weather literacy among farmers.

Institutional interventions: Institutional interventions either by strengthening the existing ones or initiating new ones relating to seed bank, fodder bank, commodity groups, custom hiring center, collective marketing, introduction of weather index-based insurance and climate literacy through a village level weather station are introduced to ensure effective adoption of all other interventions and promote community ownership of the entire Programme.

Village Climate Risk Management Committee (VCRMC)

A village committee representing all categories of farmers including women and the land less is formed with the approval of Gram Sabha to take all decisions regarding interventions, promote farmers participation and convergence with ongoing Government schemes relevant to climate change adaptation. VCRMC participates in all discussions leading to finalizing interventions, selection of target farmers and area, and liaison with gram panchayat and local elected representatives and maintain all financial transactions under the project.

Conclusions

Precision agriculture gives farmers the ability to use crop inputs more effectively including fertilizers, pesticides, tillage and irrigation water. More effective use of inputs means greater crop yield and/or quality, without polluting the environment. However, it has proven difficult to determine the cost benefits of precision agriculture management. At present, many of the technologies used are in their infancy, and pricing of equipment and services is hard to pin down. This can make our current economic and environmental issues that surround production agriculture today. Questions remain about cost-effectiveness and the most effective ways to use the technological tools we now have, but the concept of "doing the right thing in the right place at the right time" has a strong intuitive appeal. 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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Plant Disease Triangle: Fundamental Elements for Disease in Plants

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Introduction

The disease triangle represents the three fundamental elements required for disease in plants:
1. A susceptible plant.
2. A pathogen capable of causing disease.
3. A favorable environment.

The Plant

Susceptibility to disease can be affected by many factors, including the growth stage of the plant, its genetic predisposition and stress. By careful observation of a diseased plant, one can begin to speculate about what basic functions of the plant are affected and, therefore, what kind of disease it may be. Symptoms are the expression of disease by a plant as a response to the activities of the pathogen. It may be localized, such as leaf spots or systemic such as stunting that affects the entire plant. Some symptoms develop first on young and otherwise healthy tissues, other occur first on senescent tissues, such as aging flowers or lower leaves that are turning yellow. Many symptoms of plan diseases involve the death of plant tissues. Symptoms alone are not enough for accurate diagnosis of many plant diseases.

The Pathogen

The second vertex of the plant disease triangle is the pathogen. The word *pathogen* comes from the root word *pathos* ("suffering") and the suffix *–gen* ("origin" or "genesis"). Together they mean "the cause of a disease". Most plant diseases are caused by parasites. A parasite is an organism that obtains its nutrients from another living organism. Parasites of plant include fungi, bacteria, nematodes, viruses and even other plants. Parasites become pathogens when they do not merely live on and obtain nutrients from a host organism but actually case harm to the host, resulting in disease symptoms. Pathogens that are also parasites are infectious. They can be spread (transmitted) from plant to plant, potentially causing an epidemic. These living organisms that cause diseases are sometimes called biotic pathogens. There are also abiotic (nonliving) agents that cause disease. Noninfectious factors may affect many plants in an area, but the diseases they cause are not "contagious", i.e., they are not transmitted from one plant to another.

The Environment

An environment favorable for disease development (the third vertex of the disease triangle) consists of factors affecting the plant, factors affecting the pathogen, and sometimes additional organisms, such as vectors. The environment in which plant disease occurs consists of a wide range of factors that should be investigated when a diagnosis is being made. These factors include recent temperature (such as extreme highs and lows), rainfall or irrigation (amounts, timing and source), and light intensity or shade. Characteristics of the soil, such as drainage, soil type and pH are also important.

Determination of Disease-Causing Organism: Koch's Postulate

1. The suspected pathogen must be consistently associated with diseased plants.
2. The suspected pathogen must be isolated in a pure culture and its characteristics noted.
3. The diseased must be reproduced in a healthy plant inoculated with the isolated organism.
4. The same pathogen characterized in step 2 must be isolated from the inoculated plant.

Biotrophs and Necrotrophs

Plant diseases often involve the interaction of plants and parasites. Thus, diseases are greatly affected by the biology of the parasites.

Biotic pathogens can be divided into two categories (biotrophs and necrotrophs) that describe their approach to causing disease.

Biotrophs require living plant tissues.

Necrotrophs usually produce destructive toxins and enzymes that destroy plant tissues. Some parasites are so dependent on their hosts that they are unable to exist without them. These parasites, called biotrophs or obligate parasites, can obtain nutrients only from plant cells. They often form some kind of survival structure in the absence of a host. In some cases, biotrophs do not form a survival structure and will perish if they do not find a way to move to another living plant before the host plant dies. Most plant pathogens are more flexible in their adaptation and can live either as parasites or as saprophytes, organism that obtain nutrients from dead organic matter. Organisms with the flexibility to switch back and forth between the parasitic and the saprophytic life style are described as facultative. Facultative saprophytes are better adapted to living as parasites but can survive as saprophytes when necessary. Facultative parasites are primarily saprophytes but can live as parasites if given the opportunity to invade compromised or senescent plant tissues. Many other bacteria and fungi are obligate saprophytes living only on dead organic matter and incapable of causing plant disease. These organisms may act as secondary invaders of dead and dying tissues. They contribute to the decay of plants and other organisms. At the other end of the spectrum of parasitism are the facultative parasites and facultative saprophytes, or necrotrophs. As the name suggests, they obtain nutrients from dead organic matter or from dead or dying cells of living plants. In contrast to the more delicate invasion by biotrophs, necrotrophs tend to produce toxins and enzymes that rapidly kill and degrade plant tissue and inhibit defense mechanisms by the plant. Necrotrophs commonly penetrate plants through wounds or natural openings.

The Disease Cycles

Pathogens, like their hosts plants, have life cycles. These may be as simple as that of a bacterium, in which a single cell divides into two cells. When interaction between a plant and a pathogen result in disease, the interactions are described by the disease cycle. A disease cycle may be simple or complex, but all disease cycle follows a pattern of discrete steps occurring in a predictable order. Disease cycles may be completed in as little as a few days or (in some tree diseases) as long as several years. It is important to be able to identify the stages of the disease cycle of each disease, because they will suggest ways to prevent or manage the disease.

The life history of a pathogen consists of two phases: (i) pathogenesis and (ii) survival.

Pathogenesis is the chain of events whereby disease occurs

Pathogenicity is the ability of the parasite to interfere with one or more of the essential functions of the plant, thereby causing disease.

Each cycle begins with the introduction of the pathogen into a plant environment and terminate with the cessation of its activities. Primary cycle begins only with after a period of rest or dormancy or seasonal inactivity, while secondary cycle originates during the growing season and there is neither a period of rest or dormancy.

Pathogenesis in both primary and secondary cycles proceed in the following stages.

1. Inoculum – Inoculation is the initial contact of a pathogen with a site of plant where infection is possible. The pathogen(s) that lands on or is otherwise brought into contact with the plant is called the inoculum.

2. Penetration – Is the entrance of the pathogen into a plant and this usually takes place through wounds, natural openings etc.

3. Infection – Implies the establishment of the pathogen within the tissues of the plant.

4. Incubation – This is the interval of time between the infection by the pathogen and production of disease symptoms.

5. Invasion – This refers to the latter stages of infection in which the pathogens invade and ramify the tissues and cells of the plant.

6. Reproduction – After establishing itself between the plant cells and tissues and obtaining nourishment from them, a pathogen may increase in size and number.

7. Dispersal – After reproduction, a plant pathogen or its propagules must be dispersed and disseminated to other plants.

8. Survival – After passing through its pathogenic phase during crop growth and during the growing season. A pathogen must survive until the next growing season. Many pathogens produce hardy structures with which they can survive from one growing season to another.

Measurement of Plant Disease

1. Incidence of the disease i.e., the number or proportion of plant units that are diseased i.e., the number or proportion of plants, leaves, stems and fruit that show any symptom) in relation to the total number of units examined. Measuring disease incidence is relatively quick and easy, and this measurement is the one that is used commonly in epidemiological studies to measure the spread of a disease through a field, region or country.

2. Severity of the disease i.e., the proportion of area or amount of plant tissue that is diseased. Disease severity is usually expressed as the percentage or proportion of plant area or fruit volume destroyed by a pathogen. More often, disease assessment scales from 0 to 10 or 1 to 4 are used to express the relative proportions of affected tissue at a particular point in time.

Importance of Millet-Based Pulses Crop System in Rainfed Agriculture

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Millets and Pulses as a Part of Rainfed Agriculture

Rainfed areas tend to have lower productivity, higher yield instability and house the majority of the poor and marginal farmers. At the same time, considering the yield gaps prevalent at this day. Rainfed areas are key to fight against poverty and marginalization, to securing a long-term national and regional food supply to tackle malnutrition. Rainfed areas are highly diverse covering a wide range of climatic, agro-ecological and socio-cultural regions with different kinds of cropping patterns, farmers preferences, socio-economic indicators and crop potentials requiring more subtle and location-specific approaches.

Millet-Based Pulses Crop System

The changes in cropping pattern also have implications on resource use. Continuous monocropping increases vulnerability of farmers to weather risks, degrades soil fertility, depletes ground water, and increases build-up of pests and diseases. There is a need to evolve management practices for farmers preferred crops without degradation of the natural resource base and also there is need to define agroecological zones where such cropping patterns can be adopted sustainably.

The Pulse-based cropping systems are environmentally sustainable also, as they require lower use of fertilizers, pesticides and irrigation in addition to enhancing the productivity of cropping systems by increasing yield of subsequent crops. To achieve appropriate land use, efficient inter and sequence-crop systems were based on soil type, rainfall and length of growing season.

a. Intercropping sorghum with legumes not only produces higher yield per unit area but also provides nutritional benefits, economic enhancement and soil health management.

b. Crop sequence with Pearlmillet-Chickpea, Fingermillet-Black gram, Green gram are found to be more feasible and profitable.

Millets and Pulses Cultivation in Rice Fallows

Millets are known to be climate resilient crops, their cultivation in traditional areas is reducing. Following rice fallows sorghum and pulses cultivation plays significant role in economic security of farmers.

Challenges Related to Millets and Pulses in Rainfed Agriculture

Rainfed agriculture has wide variability or fluctuations in rainfall, soils, temperature, terminal droughts and vulnerable to climate change impacts. The following challenges are:

1. Biotic stress: Difficulties in timely sowing and non-adoption of disease resistant cultivars resulted into severe infestation of pests and disease.

2. Lack of irrigation facilities: Irrigation facilities are scanty and these crops are low remunerative, the farmers grow other cash crop or vegetable with available irrigation and due to lack of protective irrigation is a major reason for lowyields.

3. Low Productivity: Majorly dependent on rainfall most of the area under rainfed cultivation, no use of soil type, high yielding cultivars, non-adoption of soil moisture conservation practices and improved production technologies led to the low productivity.

4. Fluctuating market prices: There are no standardized market facilities and intelligence and procurement by the government market prices of the millets and pulses are some times less than cultivation cost. v. Unawareness about health and nutritional benefits: The millets are good for human health and overcome several diseases, their consumption is reducing drastically due to unawareness, lack of commercial ventures and policy ignorance.

Ways to Strengthen the Importance

The farmers have limited resources and diversified needs under several socio-economic and farming constraints which had become their primary concern. Millets and pulses are less remunerative which requires the following supports to make farmers more profitable.

1. Institutional support: There is a large scope for increasing productivity and profitability for farmers through promising production technologies developed by research and development programmes. Weather forecasting and resource-based crop selection coupled with soil test-based recommendation have crucial role in bringing out the wide yield gap.

2. Input support: Availability of quality inputs like seeds of High yielding varieties, disease resistant varieties, fertilizers, agro-chemicals in time and place are the keys for adoption of new technologies for increasing productivity and profitability.

3. Market support: Standardized market facilities, intelligence development, get rid of from middlemen and buy back arrangements at grass root levels would enhance confidence of the farmers.

Strategies for Adoption

Millets and Pulses have huge potential to enhance the income of the resource's poor farmers in dryland conditions. The following key steps in order to enhance the farmers income.

1. Enhancing productivity introducing location specific millet-based pulses and suitable promising production technologies from research and development organisations.
2. Emphasis on moisture conservation practices and also link with watershed development programme.
3. Introduction of millet-based pulses in new niches and allied farming involving women.
4. Creating awareness about health and nutritional benefits of millets and pulses through effective mass and local media to bring change in the consumer preferences.
5. Introduction of Mechanization and financial support.

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Biofertilizers Use in Agriculture

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Introduction

Biofertilizers are products of beneficial microorganisms which increase agricultural production by way of nutrient supply and mobilization of unavailable nutrients pool to be used by plants. Biofertilizers have a greater role in modern agriculture as they possess way more benefits than chemical fertilizers.

Advantages of Biofertilizers

Biofertilizers supply both macro and micro nutrients to the plant either by fixing or solubilizing different nutrients. Biofertilizers not only secrets different enzymes but also different plant growth promoting hormone. They protect the plants from various diseases by releasing certain antibiotic compounds. Biofertilizers reduce the problem of water scarcity by releasing certain compounds which reduces soil dispersion and helps in soil aggregation.

Biofertertilizers for Different Crops

Biofertilizer	Crops	Application method
Rhizobium leguminosarum	Pea, legumes	Soil application and seed treatment
Rhizobium phaseoli	Bean group	Soil application and seed treatment
R. japonicum	Soybean	Soil application and seed treatment
Azotobacter	All crops except legumes	Soil application and seed /seedling treatment
Acetobacter	Sugarcane	Soil application and set treatment
Azospirillum	All crops except legumes	Soil application and seed treatment
Phosphate solubilizing bacteria	All crops	Soil application and seed treatment
Potassium mobilizing biofertilizer	All crops	Soil and seed treatment
Sulphur solubilizing biofertilizer	All crops	Soil application and seed treatment
Zinc solubilizing biofertilizer	All crops	Soil application and seed treatment
Biofertilizer consortia (Azotobacter + *Azospirillum* + nutrient solubilizing / mobilizing biofertilizer	All crops	Soil application
Vesicular arbuscular mycorrhiza (VAM)	Crops and trees	Soil application and seedling inoculatation
Blue green algea	Transplanted and beushaned rice	Stagnated rice field
Azolla	Transplanted and beushaned rice	Stagnated rice field

Method of Application of Biofertilizer

Seed treatment with solid form – Mix 200 g of solid form of biofertilizer (1 packet) with 400 ml of water to prepare slurry. Sprinkled the prepared slurry over 10 kg of seed to form a coating over the seed. Then dry the seeds in shade on polythene sheet or pucca cemented floor for 30 minutes. Sow the seeds within 24 hours of treatment. Calculate the quantity of biofertilizer as per seed rate/ac.

Seed treatment with liquid form- Mix 100 ml of liquid form of biofertilizer with 2-3 l of water and soak 10 kg of seed for overnight. Dry the seeds under shade on polythene sheet or pucca cemented floor. Sow the seeds within 24 hours of treatment. Calculate the quantity of biofertilizer as per seed rate/ac.

Seedling root dip with solid form - Mix 400 g of biofertilizer with 40 l of water. Dip root portion of the seedlings required for one acre in the solutions for 30 minutes.

Seedling root dip with liquid form - Mix 200 ml of biofertilizer with 40 l of water. Dip root portion of the seedlings required for one acre in the solutions for 30 minutes.

Use of solid form of VAM biofertilizer- The inoculum should be applied 2-3 cm below the soil at the time of sowing. Sow the seeds or cuttings just above the VAM inoculums. Apply 5-10 g of bulk inoculums in each poly bag. While planting saplings, apply 20g /seedling in each spot. In the existing tree, 200g inoculums are required for each tree.

Soil application with solid form for sugarcane: Suspend 5 kg of bio fertilizer / acre in 10 l of water and mix thoroughly with 100 kg of FYM/ vermicompost. Sprinkle the mixed bio fertilizer in FYM over cane setts in the rows at planting. Cover rows immediately rows with soil.

Set Treatment with solid form -Mix thoroughly 5 kg bio fertilizer/ac in 100 l of water. Treat cane set by dipping in the suspension for 30 minutes before planting.

Soil application with liquid form of biofertilizer- Mix 400 ml of biofertilizer in 4l of water/ ac and add 50 kg cow dung manure or vermicompost**.** Apply it before final land preparation or in furrows at sowing.

Use of biofertilizer consortia- Apply biofertilizer consortia of *Azotobacter* + *Azospirilum* **+** phosphorus solubilising bacteria @ 5 kg /ac mixed with 50 kg of cow dung manure or vermicompost in furrows at sowing or just before final land preparation.

Use of Blue Green Algae (BGA) – Apply dried flakes of algal culture @ 4 kg/ac in standing water of rice field after beushaning or 15 days after transplanting. Impound water in rice field for a week. Apply biofertilizer for 3-4 consecutive seasons in the same field for greater benefit in long run.

Use of Azolla

Green manure: Apply *Azolla* @ 2-5-4.0 t/ac and incorporate it before transplanting of rice.

Azolla as dual crop: Apply *Azolla* @0. 5 t/ac three days after transplanting or beushaning of rice. Allow it to multiply for 25-30 days. Then incorporate *Azolla* fronds into the soil at the time of weeding.

Conclusion

At present, biofertilizers can be a great alternative over synthetic fertilizers as it has numerous benefits. It will not only increase yield potential of developing countries but also lead them towards ecological balance and sustainable agriculture.

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Insect Pests of Brinjal and their Management

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Introduction

Brinjal (*Solanum melongena* L.) is an impotent solanaceous crop in India. Brinjal is also known as egg plant and augersine. Many insect pests like brinjal lacewing bug, fruit and shoot borer, Stem borer, Hadda beetles, and leaf roller are infecting the brinjal crops and reducing the productivity and quality of products, among which fruit and shoot borer and red lacewing bug are important. The present article emphasis on the identification, life cycle, nature of damage and management of major insect pests of the brinjal crop.

Brinjal Lacewing Bug

Urentius sentis (Hemiptera: Tingidae) It is a major destructive pest of brinjal and distributed in the north-western parts of the India. Except of brinjal, it has not been reported feeding on any other plants.

1. Identification and life cycle: The full-grown nymphs are about 2 mm long and 1.35 mm broad. They are pale ochraceous and are stoutly built, with very prominent spines. The adult is straw coloured on the dorsal on the dorsal side and black on the ventral side. On the pronotum and wing, there is a network of marking and veins. This pest active during April to October and hibernate in November to March.

2. Damage symptoms: Both nymph and adult caused Damage in plant. Nymph and adult such the sap from leaves and caused yellowing spots which, together with the black scale-like excreta deposited by them, impart a characteristic mottled appearance to the infected leaves.

3. Management:

i. Remove the affected plant and destroy.
ii. Apply one litre of dimethoate 30EC in 325 -350 litre of water per ha.

Fruit and Shoot Borer

Leucinodes orbonalis (Lepidoptera: Pyralidae) This pest is widely distributed in Sri Lanka, India, Pakistan and East Africa. It has also been reported feeding on many other solanaceous plants and occasionally on the green pods of pea also.

1. Identification and life cycle: The moth is white but has pale brown or black sports on the dorsum of the thorax and abdomen. Its wings are white with a pinkish or bluish tinge and are ringed with small hair along the apical and anal margins. The mature larva come out of their feeding tunnels and pupate in tough silken cocoon among the fallen season. Tha pupal stage lasts 6-17 days and the life-cycle is completed in 20-43 days during the active season.

2. Damage symptoms: Larva bores into tender shoots and causes withering of terminal shoots / dead hearts also bores petioles of leaves, flower buds and developing buds, causes withering of leaves, shedding of buds and make fruits unfit for consumption. Attacked fruits are with boreholes plugged with excreta. Fruits become out of shape also.

3. Management:

a. Remove the affected terminal shoots.
b. Remove the affected fruits and destroy.
c. Avoid continuous cropping of brinjal crop.
d. Grow the varieties with long and narrow fruits in endemic areas.
e. Install pheromone trap@12/ha.
f. Encourage the activity of larval parasitoids: *Pristomerus testaceus* and *Cremastus flavoorbitalis*.
g. Avoid use of synthetic pyrethroids.
h. Avoid using insecticides at the time of fruit maturation and harvest.
i. Use neem seed kernel extract (NSKE) 5 % per hac.

j. Spray any one of the following chemicals starting from one month after planting at 15 days interval.

Brinjal Hadda Beetles

Henosepilachna sp. (Coleoptera: Coccinelidae): Two species of Hadda Beetle, *Viz., Henosepilachna dodecastinga* and *H. vigintioctopunctata* attack different solanaceous vegetables like brinjal, tomato and potato. Another species, *Epilachna demurili*, on attack cucurbitaceous exclusively.

1. Identification and life cycle: *H. vigintioctopunctata* beetles are deep red and usually have 7-14 black spots on each elytron whose tips is somewhat pointed. Beetle of *H. dodecastigma* are deep copper- coloured and have six black spots on each elytron whose tip is more rounded. *E. demurill* beetles have a dull appearance and are light copper-coloured. Each of their elytron bears six black spots surrounded by yellowish ring. *H. vigintioctopunctata* passes the winter as a hibernating adult among heaps of dry plants or in cracks and crevices in the soil. It results, active during March-April and lays yellow cigar-shaped eggs, mostly on the underside of the leaves, in batch of 5-40 each. The pupae are darker and are found fixed on the leaves, stem and most commonly, at the base of the plants. The pest passes through several broods from March to October and its population is maximum at the end of April or in early May.

2. Damage symptoms: Both the adult and grub cause damage by feeding on the upper surface of leaves. They eat up regular area of the leaf tissue, leaving parallel band of uneaten tissue in between. The leaves, thus, present a lace-like appearance. They turn brown, dry up and fall off and completely skeletonize the plants.

3. Management:

a. Collect damaged leaves with grubs and egg masses and destroy them.
b. Shake plants to dislodge grubs, pupae and adults and destroy.
c. Conserve natural enemies in brinjal ecosystem.
d. Spray Carbaryl 50 WP @ 3g/lit.

Stemborer

Euzophera perticella (Phycitidae: Lepidoptera)

1. Identification and life cycle: Creamy and scale-like, laid singly / in batches on young leaves, petioles and branches. Fully grown larva is creamy white with few bristle-like hairs, 20 mm. Pupates within cocoon inside larval tunnel, 9-16 days. Adult is greyish brown, forewings with transverse line and white hindwings. Life cycle is completed in 35-76 days.

2. Damage symptoms: Larva bores into main stem of young and old plants and move downwards. Top shoots of young plants crump and wither. Older plants become stunted. Fruit bearing capacity is adversely affected. There is a distinct thickening of stem at the entry point.

3. Management:

a. Collect and destroy the damaged and dead plants
b. Use light traps to attract and kill the moths.
c. Conserve larval parasitoids *Pristomerus testaceus* and *P. euzopherae*
d. Spray any one of the insecticides starting from one month after planting at 15 days interval. Carbaryl 50 WP 2 kg + wettable sulphur 50 WP 2 kg, Quinalphos 25 EC 1.5 L + Neem oil 1.0 L, NSKE 5%.
e. Avoid using synthetic pyrethroids as they cause resurgence of sucking pests.

Brown Leafhopper

Cestius phycitis (Cicadellidae, Hemiptera)

1. Identification and life cycle: The adults are small light brown colour with having bright yellow marks on its thorax.

2. Damage symptoms: It is a vector of little leaf of brinjal. Nymphs and adults suck cell sap from ventral side of leaf and inject toxins into the plant tissues and cause reduction in size of leaves, shortened petioles, excessive growth of branches general stunting of plants, conversion of floral parts into leafy structures and give the plants a bushy appearance. Fruiting is rare.

3. Management:

a. Rogue out infested plants as soon as they appear in the field and completely destroy them.

b. Before transplantation dips the seedlings in 0.2% carbosulfan 25 DS solution to control the insect vectors.

c. Spray 3-4 times at 10 days interval with methyl parathion 750 ml or dimethoate 500 ml or monocrotophos 500 ml or endosulfan 1.0 L or imidacloprid 125 ml in 500 -750 L of water /ha.

Physiological and Morphological Markers for Salt Stress Affected Plants

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Summary
Plant growth and development is adversely affected by different kind of biotic and abiotic stresses. One of the major abiotic stresses, salinity, causes complex and major changes in plants by influencing the physiology by interactions of genes. The modulated genetic regulation stuns metabolic balance, which may alter plant's physiology and eventually causing economic losses. To improve agricultural output, researchers have concentrated on identification, characterization and selection of salt tolerant varieties and genotypes. Nowadays, phenotyping plants through Machine learning (deep learning) approaches that analyze the images of plant leaves to predict biotic and abiotic damage on plant leaves have increased. Here, we review salinity stress related markers on physiological and morphological levels for different crops.

Introduction
Growth and development of plants are affected by various biotic and abiotic stresses. Salinity is one of the major abiotic stresses which adversely affects the overall growth and development of plants and yield of the crop also Almost one Billion of hectare of the world's land is salinized and it is a major threat to agriculture in arid and semi-arid regions, where water scarcity and inadequate drainage of irrigated lands severely reduce crop yield. Salt accumulation inhibits plant growth and reduces the ability to uptake water and nutrients, leading to osmotic or water-deficit stress. Salt is also causing injury of the young photosynthetic leaves and acceleration of their senescence. Salinity resulted in the reduction of the yield due to the reduced photosynthesis efficiency, chlorophyll, total protein, biomass, stomata closure and increasing the oxidative stress.

The harmful effect of salinity can vary depending on climatic conditions, light intensity, plant species or soil conditions. Depending on the ability of plants to grow in saline environments, they are classified as either glycophytes or halophytes, and their response to salt stress differs in terms of toxic ion uptake, ion compartmentation and/or exclusion, osmotic regulation, CO_2 assimilation, photosynthetic electron transport, chlorophyll content and fluorescence, reactive oxygen species (ROS) generation, and antioxidant defenses. Most salinity adaptive mechanisms in plants are accompanied by certain morphological and anatomical changes.

To improve productivity in salt stressed condition, selection and adoption of plant varieties with high salt tolerance has always been a preferred choice this selection is based on morphological, physiological and molecular markers. In morphological markers various characters such as root or shoot morphology, early senescence, biomass of grains is some of the important parameters that are considered whereas physiological and biochemical markers examine chlorophyll content, accumulation of proline, sucrose, stress protectants, membrane stability and hormones content. These physiological markers, especially hormonal, polyamine & proline changes in plants are important to increase salt tolerance of plants.

Detection of Salinity Stress
1. Morphological Markers: salt concentration in land varies from place to place and affects the growth of plants. Most commonly NaCl salt is used for salt stress studies. The stress effects on morphology are manifested by different means such as dry or fresh total biomass, plant height and by other morphological markers. Generally, an increase of salt content in the growing environment increases the impact of salt stress on plant growth. This response varies from plant to plant. In arbidopsis, wheat, maize, rice and rye grass the decrease the total plant biomass was observed at 100-150mM NaCl levels, while in tomato and sunflower, the weight decreased on 50mM NaCl application. Studies on salinity effect on trees are meager,

even though they too are affected by salinity, in citrus and acacia, it caused biomass changes (decrease of 13% and 15%, respectively) at early stages of growth, however, palm was less susceptible as it experienced growth changes (biomass did not decrease) at severe salt stress levels.

Salinity stress also affects germination rate of seeds and thus germination is also an informative marker for salinity stress. Since germination is among the foremost morphological processes, it is a useful indicator of stress as compared to biomass as stress can be known as early as 2–14 days depending on a plant species.

In addition to total plant biomass changes, the weight of shoot, root and leaves are frequently used for evaluation of salt stress. The length of roots and shoots, root architecture and the number of secondary branches on them, diameter of shoot, the tiller numbers, leaves number are used as growth parameters in salinity. Besides the growth parameters, the flowering time may show the effect of salt stress on the reproductive stage of plants. In Arabidopsis, wheat, barley, maize and rice the flowering is delayed under salinity stress.

2. Physiological Markers: Measurement of Na^+ or Cl^- ions concentration in the leaves and roots reflects salinity stress in plants. Measurement of potassium ion (K^+) content and/or ratio of K^+/Na^+ are also frequently used. In addition, ratios of other ions such as Na^+/Ca^{2+}, Ca^{2+}/Mg^{2+} and Cl^-/NO_3^- are usually evaluated as they influence nutrient uptake. Increase of other salts in the soil in addition to available 50–100 mM NaCl alters the intracellular concentration of salt (Na^+ and Cl^-) in Arabidopsis, wheat, rice and maize. Salinity stress decreases photosynthesis process. This is evident by monitoring stomatal conductance, chlorophyll fluorescence and chlorophyll contents. The decrease in chlorophyll content was observed under 50 mM–250 mM salt application in major crop plants. The osmotic parameters of plant changes rapidly in response to salt stress. This is usually expressed by evaluating the changes in turgor pressure, osmotic pressure, RWC and water potential. Another way of evaluating osmotic changes occurring during salinity stress is the measurement of osmolytes such as sucrose, proline, glycine-betaine. These osmolytes are stress protectors and their accumulation in plants experiencing salinity stress is an adaptive mechanism. Sucrose and proline normally increase in salinity levels of 75–200 mM, however, it varies among plants; for example, in Arabidopsis, wheat and rice it is at 75–200 mM NaCl application, while in maize it is at 100 mM.

3. Oxidative Stress Markers: Salinity stress causes imbalance of reactive oxygen species. This imbalance is mainly as a consequence of disruption of electron transport Chains (ETC) during photo inhibition and/or decrease in water potential. The reactive oxygen species is dramatically increased upon salinity stress and the first reactive oxygen species reaction is termed as "oxidative burst". The higher level of reactive oxygen species becomes toxic for cells resulting in cellular damages and may lead to its death, if increase is unchecked. Moreover, reactive oxygen species also acts as signaling molecule that may lead to the changes in transcript, proteins and metabolites in order to activate some of the adaptive mechanisms. Since different plant species have different sensitivity towards salinity, the imbalance in reactive oxygen species level is also detected at different salt concentration, for example, 50–100 mM salinity level in Arabidopsis, tomato, wheat, rice, maize plants, 120 mM NaCl in sunflower, 255–300 mM in ryegrass, 400 mM–600 mM in salicornia. In addition to the concentration, duration of salinity is also a crucial factor in determining the alteration in cellular ROS, for example, Arabidopsis, tomato and rice show ROS imbalance after several hours of salt treatment while in wheat, maize, sunflower, ryegrass and salicornia the ROS level significantly increases after several days. Additionally, higher changes in ROS under salinity is observed in older leaves as compared to younger leaves of rice and maize.

Evaluation of Salinity Stress in Plants by Different Stress Markers

Depending on the concentration and duration, generally, salinity affects all the plants, some of which, like Arabidopsis and tomato are more sensitive, whereas others such as wheat, rice, ryegrass and so for they are less sensitive. Nevertheless, the changes at molecular, physiological, morphological level under salinity stress have similar trends (either increase or decrease) for the discussed crop plants. The measurements of Na^+ and K^+ ions content in plants give strong proof for salinity stress. Other stress signs may also provide the information related to salinity strength and time of exposure. For example, the morphological stress markers such as relative weight changes and germination may predict the moderate and toxic level of salinity. Monitoring the morphological changes coupled with Machine learning approaches could prevent salt stress in plants in smart greenhouse. In addition, evaluating salt sensitive (Tomato or Arabidopsis) and tolerant (salicornia) plants side-by-side in a smart greenhouse could reliably predict the ability of the examined plant to tolerate the extent of salt stress.

Basically, these morphological, physiological and molecular changes in plants follow the order, where the first changes by stress will be visualized by molecular, followed by biochemical then physiological and at last by morphological markers. Additionally, the ROS molecule plays an important role in signaling for stress and thus, these oxidative stress markers changes are detectable at similar time with molecular markers changes after exposure by salt application. Therefore, each stress marker has order in terms of time observation after stress, where the oxidative and molecular stress markers are early sensors for stress compared with other markers but they will not specify stress type.

Table: 1. Differences in old and young leaves of crop plants triggered by salinity stress:

Parameters	Plants
Higher accumulation of Na^+ in old leaves than young leaves	Wheat, Barley, Rice, Maize, Sunflower
Higher accumulation of Cl^- in old leaves than young leaves	Wheat, Barley and Sunflower
Higher photochemical efficiency decrease in old leaves than young leaves	Wheat, Barley and Rice
Higher decrease of total chlorophyll content in old leaves than young leaves	Wheat, Barley, Sunflower
Higher soluble protein decreases in old leaves than young leaves	Rice and wheat
Higher increase in MDA content in old leaves than young leaves.	Rice and maize
Higher ROS reduction and H_2O_2 generation in older leaves than young leaves	Rice and maize

Prediction and Identification of Stressed Plants Using Deep Learning Approaches

Machine learning techniques are developing rapidly for agricultural needs such as for plant recognition, plant or fruits counting, classification of crop types, phenotyping of various plant species, classification of mutants, leaf counting, identification of vein patterns and leaf characteristics detection of plant diseases, weed control, as well as the prediction of biotic stresses in plant leaves. Basically, these approaches analyze big data of images, from monitoring various morphological changes in plants to identifying and/or classifying and/or phenotyping plants. There are so many different machine learning approaches out there but some are frequently applied in plants, such as Artificial Neural Networks (ANN), Logistic Regression, Random Forest, Support Vector Machines (SVM), K-Nearest Neighbors (KNN). Among these different machine learning approaches, the deep learning models such as Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM) are recently on the increase for use in imaging analysis. This is because the CNN has shown great accuracy in finding specific patterns in image data, so it is mainly used for identification and classification of different damages in plant leaves, especially for searching the damages caused by biotic and abiotic stimuli. The other models, RNN and LSTM, are also valuable in the analysis of time series image data, which is important for prediction of damages in plant leaves. It has also been pointed out that various combinations of deep learning approaches can be used for classification and prediction of plant characteristics and these combinations of different models can be used in the future for accurate diagnosis of signs of stress in plants for smart greenhouse procedures.

Generally, all these high-throughput phenotyping technologies are based on the analysis of different type of images such as RGB imaging, near-infrared imaging, infrared thermal imaging and fluorescence imaging. These prediction of plant diseases and pest attacks or environmental impact on plants by machine learning approaches are mostly focused on identification of visual symptoms of biotic damage, which are discussed as morphological stress markers. Currently, deep learning approaches are beginning to combine morphological stress markers data (visible signs in leaves) with physiological stress markers such as transpiration rate, biomass, water content, biochemical components (sodium concentration), photosynthetic efficiency, caratenoides. However, to the best of our knowledge, there is still no extensive research on deep learning approaches for predicting abiotic or biotic stress in plants that use a combination of oxidative, molecular and morphological markers. In addition, using deep learning analysis for attached or detached leaves and whether these leaves are mature or young for better prediction has not been done yet.

Conclusions

Continuous expansion of soil salinization area is inversely proportional to crop yield and this poses a challenge to global food security. To improve plant adaptability and performance to such condition, different areas such as plant stress physiology, molecular biology, genetic engineering, biotechnology are being exploited. Machine learning approaches are promising in developing smart greenhouse, by phenotyping of plants and controlling the environmental growth parameters. Developing such controlled growth room conditions require not only equipped imaging technologies but also important physiological, oxidative and molecular data. Morphological markers in plants such as root or shoot growth, germination, flowering time indicate obvious signs of stress but also the appearance of senescence symptoms under salinity stress is an important sign—which appear early in older leaves after salt application. From physiological parameters, the chlorophyll content, RWC, electrolyte leakage, stomatal conductance, water potential, proline, glycine betaine changes in plants are commonly detected under NaCl stress. These physiological changes manifest themselves before the molecular markers. ROS and ROS-related-enzyme changes are also early recognizable markers for stress. Molecular and oxidative stress may be useful in early detection of salinity stress impact. Still, each stress marker, either morphological, physiological, oxidative or molecular changes in plants, have their own limitation. An integrated approach and usage of different sensors for specific areas of the plant such as old leaves would increase the sensitivity in detection of salinity stress in plants. However, this integration of morphological, physiological, molecular and deep learning parameters requires concerted studies.

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Protective Role of Exogenously Applied Polyamines in Abiotic Stress Tolerance of Crop Plants

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Recently, climate change has altered many ecosystems due to a combination of frequent droughts, irregular rainfall, increased salinity of lands and high temperatures. These environmental changes have also caused a reduction in crop yield globally. Hence, there is an immediate requirement to completely understand the plant responses to abiotic stress and to apply the acquired knowledge to improve stress tolerance in crop plants. The accumulation of polyamines in response to most of the abiotic stresses is one of the most remarkable plant metabolic responses. Therefore, by exogenous application of polyamines improves plant tolerance to drought, salinity, low and high temperature stresses and protect them from these extreme conditions, there by resulting in optimum crop yields.

Protective Effects of Polyamines During Drought

Under drought conditions, exogenous polyamine treatments lead to improved stress tolerance in the various plants' species studied. For example, exogenous application of putrescine by foliar sprayings enhanced water status, chlorophyll, proline, amino acids and soluble sugars contents in wheat plants subjected to water stress, which resulted in enhanced plant height, leaf area and grain yield. Tobacco leaf discs pre-treated with putrescine one hour before polyethylene-glycol addition significantly prevented water loss and maintained the maximum photochemical efficiency of photosystem II, suggesting an important role for putrescine in the modulation of plant tolerance against osmotic stress. One of the best plant responses against drought is to keep water content in tissues. Recently, Zhu *et al*., observed that exogenous putrescine application reduced stomatal density, maintained the chloroplast structure, and prevented cell plasmolysis, which contributed to an increase in water-use efficiency and drought tolerance in lettuce. Physiological and proteomic analyses suggested that polyamines could activate multiple pathways, as well as osmolyte accumulation that enhances bermudagrass adaptation to drought and salt stresses. In agreement with this, spraying valerian plant with spermidine or spermine also increased the activities of antioxidant enzyme-systems, proline content, and photosynthetic pigments in response to drought stress. Pre-treatment with spermine conferred dehydration tolerance of citrus plants cultured in vitro via modulation of antioxidative capacity and stomatal closure. In Damask rose in which foliar applications of spermine or spermidine (0.5 mM) improved relative water and chlorophyll contents, as well as stomatal conductance in plants subjected to water stress. The levels of proline and antioxidant enzyme activities were also increased in rose plants. The exogenous application of spermine or spermidine produced the activation of the antioxidant machinery and changes in polyamine metabolism, resulting in increased tolerance to water stress. Seed germination and early seedling growth are the most sensitive stages to water deficit. Drought induces a reduction in germination rate and a delay in the initiation of germination and seedling establishment. Therefore, it is important to establish suitable approaches that might alleviate the negative effects on seed germination caused by water deficit. Seed priming is a pre-sowing treatment that exposes seeds to a certain solution that allows partial hydration, but radicle emergence does not occur. Chemical priming is a promising field in plant stress physiology and crop stress management. Polyamines are among the group of chemicals acting as priming agents that can potentially confer enhanced tolerance when plants are exposed to various abiotic stresses.

Protective Effects of Polyamines During Salinity

Several studies have demonstrated that exogenous applications of polyamines improve plant tolerance to salt stress. Treatment with putrescine improved the photosynthetic capacity of cucumber plants by increasing photochemical efficiency of PSII, thereby alleviating the deleterious effects of NaCl. Quinet *et* *al*., reported that exogenous putrescine reduced Na^+ accumulation in roots of a salt-sensitive rice cultivar after few days of salt exposure, produced increased putrescine biosynthesis, and high proportion of conjugated polyamines within stressed tissues. Putrescine induced transcriptional activation of genes coding for amine oxidases and increased ethylene production in salt-treated plants. In lemon, putrescine treatment reduced the salt-induced increase of malondialdehyde, suggesting that putrescine may protect the plasma membrane against stress by maintaining membrane integrity. Putrescine was also shown to have a positive effect on photosynthetic machinery of tea plants grown on 50–100 mM NaCl, by controlling ROS scavenging activity. It has also been shown that seed priming with Putrescine is effective at improving seed germination under salinity. For instance, putrescine priming improved seed germination in chamomile and sweet majoram grown under saline conditions. Exogenously supplied spermidine improved salinity tolerance in cucumber and ginseng seedlings by inducing the activity of antioxidant enzymes and proline level. Similarly, a protective effect of exogenous spermidine was observed in two Kentucky bluegrass cultivars through increased activity of several antioxidant enzymes and reduction of malondialdehyde levels. Treatment with spermidine to chrysanthemum seedlings also reduced the uptake of Na^+, and ameliorated osmotic and ionic balance, enzymatic ROS scavenging capacity, cell membranes stabilization and photosynthetic capacity. Rice seeds soaked with spermidine showed improved germination sates and seedling growth by preventing chlorophyll loss, increasing the levels of anthocyanin and phenolics and reducing the contents of H_2O_2 and proline.

Protective Effects of Polyamines During Low Temperature Stress

Several studies have reported that exogenous PA treatments improve plant tolerance to low temperature. Putrescine-priming of fennel seeds improved germination performance and seedling growth and enhanced tolerance to low temperature stress, as compared with non-primed seeds. In tomato, exogenous putrescine improved tolerance to chilling by reduction of H_2O_2 and malondialdehyde levels and modulation of the antioxidant machinery. More recently, the involvement of ABA has been reported in the putrescine-induced tolerance to chilling stress, which is consistent with previous results obtained in Arabidopsis. Regarding spermidine, cucumber plants pre-treated with this polyamine before they were exposed to chilling showed higher growth rates and leaf chlorophyll content than control plants during chilling. Moreover, pre-treatment with spermidine alleviated the decline of chlorophyll fluorescence yield, the photosynthetic electron transfer activity of thylakoids, and the activity of various enzymes involved in C metabolism, and reduced lipid peroxidation in the thylakoid membranes. Overall, the results indicated that spermidine pre-treatment improved chilling tolerance of the photosynthetic apparatus in cucumber. Exogenous pre-treatment with spermidine also alleviated low temperature injury in mungbean seedlings by modulating of the ascorbate–glutathione pathway and reduction of components in the glyoxalate cycle, indicating that oxidative stress was reduced in spermidine pre-treated seedlings. In rice, it has recently been reported that seed priming with spermidine improves tolerance to chilling stress by increasing α-amylase activity, soluble sugars and protein contents, as well as the activity of antioxidant systems. Exogenous putrescine or spermidine applications increased antioxidant enzyme activities and chilling tolerance, suggesting that polyamines regulation of antioxidant systems is important for chilling tolerance. Therefore, polyamines may act as elicitors that activate a stress protection response, which may compensate for the negative impact of low temperature stress.

Protective Effects of Polyamines During High Temperature Stress

The effect of exogenous polyamine treatment on plant tolerance to high temperature has been the subject of many studies. For example, the effect of putrescine, spermidine and spermine in heat-shock protection was investigated in soybean seedlings. Pre-treatment with polyamines 2 h before heat-shock at 45°C for additional 2 h, enhanced the recovery of both roots and hypocotyl growth. It was shown that polyamines decreased electrolyte leakage and malondialdehyde levels from different tissues, thus suggesting protection of membrane integrity. The results also suggested that under stress conditions, polyamines may replace Ca^{2+} in maintaining membrane integrity by binding to membrane phospholipids. The exposure of wheat plants to high temperature stress (35°C) during 4 h or 8 h significantly decreased growth, total polyamine and essential amino acid contents [109]. Pre-treatment of wheat plants with putrescine before exposure to high temperature led to higher tolerance to heat stress possibly by increasing total PA and amino acids contents, and decreasing ethylene and $NH4^+$ production. Many regulatory factors, ethylene-related genes, polyamine biosynthetic genes, hormone pathways genes, and oxidation reduction genes exhibited regulation in response to spermidine treatment. The results indicated that spermidine might play an important role in the regulation of tomato fruit response to high temperature during ripening stage. Exogenous application of spermidine up-regulated most identified proteins involved in photosynthesis, implying an enhancement in photosynthetic capacity. Physiological analyses showed that spermidine could improve net photosynthetic rate and biomass accumulation. In addition, the results suggested that increased heat-stress tolerance by exogenous spermidine could contribute to the higher expression of proteins involved in cell rescue and defense, and that spermidine may regulate the antioxidant enzyme activities and related genes expression in tomato seedlings exposed to high temperature. Exogenous application of spermidine and spermine in spring wheat increased the relative water content, chlorophyll levels, stomatal conductance, transpiration rate, the maximal quantum yield of PSII photochemistry, antenna conversion efficiency, and photochemical quenching coefficient of flag leaves under high temperature.

Future Prospects

Several studies report improved stress tolerance by using either exogenous polyamine applications or genetic manipulation of endogenous polyamine levels in transgenic plants. There are already several patents on the use of polyamines as stress-protective compounds. However, we still do not know the precise molecular mechanism underlying polyamine protective effects against stress. In the future, we need to deeply study polyamine signalling and early events triggered by these compounds. We still need to address fundamental questions such as PA transport between organelles and cells, PA perception and signalling pathways. A detailed mechanistic and signalling analysis addressing these and other fundamental questions will provide new leads for crop protection against biotic and abiotic stresses.

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Post-Harvest Management of Underutilised Ficus Auriculata Fruit

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Introduction

Manipur is the biodiversity hotspot of many underutilized fruits and vegetables. Manipur is bestowed with the most congenial climatic condition for the growth of various underutilized fruits and vegetables. Most of these underutilized fruits and vegetables are very rich in vitamins, minerals and antioxidants. They are important sources of essential vitamins, minerals, dietary fibres and bioactive compounds. It makes balanced diet in human nutrition which leads to the development of sound health and happiness of the human being. They are vital for all age group of people including children and infant. Among these underutilised fruits, Ficus auriculata is also one of the underutilised fruits. Ficus auriculata is an evergreen to semi deciduous shrub having high nutritional and medicinal value. The young tender leaf is also consumed as an indigenous food item which helped in the prevention of diabetes. Ficus auriculata fruit is one of the underutilised fruits which is wildly available in plenty in every hillock of Manipur during June to August. Ficus auriculata fruit is a natural fruit which contains high quality protein, fat, vitamins, mineral, fibre and low fat. It is used for the formulation of indigenous herbal medicines which is used for curing diarrhoea, dysentery and also help to prevent cancer development. They are indispensable for maintaining good health. It is seasonal fruit and highly perishable. Due to lack of storage and lack of knowledge on processing and preservation, a large amount of Ficus auriculata fruits goes wasted every year. Fruits are very cheap and available in abundance during the season but it cannot be stored for a long period of time. It starts deteriorate shortly after harvest. Post-harvest losses of fruits can be reduced to a great extent through proper processing, preservation and value addition.

Nutritional Value of Ficus Auriculata Fruit

Nutrient	Value	Nutrient	Value
Moisture	87.93 %	B carotene	898 ug
Ph	5.39 %	Calcium	15.6 mg
TSS	4.42 %	Magnesium	68.0 mg
Total sugar	4.15 %	Potassium	329 mg
Protein	3.5 %	Sodium	29 mg
Fat	1.71 %	Phosphorous	31 mg
Starch	13.13 %	Boron	0.03 mg
Vitamin C	5.48 mg	Iron	5432 ug

Preservation and Value Addition of Ficus Auriculata Fruit

Preservation is the process of prevention of decay or spoilage thus allowing it to be stored in fit condition for future use. It can retain any food over a period of time without losing optimum qualities of colours, texture, flavour and nutritive value. So, preservation in the form of value-added product can only extend the life of fruits. Value addition is the process of converting fruit in to something new through processing, cooling, drying, fermenting, extracting, packaging or any other type of process that differentiates the product from original raw commodity. It makes more attractive to the buyers and increases the taste, texture and color of the finished product. Ficus auriculata fruit are converted in the form of pickle, chutney, jam, jelly, squash, RTS, and dry preserves. It also helps in increasing the shelf life of food thus increasing the supply. Delay in the use of fresh foods alters their freshness, palatability and nutritive value but by preserving these foods, spoilage can be avoided. Thus, perishable foods can be made available throughout the year by preservation and value addition. It helps to add variety in our diet and make it better balance.

It can be used at the time of scarcity, natural drought etc. It saves time and energy of housewives. It helps in stabilizing the prices of the food by making the availability of seasonal foods throughout the year. It also helps to improve the health of the people. Promotion of value-added product is essential to minimize the post-harvest losses and to obtain maximum returns to the farmers. It also helps to create employment opportunities to many unemployed youths and many farm women. Some of the value-added products are given below.

Ficus Auriculata (Heirit) RTS

Ingredient: Heirit juice 1 litre, sugar 1 kg., water 6.6 litre, citric acid 20g., sodium benzoate 2 g.
Method:

a. Wash and remove the outer cover.
b. Cut into small pieces.
c. Mix fruit piece with water at the rate of 1:1.
d. Extract juice by using pulper.
e. Strain the juice by using muslin clothe.
f. Make sugar syrup by adding sugar with water and citric acid.
g. Strain the syrup with a muslin clothes.
h. Mix sugar syrup with juice and stir properly.
i. Add preservatives by dissolving in small quantity of water.
j. Pour in to sterilised bottle by keeping head space of 2.5 cm and seal it properly.
k. Level and store properly.

Ficus Auriculata (Heirit) Jelly

Ingredient: Strained clear heirit juice - 1 litre, sugar -1 kg., citric acid- 5g., pectin- 10g.
Method:

a. Wash and remove the outer cover.
b. Cut into small pieces.
c. Boil fruit piece with water at the ratio of 1.5:1 for about 20-30 mins.
d. Add citric acid during boiling at the rate of 2gm per kg of fruit.
e. Strain the juice by using muslin cloth.
f. Cook the juice extract by adding sugar at the rate of 1kg per kg of juice.
g. Add pectin by mixing with little sugar when it starts setting.
h. Add remaining citric acid when it starts forming jelly or reach 65 0Brix.
i. Remove scum and fill hot in to sterilized bottle and seal it properly.
j. Level and store in cool and dry place.

Ficus Auriculata (Heirit) Pickle

Ingredient: Unripe heirit-1kg, salt-100gm, red chilli powder -20gm, cumin powder -10gm, ajwain powder -5gm, turmeric powder -10gm, mustard oil-300ml.
Method:

a. Select sound unripe heirit and wash properly
b. Dry them well and cut heirit in to four pieces
c. Cure it with salt for 5 - 7 day exposing to sunlight by turning upside down
d. Strain the salty water and put the cured heirit in a steel vessel
e. Mix the cured heirit piece with spices, salt and little oil and stir properly
f. Put the pickle in to sterialised jar and add the remaining oil to make a layer of oil on the top of the pickle
g. Seal it and store it in cool dry places.

Economics of the Different Value-Added Products

Sl. No.	Name of the Product	Cost of Production (Rs)	Gross income (Rs.)	Net income (Rs.)	B.C. Ratio
1	Ficus (heirit) RTS	3250	8640	5390	1.6:1
2	Ficus (heirit) Jelly	2300	6400	4100	1.7:1

3	Ficus (heirit) Pickle	1100	3500	2400	2.1:1

Conclusion

Ficus auriculata (heirit) is an underutilised fruit which is wildly available in plenty in every village of Chandel district. Due to lack of knowledge and no storage facility, it goes wasted every year. Ficus auriculata fruit is highly perishable, so processing and value addition in the form squash, RTS, jelly and pickle could reduce the post-harvest losses by extending the shelf life to some extent. The enterprise on processing and value addition of ficus auriculata fruit could improve and sustain livelihood of many farm families by enhancing their income generation. By consuming the raw fruit and value-added product of ficus, it will also help to improve the nutritional status of many people. The preserve value added product could reduce the post-harvest losses from 20% to 80%. The shelf life of squash and jelly extended up 12 months, for RTS up to 3 months and for pickle up to 2 years. The benefit cost ratio is also calculated for every product.

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A Traditional Black Rice

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Introduction

Rice, a major cereal crop belongs to the family Poaceae is the staple food for more than half the world population. The cereal has a wide genetic diversity, with thousands of varieties grown worldwide. Of the Pigmented rice varieties "Black Rice" has received increasing attention due to its sensory characteristics, its high nutritive value and mainly because of its beneficial health properties (Kushwaha, 2016: Ito et al.,2019).

Black rice is a specialty rice variety with black bran covering the endosperm. But to its usual color and sweet nutty flavour, black rice has become popular for making sweet snacks and desserts in many Asian countries Anthocyanins particularly cyanidin 3-glucosidase and peonidin3-glucoidase are responsible for the colour of black rice.

Recently some rice varieties having blackish purple pericarp, such as Heukgwangbyeo, Heukjinjubyeo and Heuknambyeo were developed in korea. However, there is no reports on their starch and flour properties. This paper reviews the historical aspects, botanical description, Nutrition value, Health benefits etc.

Historical Aspects

The term "Black Rice" actually refers to a variety of rice types from the species oryza and is descriptive of the colour of grain, rather than other properties. The dark purple colour of black rice is due to the high Anthocyanin content located in the pericarp layers. Black rice also contains higher levels of proteins, vitamins and minerals than common white rice It is popular and mixed with white rice prior to cooking to enhance the flavour, colour and nutritive value

Black rice is considered a delicacy in Europe and United states (Bassinello et al.,2008). Black rice varieties began to be studied in Brazil in 1994.In the year 1996-1997 agricultural years the IAC-1762 strain showed good agronomic stability, with productive potential suitable for the pattern of special types, adapting to the systems farming.

In 2001 onwards, the purification of these seeds began under the control of the Brazilian Agricultural Research Corporation which also developed some black rice strains to be used for production and commercialisation. In 2013, after several years of development and genetic improvement, the Agricultural Research and Rural Extension of Santa Catarina developed a new variety through commercial cultivation. In some regions of Brazil farmers are currently growing and marketing black rice using organic and biodynamic system.

Geographical Distribution

China is one of the leading producers of Black rice followed by Sri Lanka, Indonesia, India and Philippines etc. Thailand occupies the ninth position to black rice cultivation. China is responsible for 62% of global production of black rice and it has developed more than 54 modern black rice varieties with high yield characteristics and multiple resistances. However, some types grow in several countries, including Philippines, Bangladesh, Korea and Japan.

Other Names

1. Purple Rice.
2. Forbidden Rice.
3. Heaven Rice.
4. Imperial Rice.
5. King's Rice.
6. Prized Rice.

Black Rice as Forbidden Rice

Black rice is also called as "Forbidden rice", which is a medium grain, on glutinous heirloom rice. It has a dark purplish-black color with a nutty, slightly sweet flavour. Today Black rice is picking up in popularity and popping up in more health food stores. In India, black rice is cultivated only in few areas especially the north eastern states particularly Manipur.

Botanical Description

It is medium grain rice that is high in antioxidants and nutrients. It prefers warm climates and long growing seasons of at least 3 to 6 months. Black rice thrives under full sun and with generous watering. Its germination requires at least 21degree Celsius.

In Tamil it is known as "Kavuni", a traditional rice well known for its anti-diabetic property. Also, it is known as a long duration, poor tillering and photosensitive variety and owing to these traits it is not being cultivated widely. Morphologically dehusked grains of black rice is dark brown to black in colour and the polished grains are light brown. (Valarmathi et al.,2013)

Amylose content is about 24.2%. Total dietary fibre and proteins were found to be 21 to 52% and 7-24% respectively. Also, it was found to have a higher quantity of beta-cartene (26-65%) and lutein (95-96%). Ash content is low (0.54%). It possesses a higher amount of Iron (20-30%), calcium (33-45%), copper (9-14%), sodium (21-38%), potassium (7-15) and magnesium (9-26%).

Demand for Black Rice

The demand for Black Rice has been increasing in today's world because of their several biological activities due to the presence of antioxidants and phenolic compounds. Phenolics donate hydrogen and act as decreasing agents. Phenolics also act as single oxygen quenchers and free radical hydrogen donors and due to these properties, phenolics have a protective effect on cell constituents against oxidative damage. Such antioxidant characteristics of phenolics have been shown in epidemiological studies to prevent cardiovascular, cancer and nerve diseases.

Cost

The cost of Black rice is approximately Rs.160/Kg.

Nutritional Value of Black Rice

The calories of black rice are not very high. Black rice contains around 160 calories but offers a very high number of flavonoids. It is also a good source of fibre, minerals and proteins. The grain hull contains the highest levels of anthocyanin antioxidants.

Nutrients	In grams
Carbohydrates	32
Proteins	4
Fats	1.5

Fibre	2.3
Iron	0.7

Benefits of Black Rice

1. Weight Management.
2. Anti-diabetic effects.
3. Rich in Antioxidants.
4. Improves digestion and Metabolic health.
5. May improves heart health.
6. Anticancer Properties.
7. May supports eye health.

Conclusion

As a conclusion it is clear that this cereal has a long-lasting tradition, both as a food and as an efficacious medicine. It can be noted that anthocyanin and other bioactive compounds in black rice exhibit higher antioxidant activity properties and moreover, the amino acid in it gives complete nourishment. These paper offers a wide range of options, thereby providing extra health benefits to consumers. Furthermore, awareness among the public towards consuming black rice will give way for a healthier life.

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Applications and Prospects of Nanotechnology in Agriculture

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Introduction

Recent advancements in the commercial fabrication of nano materials have expanded its potential use in various fields. Nanotechnology has been utilized in various fields such as medicine, environmental science and food processing etc. However, use in agriculture has been unexploited and under explored for long time. Preliminary studies show the potential of nano materials in improving seed germination and growth, plant protection, pathogen detection and pesticide/herbicide residue detection. Nanotechnology is recognized by the European Commission as one of its six "Key Enabling Technologies" that contribute to sustainable competitiveness and growth in several industrial sectors.

1. Richard feynmann, physicist (noble laureate, 1965) is considered as father of nano technology
2. K. Eric Drexler coined the term NANOTECHNOLOGY in his book ENGINES OF CREATION: THE COMING ERA OF NANOTECHNOLOGY (1986). He also co-founded the foresight institute to help increase public awareness and understanding of nanotechnology concepts and implications.

Agricultural Nanotechnologies: What are the Current Possibilities?

Nanomaterials in agriculture aim in particular to:

1. Reduce the amount of sprayed chemicals (pesticides/herbicides/fertilizers) by usage of nano formulations, hence they help in reducing environmental pollutants.
2. Minimize nutrient losses in fertilization
3. Increase yields through optimized water and nutrient management.
4. The main regulation covering nanotechnology applications is the REACH (Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals), and there is an ongoing discussion on the definition, which covers nanoparticles in aggregates and agglomerates in the size range of 1—100nm
5. Nanosensors as a tool for smart farming for detection of pests, diseases and residues of agrochemicals
6. Aid as a valuable tool for nanoparticle mediated gene/DNA transfer for development of improved varieties.

Constraints

1. Exposure of nanomaterials to human being and accumulation in agri-food chains.
2. Interaction of nanoparticles with the nontarget sites, which lead to certain environmental and health issues (Claudia *et al.,* 2014).
3. Higher production costs.
4. Lack of public awareness on the usage of this technology.
5. Developments in agricultural sector are greatly limited due to low investment.
6. The need of labeling of the products of nanotechnology further prevents the innovative applications of this technology in the agricultural fields.
7. Agro-nanotech innovative products are experiencing difficulties in reaching the market, making agriculture still a marginal sector for nanotechnology.

Future Prospects

1. Nanoporous zeolotes for controlled release and efficient amount of water, fertilizer etc.
2. Nanocapsules for delivering of herbicide, vector and managing of pests.
3. Nanosensors for detecting aquatic toxins and pests.

4. Nanoscale biopolymers, (proteins and carbohydrates) based nanoparticles with few properties such as low impact on human health and the environment may be used in disinfection and recycling of heavy metals.
5. Nanostructured metals can be explored in decomposition of harmful organics at room temperature.
6. Smart particles can be useful in effective environmental monitoring and purification processes.
7. Nanoparticles as a novel photocatalyst.
8. Research on green methods of nano production should be focused that might revolutionize the application of nanotechnology in agriculture.

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Zero Budget Natural Farming in Andhra Pradesh: Towards Sustainable and Profitable Farming

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Introduction

Agriculture is the largest contributor to the gross state domestic product (GSDP) of Andhra Pradesh, with the share of 34%. This sector provides livelihood for up to 60% of the state's population. Andhra Pradesh is the 9th largest crop producing state in India. Andhra Pradesh is the largest producer of fruits, chillies, cocoa, lemon, palm oil, papaya and tomato. Among, the Indian states the second largest producer of cashew, mango and sweet orange. It is, therefore, natural that agriculture, given its predominance in the state economy, would be given top priority with respect to improvement of the farmers' conditions and welfare. This assumes particular importance at a time when farmers' distress is among the most serious concerns engaging policymakers. Farming practices like the Zero Budget Natural Farming (ZBNF) have considerable significance in this respect.

Overview of Agriculture and Allied Sector in Andhra Pradesh

Contribution to GSDP (%)	34.0
Population employed (%)	60.0
Total area under cultivation (in million hectares)	3.97
Total Volume of fruit production (in million tonnes)	12.098
Fruit Production as a proportion of national production (%)	13.0

ZBNF: Adoption and Funding

The ZBNF avoids the use of synthetic fertilisers and other 'non-natural' agricultural inputs. It is based on the principle of poly-cropping that enables the farmers to recover expenditure on longer-duration crops from the short duration ones, thereby characterising the process as 'zero budget'. The initiative has been pioneered by Rythu Sadhikara Samastha (RySS), non-profit company owned by the state government, Initiated in June 2015. The programme has been implemented at the field level commencing from the kharif season of 2016. The programme was mentioned by the Paris Peace Forum 2018 as a notable example of sustainable development.

The ZBNF initiative has been witnessed more than one actor coming collectively for funding. The Andhra Pradesh country authorities and Ministry of Agriculture authorities have been helping the programme beneath PKVY and RKVY schemes. The Azim Prem ji Philanthropic Initiatives (APPI) has been helping RySS in enforcing ZBNF since (2017) via technical help grants. The APPI is likewise running beneath RySS in helping the increase and growth of human sources and technical practices for selling the ZBNF practice. From June (2018) BNP Paribas and United Nations Environment Programme has been helping the ZBNF as a part of the Sustainable Indian Finance Facility.

ZBNF: Progress and Targets

Farmers to have adopted ZBNF	163,000 (across 9722 villages)
Farmers enrolled (as on September 2018)	354,000
Farmers to be covered by FY2018-19	500,000
Farmers to be covered by 2024	6 million

Poor Farmers, Women and Agro-Forestry

The significant part of ZBNF is the emphasis on little and helpless farmers. Around 20 % of farmers covered under the most unfortunate. This incorporates farmers with under 2.5 sections/acres of dry-land for single lady farmer and farmers having a place with planned stations and booked clans. The program has eager goal of giving food security to those helpless ranchers by empowering them to create a total compensation of ₹100,000 per annum for every family. The pay is relied upon to be created through diminished info costs, expanded efficiency and enhanced jobs. Exceptional models are being utilized to address the particular necessities of helpless farmers like giving uncommon admittance to bank credit, utilization of poly-trimming and raising terrace poultry and cows.

Local area asset people (CRPs) are being allocated to minimal farmers to empower them to carry out the ZBNF. The CRPs are the farmers with ability in regular cultivating and are locked in by the RySS to impart information on the ZBNF to different farmers across the state. The CRPs are fundamental to the reception and food of the ZBNF and they have been teaching the farmers on the advantages of the training, just as the strategies for embracing the ZBNF through entomb alia influence, common-sense instructional courses, rancher field schools and video dispersal.

Notwithstanding helpless farmers, the ZBNF places accentuation on urging provincial ladies to create as business visionaries by offering to ranchers ZBNF-related data sources like normal composts and biocide combinations. The program likewise visualizes preparing ladies to film and spread recordings on ZBNF techniques to support different farmers into the program. A conspicuous result of the methodology is financial strengthening of the provincial and monetarily peripheral ladies, who, because of the endeavours, can expect administrative roles in nearby networks. For sure, lady's self-improvement gatherings (SHGs) are assuming a critical part in spreading mindfulness on the training. The state government expects to use the organization of ladies SHGs, containing 730,000 ladies and covering 80% of cultivating families in the state. Men from similar families from which ladies are advancing the ZBNF are likewise being urged to frame SHGs to build the interest and organization of the SHGs in the ZBNF program.

Finally, the RySS plans to acquire the agro-ranger provider version to re-set up woods land region. This consists of empowering ancestral and neighbourhood ranchers to plant timber along vegetation on a comparable plot of cultivable land. The version is relied upon to result in greater noteworthy land usefulness, everyday scene rebuilding and avoidance of biodiversity misfortune. In the dry season willing locale of Andhra, this system has superior improvement of abode lakes for water storage.

Human Resource, Training and Technology

The Andhra Pradesh authorities is schooling younger graduates and postgraduates with a heritage in agriculture to expand as Natural Farming Fellows (NFFs) to make contributions to the ZBNF. The NFFs will paintings carefully with the farmers and might test in devising farming strategies and progressive farming fashions the use of standards of herbal farming. So far, 230 NFFs had been recruited and trained.

Training is a vital factor of the ZBNF programme. The country authorities and the RySS are engaging in sensible demonstrations for farmers at the advantages of training the ZBNF thru better crop yields, decrease farming expenses and long-time period sustenance of the environment. Several schooling programmes and workshops were carried out to introduce the ZBNF exercise and strategies to the farmers. The RySS, in collaboration with the training branch of the Andhra Pradesh authorities, is growing content material on herbal farming for faculties. The team of workers and college students in authorities' faculties are being recommended to apply herbal farming strategies in faculty gardens.

Information generation is being actively hired withinside the unfold and consolidation of the ZBNF through growing farmer databases, acting e-monitoring of the ZBNF practices throughout the state, tracking functionaries, geo-mapping fields and disseminating weather records.10 Video content material at the ZBNF techniques and strategies are being evolved through the RySS in partnership with the Digital Green Foundation. Workbooks, primers, crop playing cards with targeted records at the procedures below the ZBNF, defined truly with visuals, are being made available to farmers withinside the vernacular language. Such efforts are important to make sure that the farmers continue to be dedicated to the ZBNF and chorus from switching returned to standard farming the usage of chemical inputs.

Results

Initial outcomes on adoption of the ZBNF are encouraging. Studies carried out with the aid of using the RySS on crop reducing experiments in 2017 factor to farmers the usage of the ZBNF practices incurring much less cost, gaining greater yield and incomes better earnings. Farmers developing paddy the usage of the ZBNF have suggested greater than 50 in line with cent growth in internet earnings, compared with their non-ZBNF counterparts. The growth in internet earnings for business plants, which include rain-fed groundnut and cotton, are a whole lot larger. Yields were considerably excessive for the ZBNF groundnut farmers and additionally higher for paddy farmers. Higher yields vindicate the software of sustainable farming practices, which additionally enhance the farmers' ability to evolve to weather change. There is likewise preliminary proof of the ZBNF strategies enhancing the resilience of farmlands and plants towards severe climate events.

Final Thoughts

Andhra Pradesh's efforts to expand ZBNF by encouraging farmers to adopt its practice have significant implications for a country struggling to find solutions to increase farmer incomes. This is particularly important at a time when policymakers are struggling with various options – increasing minimum support prices, waiving off agricultural loans and introducing direct income transfers – to support the farmers.

India and Andhra Pradesh's efforts in institutionalising the exercise, however, wishes to triumph over the essential mission of convincing the farmers to stay dedicated to the exercise and now no longer revert to chemical-primarily based totally farming. Chemical input-intensive farming has intrinsic appeal – not just in terms of being a familiar practice with the farmers for decades, but also because of the uncertainties of returns associated with new, alternative practices like the ZBNF. It's important that the encouraging economic results from the application of the ZBNF be widely published and demonstrated to make it as 'convincing' option. At the same time, it is also essential for the community-based approach to embrace all stakeholders to expand the ZBNF. Among these stakeholders, the roles of local bodies and women SHGs are particularly essential for to expand the ZBNF.

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Processing and Value Addition of Tomato

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Worldwide, tomatoes are considered an important agricultural crop and an integral part of the human diet. Although tomatoes are commonly consumed fresh, over 80% of the tomato consumption comes from processed products such as tomato juice, ketchup and sauce. Recent studies have indicated the potential health benefits of a diet that is rich in tomatoes.

Lycopene, a major carotenoid without pro-vitamin activity, present in red tomatoes, is considered responsible for their beneficial effects (Shi *et al*., 1997; Rao *et al.,* 1998). India is the 4th major tomato producing country in the world next to China,USA and Turkey. Presently, India is the major exporter of tomatoes to Pakistan, Bangladesh, U.A.E, Nepal, Maldives and Oman (Anonymous, 2001). Tomato is herbaceous sprawling plant growing 1-3 m height with weak woody stem. The flowers are yellow in colour and the fruits of cultivated varieties vary in size. Tomato is a native of mexico and peruvian region. The color of the tomato is due to Lycopene**.** India ranks second in the area as well as in production of tomatoes. Tomato is one of the most versatile vegetable with wide usage in India. Andhra Pradesh stands first in production of tomatoes producing 2764.32 tons (2017-2018) followed by Madhya Pradeshand Karnataka. Tomatoes are the major dietary source of the antioxidant lycopene which has been linked to many health benefits including reduced risk of heart disease, cancer, stone formation, promotes healthy skin, lowers cholesterol, reduces migraines, anti-inflammatory, boosts immunity etc.

Methods of Processing of Vegetables

The different methods used for vegetable preservation are fresh storage, cold storage, freezing, drying/ dehydration, concentration, chemical preservation, Preservation with sugar, Pasteurization, Sterilization, Filtration, Irradiation etc.

Blanching

Exposing the tomatoes to hot or boiling water - as a pre-treatment before drying the tomatoes has the following advantages:
1. It helps clean the material and reduce the number of micro-organisms present on the surface;
2. It preserves the natural colour in the dried products; for example, the Lycopen (red) pigments dissolve in small intracellular oil drops during blanching and in this way, they are protected from oxidative breakdown during drying;
3. It shortens the soaking and/or cooking time during reconstitution. During hot water blanching, some soluble constituents are leached out: water-soluble flavors, vitamins (vitamin C) and sugars.

Use of Preservatives for Processing of Tomatoes

Preservatives are used to improve the colour and keeping qualities of the final product for vegetables in general and tomato in particular. Preservatives include items such as sulphur dioxide, ascorbic acid, citric acid, salt and sugar and can either be simple or compound solutions.

The strength of sulphur dioxide is expressed as "parts per million" (ppm) 1.5 grams of sodium meta bisulphite in one litre of water gives 1000 ppm of sulphur dioxide. The use of SO_2 improved colour, rehydration ratio, and minimized the loss of ascorbic acid and lycopene. Sodium meta bisulfate dipped tomatoes had better rehydration ratio and colour than gas sulfured sun-dried tomatoes (Vishal et al, 2015).

Processing of Tomatoes

Tomato is a valuable raw material used for processing products such as tomato juice, ketchup, sauce, paste, canned fruit. In developed countries 80% of the fresh tomatoes are processed into various processed products. Processing allows fresh table tomatoes to be kept for longer time. Processing can be done for form household consumption and for commercial purpose.

The advantages of processing tomatoes are it enables off season availability, improve storage capacities for tomatoes, longer storage periods than fresh tomatoes, etc. The disadvantages are cost of setting up of processing facilities will be higher. Tomato can be processed in to a number of products Tomato juice, Tomato puree and paste, Tomato sauce or ketchup, Tomato chutney, Tomato soup, Tomato chilli sauce.

Tomato Juice

A good quality juice should be of deep red color, possesses the characteristics taste and flavour of tomato, contain about 0.4%acid, be uniform in appearance and have high nutritive value. In addition, juice should contain 0.5% salt,1%sugar, 0.4%acid.hot pulping is superior to cold pulping because in the latter case, extraction of juice is sum what difficult and it is yield is less.

Tomato Juice

Tomatoes are washed in clean water, chopped into pieces and heated at 70-90 ºC for 3-5 mins. The juice was extracted followed by addition of salt, sugar, citric acid and homogenized. This mixture is heated at 82-88ºC for a minute and filled hot into bottles or cans followed by sterilization in boiling water for 30 min, cooling and sealing.

Tomato Puree and Paste

Tomato pulp without skin or seeds, with or without added salt, and containing less than 0.9% salt free tomato solids, is known as medium tomato puree. It can be concentrated further to heavy tomato puree which contains not less than 12% solids. If this further concentrated so that it contains not less than 25% tomato solids, it is known as tomato paste which has TSS 25%. Strained tomato juice is made into desired consistency by heating and filled hot into bottles or cans followed by boiling in hot water for 20 min, cooling and storing at ambient temperature.

Tomato Sauce or Ketchup

It is made from strained tomato juice or pulp and spices, salt, sugar, and vinegar, with or without onion and garlic, and contains not less than 12 % tomato solids and 25 % total solids. FSSAI specification: Pulp-25 %, TSS-25 %, Preservative: 70 ppm of SO_2.

Washed tomatoes are chopped and heated at 70-90º C for 3-5 min, pulp was extracted and heated with one third of sugar. The spice bag was added and heated till the volume becomes one third of original volume of pulp. The spice bag was removed and remaining sugar was added by further heating. When the desired end point reaches, vinegar and preservatives are added followed by filling, cooling, pasteurization, crown cooking and stored at ambient temperature.

Tomato Chutney

It is basically a mixture containing fruits and vegetable along with spices, salt, sugar, and vinegar. A good chutney is reasonably smooth, perishable and appetizing and chutney have flavor of the fruits and vegetable used in preparation. FSSAI specifications for chutney should have minimum 15 % TSS and 40 % fruit part. Washed tomatoes are blanched for 2 min, peeled, crushed and ingredients of chutney were added except salt and vinegar and heated to desired consistency. Vinegar and salt are added and cooked for 5 min. After adding preservative, it was filled in hot bottles, sealed and stored at room temperature.

Tomato Chili Sauce

Is highly spiced product made from ripe, peeled and crushed tomatoes salt, sugar, spices, vinegar, with or without onion and garlic. The method of preparation is similar to that for tomato sauce expect that the total unstrained pulp is used and seeds are not removed. Hot product is filled in bottles or cans and processed in water at 85- 90°c for 30 minutes.

Many valuable products can be prepared out of dehydrated tomato powder, tomato juice and tomato pomace. There is a huge demand for ketchups and sauces in urban areas. The excess tomato produced during season can be judiciously used for the production of above valuable byproducts to increase the economic value of the crop as well as increase the income of farmers who are producing this super vegetable.

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