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The Internal Transcribed Spacer (ITS) marker in nematode taxonomy and its utility

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The traditional way of nematode's identification:

Morphology and morphometric studies have always played an important role in nematode taxonomy and systematics. The morphological measurements often provide proper diagnosis of the species. But morphological detection needs the skilled taxonomists and is time taking in particular. The role of morphological detection cannot be neglected, but for precision, it should be integrated with molecular approaches such as genomics, proteomics etc.

Molecular diagnosis of nematodes:

The molecular diagnosis approaches are rapid, accurate and reproducible. These approaches use a different kind of markers and biotechnological tools for the identification of nematodes. The huge availability genomic information for diverse kinds of nematodes escalating the identification processes. In the last two decades, the marker-based identification of nematodes is enhanced and scientist has utilized a different kind of molecular markers, which includes RFLP, AFLP, RAPD, SSR, SNP and ITS etc.

Internal Transcribed Spacer (ITS) marker:

For the molecular diagnostic of nematodes, the ITS region offers a unique molecular marker. The Internal Transcribed Spacer Region (ITS)is located in between the18S and 28S rDNA genes. The rDNA component frequently occurs in the genome and can be amplified by PCR protocols.

The advantages of using ITS marker:

The main advantages of using ITS marker are that the diagnosis is possible with a single juvenile or egg of unknown organism. The ITS markers are codominant and have high reproducibility. These markers are widely utilized for the identification of plant-parasitic nematodes, animal parasitic nematodes and free-living nematodes. Nowadays huge genomic data sources for diverse kind of nematode species is available, so in future, ITS marker will facilitate the rapid detection of nematode species occurred in the field.

The practical utility of ITS marker in nematode taxonomy:

1. Helps in understanding of alpha and beta taxonomy, which deals with the identification and classification of an unknown organism
2. Helps in making the dendrogram, which reveals the phylogenetic relationship
3. Helps in estimating the genetic structure of a localized population
4. Helps in understanding of gamma taxonomy, which deals with an understanding of the evolutionary relationship

Summary:

The molecular diagnosis based on these particular markers has assisted the taxonomist for rapid and accurate identification of nematodes. These identification are generally

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based on the amplification of nematode-specific genomic sequences. The problem with morphological taxonomy is that it needs several samples for precision in identification. Most often these samples are destroyed during the processing phase. But these technical glitches are overturned while using molecular approaches because even one sample is efficient for the diagnosis. Currently three molecular markers namely ITS, d2/d3 and cytB is widely in use for the identification of nematode species.

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Recent trends in real time herbicide applicator technology

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Summary

Weed competes with crop for nutrition, soil and water and, reduces its yields drastically. Conventional methods i.e. manual, mechanical and chemical methods have limitation in controlling weeds. With the advancement in electronics and computer Site specific Weed Management (SSWM) can provide a solution for precise weeds management. SSWM technologies with basic components and functions are described. SSWM consists 3 basic process i.e. image sensing, crop-weed discrimination and herbicide application. Digital image processing plays a crucial role for crop-weed discrimination and fascinates herbicide application.

INTRODUCTION

Weed control is a serious issue in agricultural production system. It drastically reduce crop yield via. Competition for natural resources i.e. sunlight, water and nutrients (Ozlüoymak, *et al*., 2019).Various methods for controlling weeds i.e. manual, mechanical and chemical were used. Manual weed methods were tedious, time consuming and expensive. Mechanical methods using intercultural tools are effective only for inter row weeding. Chemical methods are wieldy used; these are effective for both intra row and inter row weeding. But the methods involves through field coverage which nowadays contaminating natural resources i.e. soil, environment and water (Savci, 2012). Applying chemicals to only weed patches using site specific weed management (SSWM) technologies can provide an effective and better solution. Real time digital image processing integrated with spot herbicide applicator technology can save 75% herbicide compared to conventional ((Yang et al. (2003)), 69.5% savings (Mackvandi (2008)). SSWM involves a 3 step process i.e. sensing, digital image processing and herbicide application. Ground based sensing i.e. optical imaging from ground has ability for providing higher spatial resolution, real time data processing over airborne remote sensing. This article provides a general overview of the complete process of SSWM. There are 3 steps for the complete process. Field image acquisition, crop – weed discrimination and herbicide applicator technology.

General components of real time herbicide technology

A. Image acquisition- Cameras
B. Digital Image Processing- computer and image processing software
C. Applicator technology- Tank, solenoid valve, sprays nozzles mounted on boom, microcontroller, and pump with motor.
D. Other devices-Global positioning system (GPS) integrated with camera, vehicle.

1- Field image acquisition

Various camera RGB (Kodak, Nikon, Sony, Samsung cameras etc.), Infrared (InfRec R500), multispectral cameras and hyper-spectral cameras (Delta Tee Enterprises 400-1000nm,) can be used for acquiring the field images on continuous basis. RGB cameras are cheaper, perceives information closer to eyes i.e. visible range and it is easy to interpret. Color based soil-vegetation separation are based upon it. Infrared cameras provide information which our eyes can't perceive, sometimes information provided is also difficult to interpret.

Multispectral cameras provide larger information in continuous bands with broad range of spectrum. It has limited number of bands (3-10) from ultraviolet, visible and infrared range. Hyper-spectral bands also provides information in ultraviolet, RGB as well as infrared range, but in narrow range continuous bands, number of bands are much more than multispectral i.e. (few 100-1000), appropriate bands can be used to distinguish crop, weed and soil.

2- Digital image processing for crop weed discrimination

Digital image processing provides an efficient approach for segmenting crop-soil and weed images acquired from the cameras. It generally follows a four step procedure for crop-weed discrimination i.e. pre-processing, vegetation segmentation, feature extraction and classification. In this image taken from the cameras were preprocessed for removing noise, resizing and image enhancement. Than a basic threshold based segmentation process for separating green plant using excessive green index, normalized difference index etc., were performed for creating vegetation segmented regions. This will go as an input to the next step, where suitable features i.e. Biological morphology, visual texture and spectral features were extracted from the vegetated segment region. After this vegetated segmented region are classified into groups by performing thresholding techniques on obtained binary image. The another approach for classification except thresholding is machine vision based learning algorithm i.e. Artificial Neural Network, Principle Component Analysis etc. which automatically extracts features from vegetated segment regions and classified it into groups.

3- Herbicide applicator technology

It applies the herbicides to the weed patches on the basis of response obtained from crop- weed discrimination process. If the classification steps results, output as weed. The micro-controller provides an open signal to the solenoid valves near to the weed. Weeds spatial coordinates were obtained from Global Positioning System (GPS) integrated with camera. Then a continuously operated pump will supply the chemicals to the nozzles in near to weed patch and spraying will be done (Blue river technology). In some machines applicator is provided with a moving mechanism in lateral direction, that reaches to weed location and applies a jet to the weed patches (Eco-robotix).

Working of Machine

The entire system is mounted on a moving vehicle i.e. tractor or self- propelled machine. As machine moves over terrain, cameras mounted in it will capture the field images which will goes to the computer having image processing software like MATLAB, Image Studio Lite etc., where the image will be processed and the weed will be segmented out from the soil and crop. The GPS integrated with camera will provide the location of weed coordinates. Location of applicator unit on vehicle was initially setup by considering total time i.e. image processing and time required for fully opening of solenoid valve. After receiving the weed signal, microcontroller actuates the solenoid valve nearer to weed and herbicide would be spray on it.

Way forward

Various companies like Eco robotix, John Deere working in collaboration with blue river technology had made successful prototypes, but they are not yet commercialized. Higher cost in initial developing stages and selective crops are some of the reasons. Multiple crops with different weeds type and varieties, variable rate metering

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based upon weed geometry and characteristic can be a problem need to address in future for success of machine.

CONCLUSION

Digital image processing in collaboration with the applicator technology have the greatest potential to save huge amount of chemicals. Three steps were performed by SSWM technologies i.e. image sensing, digital image processing for crop -weed discrimination and herbicide application on weeds. It will prevent the environment, soil and ground water resources. The application cost, labor requirement and energy will also be saved by amount of chemical applied.

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Remote Sensing Monitoring and management of salt affected soil

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Abstract

The extent and geographical distribution of degraded lands like Salt-affected lands, areas under soil erosion and shifting cultivation waterlogged areas, and ravines form an essential input for planning reclamation/conservation programmers. Remote sensing satellites provide timely, accurate and reliable data on degraded lands at definite time intervals in a cost effective manner. The details of the methodology employed to derive information from remotely sensed data on above mentioned degraded lands and the results of the experiment are discussed. The salt-affected soils of India have been mapped for the whole country at 1:250,000 scale by the National Remote Sensing Agency (Hyderabad) in association with National organizations like National Bureau of Soil Survey and Land Use planning, Al1 India Soil and Land use Survey and provincial soil survey organizations and Agricultural Universities. The changes in the spatial extent of eroded and shifting cultivation areas and salt-affected soils are also studied using multi-temporal satellite data. The development of satellite image processing, artificial intelligence, global positioning system and mathematical morphology has promoted the use of GIS technology for storage, retrieval, management and analysis of spatial data as well as solving decision making problems. The information generated on degraded lands through remote sensing data and other ancillary information available is stored in GIS to perform integrated analysis. Throughout the world the concern for the environment is increasing day by day due to physical, chemical and biological degradation of the natural resources that have led to the ecological imbalances.

INTRODUCTION

The over-exploitation and mismanagement of land resources have resulted in the degradation of land, a major environmental issue in the temporary times. Nearly 175 million hectares of land in India is subject to one or other kind of degradation process. The main degradation processes operation lands are erosion (mater and wind, accumulation of excess salt (salinization / alkalisation), chemical degradation (toxicities *l* deficiencies), physical degradation, biological degradation (decriena fsleora and fauna) and water logging. About 150 million hectares of land are suffering from different types of erosion, out of which 69 million hectares are in severe deterioration phase (ANON, 1976). The salt-affected soils and waterlogged areas are reported in 7 million hectares and6 million hectares, respectively BALI, 1985). About 4.36 million hectares of forest land is under shifting cultivation that leads soi1 erosion. Hence, the timely information on the extent and geographic distribution of degraded lands viz., areas under sail erosion and shifting cultivation, salt affected soils, waterlogged mass, ravines, etc. forms an essential input for planning reclamation / conservation programmers of these lands. Moreover, these lands store be monitored at regular intends of time to the impact of the implemented reclamation/conservation measures. Among the new technologies developed for the study of natural resources the space borne remote sensing technology in association with computer technology provide the most valuable one to study the various aspects of environment degradation. The systematic efforts in the application of remote sensing technology in the study of natural resources has resulted in the development of well-established methodologies for mapping and monitoring of various degraded lands in a cost effective manner. In India, initially aerial photographs were used in deriving information on degraded lands (Iphorst and Iyer. 1972; Iyer *etal.* 1975).

Remote Sensing Techniques

Salt-affected soils can be detected on aerial photographs and other remote sensing imagery often in the advanced stage of the Stalinizations/alkalization process, that is, when the soil surface is already affected. In visual image interpretation, the presence of salt is inferred from photographic elements and landscape features such as position in the landscape, gray tone, and drainage condition, technology of the surroundings, vegetation, and land use. A poor crop stand on a salt-affected soil shows a different surface reflectance than that of a healthy vegetation cover on a salt-free soil. Salt detection is often satisfactory when aerial photographic interpretation is combined with satellite data analysis. Difference in surface reflectance helps separate salt-affected soils from non-affected ones. A variety of remote sensing data, including aerial photos, video images, infrared thermography, visible and infrared multispectral, microwave and airborne geo- physical data, is available for salinity mapping and monitoring. A representative set of soil samples was first taken for laboratory determinations, including organic matter content, pH, and electrical conductivity, and this was followed by the selection of the most correlated spectral bands with the measured soil properties. In this study, multiple regression analysis was used to predict soil salinity level. When hyper spectral data are available, wavelength positions of absorption features related to salinity can be identified, and parameters such as depth, width, area, and asymmetry of the absorption features can be correlated with salinity.

Geographical information system (GIS)

The advancements in the field of computer technology, image processing, global position system and mathematical morphology have resulted in the development of Geographical Information System (GIS) technology for storage, retrieval, management of special data (e.g. maps derived from remotely sensed data etc.), attribute data (e.g. Soil properties, climatic parameters etc.) and other related information more efficiently. GIS proved to be an effective tool in handling spatial data available at different scales, voluminous point data such as soil information, rainfall, temperature etc. and socioeconomic data and to perform integrated analysis of data on various resources of any region and to arrive at optimum solutions for various problems. In India, GIS is being used in various fields such asfor optimum land use planning, planning for sustainable development of land resources, assessment of crop water requirements, development of wastelands etc. The efforts are going on to use GIS in crop yield modeling, developing measures for reclamation / management of Salt-affected soils, quantification of soil loss to suggest suitable conservation processes, evaluation of soils for various purposes like horticulture, agro forestry, silvipasture, and aquaculture development.

Methodology

The two methods used in the interpretation and analysis of remotely sensed data to derive information on degraded lands are visual interpretation and digital analysis. Visual

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interpretation involves identification and delineation of degraded lands that are manifested on False Colour Composite (PCC) or black & white prints in different size, shape, tone, texture, pattern etc. The remotely sensed data in Computer Compatible Tapes (CCTs) or floppies or diskettes are analyzed with the help of computers having image analysis software packages. The special reflectance of degraded lands forms the basis in the digital analysis. Both visual and digital techniques are used in extracting valuable information on degraded lands from remotely sensed data. The False Color Composites or Computer Compatible Tapes are analyzed initially with the help of topographical maps, published reports and other available ancillary data; broad categories of degraded lands will be delineated. Again each unitwill be divided into sub units on the basis of erosion status or drainage density or vegetation cover or land delineated units will be transferred on to base maps prepared from Survey of India. Represented sample will be selected for various degraded lands for ground truth collection. During field visits, features of topography and soil profiles will be studied; site characteristics and soil samples will be collected for laboratory analysis. The preliminary interpreted maps willbe modified in the light of field data and soil chemical analytical data; final maps are prepared with appropriate legend.

Salt-affected soils

Salt-affected soils have distinct expression on the FCCs in bright to dull white tone patches with in the background of normal soils supporting good vegetation (that appears as bright red / magenta tone). The salt-affected soils with poor crop growth appear in dull red tone / mottled tone and enable to identify and map them. In general, the FCCs of February- March period were found suitable to map salt-affected soils in the Indo-Gangetic alluvial plain and other areas. In certain cases, especially in black soil areas, data of two different seasons help in better delineation of these soils in addition to more intensive. The salt-affected soils of India have been mapped at 1:250,000 scale through visual interpretation of Land sat TM/IRS imagery at the National Remote Sensing Agency (NRSA, Hyderabad) in association with the National Bureau of Soil Survey and Land Use Planning (Nagpur), Al1 India Soil and Land Use Survey (New Delhi) and state government organizations. The legend of the salt-affected soil map shows physiographic units, nature of the problem (saline / saline-sodic / sodic), magnitude of the problem (slight / moderate /strong) and extent of problem in each mapping salt-Affected soils in parts of Pali district, Rajasthan dong with the legend. NRSA has also mapped salt-affected soils at 1:50,000 scale on a limited extent; using Land sat TM and **IRS** FCC imagery at the same scale. The salt-affected soil maps have been prepared for Mainpuri and Unnao districts of Uttar Pradesh and for South Coastal districts of Andhra Pradesh. The map shows the physiographic unit, type of salt-affected soil and magnitude of the problem. At 1:50,000 scales, pure units could be mapped and even small units, not to be mapped at 1:250,000 scales could be C delineated.

Other degraded lands

Besides above mentioned major categories of degraded lands, the other degraded lands are ravines, waterlogged areas, wetlands and marshy areas. These categories of degraded lands are also manifested distinctly on remotely sensed imagery. The ravines are seen on FCC with light greyish brown to dark greyish brown tone with course to medium texture along the major river systems. Venkataraman and Ravi (1992) classified the ravines dong the Yamuna River in Uttar Pradesh state into deep and shallow ravines through digital analysis of Lands at TM data. The area estimated under the ravines was 18,470 ha in Mainpuri district of Uttar Pradesh state. Space borne multi spectral data have been successfully used in mapping and monitoring of waterlogged / wetlands / marshy areas. The waterlogged areas appear in different shades of bluish green or greenish blue patches on FCC with smooth texture. Delineation of waterlogged areas in black soil region poses problems, where multi date imagery was found to be useful. Efforts are being made to use microwave remote sensing using Synthetic Aperture Radar **(SAR)** data. Dwivedi e*t al.* (1994) studied the wetlands of Sunder ban and its adjoining areas in West Bengal, using microwave **SAR** data from ERS 1satellite. They could map the coastal and inland wetlands through visual inter pore of ESR station-SAR data in conjunction with IRS-1B LISS-II data. In the case of coastal wetlands, they could identify and map the estuaries, creeks and mangrove forests. Similarly, in the inland wetlands they could demarcate lakes / ponds, lakes, seasonal waterlogged areas and swamps / marshy areas.

GIS for management of Salt-affected soils

The satellite data were registered with the topographical maps of the district and re sampled to the map through identification of sufficient number of ground control points and the district boundary was extracted. Subsequently, am ask was built for the area falling outside the district. Based on available information, training areas are defined for various land use cover classes including salt-affected soils. Studying the spectral response of salt-affected soils and relating them with soil properties they could be grouped into strong and moderate degree classes. Then image classification was done to obtain the spatial extent of salt-affected soils. The base map of the district was prepared dong with road railway and canal network and scanned using Context scanner. The scanned base imported into a PAMMGIS environment. The soil sample points in 17 locations were identified and an attribute database was created for these points, including: soil pH, WP, electrical conductivity, gypsum requirement, etc. The classified from remotely sensed data was also imported into the GIS environment. InP A " GIS the overlaying of base map, classified data and attribute data was done using the "Mapper" module. Attempts are going on to extrapolate the information available for 17 points to other unknown points for the calculation of gypsum requirement for the entire district.

Conclusion

Space borne satellite data have become valuable tools in studying the spatial extent of degraded lands and for monitoring the changes that have taken place over a period of time due to reclamation / conservation measures. The methodologies are well established to extract precise and timely information on different aspects of degraded lands in a cost effective manner on operational basis. The present status is that the remote sensing techniques are being regularly used in the study of degraded lands. The usage of **GIS** in storing, retrieving, integrated analysis and presentation of results on degraded lands started on a limited scale. In the near future it will become a very important tool for handling voluminous data generated on degraded lands through conventional and remote sensing techniques and for integrated analysis of data to derive plans for reclamation and conservation of natural resources. The future generation of satellites with higher spatial and spectral resolutions (e.g. IRS-1C) and advanced GIS techniques not only enable to derive information on degraded lands but also to store and manipulate data for arriving at environment friendly plans.

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Waste Management: Current status and future prospects

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INTRODUCTION

Population blast, rapid urbanization and economic growth have contributed towards daunting challenge of rapidly increasing municipal, industrial and agricultural waste generation in India. Around 100,000 metric tons (MT) of solid waste is generated every day in urban areas in India. About 70-90% of this waste is removed by municipal services because of insufficient fiscal and logistical resources (Yedla, 2016) while majority of these wastes are dumped in an unhygienic manner without proper treatment or containment. India, being the agro based economy with year-round crop cultivation, generates a large amount of agricultural waste including crop residues. The agriculture economy plays a crucial role in overall economic growth but still there is limited discussion on the management of agricultural waste in the published literature so far. The rationale behind this could be from the fact that agriculture industry is not regulated as the municipal solid waste (MSW) which is governed by public entities such as municipalities and hence the generation and management data are collected, recorded, and analyzed in the public domain. Agricultural waste is predominantly handled by the owners of the agricultural land which is predominantly in the private sector, with little public sector involvement. The growing demand of food in developing countries has led to tremendous increase in food production and multitude of activities related to agriculture in both developing and developed nations. These activities together contribute to increase in waste generation and an overall increase in environmental pollution.

The condition of agrarian distress in country has driven the government to form policies for strengthening farmer's position in country. Secondary agriculture being one of such efforts established by government which refers to value addition to the primary produce, adoption of alternative enterprises and utilization of crop residues. Waste management is one of the avenues of secondary agriculture which constitutes various income generation activities that make use of residues and wastes of various field crops, horticulture crops, products of animal origin and forest produce.

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Table.1 Waste management as Type C Avenues of Secondary Agriculture (Courtsey: DFI IX report)

Cotton Stalk Products	Fibre Boards etc., from Rice Straw	Banana Fibre Extraction & Products
Agave Fibre Extraction & Products	Urea Enriched Fodder Block from Rice Straws	Food Plates from Wheat Husk, Arecanut Leaves, Siali Leaves etc.,

According to United Nations, agricultural waste usually comprises of manure and other wastes from farms, poultry houses and slaughterhouses; harvest waste; fertilizer run-off from fields; pesticides that enter water, air or soils; salt and silt drained from fields. As per world energy council, agricultural waste can also comprise of spoiled food waste apart from all the above waste. The harvest waste, commonly known as crop residue waste contains both categories of waste- field residue and process residue. Field residue refers to those left in an agricultural field after the crop has been harvested like stalks, stubble (stems), leaves, and seed pods and the process residues are those left after the crop is processed into a usable resource like sugarcane bagasse and molasses.India is a major agricultural producer and generates about 1586 million MT agricultural wastes per year—about 686 from crop residues (Hiloidhari and Baruah, 2017), 680 from animal dung (Lohan *et al.,* 2015), and 220 from surplus grains, fruits and vegetables that are wasted due to inadequate storage facilities (Cordeon *et al.,* 2015).

Potential aspects of waste-to-wealth generation:

- The economic products of primary agriculture activities directly contribute to the economy and to the income of rural households whereas the residues and wastes of crops and animals also provide opportunities of income generation.
- Further, various by-products emerging out of the agriculture commodity processing can be used for energy production (briquette making), various consumer goods (leaf plates, fiber products *viz.,* ropes, mats, chairs and other handicrafts).
- Rice husk ash is a valuable industrial raw material for steel, cement, and refractory bricks. It can also be used for waste water treatment, thermal insulation, mortar and concrete production, soil amendment, ethanol and reactive silica production.
- Extraction of pigment / colouring agents from fruits and vegetables can form another avenue for income generation activity.
- Use of crop residues such as corn cobs, cashew, apples and groundnut shells for production of industrial chemicals could be a potential avenue which would call for income generation in the rural areas by large investments and infrastructure, waste aggregation, pre-conditioning and supply to the industries. These would be feasible means for of rural-urban industrialization and can complement the current income levels of rural households.
- New scope of employment generation in rural areas could be advanced by utilizing organic and vegetable wastes in urban areas especially in the market areas for

their aggregation and conversion into organic compost.

- Generating income opportunities for rural population would need proper identification of RuRban (Rural-Urban) clusters that would especially bank on the slack resources of land and time available in the rural areas.

The Path Forward

Waste can be recycled and treated as a resource, using a variety of technologies and infrastructure ranging from waste collection; it's processing to decentralized equipment that could function at individual household scale.

- ✓ Agricultural wastes have a great prospective for use as soil amendments, bio-fuels and industrial raw materials.
- ✓ Agro-ecosystem resilience could be enhanced by soil recarbonization that has ample benefits in context of climate change and its mitigation through soil C sequestration. The challenges of poverty alleviation, food and nutritional security, enhancing biodiversity, improving water resources could be solved by creating jobs and empowering underprivileged communities.
- ✓ Installing power plants that uses fly ash as a secondary raw material for construction or materials mine filling, as well as higher-value applications such as concrete additives should be entertained. Implementing performance based standards rather than prescriptive standards should be utilized.

CONCLUSION

In summary, the concept of waste is a deceit as all output from farming is an item of value. It has been quoted rightly by committee on Doubling farmer's Income "Waste to wealth is an artificial construct — the waste is only in the eye of the beholder that imagines waste — when actually the all farming output has inherent value. There is a need to end the perception of waste from farms and instead to view every unit of output as an opportunity to generate value".

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IDM Strategies for Yellow Mosaic Disease of Soybean

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INTRODUCTION

Soybean (*Glycine max* L.) is important oil and protein crop, it contains about high quality protein (40-42%), oil (18-20%). India ranks fifth in the area and production of soybean in the world after USA, Brazil, Argentina and china. In India, during 2018-19 the soybean crops area was around 10.80 mha with the production of 12.10 million tones and productivity is 1120 kg/ha. (Anonymous, 2019). In Maharashtra total area under soybean is about 3.93 mha with production of 4.39 metric tons with productivity of 1137 kg/ha during 2018-19 (Anonymous, 2019).

Yield loss caused by this disease is very high (30-40%), which can go to as high as 80% in severe cases (Nene, 1972). Therefore, it is important to contain the disease before it causes serious damage to the soybean industry in the country. Yield loss per annum due to YMD was estimated to be $ 300 taking black gram, mung bean and soybean together. YMD of soybean was first observed in North India, as early as 1970s and since then it had spread at alarming proportions. Ministry of agriculture, cooperation and farmers welfare government of India (oilseed division) send a letter to the director of agriculture of various state for management of whitefly and YMD of soybean. There are many diseases found on soybean crop from that some major diseases are causing heavy losses such as Rust, YMV, Root rot, Pod blight, Bacterial blight and Alternaria leaf spot.

Economic importance:

Yellow Mosaic Disease is reported to be most destructive viral disease among the various viral diseases. It causes severe yield reduction in all soybean growing countries in Asia including India. Yield loss due to YMD is 75 percent if Infection before flowering, 52 percent at the time of flowering and 15 percent after flowering. Yield loss due to YMD in worldwide is 2,112.6 thousand metric tones and in India yield losses is 196.1 thousand metric tones.

Symptoms:

Small, yellow specks initially develop along the veinlets and later coalesce to produce yellow mosaic.Initially small yellow spots appear on green lamina. The yellow discoloration slowly increases and newly formed leaves may completely turn yellow. Diseased plants are usually stunted with distorted (puckering, crinkling, yellowing) leaves. The plant parts are often stunted. Flattened or curved and contain fewer and smaller seeds. In early infection causes death of the plant before seed set.

Biochemical changes due to YMD disease:

Virus infected leaves had less chlorophyll and sugar contents when compared with healthy leaves. Seeds of infected plants contained significantly lower % of chlorophyll, proteins, phenols, free amino acids and oil as compared with seeds of healthy soybean plants.

Incitant:

YMD is caused by different strains and variants of two distinct Begomovirus species *viz.* Mungbean Yellow Mosaic Virus (MYMV) and Mungbean Yellow Mosaic India Virus (MYMIV). MYMV and MYMIV occurs across the Indian Subcontinent.

Host range:

MYMV/MYMIV affects the majority of legume crops including- Soybean, Mungbean, Black gram, Moth bean, Common bean, Lima bean and Dolichos.

Etiology:

- MYMV belongs to the genera *Begomovirus*of the family *Geminiviridae.*
- The largest genus, *Begomovirus* currently Contains 288 species.
- *Geminiviridae* are bisegmented (geminate) in shape and 30 x 20 nm in size.
- It's circular ssDNS bipartite genome
- Components, DNA-A and DNA.

Transmission:

Disease could not be transmitted by sap inoculation. However, Thailand strain is sap transmitted Since the virus was not found in the embryonic axis, it may not be seed transmitted. However, in recent their detection in flower, cotyledon and seed coat observed. Members of the genus Begomovirus are transmitted by only one species of White fly *Bemisia tabaci* in persistent and circulative manner. It is polyphagous and recorded on more than 600 plant species transmitting more than 60 plant viruses. Weeds also play a role in spreading of virus.

Epidemiology:

The increased disease incidence might be attributed to the higher temperature prevalent during crop growth period which was favourable for the virus multiplication and for the vector white fly to develop and multiply. Average max. and min temp. range 37.5 and 22.5 ^{O}C Late planting, dense population, higher dose of N fertilizer, weed populations favours faster spread of virus.

MANAGEMENT STRATEGIES:

Cultural /mechanical methods

- Use optimum seed rate @30 kg/acre.
- Cultivate two or more varieties and change of varieties at least after every two years.
- Avoid excess N application.
- Weed free cultivation.
- Installed Yellow Sticky Trap of 12'' x 10'' @ 10-12 /ha.
- Rouging of infected plants.
- Use YMV resistant/tolerant varieties.
- Ex. JS 9560, JS 20-29, JS 20-34, JS 9752, JS 20-69, MAUS 71.
- Seed treatment - Treat seed with Thiamethoxam* 30 FS @10 ml/kg seed or Imidacloprid* 48 FS @ 1.25 ml/kg seed.
- Intercrop with Maize or sorghum or Tur.

Botanical and Chemical Uses

- Pre sowing soil application of Phorate @ 10 kg/ha
- Spray Thiamethoxam 25 WG* at 25 DAS
- Spray 0.5% Neem Kernal Extract at 35 DAS
- Spray Imidacloprid 17.8 SL* @ 65 ml/ha at 40-45 DAS
- Avoid using synthetic pyrethroid. (*Not included in label claim)

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Symptoms **vector- white fly**

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Zero Budget Natural Farming

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INTRODUCTION

"ZBNF is self-nourishing and symbiotic in nature."- Subash Palek. Zero Budget Natural Farming (ZBNF) refers to natural agricultural farming system withdrawn from the traditional Indian agricultural practices. Padma Shri Subhash Palekar, an agriculturist promoted the concept of natural farming with zero budget. His findings led to the development of alternative technique to rectify the inappropriate and high level use of chemicals imposed during the green revolution era. The procedure includes the use of organic fertilizers and pesticides that do no harm to the soil and the environment. The farmers spend nearly more than 70 percent to what they earn and most of the farmers have reached the state of insolvency. In this connection, the Indian Government is working to double the farmers earnings by 2022. This can be achieved with ascept called Zero Budget Natural Farming, reduces the total outlay on the inputs and dependency on loans to purchase inputs they cannot afford. The term Zero Budget means no expense/no credit and the term Natural Farming indicates practicing agriculture with natural inputs and for nature, thus avoids the application of chemical pesticides and fertilizers.

The ZBNF can be called as "Do Nothing Farming" since the activities are done by the nature itself. The farming practices are done by her with no tillage, no application of fertilizers, herbicides and pesticides. The key difference between organic farming and natural farming is that former applies the organic manures like farm yard manure and vermicompost while the latter allows the nature to take care of the crop and its practices. In Japan, the Natural Farming is started by Fukuoka and allowed the crop propagation in a natural way. The productivity obtained was similar to that of the chemical fertilizers without much damage to the soil. The core centrality of natural farming is to minimize the cost incurred for inputs and practices. The naturally available pesticides such as pyrethrum, neem, tobacco leaves inhibits and controls the pest population.When the nature is not disturbed, nature would take care of the world. In India, Zero- Budget Natural Farming (ZBNF) was introduced by Subash Palekar, with similar ideology in addition with few supplements. The few indigenous techniques such as Beejamruth, Jeevamruth and Neemastram, Bramhastram are introduced. These techniques are used for the enrichment of the soil and boost the propagation of plants, microorganisms, flora etc without the use of chemical pesticides and fertilizers and external manure.

Palekar findings:

1. The dung from the local and indigenous cows are found effective in the enrichment of infertile and barren land instead of dung from exoctic cows such as Jersey and Holstein. In shortage of local dung, farmers may opt for dung from bullocks or buffaloes.
2. The Kapila cow, native breed of Karnataka and Kassorgod has been recommended as best breed for natural farming, as it consumes very less and has high medicinal properties. The

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dung and urine of this cow is considered to be miraculous.

3. On an average, cows can produce 11 kgs of cow dung per day.10 kilograms of native breed cow dung is required per month to fertilize the land. Hence with the help of these cows, the farmer can fertilize 30 acres of land in a month.
4. To ensure fertility, the urine should be stale, dicot flour and jaggery can be supplemented as additives.
5. The more dung is obtained from native cow provides with lesser milk which is used for remunerating the soil.

Urgent Need for Adoption

Inorganic farming has made not only food as toxic but, it has also lead to barren land with minimum yield. The increased cost of production, high cost of inputs, debt with raised interest rates, fluctuating market prices etc. When the yield is minimum, the farmers find it hard to repay the debt and led farmers to commit suicide. Thus, Indian farmers are under a vicious cycle of debt. With the help of ZNBF, farmers can make infertile land to fertile land and hence by using this method, the yield may increase over the years.

Schemes supporting ZBNF

Rashtriya Krishi Vikas Yojana, a centrally sponsored scheme was initiated in 2007 to provide support to the various activities in agriculture to accomplish 4 percent annual growth. During the twelfth year plan, around 7600 projects were implemented in the field of crop management, horticulture, natural resource management. Based on feedback from the states, it was revamped as Rashtriya Krishi Vikas Yojana Remunerative Approaches for Agriculture and Allied sector Rejuvenation (RKVY-RAFTAAR). A fund allocation of ₹3,745 crore is alloted in the year 2019 to enhance the efficacy of the programme, and the Paramparagat Krishi Vikas Yojana, a programme to promote the organic farming and enhance the soil health was implemented in the year 2015. The allocation of ₹325 crore is allocated to the above programme for the same.Andhra Pradesh is utilizing the above said schemes to promote organic farming.

States adopted ZBNF

Around 1.6 lakh farming communities in thousand villages are following ZBNF with the support of state (Economic Survey). This technique was initiated in Karnataka with the help of State farmer's association and followed by Andhra Pradesh with an aim of practising 100 percent natural farming state by 2024. In Tamil Nadu, ZBNF is followed in some parts of Pollachi, Krishnangiri, Dindigul and Kancheepuram districts.

Four Pillars of ZNBF

1. **Jivamrita/jeevamrutha:** Afermented microbial culture that provides nutrients and as catalytic agent that accelerates the activity of earthworms and microorganisms in the soil. It consists of 20 kg of cow - dung, 5 to 10 litres of urine, 20 kg of jaggery and 2 kg of dicot flour. Required of undisturbed soil is added to the above mixture along with the inoculation of microorganism.The mixture is left for fermentation process, where the aerobic and anaerobic microorganisms such as bacteria and fungi act and multiply on the organic substance. On each irrigation, jeevamrutha is applied directly to the crops. Initially three years are required for transition, then the land becomes self sustained.
2. **Bijamrita/beejamrutha**is a pretreatment technique used for seedlings, seeds orplanting material and it is potent in protecting young roots and shoots from

soil-borne, seedborne diseases and fungal diseases.The composite has a mixture of jeevamrutha, 5 kg of local cow dung, 5 litres of urine, 50 grams of lime and handful of undisturbed soil. It serves as an anti bacterial and natural fungicide.

3. **Acchadana - Mulching**. Mulching is the process of covering the top layer of the soil by covering it with stone, grass, straw etc.
   a. **Soil Mulch**: The soil mulch prevents the upper surface of the soil during cultivation practices and avoids deep ploughing. It also promotes water retention and aeration in the soil.
   b. **Straw Mulch**: Straw material is referred to as dried biomass waste obtained from the previous crops and it also can be the dead material of any living organisms.The humus is thus formed from the decomposition of dry organic matter through the microbial actions.
   c. **Live Mulch**:It is a process of growing multiple cropping patterns of monocotyledonsand dicotyledons in the field, to provide all important elements to the crops and soil. The crops belonging to leguminaceae (dicot) family (pulses) will fix nitrogen in the soil. The monocot crops such as paddy and wheat provides nutrients like sulphur, phosphate and potash
4. **Whapasa**- A state of having both water molecules and air molecules present in the soil, the promotes reduced irrigation, forenoon irrigation, in alternate furrows. The farmers who practices ZBNF have reported a notable reduction in the need for irrigation

Other essential techniques of ZBNF

1. **Intercropping** – Intercropping is done to compensate for the cost and expenses faced by the farmer and thus making farming close to zero budget.
2. **Contours and bunds**– The contour and bunds are made to conserve the rain water, which promote maximum efficacy for different crops.
3. **Local species of earthworms**– The earthworms creates macro, micro pores and decomposes the soil. The rejuvenation of the soil is enhanced by the earthworms.
4. **Cow dung**– The dung from the local cow native breed has more beneficial and massive concentration of microorganisms as that of exoctic cows. ZBNF is focused on Indian cow, which is part of rural livelihoods.
5. **No-Tillage** – Regular tillage, constant application of chemical pesticides and fertilizers affect the soil status and earthworms. Hence tillage is avoided to retain the soil moisture and accelerate the population of earthworms. Earthworms enrich the stratum with their castings and make the soil porous and enrich the soil with their castings. The seeds are broadcasted and covered with a layer of straw before the harvest the preceding crop.

Advantages of ZNBF

This indigenous technology increases the fertility of the soil, the quantity and quality of the product obtained are raised. The fertility is enhanced by earthworms which decomposes the organisms present in the soil and thereby increases the aeration of the soil and creates micro and macro pores which intern raises the water holding capacity of the soil, seed diversity, quality of the produce, etc. The approaches used in this method reduces not only the costs but also

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protects from harmful effects of chemical pesticides, herbicides and fertilizers such as pollution and hazardous to living organisms.

CONCLUSION

Indiscriminate and inappropriate uses of pesticides and chemicals have been a peril to the soil, water and the environment. Many research and reports have claimed the adverse and serve externalities of chemicals on soil structure, fertility, pollution of groundwater and decline in soil microorganisms since after late 1950's. LVC (La Via Campesina), a farmer organization suggested that zero budget natural farming remarks various social and economic benefits apart from the practices in agronomic terms. Recent studies reported and advised the farming community to switch over Zero Budget Natural Farming with the least cost of external inputs, labour, production and supplements the nature with products that enhance the soil microflora and fauna. This model, an eco friendly and sustainable has to be adopted in a larger scale to increase the farmers' income and sustainability.

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Role of nano-micro nutrients in vegetable crops

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INTRODUCTION

Nanotechnology, a new emerging and fascinating field of science, permits advanced research in many areas, and nanotechnological discoveries could open up novel applications in the field of biotechnology and agriculture. In the field of electronics, energy, medicine, and life sciences, nanotechnology offers an expanding research, such as reproductive science and technology, conversion of agricultural and food wastes to energy and other useful byproducts through enzymatic nano-bioprocessing, chemical sensors, cleaning of water, disease prevention, and treatment in plants using various nanocides (Carmen et al. 2003; Nair et al. 2010). Although fertilizers are very important for plant growth and development, most of the applied fertilizers are rendered unavailable to plants due to many factors, such as leaching, degradation by photolysis, hydrolysis, and decomposition. Hence, it is necessary to minimize nutrient losses in fertilization, and to increase the crop yield through the exploitation of new applications with the help of nanotechnology and nanomaterials. Nanofertilzers or nano-encapsulated nutrients might have properties that are effective to crops, released the nutrients on-demand, controlled release of chemicals fertilizers that regulate plant growth and enhanced target activity (DeRosa et al. 2010; Nair et al. 2010).

Aerosol spray (with the help of nebulizer) is much superior than traditional spray for application of nanoparticles to plants and microorganisms. Lower concentration (5 ppm or less) can absorb and penetrate better through plants. Nanoparticle size 20 nm or less may be better to apply. Nanotube is found to be the better shape for more penetration both in plants and microorganisms.

Uptake of nanoparticles in plant systems

Nanoparticles are adsorbed to plant surfaces and taken up through natural nano-or micrometer-scale plant openings. Several pathways exist or are predicted for nanoparticle association and uptake in plants.Nanoparticle uptake into the plant body can use different paths. Uptake rates will depend on the size and surface properties of the nanoparticles. Very small sizes nanoparticles can be penetrate through cuticle. Larger nanoparticles can penetrate through cuticle-free areas, such as hydathodes, the stigma of flowers and stomata's. Nanoparticles must traverse the cell wall before entering the intact plant cell protoplast. Result suggests that only nanoparticle less than 5 nm in diameter will be able to traverse the cell wall of undamaged cell efficiently.

Nano-fertilizers for balanced crop nutrition

In India, fertilizers are squarely responsible for enhanced food grain production from 1960s (55 mt) to 2011 (254 mt) that coincides with the exponential increase in fertilizer consumptions from 0.5 mt to 23 mt, respectively. It has been unequivocally demonstrated that fertilizer contributes to the tune of 35-40% of the productivity of any crops. Cosidering its importance, the Government of India is heavily subsidising the cost of fertilizers particularly urea to encourage farmers to use them to promote productivity of crops. This resulted in imbalanced fertilization and

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occurance of nitrate pollution in ground waters. In the past few decades, use efficiencies of N, P and K fertilizers remained constant as 30-35%, 18-20% and 35-40%, respectively, leaving a major portion of added fertilizers stay in the soil or enter into aquatic system causing eutrophication. In order to address a number of issues such as low fertilizer use efficiency, imbalanced fertilization, multi-nutrient deficiencies and decline of organic matter, it is quite pertinent to evolve a nano based fertilizer formulation with multiple

Effects of Nanoparticles on Plant Growth and Development

Nanoparticles interact with plants causing many morphological and physiological changes, depending on the properties of NPs. Efficacy of NPs is determined by their chemical composition, size, surface covering, reactivity, and most importantly the dose at which they are effective (Khodakovskaya et al. 2012). Researchers from their findings suggested both positive and negative effects on plant growth and development, and the impact of engineered nanoparticles (ENPs) on plants depends on the composition, concentration, size, and physical and chemical properties of ENPs as well as plant species (Ma et al. 2010). Efficacy of NPs depends on their concentration and varies from plants to plants (Table 2.1). However, this review covers plausible role NPs in seed germination, roots, plant growth (shoot and root biomass) and photosynthesis.

Role of Nanoparticles in Photosynthesis

We know that photosynthesis is a key process for plants on earth that changes light energy to chemical energy. Plants convert only 2–4 % of the available energy in radiation into new plant growth (Kirschbaum 2011). Nowadays, scientists are trying to improve this low efficiency of vascular plants by manipulating techniques and gene manipulations. For speed-up of plant photosynthesis and turbocharged crops, scientists are working with Rubisco, an important enzyme for photosynthesis process to catalyze the incorporation of carbon dioxide into biological compounds. Recently, Lin et al. (2014) developed new tobacco plants by replacing the Rubisco gene for carbon-fixing in tobacco plant, with two genes of cyanobacterium Synechococcus elongates; these new engineered plants have more photosynthetic efficiency than native plants. Also, in the field of nanobiotechnology, researchers want to develop bionic plants that could have better photosynthesis efficiency and biochemical sensing. Giraldo et al. (2014) reported that embedded SWCNTs in the isolated chloroplast augmented three times higher photosynthetic activity than that of controls, and enhanced maximum electron transport rates, and SWCNTs enabled the plants to sense nitric oxide, a signaling molecule. They suggested that nanobionics approach to engineered plants would enable new and advanced functional properties in photosynthetic organelles. Also, they said that still extensive research would be needed to see the impact CNTs on the ultimate products of photosynthesis such as sugars and glucose. Also, Noji et al. (2011) reported that a nano mesoporous silica compound (SBA) bound with photosystem II (PSII) and induced stable activity of a photosynthetic oxygen-evolving reaction, indicating the light-driven electron transport from water to the quinone molecules, and they suggested that PSII-SBA conjugate might have properties to develop for photosensors and artificial photosynthetic system. SiO_2NPs improves photosynthetic rate by improving activity of carbonic anhydrase and synthesis of photosynthetic pigments (Siddiqui et al. 2014; Xie et al. 2012). Carbonic anhydrase supplies $CO_2$to the Rubisco, which may improve photosynthesis (Siddiqui et al. 2012).Nano-anatase TiO_2have a

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photocatalyzed characteristic and improves the light absorbance and the transformation from light energy to electrical and chemical energy, and also induces carbon dioxide assimilation. TiO2NPs protect chloroplast from aging for long time illumination (Hong et al. 2005a, b; Yang et al. 2006). 30 M.H. Siddiqui et al.Nano-anatase TiO2enhances the photosynthetic carbon assimilation by activating Rubisco (complex of Rubisco and Rubisco activase) that could promote Rubisco carboxylation, thereby increasing growth of plants (Gao et al. 2006). Ma et al. (2008) studied the impact of nano-anatase on molecular mechanism of carbon reaction and suggested nano-anatase-induced marker gene for Rubisco activase (rca) mRNA and enhanced protein levels and activities of Rubisco activase resulted in the improvement of the Rubisco carboxylation and the high rate of photosynthetic carbon reaction. The exogenous application of TiO2NPs improves net photosynthetic rate, conductance to water, and transpiration rate in plants (Qi et al. 2013). According to Lei et al. (2007) nano-anatase promoted strongly whole chain electron transport, photoreduction activity of photosystem II, O2-evolving and photophosphorylation activity of chlorophyll under both visible and ultraviolet light.According to Govorov and Carmeli (2007), metal nanoparticles can induce the efficiency of chemical energy production in photosynthetic systems. The chlorophyll in photosynthetic reaction center binds to the AuNPs and Ag nanocrystals, thereby forming a novel hybrid system that may produce ten times more excited electrons due to plasmon resonance and fast electron-hole separation. The enhancement mechanisms may help in the design of artificial light-harvesting systems.

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Role of consumer's awareness about industrial biotechnology to enhance its positive perceptions

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INTRODUCTION:

Biotechnology is a vast applied field of biology which uses the living biological systems and modern technologies to fetch commercially important products. In a broad-spectrum view, biotechnology is a combination of multiple sciences i.e. Biology, chemistry, bioengineering and informatics etc.

Industrial biotechnology as an applied field of Biotechnology:

Industrial biotechnology includes the innovative approaches of biotechnology for developing or processing of certain economically valuable products, like chemicals, health products, cosmetics, biofuels, human and animal nutrition and therapeutics etc. This branch of biotechnology primly uses the enzymatic systems or whole microorganism to produce new products or bio-convert the raw material into valuable products.

The changing scenario of health and eco-safety concern:

The chemical synthesis of the aforementioned is posing severe threats to biodiversity in many ways. The chemical synthesis processes generate huge contaminants which pollute the aquatic, terrestrial as well as atmospheric ecosystems. The changing trend of food style, health awareness, eco-safety and environmentally friendly sustainable agricultural practices, are advocating strongly advocating the scientific societies to search for an additional alternative system to develop daily use products.

The problems associated with communication gaps with the public:

In the current scenario, there is a huge void in public communication regarding the benefits of biotechnological approaches. Rather the knowledge of public is most often limited to the genetic engineering process, which is contradicted often in lack of proper information. As an agricultural graduate, I have seen the split responses of farming and scientific communities regarding the uses of *Bt* crops. These split responses either in favour of its uses or against it use are due to the lack of extension of proper information or passes of misleading information purposefully. Keep aside the above example, some scientific reports have even proved the potential risks of genetic engineering, the best example is related to the carcinogenic effects of Glyphosate herbicide-resistant crop, which came in news recently. The truthfulness of this information is yet to be acquainted, but already it's accepted as detrimental.

Why industrial biotechnology sector should be promoted in our nation?

The nations throughout the world are mostly interdependent for their needs, thus trading among countries is touching the sky in terms of export and import of several essential commodities. However, these biotechnological inventions of industrialized nations creating an imbalance of trade and prosperity of the society between the developed and developing nations. In some cases, product substitution by the developed countries also leads to instability in the economy among developing countries. The

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development of techniques to convert corn starch to fructose sugar by developed countries regressed the sugar exporting countries in past. The same problem was seen with the export of guar gum by our nation to the developed countries, which is drastically reduced, as the need of this guar gum is overturned by product substitution with the help of biotechnological inventions by the guar gum importing countries.

Consumer awareness is the key to enhance the public perception of industrial biotechnology:

The knowledge about biotechnological inventions, consumer's perception and their assertiveness have played and will play a greater role in the recognition and acceptance of genetically engineered technologies. In past, there was a survey conducted in some states of India regarding the awareness of GM crops and other GM products and the risk associated with that from a range of people belonging to different age groups. Less than 10 per cent of people were familiar with the term or knowledge of genetically engineered crops. Surprisingly nearly 90 per cent of people were knowing about *Bt* cotton, but the fact is that they think it is something different from GM crops. The source of information for them was mostly printed newspaper or some government agencies. Most of the farming communities in were in the favour of GM crops as they were aware of the potential advantages of these crops regarding high yield, less utilization of pesticides, quality and nutrition aspects. The farming communities even thought that the negligence towards the uses of GM crops in a political issue, but it should be motivated after proper analysis of risk and benefits associated with it. In spite of advantages, there were not knowing the potential harm to human and animal health life, the threat to biodiversity and ecosystem. So this survey indicated that the public was known about the GM technologies and they lacked information regarding the potential risk associated with it.

CONCLUSION:

The public perception of biotechnological innovations can be boosted by effective communications and by creating awareness by the government-supported agencies or by researchers. As the industrial biotechnology sector is advancing in developed nations, as it sufficiently caters the needs of the public and strengthening the economy of these nations. The negligence and resistant towards uses of GMOs or LMOs will make us dependent on other nations in future. Directly and indirectly, we use many imported products in over routine life which is the result of biotechnological approaches, e.g. soap, detergents, oils, shampoos, cosmetics and several other health products. In this case, the public might be not knowing how these products are made but still, they have accepted it. But in case of GM crops, a purposeful hindrance is created which should not be supported and the public should be acknowledged about the usefulness of biotechnological advancements for enhancing its positive perceptions.

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Types of mulches and their role on soil properties, growth and productivity of crop

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INTRODUCTION:

Mulch is a protective layer of material that spread on top of exposed soil between plants. Reasons for applying mulch include conservation of soil moisture, improving fertility and health of the soil, reducing weed growth and enhancing the visual appeal of the area. A mulch is usually, but not exclusively, organic in nature. It may be permanent (e.g. plastic sheeting) or temporary (e.g. bark chips). Mulches of manure or compost is incorporated naturally into the soil by the activity of worms and other organisms.

OBJECTIVES OF MULCHING

- Conserve moisture
- Maintain soil temperature
- Increase fertilizer use efficiency
- Save young germinating and tender plants from direct sun, Reduce run-off, soil erosion & enhance infiltration rate
- Check weed growth and maintain cleanliness.
- Add organic matter in soil
- Stimulate micro flora
- Protect vegetables/seed crop from heavy rains, snow, hails and cold freezing injury
- Promote earlier harvest
- Increase plant growth and yields
- As the organic mulch decomposes, it improves physical, chemical and biological properties soil

TYPES OF MULCH

- ORGANIC
- INORGANIC

ORGANIC MULCH

Types of Organic Mulch

- Grass mulch, straw & hay, pine needles, broad leaves, bark chips, saw dust, compost, farmyard manure, newspapers, lawn cuttings, charcoal dust and fly ash

Properties of Good Organic Mulch

- Doesn't get water saturated
- Drains freely
- Permits good aeration
- Free from contamination by weed seeds or fungal pathogens
- Easy to make, or obtainable at a reasonable price
- Nitrogen content not too low relative to carbon content
- Easy to apply

Problems with Organic Mulch

- Thick layers of matted organic matter can use oxygen and prevent its diffusion into the soil
- Damp decaying mulch can cause rot while in direct contact with plants
- Acidic condition in the soil due to pine needles
- Reduction of heat transfer from soil to air due to an insulating mulch could cause air frost
- Temporary soil nitrogen depletion as organic mulches have relatively high carbon content

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INORGANIC MULCH

TYPES OF INORGANIC MULCH

- **PLASTIC SHEETS** - Does not decomposes in the soil
- **STONE -** provides great insulation
  - degrades very slowly
- **GEOTEXTILE –** blanket like synthetic fiber

CHARCTERISTICS OF INORGANIC MULCH

- **Polyethylene**: Plastic mulch habitually used in agriculture that remains in the field after cropping
- **Photodegradable**: Plastic mulch that break down, these are made of polyethylene and special additive to accelerate the degradation process. Degradation depends on level of ***uv*** radiation, the temperature and type of additive.
- **Biodegradable**: It is made from artificial or natural chemical compounds. Microorganisms, in a process that generate water, CO_2, CH_4 and possibly non-toxic wastes for the environment, can simulate this material.
- The black and white black plastic transmitted very little light (0%-2%) when either new or field exposure.
- The white mulch transmitted the greatest amount of light with 46%.

TYPE OF PLASTIC USED IN MULCHING

- Reflective plastic mulches (RPM)
- Infra – red transmitting (IRT) mulches
- Biodegradable plastic mulches
- RPM
- Painting the plastic with aluminum paint increases its reflectivity and cools late-planted crops resulting in better fruit quality.
- IRT
- These materials results in warmer soils than black plastic.
- The IRT mulch retard the growth of weeds.
- Crops grown IRT mulch will develop seven to 10 days earlier than crops grown on black plastic.

Problem with inorganic mulch

- Not decomposes in the soil
- Greater initial costs
- Costly to remove
- Increased management
- Require skilled labour
- There is zero nutritional value to your plants and landscape beds

CONCLUSIONS

- Mulch of any kind useful in altering the soil hydrothermal regime and provided favorable soil environment for plant growth.
- Among the plastic mulches, black plastic mulch is much more effective against moisture conservation and moderation of maximum and minimum soil temperature.
- Organic mulches like grass, straw etc., decompose after some times and enhance the long-term fertility status of soil through altering the physical, chemical and biological environment of soil.
- Keeping in view the scarcity of irrigation water and problem of suboptimal soil temperature the mulching is a best practice for agricultural crops in respect of nutrient availability, crop growth and productivity.

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Oats: An Overview

Article id:
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INTRODUCTION:

Oat (*Avena sativa* L.) is an important winter cereal in the world. The crop is widely cultivated for use as food, feed and fodder. The bulk of the oats produced in the world are used extensively as feed for livestock (cattle, sheep, poultry and horses) and only 17% of the world production (grain) is used as human food. It ranks sixth in the world cereal production following wheat, maize, rice, barley and sorghum. It is considered to be a valuable component in agriculture as oat reduces disease pressure in cereal crop rotations and is therefore highly suited for sustaining, extensive production systems. Oat is the most environmentally friendly crop in the US, since it is non-host for major cereal diseases and pests (Arora et al. 2012).

Oats have been used as livestock and human food since ancient times, some have been used as pasture, hay, but most have been used as a feed grain. Oats straw has been important bedding for livestock through history. Oats both as forage and grain are good source of protein, fibers and minerals. They have more protein per kg than corn. Most of the oat grain worldwide is consumed as animal feed. It is principally fed to dairy cattle, horses, mules and turkeys with lesser quantities fed to hogs, beef cattle and sheep. Oat hulls, a food processing by-product, are used as an animal feed, fuel for power plants and in chemical industry. Oat bran has received considerable attention from the medical community for its role in reducing blood cholesterol. Nutrition expert's glucans, the water soluble fibers present in oat bran inhibit cholesterol, which helps in preventing heart disease. Nutritionists also recommend increased dailyβbelieve that intake of fibre, such as that in oat bran, because it assists in regulating gastrointestinal function. Several breakfast cereals and bread products are made from oat flour and rolled oat products. Some oat products have been used as an antioxidant and stabilizer in ice-cream and other dairy products.

The centre of origin of oats is Asia Minor. The genus *Avena* as such incorporates, diploid, tetraploid and hexaploid species based on a basic chromosome number of x= 7. The cultivated oat *Avena sativa* L. (2n=6x=42), a naturally allopolyploid, together with wild weedy hexaploid species like *A. sterilis* and *A. fatua*, have evolved through repeated cycles of interspecific hybridization and polyplodization, combining three distinct diploid genomes. All the hexaploid species have a genomic constitution of AACCDD. It is well established that the domesticated oat A. sativa has evolved from the wild hexaploid species.

Botany:

The oat plant, in its early growth phase, may be erect, semi-erect, or prostrate, generally forming a rosette. The shoot comprises several hollow culms (tillers) bearing foliage leaves. The number of tillers depends on the basis of seeding, genetic features of the cultivar and growing conditions (e.g. dose of fertilizers applied). The tiller terminates in a large inflorescence called panicle.

The panicle consists of a central stem (rachis) and branches which arise in whorls at the nodes. Each main and lateral rachis ends in a spikelet (flower); spikelets are also borne at the nodes of the rachis. The spikelets, often drooping but

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upright in some cases, are subtended by two loose membranous glumes, which are generally longer than the spikelet. In hulled varieties, the spikelets usually contain three florets, one of which is rudimentary and nonfunctional. In naked (hulless) oats, 3 to 7 florets may be produced per spikelet. The florets consist of a lemma and palea, which enclose the reproductiveorgans – stamens and ovary. The lemma (which is awned or awnless) and the palea adhere to the developing seed in the hulled oats. The hulless oats thresh free from lemma and palea. Generally, two kernels (seeds) are produced per spikelet, but sometimes only one develops. The oat kernel (also called groat), a caryopsis, is spindle in shape, and generally thinly covered with fine hairs (trichomes). The kernel comprises seed coat layers, starchy endosperm, and the embryo. The oat is also broadly classified into spring and winter types depending upon the season of planting.

Uses of Oat:

Use (s)	Component of oat
Food uses:	
Bread	Oat flour, Oat starch, Oat lecithin
Beverage	Whole oat
Biscuits and cookies	Oat flour
Breakfast cereal	Whole oat
Pasta products	Oat starch
Granola bars and cereals	Whole oat and resistant starch fractions
Infant Food	Whole oat
Oat milk	Whole oat extract
Oat based non-dairy fermented yoghurt, Adavena M40	Whole oat
Fat substitute in meat balls, dairy and bakery products	Oat bran
Fat substitute	Oat dextrin, Soluble β-glucan
Stabilizer in ice creams	β-glucan
Clinical Uses:	
Gluten-free diet	Whole oat
Cholesterol lowering effect	β-glucan
Ant cancerous effect	β-glucan ,Short chain fatty acids
Industrial Uses:	
Methane production for Biogas	Oat husk

Nutritional value:

Nutritional value per 100 g

Energy	1,628 kJ (389 kcal)	**Monounsaturated**	2.18 g
Carbohydrates	66.3 g	**Minerals:**	
Dietary fiber	11.6 g	**Calcium**	54 mg
Polyunsaturated	2.54 g	**Iron**	5 mg
Protein	16.9 g	**Magnesium**	177 mg
Vitamins:		**Manganese**	4.9 mg
Thiamine (B1)	0.763 mg	**Phosphorus**	523 mg
Riboflavin (B2)	0.139 mg	**Potassium**	429 mg
Niacin (B3)	0.961 mg	**Sodium**	2 mg
Pantothenic acid (B5)	1.349 mg	**Zinc**	4 mg
Vitamin B6	0.12 mg		
Folate (B9)	56 µg	**Other constituents**	Quantity
Fat	6.9 g	**β-glucans**	4 g
Saturated	1.21 g		

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Health Benefits of Oats: Following are some of the health benefits of Oats.

- Oats are a source of low calories, high protein and high fiber.
- Oats may help in reducing bad cholesterol.
- Oats are heart healthy and protect from cancer.
- Oats regulates the blood sugar levels by improving insulin sensitivity.
- Oats are a source of good antioxidants.
- Oats may help in controlling blood pressure.
- Oats may help in weight loss.
- Oats may help in building strong immune system.
- Oats are gluten free and safe.

Soil and Climatic Requirement

Soil:

Oat can be cultivated on wide range of soils. However they thrive best on well drained loamy soils having good organic matter. The optimum soil pH range required is 5.0 to 6.5 for higher yield. Oat crop tolerates higher pH range soils than wheat or barley.

Climate:

- Grows best in cool and moist climate.
- Also, best adapted to cotton belt.
- Cool weather is important during grain filling for high yield.

Varieties: Kent, Algerian, Bunker 10, Coachmen, HFO 114, UPO 50.

Hybrid Varieties of Oats in India:

Brunker-10, NP-2, Weston-ll, Np-l, Kent, Palampur l, OS-6, OS-7, OL-9, HFO - 114, UPO-94; Algerian, Bundel Jai-822, Harita (RO -19), Sabzaar (SKO-7), Haryana Javi-8 and Bundel Jai 2001-3.

CULTURAL PRACTICES

Land preparation:

Land should be made **weed** free from planting or crop and it should be ploughed 6 to 7 times to achieve fine tilth stage.

Seeds and sowing:

- Fanning the light weight seeds is mandatory. Otherwise, even if those germinate, results week stem and poor yield.
- About 25-30% seeds are normally rejected.
- Seed rate recommended is 100 kg/ha.
- Best time of sowing for oats is mid October to mid-November.
- 15th October is optimum time for fodder production.
- Method of sowing: Drill sowing is better than broadcasting.

Spacing: 20-23cm row spacing for fodder and 23-25cm for grain production is optimum.

Manures and fertilizer:

- 12.5 t/ha of FYM is to be applied before last ploughing and to be incorporated before sowing.
- 80:40:0 kg NPK/ha is the recommended dose of fertilizers.
- 100% P is to be applied as basal.
- 60kg N is to be applied as basal, 10kg at first irrigation and 10kg at second irrigation is good for higher yield.
- 10 kg of N is to be applied after first cutting if sown for fodder cum grain.

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Water management:

- Oats requires higher water than wheat.
- 4-5 irrigations provide good yields. Generally, irrigation immediately after each cutting is mandatory.
- Critical stage for irrigation of oats is tillering stage.

Weed management:

- One hand weeding is sufficient.

Cropping system:

- Sorghum-oat-maize
- Maize-oat-maize
- Cowpea-oat + mustard-maize + cowpea
- Sorghum + cowpea-oat + lucerne

Harvesting in Oats Cultivation:

Oat crop will become available for harvesting after 4 months of sowing. If it is for fodder use, 2 cuttings should be taken @ 40 to 45 day's interval and leave for seed setting. In order to avoid grain shedding, crop harvesting should be done in early April month.

Yield of Oats Crop:

If oats are cultivated for fodder purpose, an average fodder yields of 220 to 300 quintals per hectare and an about 5 quintals grain/ha can be obtained. If they are cultivated for grain purpose, an average grain yield of 15 to 20 quintals/ha and straw yield about 25 quintals/ha can be achieved.

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Environmental Sensitive Genetic Male Sterility: A Novel Tool in Recent Era of Rice Breeding

Article id: 21810

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INTRODUCTION

- Rice is the seed of the grass species *Oryza sativa* or *Oryza glaberrima*
- It is the agricultural commodity with the highest worldwide production
- The majority of rice produced in Asia is in from India, China, Indonesia, Thailand, Myanmar and Bangladesh (IIRI-World Rice Statistics, 2010)
- Rice is one of the oldest cultivated crops with a basic chromosome number of 12 and total 24 species among them only 2 are cultivated species, i.e., *Oryza sativa* – Asian rice and *Oryza glaberrima* – African rice and rest are wild species which include both diploid and tetraploid forms
- Genome size is 430 Mb
- Genome sequencing by India – 11th Chromosome (IRGP, University of Delhi).

What is male sterility?

- Male sterility is an inability of living organism to effect sexual reproduction or in case of plant, it is the failure of plants to produce functional anthers, pollens or gametes.
- Generally male sterility is more prevalent than female sterility.
- J. K. Koelreuter (1763) observed anther abortion within species and species hybrids.
- Genetic male sterility has been reported in cabbage (Rundfeldt, 1960), cauliflower (Nieuwhof, 1961)
- In rice, first PGMS was found in 1973 in *japonica* cultivar Nongken 58 (58N) from China (Shi, 1985), whereas first TGMS was found in 1987 in *indica* cultivar Annong (AnN) from China (Tan *et al.*, 1887) as spontaneous mutation
- Male sterility was artificially induced through mutagenesis (Kaul, 1988)
- Male sterility systems have been also developed through genetic engineering (Williams *et al.* 1997)and protoplast fusion(Pelletier *et al.* 1995).

Types of male sterility in rice

- In rice, following types of male sterility (MS) are observed
  a) Phenotypic MS includes three types of male sterility *i.e.*, Structural or Staminal MS, Pollen MS and Functional MS.
  b) Genotypic MS includes four types of male sterility *i.e.*, Cytoplasmic MS, Genic or Genetic MS, Cytoplasmic Genetic MS and Transgenic MS.Genetic MS is of two types *i.e.*, Environmental sensitive and Environmental insensitive Genetic MS.
  c) Chemically induced MS

Environmental sensitive genetic male sterility

- Certain environmental factors can affect male reproductive development in several plant species of environmentalsensitive male fertile mutants (Batch and Morgan, 1974).
- There are main three types of Environmental Sensitive Genetic MS that have been reported in rice*i.e.*, Photoperiod Sensitive Genetic MS, Temperature Sensitive Genetic MS and Humidity Sensitive Genetic MS.

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- In Photoperiod Sensitive Genetic MS (PGMS) lines, fertility or sterility is associated with photoperiod available. PhotoperiodSensitive Genetic MS (PGMS) lines are sensitive to the duration of day length for the expression of sterility or fertility. Most PGMS lines remain male sterile under long-day (>13.75 h) conditions and revert back to fertility under short-day (<13 h) conditions, *e.g.*, N9044S and N5088S (Virmani *et al.*,2003).Reverse Photoperiod Sensitive Genetic MS (r-PGMS) lines express sterility under short day length and fertility under long day length hence known as r-PGMS (Peng *et al.,* 2008).
- TemperatureSensitive Genetic MS (TGMS)linesare sensitive to the temperature for the expression of male sterility or fertility. For example, most TGMS lines remain male sterile at high temperature (day temperature >30 ºC and night temperature >24 ºC) and they revert back to partial fertility at a lower temperature (day <24ºC/>16ºC night), for example, 5460S, IR68945, H89-1, and SA2 (Virmani *et al.,* 2003). ReverseTemperatureSensitive Genic MS(r-TGMS) lines are sensitive to the low temperature (<24 ºC day/>16 ºC night) for the expression of male sterility, whereas, at a higher temperature (>30 ºC day/24 ºC night), they become male fertile, which is the reverse of the TGMS system, for example, JP 38, Dianxin 1A, and IVA (Virmani *et al.,* 2003).
- Photo-Thermosensitive GeneticMS (PTGMS) lines are controlled by the interaction of photoperiod and temperature. Temperature is the key factor since PTGMS lines become completely male sterile or fertile beyond a particular temperature range, that is,>30 ºC or <24 ºC, without any influence of photoperiod. But, within this temperature range (24–32 ºC), photoperiod influences the PTGMSlines, that is, longer photoperiod hours will enhance male sterility at lower temperatures (Peng *et al.,* 2008).
- Humidity Sensitive Genetic MS (HGMS) is associated with pollen abortion at certain level of humidity. In flowering plants, the pollen coat protects the released male germ cells from desiccationand damage during pollination.The plants are male sterile at low relativehumidity (RH < 60%), but fully male fertile at high relative humidity (>80%). The lack ofthree major fatty acids in the pollen coat results in rapid dehydration of pollen grains. Application of mixtures of linolenic acid and palmitic acid or stearic acid are able toprevent over-dehydration of mutant pollen grains(Xue*etal*., 2018)
- Since the EGMS are controlled by recessive gene(s), when these lines are crossed with a fertile line, the hybrids are fully fertile in optimum day length and temperature conditions prevailing during the growth season. EGMS lines are multiplied at appropriate locations and seasons where stable fertility inducing environmental (photoperiod/temperature) conditions prevail for a continuous period of 30 days (Lu *et al.,* 2005).

Advantages of egms system over cms system of male sterility

- No need for a maintainer line for seed multiplication.
- Any genotype can be used as a male parent, unlike in three line system where only those genotypes possessing restorer gene(s) can only be utilized as male parent.
- Negative effects of sterility-inducing cytoplasm are not encountered.
- Self-producible under favorable environmental conditions.
- Any genotype can be converted into TGMS line and any other genotype can be utilized as male parent.

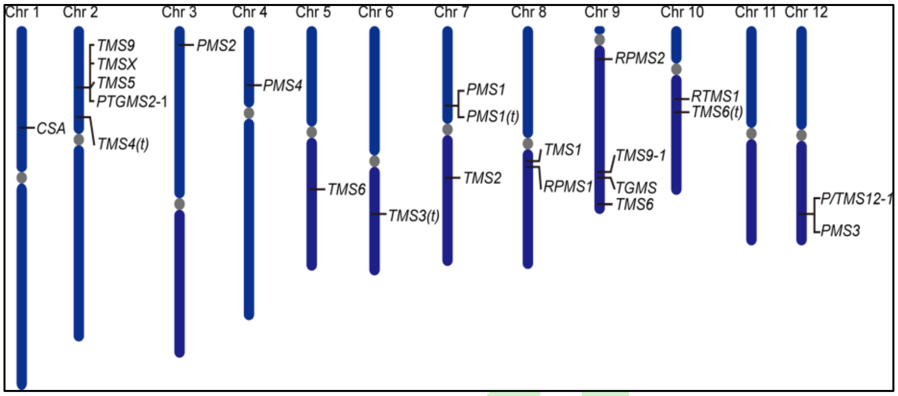

Fig 1: Distribution of genetic loci for P/TGMS in rice (Fan and Zhang, 2017)

Table 1: locus mapped for controlling egms in rice

S. N.	Locus/Gene	Reference
1	**Photoperiod Sensitive Genetic Male Sterile**	
	pms1	Zhang *et al.*, 1994
	pms2	Zhang *et al.*, 1994
	pms3	Mei *et al.*, 1999
2	**Reverse Photoperiod Sensitive Genetic Male Sterile**	
	rpms1	Peng *et al.*, 2008
	rpms2	Peng *et al.*, 2008
3	**Thermo Sensitive Genetic Male Sterile**	
	tgms1	Wang *et al.*, 1995
	tgms2	Yamagushi*et al.*, 1999
	tgms3	Subudhi*et al.*, 1997
	tgms4	Dong *et al.*, 2000
	tgms5	Yang *et al.*, 2007
	tgms6	Lee *et al.*, 2005
	tgms6(t)	Liu *et al.*, 2010
4	**Reverse Thermo Sensitive Genetic Male Sterile**	
	rtms1	Jia *et al.*, 2001
5	**Photo Thermo Sensitive Genetic Male Sterile**	
	ptgms2-1	Xu *et al.*, 2011
	pms1(t)	Zhou *et al.*, 2011

Mechanisms of EGMS in rice

- Premature tapetum degeneration is major cause of abortive pollen development.
- Insufficient production in amount Long Non-coding RNA (lncRNA) from LDMAR (Long Day specific Male fertility Associated RNA) locus.
- Point mutation in a novel noncoding RNA that produces a small RNA
- Mutation in *CSA* (Carbon Starved Anther)
- Lossof RNase Z^{S1} function
- Production of phased small-interfering RNAs
- Deficiency of a triterpene pathway

CONCLUSION

Male sterility is of particular significance in improving crop yield because of itsusefulness in hybrid seed production especially when restorers are less e.g., *japonica*. Numbers of molecular and morphological mechanisms have been studied to identify the reason behind male sterility under the influence of environmental factors i.e., photoperiod, temperature and humidity. These include specific destruction of tapetum, LDMAR suppression, small RNA, mutated *csa*, defective RNase Z^{S1}, phased small RNA and deficiency in triterpene synthesis which governs the environmental sensitive genetic male sterility (EGMS) in rice. PGMS and TGMS are governed by oligogenic inheritance. Highly heterotic two-line hybrids with economic feasibility can be produced under the favourable conditions. Deeper understanding of molecular mechanism and gene responsible for EGMS may facilitate its utilization through marker assisted selection (MAS) and genome editing.

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Energy conservation and generation in agricultural farms of India

Article id: 21811

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INTRODUCTION

The Indian economy is growing at the rate of 7-8 per cent per year and the country is aspiring to become a leading economic power in the world in the next few decades. Inadequate growth in employment, its impact on poverty and the increasing rural urban divide are matters of serious concern that are engaging the attention of our planners and policy makers. There is a direct correlation between economic development and energy use. In order to achieve this goal of becoming a leading economic power, the country has to find modern and renewable ways of producing energy to bridge the increasing gap between demand and supply.

India has a large biomass resource base, which is currently being utilized inefficiently. In addition, there are large tracts of waste lands that can be used for growing of biomass. In recent years, modern biomass conversion technologies have been developed which can convert biomass fuels into various energy forms. These technologies can play an important role in providing sustainable solutions for decentralized energy demand in villages and in industries. Diversification should lead to the accelerated harnessing of renewable energy resources that are capable of meeting a broad spectrum of requirements thus contributing to the overall national energy security, rural economic growth and environmental protection.

About 70 per cent of the population in India lives in rural areas. The rural energy scenario is characterized by inadequate, poor and unreliable supply of energy services and large dependence on traditional biomass fuels. Non commercial energy sources, predominantly fuel wood, chips and dung cakes, contribute around 30 per cent of the total primary energy consumed in the country. It has been observed that the rural energy consumption is about one tenth of average energy consumption in our country. Biomass is primarily used for meeting the cooking and heating requirements through traditional stoves and furnaces having very low efficiencies, of the order of 10 per cent.

Biomass

Biomass energy is derived from plant and animal material, such as wood from forests, residues from agricultural and forestry processes, and industrial, human and animal wastes. It is the source for producing feed, food, fiber, fertilizer and fuel for mankind and its associate’s activities. The energy value of biomass from plant matter originally comes from solar energy through the process known as photosynthesis. The chemical energy that is stored in plants and animals, or in the wastes that they produce, is called bio-energy. During conversion processes such as combustion (burning), biomass releases its energy, often in the form of heat, and the carbon is re-oxidised to carbon dioxide to return the carbon that the organism absorbed while growing back to the environment. Essentially, the use of biomass for energy is the reversal of photosynthesis.

Biomass is essentially a combustible matter, which can easily be integrated for

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obtaining domestic and industrial process heat. The chemical composition of biomass varies among species, but a plant consists of about 25 per cent lignin and 75 per cent carbohydrates or sugars. Biomass is generally regarded as a low-status fuel. Biomass energy can be used to generate heat and electricity through direct combustion in modern devices ranging very-small-scale domestic boilers to multi-megawatt size power plants electricity, or liquid fuels for motor vehicles such as ethanol, or other alcohol fuels.

Biomass resources that can be used for energy production cover a wide range of materials. The use of biomass energy can be separated into two categories, namely modern biomass and traditional biomass. Modern biomass usually involves large-scale uses and aims to substitute for conventional fossil fuel energy resources. It includes forest wood and agricultural residues; urban wastes; biogas and energy crops. Traditional biomass is generally confined to developing countries and small-scale uses. It includes fuel wood and charcoal for domestic use, rice husks other plant residues, and animal dung for power and proves heat.

BIOMASS APPLICATIONS

1. Biofuels

The production of biofuels such as ethanol and biodiesel has the potential to replace significant quantities of fossil fuels in many transport applications. The wide spread use of ethanol in Brazil has shown that biofuels are technically feasible on a large scale. In the USA and Europe biofuel production is increasing, with most of the products being marketed in fuel blends. At present this production is supported by government incentives, but in the future, with the increased growth of energy crops, and economies of scale, cost reductions may make biofuels competitive in their own right. In India as well major thrust has been made for developing biodiesel authority for production, utilization and management of biodiesel.

2. Electricity Generation

There are number of conversion routes including external combustion and internal combustion suitable for electricity generation from biomass. The heat of combustion gases can be utilized through number of thermodynamic cycle such as Striling cycle, Rankine cycle and Brayton cycle. Electricity can be generated from a number of biomass sources and being a form of renewable energy can be marketed as “Green Power”. The production of electricity from renewable biomass sources does not contribute to the greenhouse effect as the carbon dioxide released by the biomass when it is combusted, is equal to the carbon dioxide absorbed by the biomass material during its growth.

3. Heat and Steam

The combustion of biomass or biogas can be used to generate heat and steam. Heat can be the main product in applications such as home heating and cooking, or it can be a by-product of electricity generation in combined heat and power plants. Steam generated by biomass can be used to drive steam turbines for electricity generation, used for process heat in a manufacturing or processing plants, or used to service a hot water load.

4. Combustible Gas

The biogas produced from anaerobic digestion or producer gas through gasification and pyrolysis has a number of uses. It can be used in I.C. engines to drive turbines for electricity generation to produce heat for commercial and domestic needs, and in specially modified vehicles as a transport fuels.

Other Benefits of Biomass

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- Biomass is a renewable source of energy and its use does not contribute to global warming. In fact, it can reduce the atmospheric levels of carbon dioxide, as it acts as a sink and can increase the amount to soil carbon.
- Biomass fuels have negligible sulphur content and therefore do not contribute to sulphur dioxide emissions that cause acid rain. The combustion of biomass generally produces less ash than coal combustion, and the ash produced can be used as a soil additive on farm land to recycle material such as phosphorous and potassium.
- The conversion of agricultural and forestry residues, and municipal solid waste for energy production is an effective use of waste products that also reduces the significant problem of waste disposal, particularly in municipal areas.
- Biomass is a domestic resource, which is not subject to world price fluctuations or the supply uncertainties of imported fuels. In particular, the use of liquid biofuels in developing countries can reduce the harsh economic pressures of importing petroleum products.
- Perennial energy crops have lower environmental impacts than conventional agricultural crops.

CONCLUSIONS

In the future, biomass has the potential to provide a cost-effective and sustainable supply of energy, while at the same time aiding countries to meet their greenhouse gas reduction targets of International agreements. By the year 2050, it is estimated that 90 per cent of the world population will live in developing countries. It is critical therefore that the biomass processes used in these countries are sustainable. The modernization of biomass technologies, leading to more efficient biomass production and conversion, is one possible direction for biomass uses these countries.

In industrialized countries, the main biomass processes utilized in the future are expected to be the direct combustion of residues and wastes for electricity generation, bioethano1 and biodiesel as liquid fuels, and combined heat and power production from energy crops. In the short to medium term, biomass waste and residues are expected to dominate biomass supply, to be substituted by energy crops in the longer term. The future of biomass electricity generation lies in biomass integrated gasification/gas turbine technology, which offers high-energy conversion efficiencies and will be further developed to run on biomass produced fuels.

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Ecosystem services provided by homegarden

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According to Millennium Ecosystem Assessment (MA), ecosystem services are "the benefits people obtain from ecosystems". The MA also delineated the four categories of ecosystem services—supporting, provisioning, regulating and cultural. The natural environment provides a wide range of benefits to people. In agroforestry system, the multi-strata homegarden offer a many services as human needs as food, medicine, firewood, construction, fibre, animal fodder and shade as well have ornamental and religious uses. By valuing ecosystem services their importance can be understood to a greater extent and it will also simplify ecosystem management.

INTRODUCTION

The natural environment provides a wide range of benefits to people. These include, for example, production of clean water and many raw materials used in economic activities, regulation of climate and flooding, soil formation and crop pollination, and cultural benefits such as aesthetic value and recreational opportunities. "Ecosystem services refer to the many natural processes by which ecosystems, and the species that make them up, sustain and fulfill human well-being" (Daily, 1997). The Millennium Ecosystem Assessment (MEA) in 2005 was a milestone in ecosystem services history, as it located the concept at the heart of policy making and led to increasing interest on the topic amongst scientists. In 2005 the Millennium Ecosystem Assessment was published and includes a classification that divides ecosystem services into four main categories (Figure 1) (Gomez-Baggethun *et al.,* 2010; Eiter and Stokstad, 2015).

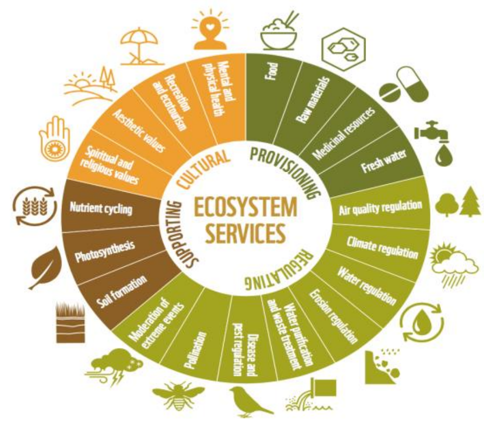

Figure 1. General Illustration of ecosystem services (https://www.google.com/url?sa=i&source=images&cd)

Provisioning services of homegarden

Home garden is an integrated system which comprises different things in its small area and the main goal of the garden is to provide a provisioning service as foods, fibre, fuel, medicines, ornamental, fresh water and conserves genetic resources to sustain human life. The several research and assessment approaches have been proposed to better

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understand the potential of different ecosystem services present in homegarden. Today the world faces a fundamental challenge of ensuring that millions of households living in poverty have access to enough food to maintain a healthy life (Adekunle, 2013). For many generations, small plots of land near the homestead have been used as home gardens to obtain basic needs as staple food, fibre, fodder and fuel for daily life. (Subba *et al.,* 2015) reported 142 plant species richness from homegardens of terai region of North Bengal, India, among all 103 reported cultivated and 59 uncultivated further cultivated species were categorized according use categorized under provisioning services. Several, studies carried out in home gardens of various regions have recorded notable richness of species and varieties. In terms of composition, high diversity of species with an immediate use in the home is the most prominent feature of home gardens (Hoogerbrugge and Fresco, 1993).

Regulatory services of Homegarden

Regulating ecosystem services are the benefits obtained from the regulation of ecosystem processes. The multifunctional role of trees makes agroforestry interventions ideal management practices to supply a variety of regulating ecosystem services. Including seven regulating ecosystem services (MEA, 2005)- Carbon sequestration, Soil fertility enhancement, Prevention of soil erosion, Water regulation, Wind regulation, Pest regulation and Pollination. Agroforestry has importance as a carbon sequestration strategy because of carbon storage potential in its multiple plant species and soil as well its applicability in agriculture lands and reforestation (Montahnini and Nair 2004).

Cultural services of Homegarden

The MEA (2005) defined cultural ecosystem service vaguely as "nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences". Cultural values of a landscape or an ecosystem are important and worth protecting because they are unique, irreplaceable and have an increasing importance in economic societies (Guo *et al.,* 2010; Szücs *et al.,* 2015). In India, most of the homegarden is culturally developed and always many rituals activities absorb in garden and many plant and animal species present in homegarden and signify as cultural value.

Supporting services of Homegarden

The supporting ecosystem services include photosynthesis, soil formation, primary production, nutrient cycling and water cycling. The integration of trees into agricultural landscapes has the potential to generate a number of improvements in the soil as a habitat for soil organisms and also for crop growth. Trees modify the soil environment in many ways: leaves intercept rainfall, transpire water taken up by roots from the soil, and provide shade to the understory and soil, and dead or pruned leaves and branches provide soil cover and nutrient inputs to soils. These processes affect the temperature, moisture, erosion, and nutrient content of the soil as well as influencing soil biota (Barrious *et al.,* 2012).

CONCLUSION

Homegarden agroforestry systems maintain rich biodiversity and provide essential goods and services which support ecosystems functioning and productivity. By valuing ecosystem services their importance can be understood to a greater extent. It will also simplify ecosystem management. Homegardens provide almost all four ecosystem services as highlighted by Millennium Ecosystem Assessment (2005) and but till today Ecosystem services scientific studies in lacking regarding the homegardens. Thus, further scientific studies are needed to understand and to reveal the functions of micro region homegardens.

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Farmer Produce Company (FPC): A Journey of Farmers from Food Grower to Food Seller

Article id: 21813

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INTRODUCTION

Agriculture has been proved to be the largest sector in the world economy and also plays a crucial role in the economic development of many nations. However, this sector has been experiencing a lot of crises which need to be dealt with in order to achieve sustainable economic development (Mariappan *et al.,* 2019).A number of small farmers in particular in developing countries struggle to cope with the aforementioned trends in the global agrofood system, which confronts them with challenges they find difficult to meet (Markelova*et al.,* 2009; Maskaure and Henson, 2005). In India, small farmers' livelihoods are being threatened due to the liberalization and privatization of Indian agriculture and the increasing interest of private capital in the agribusiness sector. The withdrawal of the state from productive and economic functions, and changes in the organization of marketing channels, present new challenges for small-scale farmers (Trebbin*et al.,* 2012).Collectivization of producers, especially small and marginal farmers, into producer organizations has emerged as one of the most effective pathways to address the many challenges of agriculture, most importantly, improved access to technology, inputs and markets (Raju*et al.,* 2017). In this scenario the solution is possible through exploring innovative market led extension models in order to integrate the farmers, especially the small farmers; with the value chain so that the net return at the farmers end is remunerative enough for them to remain in agriculture. Several institutional models have been tried in India to integrate farmers with production and value chain like Self Help Groups, Farmers Interest Groups, and Farmers' Cooperatives etc. (Mukherjee, *et al.,* 2018). In this regard, Farmer Producer Company is thought to be a tool which can organize and formalize the farmers of India, by forming a company and pool their resources to work in cooperation with fellow farmers and become the shareholders of the company which is run by the farmers with sufficient and appropriate management skills or they hire management experts to help them with their produce (Kakati, *et al.,* 2017).FPCs are expected to overcome the constraints of farmers imposed by the small size of their individual farms by leveraging the collective strength and bargaining power to access financial and non-financial inputs, services and technologies (SFAC 2014); enhance incomes, reduce costs of input purchases along with transaction costs, create opportunities for involvement in value-addition including processing, distribution and marketing (Welsh 1997; Agarwal 2010).

Status of Farmers' Producer Companies in India

As on March 2019, there were 2,083 FPOs supported by NABARD and 551 supported by SFAC in India. As depicted from the table,1. Madhya Pradesh having highest number of FPCs, followed by Karnataka and Maharashtra, West Bengal and Uttar Pradesh (Table 1.).IFAD (2004) opined that in rural areas, farmers' organizations (FOs) are the nearest and often onlyinstitutions providing essential goods and services to the rural poor and helping them to break out from the poverty cycle.The role of the Farmer Producer Organisations (FPO) is critical in the development of comprehensive and workable supply chains. These organisations can be effective and vital in the supply chain due to their capacity to connect smallholder farmers to markets.

Issues and challenges of Farmers' Producer Company

Table 1. State wise numbers of FPCs in India

There are several constraints that holds back a rapid transformation of agricultural sector in India, which is evident from several scholarly studies (Chand et al. 2011; Swaminathan and Rengalakshmi 2016). These are: a) highly unequal distribution of ownership and operational holdings of land, b) predominance of small and marginal holdings, c) rampant poverty among households dependent on agriculture, d) institutional weaknesses, e) high transaction cost due to small marketable surplus and f) poor connectivity and access to markets.Rising of equity capital and absence of tangible security and physical assets were the two noteworthy difficulties that a FPC faces in their initial period (Prabhakar et al. 2012). As studied by Raju*et al.,*2017, identified several issues with producer companies in Andhra Pradesh are as follows:

1. Lack of convergence of government agencies
2. Untapped social capital/community resources
3. Lack of business planning
4. Limited knowledge base of resource institutions
5. Traders become FPOs key functionaries
6. Few executive members handle all responsibilities
7. Market identification and price discovery
8. Lack of forward and backward integration

The reason for high growth of FPC as perceived by ASA (2009) is energetic management team and the board of directors, cooperation from banking institutions which provided hassle free loans to the PC for working capital, and a clearly identified business opportunity that gives a high return on investment.

States	2017	2018 % Increase	2019 SFAC Promoted FPOs as on 31.07.2019
Andhra Pradesh	2	0.19	7
Arunachal Pradesh	13	1.24	2
Assam	37	3.53	12
Bihar	19	1.81	29
Chhattisgarh	18	1.72	26
Delhi	4	0.38	4
Goa	2	0.19	2
Gujarat	34	3.24	21
Haryana	24	2.29	23
Himachal Pradesh	5	0.48	6
Jammu & Kashmir	2	0.19	2
Jharkhand	8	0.76	10
Karnataka	111	10.59	119
Kerala	10	0.95	-
Madhya Pradesh	127	12.12	143
Maharashtra	85	8.11	99
Manipur	4	0.38	6
Meghalaya	3	0.29	3
Mizoram	-	-	1
Nagaland	2	0.19	2
Odisha	33	3.15	41
Punjab	7	0.67	7
Rajasthan	38	3.63	48
Sikkim	29	2.77	30
Tamil Nadu	62	5.92	11
Telangana	54	5.15	20
Tripura	4	0.38	4
Uttar Pradesh	204	19.47	49
Uttarakhand	45	4.29	7
West Bengal	62	5.92	83
Source: SFAC 2019 & Anirban *et al.*, 2018			

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Challenges faced in established FPC's		
Author and Year	**Title**	**Salient findings**
NABCONS(2011)	Integration of Small Producersinto Producer Companies- Status and Scope	Lack of vision and direction from BoD Operational problems like low equity base due to low share value (share capital ranged from Rs. 1-5 lakh cross PCs) • poor marketing and value additionexpertise • no or poor business plans which were needed for obtaining finance aswell • poor skills of professionals of thePCs
Trebbin and Hassler (2012)	Farmers' producer companies in India: a new concept for collective action?	The integrity and quality of the leadership, its acceptance within the community, as well as the market environment. • Poor or no market linkage and no knowledge about market information among farmers.
Venkattakumar and Sontakki (2012)	Producer Companies in India- Experiences and Implications	• Poor credit facility for working capital and investment. • The producer companies also face difficulties in getting Agricultural Produce Marketing Committee (APMC) licenses for processing and trading.
Sukhpal and Tarunvir (2013)	Producer Companies in India: A study of organization andperformance	• A comparison of cooperatives and PCs in policy treatment in India shows that income tax exemption, non-taxable welfare income exemption, land lease at nominal rates or free, fertilizer allocation to PACS, foundation seed supply and marketing support to seed cooperatives, state agency grants to cooperatives, export incentives and provision of distribution outlets for selling products which is available to cooperatives is not available toPCs.
Desai and Joshi (2014)	Can Producer Associations Improve Rural Livelihoods? Evidence from Farmer Centres in India	• Impact of organising female farmers into producer associations in Gujarat- 18 months programme on training, information, access to inputs, risk mitigation, and market linkages got stronger impacts on members' awareness and utilisation of financialservices. • Producer associations can lower transaction costs for smallholders, but that poverty alleviation may be a longer-termprospect.
Bikkina*et.al.*(2015)	Farmer Producer Organizations as	• The Avirat model has not been successful in extending credit to its members due to

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	Farmer Collectives: A Case Study from India	unavailability of collateral freeloans. • The weather insurance innovation at affordable premium by Avirat is aimed at saving disasters in thefuture.
Kaaria*etal.*(2016)	Rural women's participation inproducerorganizations: An analysis of the barriers that women face and strategies to foster equitable and effective participation	• The triple roles of women are a key constraint to women's access to producer organizations because of their time poverty. • more gender-inclusive producer organizations can bring to rural communities and families, multiple barriers still hinder the possibility for women to become members in their own right and access the services and benefits that these organizations canprovide.
Adopted from Navaneetham *et al.,* 2017		

CONCLUSION:

The growth of agriculture and allied sector is heavily dependent on small and marginal farmers' success. The declining total factor profitability and increasing risk is being considered as major challenges in improving the livelihoods of the farmers in India. Linkingfarmers with appropriate market are always an challenging task. FPOs/FPCs have emerged as one of the most effective pathways to address these many challenges of agriculture. There is need for identifying right support system with appropriate technical guidance/experts with workable and scalable business plan/models. Most importantly, the suitably identified/selected clusters to be scaled up in producer company needs to be financially supported right from the time of community mobilization and inception.

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Economic importance of mushroom and their Uses

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INTRODUCTION

The word mushroom is derived from the French word for fungi and moulds. However, since then, better and more effective methods have been developed and there has been a huge increase in mushroom cultivation. In the last 50 years, the Netherlands has grown into the largest mushroom production country within the European Union, with an annual production of 270 million kilograms and more than 10,000 jobs. Next to China and the United States, the Netherlands holds 3rd place in the market. China is in first place with 70% of the world's production. Every year, millions of tons of mushrooms are cultivated worldwide.

The mushrooms are the fruiting bodies produced by some fungi. Not all fruit bodies are true mushrooms. Puffballs and morels are edible fruit bodies that are sometimes called "mushrooms". The function of this visible part of some fungi is to produce and disperse the largest possible number of spores in the shortest possible time. A mushroom, or toadstool, is the fleshy, spore-bearing fruiting body of a fungus, typically produced above ground on soil or on its food source. The standard for the name "mushroom" is the cultivated white button mushroom, *Agaricus bisporus*; hence the word "mushroom" is most often applied to those fungi (Basidiomycota, Agaricomycetes) that have a stem (stipe), a cap (pileus), and gills (lamellae, sing. lamella) on the underside of the cap. Forms deviating from the standard morphology usually have more specific names, such as "bolete", "puffball", "stinkhorn", and "morel", and gilled mushrooms themselves are often called "agarics" in reference to their similarity to Agaricus or their order Agaricales.

Production in India

The mushroom production and consumption are on the rise in rest of the world, India witnesses a lukewarm response in its growth. Mushroom industry in India is overwhelmingly focused on white button mushroom which is a highly sophisticated and capital-intensive activity. The recent production data showing that, the share of button mushroom in India is maximum amounting to 73% followed by oyster mushroom which contributes about 16%. There are two main types of mushroom growers in India, those who are growing white button mushroom round the year under controlled conditions and seasonal growers who are growing button mushrooms during the winter seasons in north western part of India. The total white button mushroom produced in India from both seasonal and high tech cultivation units is estimated at 94676 metric tons. Out of this, approximately 8500 metric tons of button mushrooms was produced from the seasonal growing units located in Haryana and Punjab which accounted for 9% of total button mushroom production. By effectively utilizing the seasonal variations, the farmers of Punjab and Haryana

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region have revolutionized the seasonal cultivation process with very less inputs (Mehta *et al*., 2011).

1. Economic Importance

Mushrooms are popular for their delicacy and flavor rather than food. However, it is an established fact that they are excellent sources of vitamins and minerals. In view of their high food value to man and their medicinal properties mushrooms can help in solving the problems of malnutrition and diseases. Besides, the being an important food article, mushroom are variously exploited by man. They are at the same time, also beneficial to forest.

❖ Decomposition of Dead Organic Matter Importance

There are few species of mushrooms which attack living trees where as large number of them grows on fallen timber, bark, sap wood etc. The mycelium of mushroom grows in few years and completes disintegration of wood take place. It gradually mixes with forest soil and provides food for living trees. Thus mushrooms are one of the important agents in providing available food for virgin forest.

One of the key roles that mushrooms play in natural systems is the decomposition of dead organic matter. Decomposition is accomplished by a succession of saprophytic fungi. The primary decomposers such as Shiitake, Oyster, and Wine Cap mushroom (*Stropharia rugoso-annulata*), start the process by breaking down the lignin and cellulose in wood, straw and other plant matter. Secondary decomposers take over after the substrate has been partially broken down. Secondary decomposers typically grow on compost and include the White Button mushrooms and Portobello (Agaricus spp.).Tertiary decomposers are typically soil dwellers existing in reduced substrates. These include some Agaricus species, the Peel mushroom, Conocybe, Agrocybe, and Pluteus. Primary and secondary decomposers are the most suitable for cultivation since the mycelium of these species is usually quite vigorous and with proper techniques there is a high rate of success. In addition, substrates are readily available. Mushrooms are than to be given a very high rank among the natural agencies, which have contributed to the good of the world.

❖ Snuff and Dyeing

Polyporus nigricans when dried and pounded is an ingredient in snuff.

The *Polyporus bispidus* which gives a brown dye is used for coloring silk, cotton, and wool. This is used by leather dresser's to give fawn chestnut colour and by carpenters to give a brown colour to furniture. *P. sulphureus* gives yellow colour and *Fomes ignitarius* gives a brown black colour. Many other mushrooms are also used for giving different colours.

❖ Writing Materials

Inky cap mushroom *Coprinus comatus* is very deliquescent and soon become black liquid which can be used for writing purposes.

❖ Mushroom Used for Flower Pots

Shaped fruit bodies of *Polyporus fomentarius* and *P. ignitarius* are used for flower pots.

❖ Luminosity

The ability of organism to produce light in the dark is well known in bacteria, plants and animals. Many fungi are also luminescent and either fruit body or mycelium or both may be luminous, depending on the species. Luminous is well known to woodmen, foresters, timber men and others who have occasion to pass through a

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wood in darkness. The decayed wood itself permitted with the mycelium of *Armillaria mellea*, glow strongly as long growth continues and remains damp. *Fome anosus* is also aluminous fungus. This fungus grows in mines and both the mycelium and fruit bodies are luminous. *Pleurotus japonicus* also emit light.

2. Medicinal Uses

About 100 triterpenes have been isolated from either the fruit bodies or mycelium but only a few have been tested for their bio-activity Maitake, *Grifila frondosa*, has been shown to have both antitumor and anti-viral and immunity enhancement properties. Powdered fruit bodies are used in the production of many health foods such as Maitake tea, whole powder, granules, drinks, and tablets. It has also been suggested that the phenol-analogous compounds hericenone-C, -D, -E, and Y-A- 8-c, which induces the synthesis of nerve growth factor, might be effective in treating patients suffering from Alzheimer's disease. The antitumor polysaccharide, β - (1-3)-D- glucan, isolated from Hypsizygus marmoreus showed very high activity. Dried mushroom powder from this mushroom is believed to stimulate the radical-trapping activity of blood. Excessive free radicals in the blood stream are believed to hasten the aging process.

- ✓ *Polyporus officinalis* was used in homes as a drastic purge and applied externally stop bleeding. It was also used for chronic catarrh diseases of the breast and lungs, as remedy for night sweating in tuberculosis, for rheumatism, gout, jaundice, dropsy and intestinal worms. It is used in homeopathic doses as *Boletus laricis*.
- ✓ Jew's ear (*Auricularia auriculata*) was frequently used as a poultice for inflamed eyes and as gargle for inflammation of the throat.
- ✓ *Fomes ignitarius* and *F. fomentarius* and surgeon agarics is used for rapid coagulation of blood.
- ✓ *Lycoperdon giganteum* is used as soft and comfortable surgical dressing.
- ✓ *Clavatia gigantia* is still used in anesthesia.
- ✓ *Amanita muscaria* has been used therapeutically from the earliest times as powder or tincture for swollen glands, epilepsy and various diseases. It is still used today in homeopathic doses under the name of *Agaricus muscarius*. It is used in highly diluted preparations of heart ailment and rheumatoid arthritis.
- ✓ *Volvariella volvcea* and *Flammulina velutipes* cardio toxic proteins have been isolated. They lower the blood pressure and also active against turner cells. Anti-cancerous extract of Shitake causes recession of some kinds of cancer and inhibits the growth of some viruses like influenza.

❖ Hallucination and Tinder Mushroom

The hallucinogenic mushrooms are *Amentia muscorina*, several species of Stropharia and Psilocybin. *Amentia muscorina*, the drug like stimulant is not decomposed in the stomach but apparently is excreted unchanged in the urine. Many writers have commented on the common practice of renewing the stimulation by drinking the urine of someone who has already eaten the mushroom. The hallucinogenic principle of Psilocybin is due to the derivatives Psilocybin and Psilocin. *Polyporus fomentarius* or tinder mushroom sometimes called German tinder was used in the manufacture of tinder.

3. General Uses

Daedalea quercina is sometimes used to clean down horses, particularly those whose skin is too tender for an ordinary curry-comb. It is also

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used by men for cleaning hair. The fruit bodies of *Fomes fomentarius* and *Ganoderma applanatum* are stilled used to produce a suede-like material from which hats, various articles of dress, handbags and picture frames are made.

- ✓ Dried *Coriolus versicolor* brackets have been used for making hats for costume decoration, while bottle corks are made from *Polyporus squamosus*.
- ✓ *Polyporus applantus* is used as a curio and also for the purpose of etching. Some species of polyporus have been used for making major strop*. Polyporus squamosus, P. betulinus* are suitable for this purpose.

4. Other Uses

Mushrooms can be used for dying wool and other natural fibers. The chromophores of mushrooms produce strong and vivid colors and all colors of the spectrum can be achieved with mushroom dyes. Before the invention of synthetic dyes the mushrooms were the primary sources of dying textiles. Some mushrooms have been used as fire starters and are known as tinder fungi. The Criminic and Oysters are being used for cleaning up of the environment. The technique called myco-remediation uses mycelium to breakdown the contaminants like petroleum, fertilizers, pesticides, explosives and agricultural, medical and industrial wastes.

✓ Antibiotic Activities

Antibacterial effect: Antibacterial properties compounds are poly acetylene was mostly found in genera Aleurodiscus, Clitocybe, Marasminus, Polyporus, Tricholoma etc. Antibacterial activity in the genera which parasites on tree, such as Fomes, Ployporus and Trametes reported antibacterial property in *Agaricus bisporus* and found quinoid and phenolic derivatives.

✓ Anti-Fungal Effect

Sparossol from *Sparassis ramosus*, Examples of anti-fungal activity among edible fungi include *Lentinus edodes*, cortenellin*, Coprinus comatus* and *Oudemansiella mucida.*

✓ Anti-Protozoal Effect

Omphalotus olearius is toxic mushroom with *Terpenoid illudin* M and S, reported to be active against *Plasmodium gallinaceum*. Gregory *et al*., (1966) reported *Irpex flavous* active against protozoan.

✓ Antiviral Effect

Ganoderma nutriceuticals have exhibited promising antiviral effects like anti-HIV, anti-hepatitis B and Epstein Barr vims. In *L. edodes* a polysaccharide fraction has been found to be active in-vivo and in-vitro against influenza.

✓ Anti-Tumor Effect

Calvacin from giant puffball *Calvatia gigantea* has anti-tumour activity. Chemical nature of calvacin shows that it is a non-diffusible basic micro protein. The anti-tumor activity in *Boletus edulis*. It reported the anti-tumour effect of edible mushroom.

Mushroom derived chemical compounds associated with anti-tumour activities and their source includes polysaccharide Lentinan from *Lentinus edodes*, *Pleurotus ostreatus*. Flammulin from *Flammulina velutipes*, the acid protein from *Poria corticola* protein and quinoid from *Agaricus bisporus, Ganoderma lucidum* has been reported to certain many immune regulating compounds is called as longevity mushroom. It has shown that Maitake (*Grifola frondosa*) had stronger anti-cancer and anti-tumor effect.

- **Use of Mushroom as Brain Drugs**

Psilocybin and psilocin isolated from *Psillocybe mexicana* has been found to affect mind. From *Amanita muscaria* a drug has been prepared that may treat diseases such as epilepsy and schizophrenia, which are characterized by malfunctioning of gamma amino butyric acid (GABA).

5. Nutritional Values

Raw brown mushrooms are 92% water, 4% carbohydrates, 2% protein and less than 1% fat. In a 100 gram (3.5 ounce) amount, raw mushrooms provide 22 calories and are a rich source (20% or more of the Daily Value, DV) of B vitamins, such as riboflavin, niacin and pantothenic acid, selenium (37% DV) and copper (25% DV), and a moderate source (10-19% DV) of phosphorus, zinc and potassium (table). They have minimal or no Vitamin C and sodium contents.

- **Vitamin D**

The vitamin D content of a mushroom depends on postharvest handling, in particular the unintended exposure to sunlight. The US Department of Agriculture provided evidence that UV-exposed mushrooms contain substantial amounts of vitamin D. When exposed to ultraviolet (UV) light, even after harvesting, ergosterol in mushrooms is converted to vitamin D2, a process now used intentionally to supply fresh vitamin D mushrooms for the functional food grocery market. In a comprehensive safety assessment of producing vitamin D in fresh mushrooms, researchers showed that artificial UV light technologies were equally effective for vitamin D production as in mushrooms exposed to natural sunlight, and that UV light has a long record of safe use for production of vitamin D in food.

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Production of tomato and capsicum crop under poly-house

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Poly-house is a framed structure consisting of Gl pipes covered with transparent UV stabilized polyethylene film and large enough to grow crops under protective cover. In a poly house, environment is partially controlled by opening and closing of sidewall ventilation. Although, poly-house is costlier than net house but is provides a controlled and favorable environment which results in early harvest of superior quality fruits than that of the net house. In poly-house, carbon dioxide released by the plants during the night is consumed by the plants itself in the morning which increases the photosynthesis rate by 15 times that helps in more accumulation of biomass which ultimately lead to high yield in comparison to net-house and open field condition. It also gives additional protection to the crop from high or uneven rainfall and frost especially in winter season. The poly house can also be used for raising nursery during adverse weather condition.

Site selection and orientation:

The site for the poly house should be well drained, fairly shadow free. It should be oriented in east-west direction to receive ample sun light during the day and round the year.

Selection of material and size of the poly-house:

The structural material preferably Gl pipes should be of good quality and UV stabilized polyethylene plastic film of 200 micron thickness should be used as cladding material. The side wall ventilation should be provided with insect proof UV stabilized net of 40-mesh size. The size of a poly house may vary from 100-250 square meters depending upon requirement, market facility and labour availability.

Cultivation of Tomato:

Indeterminate type hybrids/varieties are recommended for the cultivation of tomato under poly house as it continues to flower for longer period results in higher yield.

Seed rate and nursery raising:

For an area of 100m^2, 1.5 g of seed is sufficient. Sow tomato nursery in the last week of September which will be available for transplanting after 25-30 days. Treat the seed with 3g of Captan or Thiram per kg of seed before sowing. Nursery should be raised in the same poly house in which crop is to be grown to protect the seedling from white fly, a vector for virus and other insect-pests.

Important variety:

Indeterminate tomato varieties are suitable for cultivation under polyhouse. Avtar, Indam Hybrid, All Rounder, Arka Meghali, Arka Surabhi, etc. are suitable varieties for tomato cultivation.

Land preparation and fertilizer application:

Prepare the land to a fine tilth and apply well decomposed farmyard manure @ 2.5 q/100m^2 15 days before transplanting. Apply urea 3.0 kg/100 m^2 in 4 equal splits. apply first dose 3-4 days prior to transplanting, second 25 days after transplanting, third 45 days after transplanting and the remaining fourth dose 90 days after transplanting. For P and K, apply single super phosphate @ 4.0 kg/100m^2 and 1.1 kg muriate of potash/100 m^2, respectively as basal dose with

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first dose of urea. if the crop is drip irrigated, then apply 3.0 kg/100 m^2 of urea in 15 equal splits at 10 days interval along with irrigation i.e. fertigation.

Spacing:

To utilize the space efficiently, seedlings should be transplanted in the poly house in a paired row pattern with plant-to-plant spacing of 30 cm. the spacing between two paired rows should be 90 cm and row to row spacing within the paired row should be 60 cm.

Irrigation:

If possible, it is advisable to install the drip irrigation system in the poly house as it reduces the humidity build up and weed infestation. First irrigation is given just after transplanting and should be surface irrigation for the establishment of the crop. Subsequent irrigation is applied at 4 to 5 day interval depending upon the soil texture and climatic conditions. If the crop is drip irrigated then irrigation should be applied at 4-5 days interval in the months of November-February, 2-3 days interval in the month of March and 1-2 days interval in the month of April-May depending upon temperature. Application of urea along with irrigation (fertigation) helps in saving the quantity of fertilizer and labour besides improving the yield and quality of the produce. The drip irrigation results in 48% saving of water as compared to surface irrigation. Do not allow the plants to wilt at any stage. Fruit will be damaged if the plants do not get appropriate amount of water and fertilizers regularly.

Earthing up and pruning:

After 20-25 days of transplanting, earthing up is to be done. Prune the plants in a poly house to single stem for better growth of plants and fruits. All lateral branches must be removed when they are one to three inches long. This allows maximum aeration and reduces pest problem. Pruning must be done regularly and plants should be checked at least once a week. Because of indeterminate nature of poly house tomato, the crop should be staked properly to get higher yield. The staking method involves the use of wooden stakes/bamboo sticks placed within the row of plants and running a number of parallel pieces of strings or wire from stake to stake for trapping the new growth of plant between the strings. This keeps the plants in an upright position preventing the fruits from touching the ground and thus improves the quality of marketable produce.

Harvesting:

The tomato fruits will be ready for harvesting in the last week of February, which will continue up to first fortnight of May. The average yield under naturally ventilated poly house condition is about 264 q/acre with surface irrigation and about 384 q/acre with fertilization.

Cultivation of Capsicum:

Bharat a F_1 hybrid is recommended for poly-house cultivation of account of high yield and good quality fruits. Its plans are 90 cm in height with dark green foliage. The fruits mature in about 90-95 days after transplanting and average fruit weight is around 50-60 g. in the poly-house, maturity is advanced by 45-50 days as compared to open field conditions. Average green fruit yield is 252 q/acre with fertigation.

Seed rate and nursery rising:

For an area of 100 m^2, 5.0 g of seed is sufficient for raising nursery. Seed should be sown in nursery from the last week of September to first week of October in the poly house to protect from insect-pests and diseases. The seedlings become ready for transplanting in 30-35 days after sowing.

Land preparation and fertilizer application:

Prepare the land to a fine tilth and apply well decomposed farmyard manure @ 5.0-6.0 q/100 m^2, 15 day before transplanting. Apply urea @ 2.75 kg/100 m^2 in 3 equal doses (1/3 at the time of transplanting, 1/3

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one month and the remaining 1/3 two months after transplanting). For P and K, apply single super phosphate @ 4.5 kg/100 m^2 and 0.5 kg nuritate of potash/100m^2, respectively as basal dose with first split dose of urea in 10 equal splits at 15 days interval along with irrigation starting from 30 days after transplanting.

Spacing:

To utilize the space efficiently, seedling should be transplanted in the poly house in paired rows pattern with plant-to-plant spacing of 30 cm. the spacing between two paired rows should be 60 cm and row-to-row spacing within the paired row should be 45 cm.

Irrigation:

If possible, it is advised to install the drip irrigation system in the poly house as it reduces the humidity build up and weed infestation. First surface irrigation is to be given just after transplanting. Initially for a few days, regular irrigation is to be applied for the establishment of the crop. Subsequent irrigation should be applied at 4-5 days interval in the months of November-February, 2-3 days interval in the month of March and 1-2 days interval in the month of April-May depending upon the climatic conditions. Application of fertigation helps in saving the quantity of fertilizer and labout besides improving the yield and quality of produce. The drip irrigation results in 30-35% saving of water as compared to surface irrigation. Don't allow the plants to silt at any stage. Fruit size will be reduced if the plants do not get appropriate amount of soil moisture and fertilizer regularly.

Harvesting:

The fruits will be ready for harvest in the first fort night of February which will continue up to second fortnight of May. The average yield under naturally ventilated poly-house is 182 q/acre with surface irrigation and 252 q/acre with fertigation.

Precautions:

- Use double door system in the poly house.
- In winter, all ventilators should be closed at night to obtain maximum yield.
- Always open the ventilator for sometime every day for exchange of air/heat.
- All ventilations must be provided with insect proof mesh.
- Inspect the poly house regularly for wear and tear.
- Monitor the crop on alternate day to check incidental entry of insectpests. It is advisable to take immediate mechanical measures for plant protection as suggested under net house technology otherwise pest will spread in a short time.

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Kadaknath poultry farming in India

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Introduction to Kadaknath Chicken Breed:- Kadaknath is one of the rarest poultry breeds of India which is native to Jhabua district of Madhya Pradesh (MP), India. Basically, Kadaknath breed is popular for its black meat and known as BMC (black meat chicken). Kadaknath chicken breed is famous for its meat quality, texture and taste. The demand for Kadaknath chicken is growing day by day and spread across most of the Indian states due to their excellent medicinal values. Especially these birds bear great medicinal value in homeopathy and useful in treating a particular nervous disorder. Basically, Kadaknath chickens are mainly reared by tribal communities in Bhil and Bhilala in the districts Jhabua and Dhar in the state of Madhya Pradesh(MP). The commercial scale of Kadaknath chicken raising especially in the states Kerala, Andhra Pradesh, Telangana and Tamil Nadu.

Kadaknath chicken meat is in black colour and eggs are in brown colour. The new Kadaknath production technology has reduced the mortality rate from greater than 50% Now you can expect to 10 to 12% of mortality, this enhanced the survival percentage and overall profits in Kadaknath chicken farming. Because of high feed conversion ratio , these birds can gain body weight of 1.10 to 1.25 kg in 100 to 125 days.

Kadaknath chickens can be reared similar to country chicken or free range chicken. However, It may require little more care initially to grow in controlled environment. Later they can be left freely in open field. One can grow these birds in back yards. Kadaknath chickens are best suited for back yard farming rather growing on commercial scales.

There are 3 different breeds of Black Meat Chicken (BMC) is available in the world.

1. Kadaknath – Native to Madhya Pradesh, India.
2. Silkie – Native to China.
3.Ayyam Cemani – Native to Indonesia.

Merits, Advantages and Benefits of Kadaknath Chicken Breed:- The following are advantages of growing Kadaknath chicken.

- ✓ Kadaknath chicken meat is textured and flavoured.
- ✓ This black meat has good medicinal values.
- ✓ Kadaknath chicken breeds are adaptable to any kind of environment.
- ✓ Kadaknath chicken meat and their eggs are sold for high price in the market.
- ✓ This bird meat contains many kinds of amino acids, and vitamins.
- ✓ This meat helps to increase blood cells and haemoglobin.
- ✓ Kadaknath chicken is said to be aids in curing pulmonary problems.
- ✓ The Kadaknath birds convert feed quickly into the meat (feed conversion ratio is high).
- ✓ The Kadaknath chicken eggs are used to treat headaches, post delivery problems, asthma and nephritis.
- ✓ Kadaknath chicken is said to be good for women health as well.
- ✓ The tribal community in MP uses Kadaknath chicken blood in the treatment of chronic disease.

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- ✓ The Kadaknath chicken eggs are also have good nutrition values and good for old people.
- ✓ Kadaknath black meat contains vitamins B1, B2, B6, B12, C and E, niacin, protein, fat, calcium, phosphorus, iron, and nicotinic acid
- ✓ The Kadaknath breed is hardy and highly resistant for diseases.
- ✓ Unlike broiler chicken, these can survive even on kitchen waste.
- ✓ The best advantage is, these birds meat has more protein, less fat, and low cholesterol when compared to similar kind of poultry breeds.
- ✓ Kadaknath chicken weighs about 1.5 Kg after growing 6 to 7 months.
- ✓ Kadaknath is one of the rarest birds available in the world.
- ✓ Commercial scale farming of Kadaknath chicken defiantly fetchs good profits if proper marketing channel is established.
- ✓ Some state governments like Madhya Pradesh have incentive scheme for people who were interested in breeding the Kadaknath chicken.

Cost of Kadaknath Chicken and Eggs:- Because of the fact that these birds have superb medicinal values, their meat cost about 600 to 800 Rs/kg. As we said above, these bird eggs also nutritious, they are sold up to 40 to 50 Rs/egg in the market.

Nutritional Value Comparison:- The following chart compares the Kadaknath nutritional values with other chicken breeds.

Properties	Kadaknath Chicken	Other Breeds of Chickens
Protein content	25%	18 to 20%
Fat content	0.73 to 1.03	13 to 25%
Linoleic Acid	24%	21%
Cholesterol	184mg / 100gm	218.mg / 100gm

How to Start Kadaknath Chicken Farming:- Well, this is similar to any other country chicken farming.

- ➢ Get good breeds of Kadaknath birds.
- ➢ Make sure you bring day old chicks with proper vaccinations.
- ➢ Start with 30 to 50 birds and keep increasing the bird count as you gain the experience.
- ➢ Find out with poultry department of Agriculture University for chicks and feed information.
- ➢ Some state government are providing incentives on these birds breeding, avail those benefits.
- ➢ For couple of weeks these require proper care and provide necessary shelter /light /water/feed.
- ➢ Don't start on large scale without knowing the poultry line of business.
- ➢ If you are starting a commercial Kadaknath chicken farming, make sure you establish a proper marketing channel.

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Some Facts about Kadaknath Chicken Breed:-

Particulars	Kadaknath
Weight of Day Old Kadaknath Chicks	28 to 30 grams
Bird Body Colour	Jet black
Price for Parent Stock (chicks)	Rs. 20 to 22
Body weight in 8 weeks	0.8 0.9 kg
Period required to attain 1 kg of body weight	13 to14 Weeks
Survival rate	95 %
Period required to attain 1.5 to 2 Kg Body weight	Like Country Chicken
Total weight (male)	2.3 to 2.5 kg
Total weight (female)	1.6 to 1.8 kg
Quality of Meat	Black like pure country chicken
Taste of the meat	It tastes like country chicken.
Meat percentage without skin (dressed)	65 %
Management/Maintenance	Low
Are these good for Commercial or Backyard poultry farming	Good for both
Age for first egg laying	23 to 24 weeks
Broodyness	Less
Egg laying/month	11-12
Annual egg laying	120
Average egg weight	40 to 45 grams.
Egg colour	Brown
Feed required	50 kg for entire growth

Hurdles in Kadaknath Farming: - Inadequate availability of Kadaknath breed chicks and lack of proper financial support from government are posing major hurdle. For better development of this breed, Local governments should provide subsidies and loans to small scale farmers.

Reference-: Source: http://www.agrifarming.in/Jebaraj, Priscilla (2019-01-03). "Jhabua scientist suggests adding Kadaknath chicken to Indian cricket team's diet". The Hindu.

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Cultivation of long melon in India

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INTRODUCTION

Long melon, locally called *tar* or *kakri*, is known by various names like snake melon, serpent cucumber, snake cucumber, serpent melon, Armenian cucumber and oriental cucumber.Long melon is also one of them. Some of them are used in the form of salad, cooked as vegetables, and preserved in the form of sweets. It is grown mainly grown in tropical, sub tropical and milder zones of India.The fruits are slender (2.5-5.0 cm diameter), elongated (40-90 cm), pale or dark green, smooth or ridged, pubescent and variously curved. Long melon popularly known as kakri is valued for tender fruits which are eaten raw along with salt and pepper. Long melon is an important river-bed crop. Where it is grown mixed with other cucurbits. Along with summer squash, it matures earlier than most other cucurbits sown simultaneously. If it is taken without salt, it is not easily digested.

Botanical name : *Cucumis melo* var. *flexuosus* Naud. (syn. var. *utilissimus*)
Chromosome number : $2n = 2x = 14$
Family : Cucurbitaceae
Origin : Turkey
Edible portion: Unripe fruits

Distribution

Long melon is cultivated in tropical and sub-topical regions of the world. It is a popular vegetable of Turkey, Saudi Arabia, Egypt, India and Pakistan. In India, it is an important crop of Uttar Pradesh, Punjab and Haryana.

Food Value

Long melon is one of the low calories vegetable; provides just 15 calories per 100 g. It contains no saturated fats or cholesterol. Its peel is a good source of dietary fiber that helps reduce constipation, and offers some protection against colon cancers by eliminating toxic compounds from the gut. Per 100 g fresh fruit weight, the constituents are 96.4 g moisture, 2.8 g carbohydrates, 0.4 g protein, 0.1 g fat and 0.3 g minerals (0.01 g calcium, 0.03 g phosphorus, 0.0015 g iron).

Uses

Long melon is primarily used as a salad vegetable. The fruits are also sometimes cooked and pickled. In South India, it is used in some kind of curry preparation with buttermilk and yogurt. Finely chopped fruit slices are mixed with yogurt, cumins, coriander, pepper, and salt to make Indian *raita*. The cut fruits can be used as a moisturizer for the skin. Long melon roots are diuretic and emetic.

Improved Varieties

Punjab Long Melon-1 (PAU, Ludhiana)

It is an early maturing selection from a local material collected from Hoshiarpur, Punjab. Vines are long with angled, hairy and light green stem. Leaf petiole is large, cylindrical and light green. The fruits are long, thin and light green. Average yield is 215 quintals per hectare.

Karnal selection:

Prolific bearer. It has tender fruits which are light green in color, long in length and flesh is crispy with good flavor.

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Arka Sheetal (IIHR, Bangalore)

It is developed by selection from a local material collected from Lucknow, Uttar Pradesh. The fruits are light green covered with soft hair and medium long (22 cm long and 7.8 cm girth) with shallow furrows. Average fruit weight is 100 g and yield is 350 quintals per hectare.

Floral biology

Plants are monoecious in nature. Corolla is showy, yellow in colour. Petals are 5 in number, united; stamens are attached to calyx tubes. Ovary is inferior. The period of bud developmental stage is completed within 12-15 days in male and within 11-13 days in female bud.

Climate

Long melon is adapted to tropical and sub-tropical climates. It is sensitive to frost. Hot and dry weather favours vegetative growth and fruit development.

Soil

Long melon prefers well-drained sandy loam or loamy sand soils with pH in the range of 6.0-7.0. The light soils are desirable for early maturity.

Time of sowing:

February-Mach month is appropriate for seed sowing.

Sowing depth:

Sowing depth of 2.5-4cm is used.

Method of sowing:

Seeds are directly sown on bed or ridge.

Sowing Time

In north Indian plains, long melon is grown both as a summer and a rainy season crop. The summer crop is sown from end February to March and the rainy season crop from June to July. Sowing in riverbeds is done from November to December.

Seed Rate

One to one and a half kilogram seed is sufficient for planting one hectare.

Spacing

Sowing is done at a depth of 1.0 cm. Depending upon the variety and other conditions, planting is done on raised beds 1.80-2.40 m wide, keeping 60-90 cm spacing between plants. Use 200-250cm of spacing between the channels and 60-90cm of spacing between the hills. Two seeds are sown at one place for good stand.

Manures and Fertilizers

Fertilizer dozes vary with soil and the variety. Apart from 15-20 tonnes of FYM applied at the time of field preparation, 100 kg nitrogen, 75 kg phosphorus and 50 kg potash per hectare are applied. Whole of phosphorus and potash and half of nitrogen is applied at the time of bed preparation. The remaining nitrogen is applied in two split dozes, the first twenty days after sowing and the second twenty days thereafter. Method of application is the same as described under muskmelon.

Irrigation

Long melon requires maintenance of adequate moisture in the soil for vegetative growth and fruit development. The first irrigation is given immediately after sowing to facilitate proper seed germination. Subsequent irrigations in summer months are given at 3-4 day intervals. In rainy season, irrigation is given only if there is a prolonged dry spell.

Interculture practices and weed control

(1) Thinning of plants should be done 10-15 days after sowing retaining only 2 healthy seedlings in each hills.

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(2) Two shallow hoeing should be done before spreading of vines to control weeds.
(3) Apply Fluchloralin or Trifluralin (0.75-1.5kg/hec.) as pre plant soi incorporation at two weeks before sowing.
(4) The crop should be top dressed with nitrogen (25kg/hec) at 30-35 days after sowing.

Plant protection practices

1. Powdery mildew

Symptoms

Powdery mildew is a fungal disease caused by *Erysiphae cichoracearum* and *E fuliginea*.The powdery mildew on the foliage and green stems is characterized by the appearance of tiny. white to dirty grey spots (sometimes with a reddish brown tinge). They become powdery as they enlarge. The effect of severe infestation may be premature death of the vines. Fruits also get covered with the white powdery mass but this is not common. The fruits remain undersized and sometimes are deformed.

Control

1. Blue copper/Blitox (0.4%) or Dithane M-45 (0.2%) bas also been recommended to spray at 8 days interval. About 3-4 sprays will be enough.
2. Sulfex (0.2%) can also be sprayed at an interval of 5-6 days. About 2-3 sprayings will be required. Spray of sulfex is economically cheaper than other chemicals such as calixin and Bavistin.
3. The cucurbitaceous weeds should not be allowed to grow near cultivated field of these vegetables.

2. Red pumpkin beetles

The commencement of their activity after winter generally corresponds with the early growing season of the spring crop of the cucurbit vegetables. The damage continues to be caused even in the later stages of the crop, but it is not so much serious as in the case of seedlings. The larval stage of the pest also does considerable damage as it bores into the roots, stems and even the fruits on which the attack starts from the portion resting on the ground. The attacked plants wither and die and the affected fruits become unmarketable.

Control

1. Plough the field after harvest to destroy the pupae and larvae of the pest.
2. Early sowing of cucurbit plants i.e. in November protect the crop from appearing the hibernation as the plants are well established by that time.
3. Dusting the crop with kerosinized ash will repel the beetles. This method is more suitable for kitchen garden crops.
4. The vines may be dusted with Malathion 5% dust @ 15 -20 kg/ha or Carbaryl 4% dust @ 15 -20 kg/ha.
5. Spray Malathion (Cythion 50 EC at 2 m1/litre of water or Carbaryl (Sevin 50 W.P. at 2 g/litre of water). The spray should be done at weekly interval.

Harvesting

Long melon fruits are harvested when they are 20-30 cm long but are still tender and succulent with hairy growth. Fruits of long melon attain marketable maturity in one week after fruit setting. Depending upon the variety, season and location long melon takes 70-90 days from sowing to reach harvestable maturity. Harvesting is done at 2-3 day intervals either early in the morning or late in the evening to prevent desiccation of fruits due to hot dry weather conditions. Over-mature fruits become tough, pale yellow and dull and show separation of carpel when cut transversely.

Post Harvest Handling

Quality in long melon suffers due to attack by fruitfly. Since the fruits develop very quickly, the quality of fruits deteriorates if harvesting is

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delayed even by a day. Fruitfly damaged and over-mature fruits are culled before marketing. The fruits are packed in baskets before marketing. In hot summer months, the fruits are repeatedly sprinkled with water so that they remain fresh and do not loose turgidity.

Seed Production

For seed production long melon fruits are allowed to ripen on vines. The seed crop of long melon should also be isolated from muskmelon, snap melon and wild melon due to their cross compatibility. A minimum isolation distance recommended is 500 m and the seed crop is inspected thrice; first at vegetative growth stage, second at flowering and fruit set stage and lastly at ripe fruit stge. The seed along with pulp is extracted from mature fruits and is allowed to ferment for 1-2 days so that the seed separates from pulp. The seed is then washed in clean water, dried to 7 per cent moisture or less and stored.

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Maize utilization and value addition

Article id: 21818

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Maize plant belongs to the tribe Maydeae of the grass family Poaceae. It is third staple crop after rice and wheat and cultivated globally. It is considered as "poor man's nutricereal" due to presence of high proportion of fats, carbohydrates, proteins, antioxidants and some of the important vitamins and minerals. It has potential to reduce malnutrition in poor and underprivileged population as being nutritive also cheaper in price. It has numerous health benefits such as lowers cholesterol level, cures diabetes, avoids anaemia, and improve carbohydrate metabolism and cardiovascular health. Being rich in pantothenic acid, boost up the physiological functions of the body. Beta-cryptoxanthin content of maize found to have anti-cancerous property. It is also considered a better substitute for a pregnant mother as rich in folate. The major portion of maize is used for poultry and animal feed rather than human consumption.

Corn is classified into quality protein maize (QPM), baby corn, sweet corn, popcorn, green, high oil corn etc. on the basis of its nutritional composition and unique characteristics. QPM is rich source of essential amino acids such as tryptophan and lysine. Baby corn is basically ear which is harvested before fertilization, as soon silks appear. Sweet corn is sweeter than normal corn in taste due to presence of sugar along with starch. Popcorn possess popping quality when heated.

It is a potential crop in providing employment opportunities to farmers and increase their income and standard of living. Each part of the maize plant (grains, leaves, stalk, tassel, and cob) has economic value. Maize grain is used to prepare various value added products such as corn starch, dextrin, corn syrup, corn oil, sorbitol and ethanol etc. Apart from these products, it also have significant application in manufacturing of industrial products such as corn flakes, cake mixes, candies, paper adhesives, carbonated beverages, biodegradable plastics, antibiotics and cosmetics etc.

Value added products of corn

- Corn starch: It is carbohydrate which is obtained from the endosperm of the maize kernel. It is used in preparation of various processed products such as sauces or soups, corn syrup and other sugars.
- Corn oil: It is fish out from the germ of corn. It is source of vitamin E and can be used as a cooking oil. It is also known to be used in industrial products such as soap, paint, nitroglycerin, rustproofing for metal surfaces, inks, textiles and insecticides.
- Corn glucose syrup: Also known as confectioner's glucose. It is made from the hydrolysis of corn starch.
- Dextrose Anhydrous: It is a form of glucose made from corn starch. It is sweet in taste but contain around 20% less sweetness as compared to sugar made from sugarcane. It is used as buffering agent, nutrition supplement in animal feed and in veterinary medicine.
- Sorbitol: It is a sugar alcohol with a sweet taste. It is made from maize starch by simultaneous hydrolysis.

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- Corn yoghurt: Corn syrup used as a sweetener in some yoghurt to increase its flavour.
- Corn beer: Corn used in making smoother and light beers. 'Chicha' is the best-known corn beer.
- Corn whiskey: Bourbon whiskey is prepared using a grain mixture which contains at least 51% corn.
- Corn plastic: Polylactic acid (PLA) obtained from corn is like plastic or resin pellets which can be used to form containers and packaging for food. These packaging is biodegradable and environment friendly.
- Corn ethanol: It is made from corn by following industrial fermentation, chemical processing and distillation. Compare to oil, it burns cleaner and also a renewable energy.
- Corn flakes: It is made by processing of corn.
- Corn meal: It is a dry corn product with long shelf life. It is used to produce fried products like corn bread and muffins.
- Candy bars: It is made using corn syrup.
- Chips and snacks: It is made from corn meal and flour.
- Instant coffee or tea: Maltodextrins are obtained from corn through wet milling process. It is soluble with little or no sweetness. It is sprayed on instant tea and coffee to keep the granules free flowing.
- Cookies: They are made by using corn starch, corn flour or dextrose.
- Cosmetics: Because of the dust free and absorbent property of the corn, it is used in cosmetics. It is also used as carrier in fertilizers, pesticides, hand soaps and animal litters.
- Paint and varnish: Tetrahydrofurfuryl alcohol resin extracted by processing of corn cobs. These resins used as solvents for dyes, resins and lacquers in the paint and varnish industry.
- Paper products: Corn raw starch and pyrodextrins are used in manufacturing of paper for their adhesive property such as postage stamps and packaging tape.
- Aspirin: Aspirin is covered with continuous film of an oxidised corn starch paste.
- Antibiotics: Various antibiotics are manufactured using corn as carbohydrate source such as corn starch, corn syrup, dextrose, lactose and sucrose.
- Spark plugs: It is made from metal and ceramic used in car engines. The ceramics part is made of corn-starch. It has a resistance to high temperatures and acts as an insulator.
- Tires: While manufacturing of tires, the rubber is pumped into a mold and powder corn starch is used so that the rubber does not stick to the metal mold.

CONCLUSION: Maize ensures better health and food security through the development of value added food products. Theses value added products would provide employment to farmers and also doubles their income. Still, there is need to utilize blue, red and purple corn in manufacturing of value added products as these corns have several health benefits due to presence of anthocyanin.

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Modified atmosphere packaging for food preservation

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Modified atmosphere packaging (MAP) has been applied in the food industry for over 90 years to extend shelf life and maintain quality and safety of fresh and fresh-cut food products. Recently, MAP has experienced a rapid development in both scientific research and industrial applications, as one of the most appropriate and practical technologies for packaging fresh and fresh-cut produce. Future prospects for MAP in food preservation include the integration of novel information and communication technologies, biosensors, and intelligent packaging materials. These offer new prospects for real-time and in-situ monitoring and control of product quality, safety, and traceability to reduce wastage and strengthen consumer confidence in the food value chain.

INTRODUCTION

Modified atmosphere is the practice of modifying the composition of the internal atmosphere of a package (commonly food packages, drugs, etc) in order to improve the shelf life. The modification process often tries to lower the amount of oxygen (O_2), moving it from 20% to 0%, In order to slow down the growth of aerobic organisms and the speed of oxidation reactions. The removed oxygen can be replaced with nitrogen (N_2), commonly acknowledged as an inert gas, or carbon dioxide (CO_2), which can lower the pH or inhibit the growth of bacteria. Carbon monoxide can be used for keeping the red color of meat.Re-balancing of gases inside the packaging can be achieved using active techniques such as gas flushing and compensated vacuum or passively by designing "breathable" films known as equilibrium modified atmosphere packaging (EMAP).

Food distribution has undergone two major revolutions in the last century, canning and freezing. These gave consumers easy availability to most type of produce. However, energy crisis, ecological awareness and demand for healthy and fresh food have created a need for a technology that allows distribution of fresh produce around the year. It uses minimum processing and little energy and maximizes nutrition and flavor. Modified Atmosphere Packaging (MAP) theoretically, offers a possibility of meeting these requirements. This new packaging concept is rapidly growing in the food packaging market. It improves the product quality, freshness and increases the shelf-life of the product as well as provides convenience to the consumer and adds value to the product. It is mainly used to extend the shelf life of fresh produce and perishable products.

HISTORY

Controlled Atmosphere Storage (CAS) was used already In the 1930s when ships transporting fruits had high levels of CO_2 in their holding rooms, thus increasing the shelf-life of the product. In the 1970s MA packages reached the stores when bacon and fish were sold in retail packs in Mexico. Since then the development has been stable and the interest into MAP has grown due to consumer demand. This has led to advances for example in the design and manufacturing of Bacon films. New techniques are designed, like the use of anti-fogging layer to

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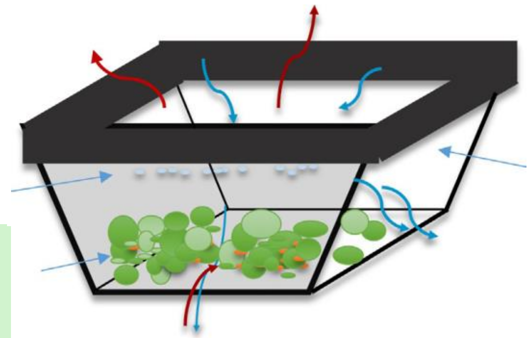
improve product visibility. From MAP a new packaging technique − EMAP has been developed.

PRODUCTS

Under MA products like red meat, seafood, minimally processed fruits and vegetables, pasta, cheese, bakery goods, poultry, cooked and cured meats, ready meals and dried foods are packaged. The three major commodity types are fruits and vegetables, meat and meat products, and seafood. It has been estimated that 25-40% of all fresh produce harvested will not reach the consumers table, due to spoilage and mishandling that occurs during distribution.

Modified Atmosphere Packaging (MAP)

Modified Atmosphere Packaging (MAP) is a technique used for prolonging the shelf-life period of fresh or minimally processed foods. In this preservation technique the air surrounding the food in the package is changed to another composition. This way the initial fresh state of the product may be prolonged. It is the shelf-life of perishable products like meat, fish, fruits and vegetables that will be prolonged with MAP since it slows the natural deterioration of the product. MAP is used with various types of products, where the mixture of gases In the package depends on the type of product, packaging materials and storage temperature. Meat and fish need very low gas permeability films so for non-respiring products (meat, fish, cheese etc.) high barrier films are used. The initial flushed gas-mixture will be maintained inside the MA package. But fruits and vegetables are respiring products where the interaction of the packaging material with the product is important. If the permeability (for O_2 and CO_2) of the packaging film is adapted to the products respiration, an equilibrium modified atmosphere will establish In the package and the shelf-life of the product will increase.



Principles of MAP

Testing the atmosphere in a plastic bag of carrots

Equilibrium modified atmosphere packaging (EMAP)

Among fresh-cut produce Equilibrium Modified Atmosphere Packaging (EMAP) is the most commonly used packaging technology. When packaging vegetables and fruits the gas atmosphere of package is not air (O_2 21%; CO_2 0.038%; N_2 78%) but consists usually of a lowered level of O_2 and a heightened level of CO_2. This kind of package slows down the normal respiration of the product to prolong its shelf-life. Of course there are other factors, like the size of the product, severity of preparation, maturity of the product and type of tissue that have an effect to the shelf-life of an EMA packaged produce.

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Technology

There are two techniques used in the industry to pack vegetables namely gas-flushing and compensated vacuum. In gas-flushing the package is flushed with a desired gas mixture, as in compensated vacuum the air is removed totally and the desired gas mixture then inserted. The label "packaged in a protective atmosphere" can refer to either of these; an example of a gas mixture used for non-vegetable packaged food (such as crisps) is 99.9% nitrogen gas, which is inert at the temperatures and pressures the packaging is subjected to.

Gases

The atmosphere in an MA package consists of N_2, O_2 and CO_2. It is the altered ratio of these gases that makes a difference in the prolongation of shelf life. By reducing the O_2-level and increasing the CO_2-level, ripening of fruits and vegetables can be delayed, respiration and ethylene production rates can be reduced, softening can be retarded and various compositional changes associated with ripening can be slowed down.

Gas atmosphere is modified by (1) direct injection of gases (often CO_2 or nitrogen) into a package, (2) evacuating air from the package or (3) interaction between package contents and the air in the package causing the package atmosphere to modify over time. The latter is what happens with fresh fruit and vegetables. With proper packaging, the natural respiration of produce causes O_2 levels to drop and CO_2 levels to rise. Modified atmosphere packages have an atmosphere different from ambient air but, that atmosphere can change over time. In the case of produce, package atmosphere is affected by the transmission rates of the packaging material and changes in storage temperatures. Higher temperatures lead to higher respiration rates, creating lower O_2 levels in the package atmosphere and higher Concentrations of CO_2. Hence, the atmosphere inside the package is modified but not controlled.

In a modified atmosphere package, the product is exposed inside the pack to the normal atmospheric gases (oxygen, nitrogen, carbon dioxide and water vapor) but in concentrations which are different from those in the ambient air. The packaging consists of polymeric film pouch or plastic container with specified gas permeability.

Oxygen is essential when packaging fresh fruits and vegetables as they continue to respire after harvesting. The absence of O_2 can lead to Anaerobic respiration In the package which accelerates senescence and spoilage. Too high levels of O_2 do not retard respiration significantly and it is around 12% of O_2 where the respiration rate starts to decrease. So oxygen is used in low levels (3-5%) for positive effect. When packaging meat and fish, the high CO_2-levels are effective bacterial and fungal growth inhibitors. In the case of vegetables and fruits, CO_2 is not a major factor since CO_2-levels above 10% are needed to suppress fungal growth significantly. Unfortunately higher levels than 10% of CO_2 are working phytotoxic for fresh produce. Nitrogen is used as a filler gas since it neither encourages nor discourages bacterial growth.

In recent years, there has been debate regarding the use of carbon monoxide (CO) in the packaging of red meat. While no risk was found in the use of low levels of CO, the fact that CO maintains the color of the meat and can, in that way, hide visual evidence of spoilage was raised. The European Food Information Council (EFIC) released a report in 2001 reviewing the data.

Packaging Films

When selecting packaging films (web substrates) for EMAP of fruits and vegetables the main characteristics to consider are gas permeability, water vapour transmission rate, mechanical properties, transparency, type of package and sealing reliability. Traditionally used packaging films like LDPE (low density polyethylene), PVC (polyvinyl chloride), EVA (ethylene-vinyl acetate) and OPP (oriented polypropylene) are not permeable enough for highly respiring products like fresh-cut produces, mushrooms and broccoli. As fruits and vegetables are respiring products, there is a need to transmit gases from and to the package. Films designed with these properties are called permeable films. Other films, called barrier films, are designed to prevent the exchange of gases and are mainly used with non-respiring products like meat and fish.

EMAP films developed to control the humidity level as well as the gas composition in the sealed package are beneficial for the prolonged storage of fresh fruits, vegetables and herbs that are sensitive to moisture. These films are commonly referred to as modified atmosphere/modified humidity packaging (MA/MH) films.

Quality assurance of MAP packages

Although Modified Atmosphere Packaging is a well-established process, it is a good practice to maintain tight quality assurance through package testing. Incorrect oxygen levels, empty gas cylinders and bad sealing bars can cause imprecise gas blends and poor package seals that can result in product spoilage. Routine package testing with headspace gas analysers, on-line gas analysers and a leak detector assure package quality, hence helps ensuring the shelf life.

Advantages of MAP	Disadvantages of MAP
Potential shelf-life increase of 50-400%	Visible additional costs
Extended transit time	Temperature control necessary
Reduces economic loss	Food safety concerns
Products distributed over larger distance	Atmospheric Maintenance
Little or no need for preservatives	Specialized training and equipment are necessary

CONCLUSION

The combination of advances in technological innovations and changing consumer demand have created push-pull factors that propel the demand for MAP in fresh, fresh-cut and, minimally processed foods.

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Effect of phosphorus and PSB on mungbean

Article id: 21820

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Botanical Name- *Vigna radiate* (L.)
Origin- India and Central Asia
Synonym- Moong

Pulse crops are important source of dietary and calories in food and feed products throughout the world. The production of pulses is not sufficient to ensure per capita per day availability of 80 g, which is the minimum requirement recommended by the World Health Organization (WHO) and FAO.

Pulses are important in agriculture system because their multiple role in dry farming which is well recognized, due to its availability to tap moisture from deeper layers of the soil by virtue of deep penetrating root system. The crop also posses unique quality of fixing atmospheric nitrogen with the help of symbiotic bacteria (Rhizobia) present in their root nodules. The fact that Pulses not only provide high nutritive value to our food and rich feed for cattle but also in some parts of the word (Middle East and West America) due to its religious preference and discourage meat production and consumption. The pulses makes diet balanced by supplying minerals and vitamins besides providing proteins as well as an abundance of food energy.

Green gram is excellent source of high quality protein. Moong is consumed as whole grains, sprouted form as well as dhal in a variety of ways in homes. It is also used as green manuring crop. Moong can be used as a feed for cattle even husk of the seed can be soaked in water and used as cattle feed. In India these crops are cultivated in three different seasons, viz., kharif, rabi and summer. Summer moong can be grown after harvesting of pea, gram, potato, mustard, linseed. Cultivation of Jayad Moong is important to increase soil fertility in these areas where paddy –wheat crop rotation is used. Crop Status during Twelfth Plan (2012-2015) the total area covered under moong in India was 30.41 lakh hectares with a total production of 14.24 lakh tonnes. The coverage of area and its production was maximum in Rajasthan (29.68 % & 25.51 %) of the total area and production). Maharashtra ranked second in area coverage (12.98 %) and third in production (11.92 %). Andhra Pradesh ranked third in area (8.74 %) and second in production (12.43 %). The highest yield was recorded by the state of Punjab (838 kg/ha) followed by Jharkhand (680 kg/ha) and Tamil nadu (675 kg/ha). The National yield average was 468 kg/ha. The lowest yield observed in the state of Karnataka (247 kg/ha) followed by C.G. (269 kg/ha) and Odisha (337 kg/ha). (DES, 2015-16).

Mungbean or greengram (*Vigna radiata L.*) is one of the important edible pulse crop. It belongs to family Papilionacea. It is the third important pulse crop cultivated throughout India (after chickpea and pigeon pea) for its multipurpose uses as vegetable, pulse, fodder and green manure crop. It contains protein, carbohydrates fat and fibres in the range of 21-25%, 60-65%, 1-1.5% and 3.5-4.5% respectively. Its seed is more palatable, nutritive, digestible and non-flatulent than other pulses grown in country. It occupies as good position due to its high seed protein content and ability to store the soil fertility through symbiotic nitrogen fixation. . In India mungbean is grown on 3.38 m ha with an

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average productivity of 474 kg ha^{-1} (Anonymous, 2001). In Uttar Pradesh mungbean is grown on 25.9 thousand ha with a productivity of 659 kg/ha.

Phosphorus helps in better nodulation and efficient functioning of nodule bacteria for fixation of N to be utilized by plants during grain-development stage, which in turn led to increase in green yield.

Plants acquire phosphorus from soil solution as phosphate and anion. Phosphorus is the least mobile element in plant and soil. It precipitates in soil as orthophosphate or is absorbed by Fe and AI oxides through legend exchange. Phosphorus solubilizing bacteria play important role in phosphorus nutrition by enhancing its availability to plants through release from inorganic and organic soil P pools by solubilization and mineralization. Principle mechanism in soil for mineral phosphate solubilization is lowering of soil pH by microbial production of organic acids and mineralization of organic Phosphorus by acid phosphatases. Use of phosphorus solubilizing bacteria as inoculants increases phosphorus uptake. These bacteria also increase prospects of using phosphatic rocks in crop production. Greater efficiency of phosphorus solubilizing bacteria has been shown through co-inoculation with other beneficial bacteria and mycorrhiza.

PSB inoculation: some heterotrophic bacteria and fungi have the ability to solubilizing inorganic phosphorus from insoluble sources, such as, tricalcium phosphate, ferric, aluminium and magnesium phosphate, rock phosphate and bone meal. Important phosphate solubilizing bacteria (PSB) are: *Pseudomonas striata, Bacillus polimixa, Aspergillus awamori, Penicillium digitatum* etc. Inoculation of seeds or seedlings with microphos biofertilizers can provide 30 kg P_2O_5 per hectare equivalent of phosphorus applied at superphosphate.

Role of Phosphorus and PSB in Mungbean for Higher Production

Phosphorus and PSB are impotrant for improving the quality of Mungbean crop. They played very important to increase the Production and quality of Mungbean. Some important role of Phosphorus and PSB are given below.

There was significant increase in plant height, branches per plant, leaf area index, nodule number and dry weight $plant^{-1}$ and dry matter accumulation $plant^{-1}$ with increase in the dose of phosphorus at all the growth stages.

The entire yield attributing characters viz. number of pods $plant^{-1}$, grains pod^{-1}, weight of grains per $plant^{-1}$ increased significantly with increasing levels of phosphorus. Grain and straw yield increased significantly with increasing levels of phosphorus.

1. Application of phosphorus either alone or in combination with PSB increased the all growth characters like plant height, branches, nodules, leaves etc. The phosphorus and PSB directly affected the growth characters. Higher dose of phosphorus and PSB increased the growth characters.
2. Application of phosphorus either alone or in combination with PSB increased the all yield attributes like Grain yield, Straw yield, Harvest index. The increasing the dose of phosphorus and PSB affected the Yield attributes. The phosphorus and PSB directly affected the yield attributes.
3. Application of phosphorus either alone or in combination with PSB increased the qualities of mungbean. The dose of

phosphorus and PSB affected the quality of mungbean.

4. Application of phosphorus either alone or in combination with PSB increased the nutrient uptake of crops. The dose of phosphorus and PSB affected the Nutrient uptake of mungbean.
5. Application of phosphorus either alone or in combination with PSB increased the Economics of crops. The dose of phosphorus and PSB affected the Economics of mungbean.

Plant height, number of primary & secondary branches plant^{-1} and number of leaves plant^{-1} increased significantly with increasing levels of phosphorus +PSB. This increase might be due to the role of phosphorus in the plant activities of growing plant. PSB also play important role in nutrient availability to plant for various metabolic process. The phosphate being the constituent of energy bond compound as well as constituent of RNA and DNA, regulates cell multiplication and elongation.

Yield attributes such as number of pods per plant, pod setting percentage, grains per pod, yield per plant and 1000-grain weight increased significantly with increasing levels of phosphorus. It resulted in higher rate of dry matter accumulation as well as its translocation from sources to sink in the plants which ultimately reflected for higher values of yield attributing characters. This might be due to the increase in vegetative development and reproductive attributes under proper availability of phosphorus and better physical condition of soil. Application of treatments the increase in yield attributes were mainly due to increase photosynthetic activity of leaves.Protein content increased significantly with increasing doses of phosphorus.

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Nanotechnology in Food Packaging

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INTRODUCTION:

Packing to the food is the important stage in case of the food processing and supply chain in order to provide shelf life durability of the food products. When the disciple of food science and processing combines that falls under the category of Food nanotechnology, providing a wide variety of application in the area of food technology. Recently research interest is focused on food nanotechnology that is functioning in the direction of food safety in adopting nano-reinforcement, nanocomposite active packaging, and smart packaging, nano-biosensors, antimicrobials nano-agents etc by provided that food security (Chellaram *et al,* 2014) also with the application as smart packaging its role is very beneficial. By nanotechnology with food-packaging materials are the chief kind of existing nanotechnology applications in the area of food segment.

A. Nano-reinforcements in Packaging Materials

Resources like metal, paper, glass etc are being replaced in the place of polymers, as polymers were the major source for all the type of food packaging substance in the recent times. The major problem in using polymer based wrapping material is its permeability for vapours and gases, to overcome this problem nano-reiforcement were used for filling up the gaps between the polymer molecules for making it more make stronger and viable to the packaging material, for rising the barrier property nano-filters is also used.

i) Nanoclays Reinforcement

The nature of nanoclay material that has a nanoscale thickness materials with blistering soft structure, platelet form with having low specific gravity, into the polymers these clays are inculpated for production it more efficient. Out of the nanolclay material the most used are organophilic and montmorillonite reason having good surface area with a quite large aspect ratio in the range of 50–1000 and its compatibility (Luduena *et al.*, 2007). Figure 1 shows the flake-like particles of different types of nanoclays.

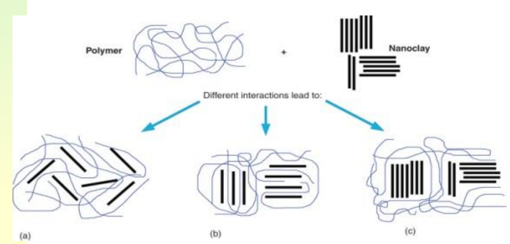

Figure 1: Different polymer–nanoclay composite structures

(a) Delamination of nanoclays (exfoliation). (b) Alternative layers of nanoclays and polymer. (c) Phase separation (microcomposite).

ii) Cellulose Nanoreinforcements:

Cellulose are obtained from microfibrils of the plants, each has crystalline and amorphous regions. The need of this kind of reinforcement is because of its low cost and greater strength. Cellulose reinforcement has a better effect on tensile properties that is modulus of polymers, but cause decrease the elongation property (Weiss *et al.*, 2006), and. The use of such reinforcements increases the resistance of the diffusivity path for the permeates and thereby

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lowering the polymer permeability, the main benefit is its barrier properties of polymers are improved by the addition of cellulose nano-reinforcement (Podsiadlo *et al*., 2005)

B. Nanocomposite Food Packaging:

Active Food Packaging with nanocomposite has a good barrier property when it interacts with the food it is advantageous by eliminating the factors that cause food spoilage releasing beneficial compounds like antioxidants or antimicrobials.

*i) Antimicrobial*packaging:

Using nano materials as antimicrobial agents in food **packaging is of great awareness. At present** titanium dioxide (TiO2), Zinc Oxide (ZnO), Silicon Oxide (SiO2), Magnesium Oxide (MgO), gold, silver nanopartilces are being utilized in abundance. Out of all silver is of greater use since of antimicrobial and antifungal action, examples like silver zeolite has high temperature stability with good antifungal and antimicrobial property for roughly against 150 different bacteria, this type of wrapping give complete freshness to the product with increasing the shelf life. (Ranjan *et al*. 2014)The Nanoparticles that has antimicrobial activity includes silver, gold, zinc, copper, cerium etc have also been patented and considered as antimicrobial agents, the main mechanisms is the nanometals affect the microorganism inactivate the protein by releasing metal ions, this causes disturbing cellular function, stops the replication of DNA. The nature of high surface area to volume ratio helps for attachment of microbial cells and molecules

ii) O_2 Scavengers:

Incorporating lesser levels of O_2 can be maintained in scavenging systems of food packaging, such lower levels are necessary to prevent corrosion reactions in food system that causing browning reactions and rancidity mainly by aerobic microorganisms. Prently, TiO2 nanoparticles with polymers have a good result on food system, it is advantageous because oxygen sensitive food products can be stored for long time by the use of nanocomposite materials.

C) Nanocomposite Packaging Systems

Food packaging system is made smart by the property to perceive packed food and converse the information about the quality. Nanosensors incorporated into food packaging systems can be used to detect spoilage occurring and accurate freshness of the product. Nanocomposites from zinc oxide and titanium oxide will work to detect volatile organic compounds.

i) *Time Temperature Integrators and Moisture Indicators:*

Time–temperature indicators or integrators (TTIs) are designed to monitor temperature history of the food and provide information whether the food is fit for consumption or not. An example is Time strip that has been made of gold nanoparticles helps in detecting any temperature changes if the temperature is above the freezing temperature, the color is red and when temperature falls below the freezing temperature, the particles get agglomerated and the red color is lost (Park and Kim, 2003)

ii) *Freshness Indicators:*

There is a need for information concerning storage and distribution of the product that can be provided by indicator for producer and consumers, the product is tested by detecting the metabolites released by the spoilage microorganisms like amine and volatile compound

iii) *Detection of Gases and oxygen*

The gas sensors that convert the chemical interface between the gas molecules and surface particles into reaction signals. In the detection nanosensors mainly use metal oxides that identify microorganisms based on gas emissions. There exists a huge demand for nontoxic oxygen free packaging systems and irreversible O2 sensors with packaging done under nitrogen or vacuum.

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CONCLUSION:

The use of nanotechnology in food industry, which offers new methods that improve food safety and nutritional value. Interest is given for nano-encapsulation in food processing and nanoclay polymer etc, in food packaging. In comparison with the traditional food analytical tools nano-biosensor provide a quick and reliable method of analysis.Nowadays, the concept of smart packaging is not a concealed theme, but it should be provided to public in such way that it can fulfil the food safety. The exploration about the risk influences should be improved to increase the consumer acceptance of nanotech processed food products and making it hazardless.

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Cultivation practices and economical importance Field beans

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Botanical name: *Vicia faba*
Family: Fabaceae
Origin: North Peru and North America
Chromosomes number: 2n=12

Economic importance: Field beans are mainly grown for seed production, which are used not only for animal feed but also for food. It is also grown for green forage because it has high nutritional value and crude protein content, but it is not the main reason for field beans growing. In addition, field beans are very suitable for crop rotation, because they improve soil fertility and leave good effect on after-crops (Sahile et al., 2008). Due to the growing demand for crop products including crude protein sources and increasing pressure on economic and environmental requirements in agro-ecosystems, legumes (also field beans) could play a major role in the crop production system (Stagnari et al., 2017). During the last decades there have not been a lot of studies about field beans in Baltic countries or even in Northern Europe. As field bean cultivation is becoming more and more relevant, various studies are started on the effect of variety and seeding rate on the yield of field beans. So far, few studies have been conducted in Latvia about the incidence and severity of diseases, but additional studies are necessary to evaluate the effects of disease control on the yield and quality of field beans. The four-factor research about field beans described in this article is the first so extensive study in Latvia in the 21st century. The aim of this study was to evaluate the effect of seeding rate, variety, fungicide application and conditions of a year on the yield and quality of field beans.

- **Climate**:

Broad beans, also called fava beans, are a cool-season crop that grow best in temperatures ranging from 60° to 65°F, but fava beans will grow in temperatures as low as 40°F and as warm as 75°F. Sow broad beans in spring as soon as the soil can be worked for harvest before the weather warms. Broad beans require 80 to 100 days to reach harvest. In mild-winter regions sow broad beans in early autumn for winter harvest.

- **Seeding**

Certified disease-free seed of high germination should be used to avoid seed-borne diseases such as bacterial blight. Seed must be handled carefully to avoid mechanical damage leading to baldhead, a non-disease condition where the growing point of the seedling fails to develop.

In Manitoba, field beans have traditionally been grown as a row crop, in rows spaced 30-36 inches apart. However, producers accustomed to growing cereals, flax and canola are starting to look at field beans as an alternative crop. Many of these producers are only interested in field beans if they can use their existing equipment (air seeders, sprayers and combines) to grow the crop. Field beans planted with air seeders will be grown in rows five to eight inches apart (solid seeded). Changing the row width can affect varieties chosen, weed control, and harvest equipment. Since there are significant differences in the cultural practices used in growing field beans as a row crop or solid seeded, these two bean production systems are described separately.

- **Planting**

Field beans are grown in rows set 30 to 36 inches apart and because of this, specialized row crop equipment set up for the specific row width is needed. Sugar beet equipment can also be modified to grow field beans on 22 inch rows.

Using row crop production, navy beans are seeded at 100,000 viable seeds per acre, which is approximately 18 viable seeds per metre of row or 40-50 lb/acre depending on the 100 g seed weight (seed size) of the variety. Field beans are seeded with a row crop planter (e.g. John Deere Maxemerge) or a special bean planter. The individual bean plants are much closer together within the row, creating competition for water, nutrients and light.

In heavier clay soils, this closer spacing of bean plants can help the beans emerge if the soil gets crusted due to a heavy rain, after planting. Field beans need to be planted in moist soil. A uniform seeding depth of 3-5 cm is important.

For beans grown under row crop production, the following table lists the general seeding rates for five different types of field beans grown in south-central Manitoba when seeded at a target population of 100,000 plants/acre.

Varieties: SWS 1 (Suttan White Seeded), BR 1 (Bihar Black Seeded) and BR 2 (Bihar Yellow Seeded).

Application of fertilizers: Apply 25 t of FYM and 50 kg P and 25 kg K/ha as basal dose. 25 kg N and 25 kg of K/ha are applied between 20 - 25 days after sowing and application of remaining 25 kg of N is done between 40 and 45 days

Weed Management

Cultivating weeds between the rows (inter-row cultivation) can be very effective in controlling weeds. Damage to beans is minimized if the inter-row cultivation is done during warm days when bean plants are slightly wilted and less susceptible to breakage. Weeds dislodged between the rows will also wilt and die quickly.

Fields can be cultivated as often as three times per growing season, but twice is most common. The first cultivation should occur when the beans are at the second trifoliate stage (see Figure 1) and the weeds are small. During this first cultivation, a post emergent in-crop herbicide can also be applied as a band over the beans to control weeds within the row. This practice will reduce herbicide costs because only about a third of the field is actually sprayed. In subsequent cultivations use caution, as close cultivation can prune shallow roots when the bean plants are larger. Do not cultivate beans when the leaves are wet, as this can spread diseases throughout the field.

Harvesting

The greatest difference between the two production systems occurs at harvest. Beans grown in rows are pulled, windrowed and then combined using a pick-up header. The standing beans are "pulled" by cutting the stem just below the soil surface with a fixed blade, rod weeder or rotary disk-type puller. The pulled beans are then left to cure in windrows. Pulling and windrowing can be done in one operation with suitable equipment. At harvest the windrows are lifted into the combine using a SUND or RAKE UP pick-up. When beans are pulled before combining, pod height above the ground is not as critical as it is in a solid-seeded system.

Pests

Beans can be attacked by aphids, bean beetles, flea beetles, leafhoppers and mites. Spray aphids away with a blast from the hose. Bean beetles and flea beetles can be controlled with sticky traps. Exclude leafhoppers with horticultural fleece or spray with insecticidal soap. and mites can be controlled. Spray mites with insecticidal soap. Small white and yellow moths are adult cabbage worms which shelter in beans. They will not harm beans.

- **Diseases**

Beans are susceptible to blight, mosaic, and anthracnose. Cut down the incidence of disease by planting disease-resistant varieties. Keep the garden clean. Avoid handling the plants when they are wet. Remove and destroy infected plants so they cannot spread disease to healthy plants. Soil-borne diseases can be reduced by changing the location of bean crops each year.

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Role of CSIR-CFTRI in Doubling of Farmers' Income (DFI) by 2022

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The Government of India has set a target in its annual budget of 2016-17 for Doubling of Farmers' Income (DFI) by the year 2022 and constituted the DFI. Doubling farmers' income in such a short period is a daunting task. Literature reveals that between 2004-05 and 2011-12 the real per caput farm income (from agriculture and allied activities) of cultivators increased by 64%. Data of National Sample Survey Office (NSSO) and Central Statistics Office (CSO) of 2002-03 and 2012-13 revealed only a 34% increase in farmers' real per caput income. This review focus on how the Council of Scientific and Industrial Research (CSIR) – Central Food Technological Research Institute (CFTRI), Mysuru can help farmers to increase their income.

INTRODUCTION:

At the moment, most farmers buy refined food at double the price that they sell as unprocessed products to big corporates. For example, they sell rice to industries for Rs10/kg and buy it for domestic consumption at Rs20/Kg! India figures as one of the biggest producers of cereals, vegetables and fruits, spices, and fibre in the world. However, the loss incurred by farmers is estimated to be around 40%. Current laws prevent farmers from selling directly to end consumers giving rise to multiple levels of intermediation, despite government's attempt to prevent this. CFTRI does not want to revolutionise the market rules, but to improve farmers' economic situation and ultimately increase their purchasing power.

The Inter-Ministerial Committee has identified seven sources of farmers' income growth namely,

1. Improvement in crop productivity
2. Improvement in livestock productivity
3. Resource use efficiency or savings in the cost of production
4. Increase in the cropping intensity
5. Diversification towards high value crops
6. Improvement in real prices received by farmers
7. Shift from farm to non-farm occupations

However, it did not give any new program to increase the income of farmers from the seven identified sources and went on to list the initiatives already launched. With respect to the shift from farm to non-farm occupations, Council of Scientific and Industrial Research (CSIR) – Central Food Technological Research Institute (CFTRI) has developed many free technologies for farmers as well as entrepreneurs. In this review, we have compiled the technologies from CSIR-CFTRI, Mysuru available for farmers and entrepreneurs to increase the farmers' income.

CFTRI technologies:

CSIR-Central Food Technological Research Institute (CFTRI), Mysore, a R&D Institution under Government of India, is devoted to food science and technology over the last six decades. The Institute holds a large portfolio of time-tested and proven technologies/processes in its knowledgebase. Many of these processes have been transferred successfully over the years to many small, medium and large scale industries. Some of these technologies are now offered free to the entrepreneurs, farmers / groups for the manufacture of such products to generate employment, entrepreneurship, effective utilisation of raw materials and to improve the

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nutritional status of people. It has been working on innovative solutions to benefit the industry, farmers, and stakeholders. The Technology dossiers which could be downloaded from CFTRI official site includes:

1. Amla Candy
2. Composite ragi bread
3. Fruit spreads
4. Ginger dehydration and bleaching
5. Green chilli sauce
6. Protein enriched buns
7. Ready-to-use dosa batter
8. Ready-to-use idli batter
9. Turmeric curing and polishing
10. Cereal Flakes Rice
11. Refining of Millets
12. Rice Milk Mix
13. Hand operated papad press
14. Leg operated papad press
15. Pedal Operated Millet Dehuller

All the technologies mentioned above are free and can be downloaded from CSIR-CFTRI official website.

Amla candy

'Amla' *Emblica officinalis* or Indian Gooseberry, is highly valued for its medicinal properties. The fruit is sour, a rich source of vitamin C, and is an important constituent of 'Triphala', a popular ayurvedic preparation. Being rich in polyphenols, it is popularly used as an Astringent or mouth freshener. The fruit is known to have cooling properties and is used in several other preparations like chutneys, pickle, 'murraba', spreads etc. Amla candy is a ready-to-eat product wherein sugar or salt is incorporated into the amla pieces which makes the subsequent drying process less energy intensive and gives a good taste and texture to the finished product. This product has a shelf life upto 8-10 months, and finds varied application as it can be used in place of fresh fruits.

i) It is a concentrated fruit product with a good nutritive value,
ii) It is in Ready-to-Eat (RTE) form.
iii) The product has a good shelf-life.
iv) The product has a ready internal market and promising export potential.

Composite ragi bread

It is a breakfast as well as snack which has specifications of containing at least 20% of 95% extraction rate ragi flour, along with wheat flour, which has a characteristic pinkish brown colour and characteristic flavor. The composite ragi bread should have the normal shape of bread with fairly good crumb grain and texture, easy to slice with moisture content in the range of 37-39%.(Details of processing technology given at CFTRI official website)

Fruit spreads

The present process is for the preparation of honey-based fruit (apple or mango) spreads to obtain products having typical flavour/sensory

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attributes of fruit as well as honey and having a long shelf-life. Production of honey based fruit spreads without any artificial flavouring agents has niche market to cater to the consumers who prefer least chemical additives. Preparation of fruit spread is one of the several important aspects of preservation of fruit pulp/produce. The honey based fruit spread prepared by this process will certainly have good market potential at national and international level. These exotic spreads can find extensive utilization in sand-wiches, chapathi, dosa or similar breakfast foods to make them more appealing and appetizing. (Details of processing technology given at CFTRI official website)

Ginger dehydration

Dehydrated ginger Ginger (*Zingiber officinale Roscoe*), belonging to the family Zingiberaceae, is one of the most popular spices being cultivated extensively in India. India's ginger production for the year 2010-2011 was about 5,17,835 tons, of which 1,24,000 tons (24 %) is produced in Assam (Source: Spices Board, India). About one third of total fresh ginger produce is dried, mostly for export purposes. The remaining quantity is used as such within the country. Green ginger is more popular in Indian cookery than dry ginger. The merits of ginger are woven into the fabric of Ayurvedic and Unani system of medicine. A celebrated saying in Ayurveda is that "there is no decoction without the participation of ginger". "The rhizome is an appetizer, laxative, stomachic, alexiteric, aphrodisiac, carminative, useful in diseases of the heart and throat, indigestion, asthma, bronchitis, dyspepsia and inflammations. Ginger provides relief in piles, rheumatism, headache, backache. body pains and it has many more therapeutic values. CFTRI has the free technology for drying ginger. Dry ginger is a product made from dehydration of fresh ginger. Dehydration achieved by careful sun drying or mechanical drying in driers to obtain hygienic and uniform quality product. The types of dry ginger are dried sliced ginger, dried whole ginger and dried whole blanched ginger. (Details of processing technology given at CFTRI official website)

Green chilli sauce

Green chilli Sauce With the fast changing scenario in food consumption pattern, the younger generation has developed a liking for more and more fast foods and tomato sauce and chilli sauce are important accompaniments. Chilli sauce is used in garnishing many dishes. 1.1. Use: Chilli sauce can be used for many recipes due to its pungent, sweetish and sourish taste. Chilli sauce can be used in snack foods like Gobi Manchurian, noodles and as an adjunct for Samosa, Cutlet, Bread etc. (Details of processing technology given at CFTRI official website)

Protein enriched buns

Protein enriched buns is a ready formulation and shall be made using the ingredients specified in the Bureau of Indian Standards (BIS) and Prevention of Food Adulteration (PFA) Act. Protein enriched buns should be soft, with good volume and fine uniform grain. (Details of processing technology given at CFTRI official website)

Ready to use dosa batter

Ready to use dosa batter in retail packs are the shelf stable ready to use (RTU) Dosa batter in retail packs is meant for instant use by consumers. (Details of processing technology given at CFTRI official website)

Ready to use idly batter

Ready to use Idli batter in retail packs are the shelf stable ready to use Idli batter in retail packs is meant for instant use by the Consumers. (Details of processing technology given at CFTRI official website)

Turmeric curing and polishing

Turmeric (*Curcuma longa L*) is an erect perennial plant that is grown as an annual crop for its rhizome. Turmeric is an important tropical spice primarily valued for its colour, aroma, antioxidant property and the powder is used in food, perfumery and pharmaceutical industries. The ground spice is used as a condiment. It is an essential ingredient in curry powders and is extensively used in traditional medicines. Traditional Indian medicine claims the use of turmeric powder against biliary disorders, anorexia, coryza, cough, diabetes. Polishing of the outside surface of the dried turmeric has a poor appearance and dull in colour with scales and root bits. The appearance is improved by smoothening and polishing the outer surface manually or by mechanical abrasion. (Details of processing technology given at CFTRI official website)

Cereal flakes rice

Flaking of rice is an important traditional industry in India. The traditional process posses considerable loss in these processes due to breakage, particularly at the edges of the flaked rice, more so when thin flakes are produced. In the continuous rice flaking process developed at CFTRI, paddy is soaked in hot water to avoid foul smell of rice flakes. Roasting is carried out in a continuous mechanical roaster. The dehusking, polishing and flaking operations are separated. Flaking is achieved by a roller flaker. The flakes are dried hygienically in a fluidized bed drier instead of spreading out on the floor as in the traditional practice. The flakes so obtained are of better quality without damaged edges. The yield is about 70% on cleaned paddy. As the grain is first dehusked, polished and aspirated before being flaked, the flakes are free of all husk- bran specs unlike in the edge- runner process. They are free of any sand particles also. Another noteworthy advantage of the process is that it yields 4-5% pure bran (amount depends on the degree of polish employed), which moreover is stabilized and does not develop free fatty acids (FFA). The husk too is pure which is totally used as fuel for raising hot water and roasting the soaked paddy, meeting much of the process heat, which in considerable energy savings. But the flakes obtained by this process have different hydration characteristics and upon soaking in milk/ water it becomes soggy. However, these flakes make excellent crispy fried chewda. (Details of processing technology given at CFTRI official website)

Refining of millets

Sorghum and the millets are the most important food crops of the arid and the semiarid tropics. Production of sorghum, pearl millet and finger millet amounts to about 20 million MT in the country. These cereals are of much importance because of their nutritional and nutraceutical potential. The term "refining" broadly means decortication or debranning or removal of seed coat to prepare a relatively seed coat free product. It may be simple scouring/polishing of the grains to prepare seed coat free grits or flour. Refined products facilitate preparation of foods of improved texture and consumer acceptability. Since these grains contain high amount of dietary fiber, refining slightly reduces dietary fiber content in the flour and thereby benefits the bioaccessibility of some nutrients, especially the minerals. However, the consumers can still avail the health benefits of dietary fibre, mostly contributed from the endosperm of the grain. (Details of processing technology given at CFTRI official website)

Rice milk mix

The product 'Rice-milk mix' is a granular instant mix for the preparation of ready-to-eat product to be consumed as a convenience breakfast food or food for nutritional intervention programme. Though the product is primarily meant for infant and pre-school children between the ages of 6 months and 6 years, it is also suitable for people of all ages. The major ingredients used are rice, sugar, green gram and skimmed milk powder. The product can be reconstituted easily in hot or warm water to offer a consistency similar to porridge or thin halwa in a short period of 3 to 5 minutes. The powdery raw food ingredients, after mixing, are subjected to thermal treatment followed by granulation and subsequent drying to offer a granular food that is nutritionally good and possesses the attractive sensory attributes in addition to a shelf-life of 6 months. The developed process is suitable for production even in a small or cottage scale industry without requiring a high investment for plant and machinery. The process provides a healthy food product which is low in fat but rich in protein content. (Details of processing technology given at CFTRI official website)

Nutro-Phyto Incubation Centre (NPIC-CIF):

The project, Establishment of a Nutro-Phyto Incubation Centre & Common Instrumentation Facility was initiated for nurturing entrepreneurs in the area of nutraceuticals and functional for basic research, scale-up and efficacy studies all through a single point of access. It is an opportunity to explore and innovate ideas into a commercially viable technology by start-up ventures and SMEs. A selection cum Project Review & Monitoring committee constituted with experts from industry and academia will be assisting in successfully managing the activities of the Park.

CSIR-800 Mission:

"CSIR-800 has been launched with the aspiration of improving the lives of 800 million fellow Indians through S&T interventions. This requires not only first rate technologies but passion, commitment and energy from all partners. The path may not be smooth, but CSIR will work hard to fulfil its dream of reaching the unreached and demonstrate to the world that S&T can change the face of a country, bring smiles to the faces of 800 million citizens, and kindle in their hearts hopes for a better future." said Shri. Narendra Modi, Prime Minister of India. With respect to this, CSIR-CFTRI evaluates all the technologies thoroughly before talk about it to the public. They develop not just the technology, but work on cost benefit analysis and business plan before disseminate the information to farmers and industries. CSIR-CFTRI efforts are of continuous improvement on existing technology solutions and innovative research to develop newer technologies. The mission is sponsored by the government and can have a great reach. So far, All India Farmers Association Presidents, Horticulture Departments, and independent farmers have approached CSIR-800 for collaboration.

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A sustainable paddy-fish cultivation among the Apatani tribe of Arunachal Pradesh

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INTRODUCTION

Integrated paddy-fish farming cultivation can be found in parts of China, Japan, Indonesia, Philippines, Vietnam, Malaysia, Thailand, Myanmar and India. In some cases these systems date back virtually to when man started paddy cultivation. These systems generally involve some form of on-farm waste recycling technique or multiple usages of resources that enhance production capacity, helping to improve farmer's socio-economic conditions and often benefiting the ecology as well. Integrated paddy-fish systems can aid intensive production of rice and fish protein with greater efficiency than they can be grown in isolation, as the by-products of one system component becomes the input for other.

The Apatani, or Tanw, also known by Apa and Apa Tani, are a tribal group of people living in the Ziro valley in the lower Subansiri district of Arunachal Pradesh in India. The Apatanis, one of the major ethnic groups of eastern Himalayas, have a distinct civilization with systematic land use practices and rich traditional ecological knowledge of natural resources management and conservation, acquired over the centuries through informal experimentation.

The Apatani plateau is geographically placed at 5000 feet above mean sea level and 26º50´-98º21´N latitude and 92 º 40´-94 º 21´E longitudes. Rice is the principal crop in addition to millet and other grain crops in their homestead plots. The cropping pattern of the area includes monocropping of wet rice once in a year in their wet plots associated with year round sequential production of various vegetables on field dykes and in their homestead plots.

The techniques of paddy-fish cultivation in Apatani tribe

Integrating aquaculture with agriculture assures higher productivity and year round employment opportunities for farmers. The plots utilized for rice-cum-fish culture are mainly based on organic fertilization using a variety of animals excreta such as poultry droppings (Paro pai), pig excreta (Alyi ekha) and cow dung (Sii ekha). Other sources of organic fertilizers are wastes of plants such as rice husks (Pinna), waste product of local beer (Poi), ashes from household fires/burned products (Mubu), remains of burnt straws (Muyu) after the harvest is over and compost fertilizer such as decomposed straws (Liissi), weeds (Tamih) and stalks (ankho).The paddy-fish culture of the Apatani, however, is a purely an organic farming practice and is distinctly characteristic of Apatani agro-ecosystem. UNESCO has, therefore, proposed Ziro valley as a World Heritage Site for it's for its ancient custom, forming the basis of the eco-preservation efforts.

They mostly cultivate amo, mipya and layi varieties of paddy which are indigenous in nature. The strains of the fish speceies include all the species of *Cyprinus carpio* (common carp), *Cyprinus carpio specularis* (Mirror carp), *C.carpio communis* (Scale carp) *and C. carpio nudus* (Leather carp). The preparation of the rice fields for fish culture begins in April-May. The fry stages (15-20 mm) of fish are stocked in the field after ten days of transplanting of rice seedlings. In this, stocking density is maintained at the rate of 5000 fingerlings/ha. The species constitutions include surface feeders (25%), column feeders (30%) and bottom feeders (45%). Water level in the field is maintained at 20-30 cm during culture period whereas the depth of the canal is maintained at 40-45 cm. They do not use any feed supplement for the fish during culture period. Generally, fishes grow up to 400-500 g within 3-4 months. The production rate is 500 kg ha^{-1} $season^{-1}$.

Indigenous trap prepared from bamboo is placed in the outlets to catch the fishes. The remaining fish in the field are caught by indigenous baskets, nets, etc. The Paddy fields are suitable for fish culture because these fields have strong dykes or bunds locally known as agher for preventing leakage of water and retaining it to the desired depth and also to prevent the escaping of cultivated fishes during floods. On the bunds, sarse (millet) is cultivated which is a common practice among the Apatani people. Therefore, no portion of paddy plots remains unutilised.

CONCLUSION

Based on farming systems performance, Apatani paddy-cum-fish agro-ecosystems is highly productive (400-500 kg ha^{-1}), 3 to 4 time of the average yield of the paddy in the state, economically viable, cost of cultivation being low with minimal external inputs making it a highly organic agriculture.

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Birds Damage and Management

Article id:
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INTRODUCTION:

Birds are known to play an important role in pollination, putting a check on pesky insects and rodents, could also be causing drastic decrease in crop yields by destroying them, is emerging concern in Indian agriculture. Wide varieties of arable crops attract granivorous birds which lead to significant damage to the crop yields globally [1,2]. However, there are few studies pertaining to the awareness of the problem among the farmers and the magnitude of crop damage caused by the birds in India [3]. The problem of crop damage by birds is faced by the farmers and the losses due to crop depredation by birds are significant in terms of the gross crop yield. Birds can inflict damage to the crops and a loss to the farmers in all the stages of crops right from sowing and planting till harvesting [4]. Birds are known to cause considerable economic damage to variety of crops during vulnerable stages in different agro-ecological regions of the country. The extent of bird damage to any crop depends on several factors like concentration of local bird population, total area under the crop, cropping pattern habitat of the area, season and physiological status of the birds. It was identified 63 bird species of birds, 1,364, from 19 families that caused damage to several crops. A whopping 52 bird species attacked cereals, pulses got attacked by 14 bird species, while oilseeds faced damage risk by 15 species and fruits by 23 species. They also caused damage to the crops of smaller grains such as pearl millet and sorghum as well as maize. Among these, the Grey Partridge, Blue Rock Pigeon and House Sparrow were found to inflict most damage to crops. Other species include the Rose ringed parakeet, weavers, munias and doves that manage to nest in close proximity to agricultural fields. Moreover, bird damage was found to be more in isolated, early or late maturing fields, varied between regions, seasons, number of species, their density, concentration of migrants and their food habits.

Nature of Damage

- The pigeons and crows inflict the damage at the germination and seedling stages.
- The birds pick up the seed from the field after the post sowing irrigation and feed on the soaked seeds which were in the process of germination.
- They also pluck out on the developing young seedlings.
- At the flowering stage, the Rose ringed parakeets infest the inflorescence and feed on the anthers and pollen grains
- At milky stage when they split and strip away the covering bracts thereby exposing the grain for easy feeding and further damage
- This type of feeding is continued till the panicles/spikes/head reach dough stage. Damage by crows starts at this stage and they completely remove the spathes and eat the grains

Lethal methods

Lethal methods involve killing of birds, shooting, trapping, fumigation, poison baiting, egg and nest destruction, etc. In past, lethal methods were extensively used to control bird pests in India and elsewhere because killing was considered to be the surest way of getting rid of harmful birds. Killing of any bird species is now illegal in India and also not approved by the public. In view of the

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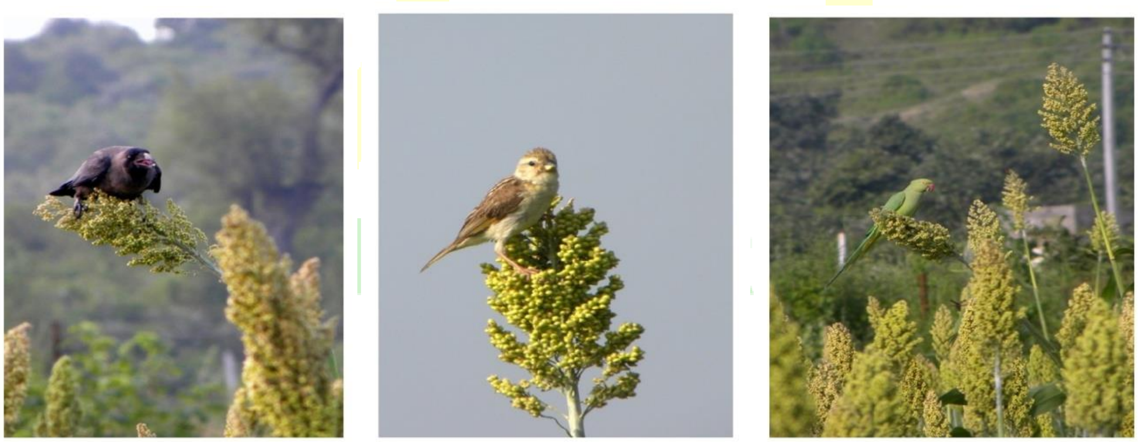
above facts, lethal methods of bird management are not recommended these days.

In India, as a common remedy to the problem, attempts are regularly being made by the famers to reduce crop losses from birds by deploying measures for control of birds either through traditional means or by using bird scaring techniques, devices, and pesticides.

Table 1: Traditional and conventional bird scaring techniques deployed by farmers in India.

Techniques	Reference
The white cloth banging	Kiruba et al. (2006) [5]
Chemical bird repellents are like trimethacarb, methiocarb, and curb	Bruggers et al. (1986) [6]
Killing and catching of birds	Singh and Dungan (1955) [7]
Methiocarb (4 methylthio) 3,5-xylyl-N-methyl carbamate, and Thiram	Sandhu (1987) [8]
Poisonous chemical	Bhatnagar (1976) [9]

Most of the farmers were not satisfied with the conventional bird scaring techniques being used by them due to their less effectiveness and nonreliable nature and as it requires continues hard work and more man power. The techniques like use of chemical repellent, net, spike guards, shooting the birds with gunshot, and making loud noise by bursting fire crackers in order to scare birds are either costly or lethal. Farmers believed that present traditional techniques are not effective enough to control this loss and they also expressed the need for sustainable techniques which can replace the traditional bird scaring techniques and help them to reduce their loss more effectively in a sustainable way. Traditional methods are like "trial and error method," and bird species become habitual for such techniques and hence they did experience "scaring" from such techniques for longer time. It was also observed during field visits that birds were not afraid of bird scaring devices and it was also a common experience of farmers. Lethal techniques may be an effective solution to the problem but by killing birds we may be destroying one of the important bioindicators in the nature.



(a) (b) (c)

Fig 1. (a)House Crow (b) Baya Weaver (c) Rose-ringed Parakeet feeding on sorghum millets

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More damage was inflicted in interior as compared to edges in the sorghum and pearl millet crops, as birds like the longer crop plants for secure feeding .The foraging activities of cropland bird species like House Crow have caused more damage to wheat, while pigeons and doves cause damage to pearl millet and sunflower. Also, the parakeets and crows were found to inflict more damage to the crops than what they actually consumed. They carried parts of kernels of the Jowar with them and then fed on the grains. But, while feeding on the grains in this way, a major portion of the kernel with the grains falls down. A maximum loss is recorded to the sorghum crops by sparrows, weaver birds, and parakeets that accounts to 52% (Figure 1). Pigeons damaged 42% of the peas crop (chick peas and pigeon peas) while sparrows and weaver birds damaged the groundnut crop by 26% in the sampling plots. ([10] . The maximum damage to the pearl millet and sunflower was caused by sparrows and weaver birds.

CONCLUSION:

Actual damage assessments of common crops indicate that Sorghum was the most affected crop due to depredation followed by pearl millet and combined chick peas and pigeon peas crops. The sustainable solution for reducing loss of crop is a need of the farmers and also such techniques will help to avoid direct or indirect effects of use of lethal bird control techniques on avian species. Though the area for this study was limited, it reveals the trends of agricultural loss due to birds. The problem of crop depredation should be study in larger agricultural area of the country and more concrete damage estimation should be done. Future work should focus on designing a sustainable solution by developing ecofriendly bird crop-specific and bird-specific scaring techniques to minimize crop depredation due to birds for improving the crop yields.

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Biodegradable packaging and its applications

Article id: 21825

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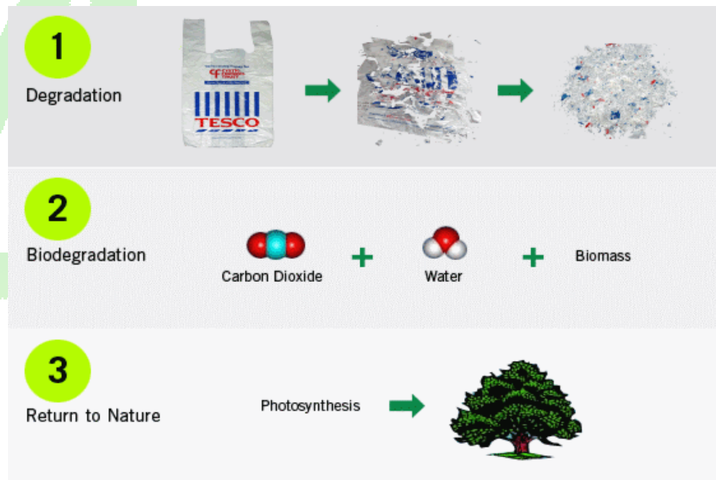
INTRODUCTION

The need for packaging can be linked to the progress of civilization and need to preserve perishables for longer period of time. Plastic packaging being used is non biodegradable as it causes ecological imbalance and aesthetic deterioration of nature. There is, therefore, great need to develop environment friendly biodegradable packaging materials which do not cause environmental pollution. Biodegradable packaging materials neither promote any waste disposal problems nor affect the trade and safety of the food product.

Biodegradable packaging includes biodegradable films and coatings synthesized from organic materials and microbial polymers. A biodegradable product has a unique characteristic in which microbes such as bacteria, fungi and algae can decompose the rugged polymer structure. American Society for Testing and Material (ASTM) declared that any product claiming to be biodegradable must completely decompose into CO2 and water with in a 180 day period (Thorat and Wadikar, 2000).

Different types of Biodegradable packaging materials are as under:

Microbial Polymers: Microbial Polymers are synthesized by microbes and are biodegradable and can be used for packaging purpose. Under imbalanced growth conditions, some bacteria like Bacillus Spp., Azotobacter Spp., Clostridium Spp., Thiothrix Spp, etc. shift from their original physiological pathways and synthesize different carbon reserve compounds such as PHA (Poly-b-Hydroxy Alkonates). Among them, PHB (Poly-b-Hydroxy Butyrate) can become very good substitute for synthetic polymers.



Biodegradation process

Edible Films and coatings:

An edible film or coating is simply defined as thin continuous layer of edible material formed on, placed on or between foods or food components. Edible packaging refers to the use of edible films, coatings, pouches, bags and other containers as a means of ensuring the safe delivery of food product to the consumer in a sound condition. These films can also act as carrier of antioxidant, flavour and bacteriostats and can improve mechanical integrity of food products. Since, package is an integral part of the whole food product, therefore, the composition of the edible packaging must meet with the following specific functional requirements:

- Neutral organoleptic properties (clear, transparent, odourless, tasteless etc.)
- Water vapour tightness to prevent desiccation.

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- Good barrier against microbial invasion to reduce spoilage and decay.
- Predetermined permeability to water vapour, O2 and CO2 to have complete control over the water and gas exchanges between the product and surrounding atmosphere.
- Good mechanical characteristics (like tensile and yield strength, Spencer impact elongation, etc.) to impart abuse resistance.
- Enhance the surface appearance (e.g. brilliance) and tactile characteristics (e.g. reduced stickiness) of foods.

Polysaccharide Films

Alginates, pectin, carragenan, starch hydrolysates and cellulose derivatives are different polysaccharides that can be used for edible coatings.

- **Alginates** are the salts of alginic acid extracted from brown sea -weed and react with several polyvalent cations to form gels and this is useful in film formation. Calcium ions are the most effective gelling agent. The gelatinous alginate coating was effective in various meats such as poultry parts and lamb carcass.
- **Carragenan** is an extract from the red-sea weed. It consists of a family of sulfonated polysaccharides of D-glucose and 3, 6-anhydro-D-galactose. Upon cooling the warm aqueous solution of the polymer, gelatin occurs presumably by the formation of a double helix structure to yield a 3D-polymer net work. Carragenan can be used as food coating which act as sacrificing agent to retard moisture loss from the enrobed food.
- **Pectin** is complex group of structural polysaccharides found in middle lamella of plant cells. It is composed of D-galacturonic acid polymers with varying degree of methyl esterification. Chemical de-esterification yields low-methoxy pectins which are capable of forming gels in the presence of calcium ions.
- **Starch**: Different sources of starch e. g. corn, potato, cassava and cereals etc. can be used. Normal corn-starch consists of 25% amylose and 75% amylopectin. Mutant varities of corn were produced which contain up to 85%amylose . These high amylose starches can be utilized for edible film formation. The films were transparent and had very low R. H. Mechanical properties of starch films which have potential as packaging materials depend on water content and humidity.
- **Cellulose derivatives**: Cellulose is composed of D-glucose units linked through b-1, 4 glycosidic bonds . The tight and crystalline structure of cellulose can be made water soluble by treating with alkali to swell the structure followed by reaction with chloroacetic acid, methyl chloride or propylene oxide to yield Carboxy Methyl Cellulose (CMC), Methyl Cellulose (MC), Hydroxy Propyl Methyl Cellulose (HPMC), Hydroxy Propyl Cellulose (HPC). The anionic CMC and non-ionic MC, HPMC and HPC possess excellent film forming characteristics.

Lipid Films

Lipid components that are used as packaging include natural waxes such as carnuba wax, candelilla wax, rice bran wax and bees wax; vegetable oils such as corn oil, soyabean oil, palm oil and acetylated monoglycerides. The primary purpose of lipid coating is to block transport of moisture e. g. waxing of fruits. Wax and oil coatings have been shown to retard dessication in apples, mango, coconut, banana, papaya, peaches, carrots, turnips, peppers, tomatoes and cucumbers.

Acetylation of glycerol monostearate (GMS) by its reaction with acetic anhydride yield stearodiacetin. This acetylated monoglyceride displays the unique characteristics of solidifying from the molten state into flexible wax like solid. Acetylated monoglyceride coatings were applied to poultry and meat cuts to protect against dehydration during storage. These coatings can be stretched up to 800% of its original length and the highly stretchable, solid-phase acetylated monoglyceride exists in the b-polymorphic form. Because of their inherent flexibility, acetylated monoglycerides are sometimes incorporated into wax to impart added plasticity without materially decreasing the resistance of coating to the moisture transport. This approach is particularly useful when wax coatings are used in food stored at low temperature.

Protein Films

Edible films can be made from different polypeptides or protein system e.g. milk proteins (casein and whey proteins), wheat proteins, corn proteins, soy proteins, gelatin from collagen etc. Although protein films are poor barrier to moisture yet they have considerable mechanical and gas barrier properties. Certain hydrophobic protein films are also there.

- Milk proteins have excellent nutritional value and possess numerous functional properties (e.g. their solubility in water and ability to act as emulsifier) which are important for formation of edible films.
- The **casein** easily forms film from aqueous solution due to its ability to form extensive intermolecular hydrogen, electrostatic and hydrophilic bonds. The films are attractive for use in food industry. **Whey protein** fractions (b-lactoglobulin and b-lactalbumin) and pure whey protein isolates can be used for film manufacturing.
- Caseinates do not require denaturation to form films but the native whey proteins have globular structure and will not form film unless denatured. Denatured whey proteins form strong films but need plasticizer. Caseinate films are successfully used in apricot, papaya, chicken eggs, apples, oranges and for enzyme immobilization. Whey proteins also find applications in decorative packaging with number of colour images, fruit and herb flavours. Whey Protein Concentrate (WPC) was reported to be least permeable to water vapour as compared to caseinate-based and whey protein (fraction)-based films. Also, the puncture strength of WPC films was lowest and provided good barrier to O2, aroma and oil at low to intermediate relative humidity.
- **Gelatin** is a protein derived from collagen which forms thermally reversible gels when the warm aqueous suspensions are cooled. It can be use as food additive, edible coating and as encapsulating agent.
- **Corn-Zein films**: zein from corn is the proteins that can be used for preparation of edible films. Zein films got the importance due to their hydrophobic nature unlike other proteins (milk, soy etc.). Corn zein films and coatings are used as O_2 and moisture barrier for nuts, candies and other foods. They have relative insolubility in water and forms strong glossy films resistant to grease and O_2. Zein has natural resistance to bacterial attack, forms tasteless coating and has stability in conditions of high humidity and high heat. Ozguler and Morris (1995) reported that corn zein coated paper proved more effective than films for wrapping O2 sensitive foods and in regards to O2 barrier properties, pouring gave better result than spraying.
- **Wheat gluten film**: Gluten from wheat is also another protein which is known to give strength to baked goods. The cohesiveness and elasticity of gluten facilitate the film formation. The film structure is obtained by reoxidising the dispersed gluten in air as a result of reformation of S-S bonds. The gluten

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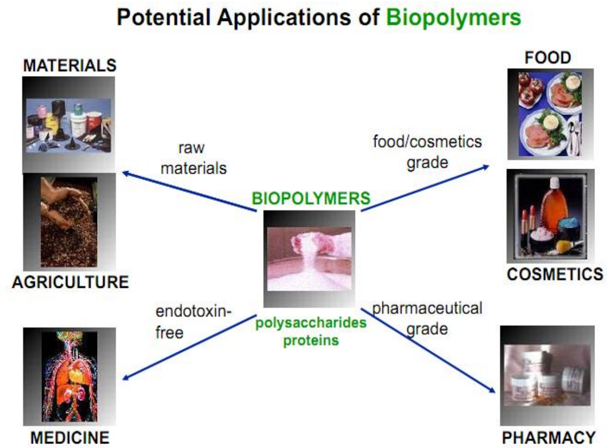
films are stronger with greater tensile strength and are also a good barrier to O_2 and CO_2. But they are highly permeable to water and need to be made impermeable for commercialization. Wheat gluten has been used for coating dry roasted peanuts and also fried chicken pieces where as gliadin fraction has been used for micro-encapsulation of fatty acid to prevent their peroxidation.

- **Soy Protein Films**: Edible films can be made from isolated soyabean protein (ISP). The exceptionally low oxygen permeability values of ISP-films provides opportunities for preserving foods from oxidative deterioration.

Advantages of Biodegradable Packaging:

Biodegradable packaging offers many advantages over the traditional synthetic polymeric packaging materials such as:

- These films can be consumed with the packaged product and there is no packaging to dispose off. It represents the environmentally ideal package.
- These may serve as carrier of additives such as anti-oxidants, anti-microbial agents, flavourings, colourings, sweetners etc. thus can enhance the organoleptic properties of the packaged food product.
- Films can supplement the nutritive value of the packaged food product. This is particularly true for films made of proteins.
- Films can be used for individual packaging of small portion of food, particularly for products such as peas, beans, nuts and strawberries etc. that currently are not individually packed for practical reasons.
- The film or coatings can be applied in heterogeneous foods like pizza, pies, ice cream, sandwiches etc at the interfaces between different layers of components to reduce moisture transfer from higher moisture to drier ingredient.



CONCLUSION:

Considering numerous advantages that biodegradable packaging offer over synthetic films, it can be anticipated that it has a great future in the area of food packaging. Research and Development efforts are required to develop biodegradable packaging having good packaging performance besides being economical.

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AGROFORESTRY: an elemental tool for soil conservation and mitigation of climate change

Article id: 21826

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INTRODUCTION

As world population increases, the needs for more productive and sustainable use of the land become more critical. Agroforestry is one of the solutions to addressing these issues whether they can be environmental, economic or social by its multifunctional properties. Agroforestry systems include both traditional and modern land use system where trees are managed together with crops and animal production system in agricultural land. They are dynamic, ecological based, natural resources management system that diversify and sustain production in order to increase social, economic and environmental benefits for land users at all scales. It is a collective name for land use system and technologies where woody perennial (trees, shrubs, palms, bamboos etc.) are deliberately used on the same land management units as agriculture crops and animals, in some form of spatial arrangement or temporal sequence.

It can therefore be considered as "climate smart" because it combines improved livelihoods with mitigation of an adaption to climate change. Trees are affected by climate variability and change, and in turn can influence regional climate by altering atmospheric processes, including water budgets. Trees on farms can have considerable effects on smallholder livelihoods, both by improving ecosystem services or functions and by increasing or diversifying farm income and food and nutritional security. The Global warming, atmospheric deposition and increase in atmospheric CO2 concentration are the primary atmospheric factors which may have impact on forest soils (Josline and Johnson, 1997).Various impacts upon forest soils, in turn, may affect forest nutrient cycling and ultimately productivity. In agro forestry system, perennial trees crops are in varying degrees intercropped with shade trees, such as fruit and timber trees. Shade trees contribute to resilient production system through the facilitation of more efficient nutrient cycling, natural pest control, and income diversification for smallholder farmers

Increasing level of CO2 in the atmosphere has drawn the attention of the scientific community towards the process of carbon sequestration and soil organic carbon store. The terrestrial environment is the most important living space for human beings, and soils are at the core of the terrestrial ecosystem. Soil Organic Carbon (SOC) is a part of the global carbon cycle and the global SOC pool (1580 Gt) is nearly three times as large as stock in the vegetation of terrestrial ecosystems (Post et al., 1990) and twice as large as stock in the atmosphere (Eswaran et al.,1993).

Why Agroforestry?

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1. Clean water and air	Produces saleable products
2. Safe and healthy food	Provides value added opportunities
3. Abundant wildlife	Diversifies risk
4. Beautiful places	Increases property values
5. Clean renewable energy	Increases crop yields & livestock production

What is Agroforestry?

Agroforestry is a sustainable land use management system in which trees or shrubs are grown simultaneously around or among agriculture crops or pastureland. It combines shrubs and trees in agricultural and forestry technologies to create more diverse, productive, profitable, healthy, ecological sound, and sustainable land use system.

Agroforestry practices

Riparian forest buffers are streamside planting of trees, shrubs and grasses that reduce water pollution and bank erosion, protect aquatic environments, and enhance wildlife habitat.	Windbreaks are rows of trees and shrubs that reduce wind speed. They improve crop yield, reduce soil erosion, improve water efficiency, protect livestock and conserve energy.
Silvopasture systems combine trees with forage and livestock production on the same field. The trees are managed for wood while at the same time provide shade and shelter for livestock.	Alley cropping systems are widely spaced rows of high value trees that create alleyways for crops. This system benefits trees and crops and provide annual and long term cash flow.
Forest farming is the cultivation of high value non-timber crops (food, medicinal and craft) under the protection of a forests canopy that has been managed to provide favorable crop environment.	Special applications are planting used to solve unique problems. Examples include the utilization of wastewater to produce a short rotation woody crop and planting to help stabilize stream banks.

Agroforestry applications

- Agri-silvicultural system are a combination of crops and trees e.g. alley cropping or home gardens.
- Silvopastoral system combine forestry and grazing of domesticated animals on pastures e.g. rangelands or on-farm.
- Agro-silvopastoral: the three elements, namely trees, animals and crops, can be integrated e.g. home gardens involving animals as well as scattered trees on croplands used for grazing after harvests.

Agroforestry for soil conservation

- Soil conservation refers to maintenance soil fertility and erosion control.
- The presence of woody perennials in agroforestry system may effects several bio physical and bio chemical processes that determine the health of the soil. Include:
- Amelioration of erosion primarily through surface litter cover and under story vegetation.

- Maintenance or increase of organic matter and diversity, through continuous degeneration of roots and decomposition of litter.
- Nitrogen fixation
- Enhancement of physical properties due to the extensive root system and the canopy cover.
- Enhanced efficiency of nutrient use because the tree root system can intercept, absorb and recycle nutrients in the soil.

Agroforestry practices used for erosion control include:

- Crop combinations multi-storey tree gardens
- Alley cropping windbreaks and shelterbelts

Important Tree species for soil conservation

Acacia nilotica, Albigia lebbck, Sesbania gradiflora, casurina, Leucaena leucocephala, Sesbania grandiflora, Pongamia pinnat, Acacia auriculiformis etc.

Carbon sequestration: it is storage of carbon storage of carbon dioxide or other forms of carbon to either mitigate or defer global warming to avoid dangerous climate change

- The 3rd assessment report of intergovernmental panel on climatic change (IPCC) asserts that the earth`s climate is changing and that its impact will be great on developing countries.
- India is signatory to the Kyoto protocol (1997), which asserts that the countries will play an important role in mitigating the effects of global warming.

Agroforestry well known buffering and resilience effects

- Climate variability is well buffered by agroforestry because of permanent tree cover and varied ecological niches.
- Resilience or recovering after a disturbance (e.g. extreme weather events, or market failure) is well performed by agroforestry because of diversified temporal and spatial management options.
- Permanent tree cover protects and improves the soil, while increasing soil carbon stocks.
- Varied ecological niches allow for the presence of different crops, e.g. shade-tolerant and light-demanding.
- Diversification of commodities allows for adjustment to market needs.
- Management flexibility is compatible with shifts in labor supply.
- Non-harvested components play an important protective role.

Agroforestry can boost synergy between adaptation and mitigation of climate change

- Mitigation of climate change mainly takes the form of carbon sequestration, e.g. biomass, either above or below ground.

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- Adaptation to climate change is very much a function of soil organic matter content and diversified, multispecies cropping technologies.
- Agroforestry performs well on the 2 above criteria and thus is a preferred approach to develop synergies between adaptation and mitigation.
- High biodiversity and resulting ecosystem services in agroforestry also contribute to synergy between adaptation and mitigation.
- Agroforestry improved fallows provide an example of such synergy.

CONCLUSION: Agroforestry systems are in great part related to increases in organic matter, whether in the form of surface litter or soil carbon. Therefore, besides their role in above ground carbon sequestration, agroforestry system also have a great potential to increase carbon stocks in the soil and certainly merit consideration in mechanisms that propose payments for mitigation of greenhouse gas emissions to reduce climate change.

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Air pollution tolerance index - tool to mitigate air pollution

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INTRODUCTION

Air pollution can be defined as introduction of foreign particles into the atmosphere in the form of chemicals, particulate matter or biological materials that cause harm or discomfort to humans, or other living organisms or damage the environment. There are various locations, activities or factors which are responsible for releasing pollutants into the atmosphere. These sources can be classified into two major categories; natural sources and anthropogenic (man-made) sources.Road transport, industry and power generation are the best known sources of air pollution, producing particulate matter and ozone. Enhanced intensity of air pollution has become a worldwide issue. Increasing pace of urbanization has resulted in loss of vegetation cover. Climate change impact has also added more stress. The main cause of increase in the level of air pollution is increasing population, urbanization and industrialization. Green plants play an important role in air pollution attenuation (Cavanagh *et al*., 2009) thus; they can be utilizedfor the same. It is thus essential that greenery should be reintroduced in such urban areas. This aim can be achieved by collaboration of nature and city. An urban forest is a collection of trees that grow within a city, town or a suburb. It includes woody plants growing in and around human settlements. Urban forests not only help in attenuation of air pollution but also in noise pollution reduction, controlling soil erosion and enhancing the aesthetic beauty of the area (Yang *et al*., 2005). Urban forests can be developed around rivers banks, roads and railways, parks, gardens, playgrounds, cemeteries, roadside etc.

Some plants are comparatively more tolerant to air pollutants. An index to identify the tolerance of air pollutants was developed which is known as air pollution tolerance index (APTI). It is mainly based on four major properties of leaves namely ascorbic acid content, relative water content, total chlorophyll content and leaf extract pH (Singh and Rao, 1983). Plant's tolerance to air pollutants generally varies with these parameters.Air Pollution Tolerance Index (APTI) is an important parameter which determines capability of plants to endure air pollution and having plants higher index value can be used as natural sinks for CO2 sequestration (Bamniya *et al*. 2011; Chaudhari *et al*. 2007). Plant sensitivity and tolerance to air pollutants varies with some basic biochemical parameters such as ascorbic acid, total chlorophyll, relative water content and leaf extract pH. APTI is developed by Singh and Rao (1983) which is calculated based on these four biochemical parameters. The Anticipated Performance Index (API) can be calculated for the plants by combining APTI values with other biological and socio-economic characters (Shannigrahi *et al*., 2004). Plants, the main greenbelt component, act as a sink and as living filters to minimize air pollution by absorption, adsorption, detoxification, accumulation and/or metabolisation without sustaining serious foliar damage or decline in growth, thus improving air quality by providing oxygen to the atmosphere (Shannigrahi *et al*. 2004).

Why APTI?

Several studies have shown the impacts of air pollution on plant biochemical parameters, such as the ascorbic acid content, chlorophyll content,

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leaf extract pH and relative water content. The use of these different parameters has given conflicting results for the same species (Han *et al*. 1995); therefore, a single parameter may not provide a clear picture of the pollution-induced changes that may occur in plants. Furthermore, categorizing plants as being sensitive or tolerant by determining the levels of these parameters in plants may be ineffective since plants show different responses to different pollutants. It is on this premise that the air pollution tolerance index (APTI), based on the ascorbic acid content, chlorophyll content, leaf extract pH and relative water content of leaves of tree species, has been used for identifying the tolerance levels of plant species (Singh and Rao 1983). The sensitivity and response of plants to air pollutants vary, and plant species that are more sensitive act as bioindicators of air pollution, while tolerant species according to the APTI are used for green belt development. The APTI index is effective in evaluating the effect of pollutants only on biochemical parameters, but in order to combat air pollution using green belt development, some socioeconomic and biological characteristics are considered to develop the anticipated performance index (API) (Govindaraju *et al*. 2012). The API is an improvement over the APTI, which has been used as an indicator to assess the capability of predominant species in the clean-up of atmospheric pollutants.

APTI calculation

Air pollution tolerance index (APTI) is an empirical relation which evaluates the tolerance level of plant species towards air pollution from leaf biochemical parameters such as leaf extract pH, ascorbic acid, total chlorophyll and relative water content. Species having higher APTI value are more tolerant to air pollution than those having lower APTI value. Species having lower APTI value may act as bio-indicators of pollution.

APTI is calculated by incorporating leaf extract pH, total chlorophyll, ascorbic acid content and relative water content into the following mathematical expression:

$$APTI = A (T+P) + R / 10$$

A is the ascorbic acid content in milligrams per gram of fresh weight

T is the total chlorophyll in milligrams per gram fresh weight

P is the pH of leaf extract and

R is the relative water content in percentage

The sensitivity of plants and tolerance parameters varies with air pollutant level at the study area. Air pollution tolerance Index is been used in studies like green belt development, traffic noise reduction and Pollution mitigation at roadside sites and around industries.

Why the 4 parameters?

Ascorbic acid

Ascorbic acid plays a role in cell wall synthesis, defense and cell division. It is a strong reductant and reducing power is directly proportional to its concentration. However, its reducing activity is pH dependent, being more at higher pH levels because high pH may increase the efficiency of conversion of hexose sugar to ascorbic acid and is related to the tolerance to pollution. Ascorbic acid, through its reducing power, protects chloroplasts against SO_2^- induced H_2O_2, O_2^- and OH accumulation, and thus protects the enzymes of the CO_2 fixation cycle and chlorophyll from inactivation and oxidative damage. Ascorbic acid, being a powerful reductant, maintains the stability of cell membranes during pollution stress and scavenges cytotoxic free radicals. An increased level of ascorbic acid in leaves is known to increase air pollution tolerance in plants (Chaudhary and Rao, 1977).

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Total Chlorophyll

Chlorophyll is an index of productivity of plant. Chlorophyll content of plants signifies its photosynthetic activity as well as the growth and development of biomass. The photosynthetic pigments are the most likely to be damaged by air pollution (Prusty *et al*. 2005). Chlorophyll pigments exist in highly organized state, and under stress they may undergo several photochemical reactions such as oxidation, reduction and reversible bleaching (Puckett *et al*., 1973). Hence any alteration in chlorophyll concentration may change the morphological, physiological and biochemical behavior of the plant. It is well evident that chlorophyll content of plants varies from species to species; age of leaf and also with the pollution level as well as with other biotic and abiotic conditions. Whereas certain pollutants increase the total chlorophyll content other decrease it.

Relative Water Content

RWC of a leaf is the water present in it relative to its full turgidity. High water content within plant body helps to maintain its physiological balance under stress conditions such as exposure to air pollution when the transpiration rates are usually high. The addition of RWC to A (T+ P) shows the capacity of the cell membrane to maintain its permeability under polluted conditions. Relative water content of leaf is associated with protoplasmic permeability, thus plants with its higher values are probably more tolerant to air pollutants (Singh *et al*., 1991). It also serves as an indicator of drought resistance in plants. Due to the air pollution, there is reduction in transpiration rate and damage to the leaf engine that pulls water up from the roots. Reduction in relative water content plant species is due to impact of pollutants on transpiration rate in leaves.

RWC = FW-DW / TW-DW x 100

FW = Fresh weight, DW = Dry weight, TW = Turgid weight

Fresh weight is obtained by weighing the fresh leaves. The leaves are then immersed in water over night, blotted dry and then weighed to get the turgid weight. The leaves are than dried overnight in an oven at 70°C and reweighed to obtain the dry weight.

Leaf extract pH

pH of leaf signifies the tolerant capacity of plant species.Reducing power of ascorbic acid is more at higher and less at lower pH values. Thus, the A (T+ P) part of the formula represents the potential of chloroplast to combat pollutants after their entry inside the plant. Studies have shown that decline of pH during the presence of acidic pollutant, pH of leaf is found lowered in sensitive species than tolerant plants. Higher level of pH in leaf extract indicates that the plants are tolerant under polluted conditions. pH plays an important role in signifying the condition of plants with respect to the study area.Thus, this combination of four parameters is suggested as representing the best index of the susceptibility levels of plants under field conditions.

CONCLUSION

Air pollution tolerant index of plants can be used to select tolerant plants to mitigate air pollution in urban areas by developing urban forest choosing locally available green vegetation like *Ficus religiosa*, *Zizypus jujube* and *Phyllanthus emblica* best suited to the area at roadsides and around industries.Reduction and increase in various parameters of the plant species studied at selected sites can be considered as an adaptation to protect plants against air pollution stress. Species having lower APTI value may act as bio-indicators of pollution. The morphological and biochemical traits of selected plants can serve as excellent quantitative and qualitative index of pollution level by capturing significant amount of health damaging particles from the atmosphere with the potential to improve local air quality.

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Contemporary Water Management Innovations Related to Water Saving and Water Sharing based on Agro-ecological principles

Article id: 21828

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INTRODUCTION

Micro-irrigation includes sprinklers and drip irrigation systems. Depending on the water available in the tube well, the decisions were made either to use a sprinkler or a drip irrigation system for providing critical life-saving irrigations to the field crops of water sharing groups' members.

Water saving: Innovations practiced by farmers

1. Renovated farm pond (water harvested after renovation)
2. Renovated bund of water body (water harvested after renovation)
3. Surface water saving
4. Ground water saving

Institutional Innovations: Water User Groups (WUGs)

The concept of social institutions through Water User Groups was promoted in all villages of the Panchayat with the objectives of educating community on the need to conserve water and to promote the concept of water sharing. These groups consisted of bore well owners and owners of farms receiving water from the bore well.

The farmers were oriented on the need to share water with other farmers. They were reminded that water scarcity was already an issue of concern in the district and were further informed that water levels in their bore wells would go down if newer bore wells were dug in their neighbouring farms. The better option would be to part with some of their water so that more farmers could be benefited. Many farmers were initially unwilling to share water, as they would not be benefited in any way by doing so.

The NGO functionaries told them that micro-irrigation systems (sprinklers and drips) were being given to them at 75 percent subsidy and that the water receivers and the organisations would jointly invest the remaining 25 percent if they agreed to part with some of their water. Few farmers duly came forward to sign Memoranda of Understanding. The other farmers were convinced with the agenda over time.

Training sessions on water budgeting were organised for farmers and each year to build their capacities to make optimal use of water. They were given extensive inputs on the preparation of water budgets. Data were collected on rainfall levels, land cover, crops, livestock and population. Water needs of households, livestock and crops were assessed and compared with the actual usage of water. They were informed that utilization of 70 percent or lesser of existing water resources implied that they were in the *safe zone*. The information in the budget could be used as a basis to plan for the next agricultural year.

There was not much positive response from most bore well owners and they were unwilling to share scarce water resources with others. Very few people turned up at the meeting held. Participation by farmers that did not own bore wells was particularly poor, as they were skeptical of a positive outcome. They were not only unsupportive of this agenda but actually began discouraging the other farmers. Special meetings were held with these farmers to

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educate them on the importance of cooperation amongst them and well owners.

Institutional Innovations in dryland agro-ecosystem

No.	Group	Practices
1.	**Social regulation of water from bore wells**	• Water should be share among all irrespective of ownership of bore-well • Ensuring acreage of bore-well owner • The participant should not dig up any new bore wells
2.	**Formation of water sharing group**	• Crop plan based on availability of water in agreement with member of CIG • Sharing water to protect the kharif crop of no-bore wells • Creating general fund for maintenance of pipeline repaired, etc. within the CIG bank account.
3.	**Setting of water sharing norms**	• Should not dig up bore-well everyone has to adopt micro irrigation system. • All the farmer has to help for collection of water • Shared water
4.	**Reduction of wastage of water**	• Reduction of area under water loving crop • Growing irrigated dry crop • Increasing catchment area

		• Field bunding

Water sharing: Dryland farmers faced with an uncertainty of declining water table, drying up of the aquifer in times of a drought year when rains fail to recharge the water aquifer and raise water table. Yet they were not worried, because under the social regulation programme (SRP), water sharing is now made possible. Social regulation is an innovative concept in sharing water among dryland farmers. They were able to provide life-saving irrigation to their groundnut crop and could reap in a better harvest. Their ability to come together and adhere to the agreed upon norms was again the crucial factor for their success. Major crops grown are groundnut and red gram. In the citrus gardens, crops like groundnut, sunflower and vegetables are grown in the inter spaces. Since these are all drylands, farmers resort to mixed cropping of groundnut + red gram + castor, cowpea + green gram and Jowar + cowpea.

A water sharing programme was developed by mutual consent of the farmers of the village. The farmers whose bore wells are filled with water, they can share their water with neighbouring farmers provided they adhere to some five conditions laid down by the group of farmers. These conditions were:

1. The participants in the social regulation programme (SRP) should not dip up any new bore wells in their fields. They need to share water available in the current live bore wells.
2. No one should grow paddy, which requires more water. All the participating farmers have to grow only an irrigated dry crop.
3. All the farmers have to help collect the rain water through water harvesting systems and enhance the recharging of the dead bore wells.

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4. Everyone has to adopt micro-irrigation systems like drip and sprinkler irrigation systems, for which subsidies (50 percent) and financial help (25 percent) from local NGO would be made available.
5. All the participating farmers of SRP (social regulation programme) need invariably practice NPM (non-pesticidal management) methods and practices.

Once the farmers have agreed upon these five conditions, they have strictly followed them and they were able to get a good crop of groundnut and no one reported any crop losses due to lack of water. Water was shared among the farmers without any troubles or fights. Since new bore wells were not dug up, and since water was not wasted, and rain water was harvested properly by all farmers, recharging of lower aquifers was made possible and they were able to get water throughout the crop season. All the villagers were happy for being able to come together and solve their water scarcity problems amicable through collective action and social regulation.

CONCLUSION

Water Sharing Norms to be followed by the society are pooling up of bore wells through a common pipeline network for sharing Water to be shared among all irrespective of having the ownership of bore well. Crop plans based on availability of water in agreement with members, Reduction of area under paddy, sharing the water to protect the kharif crop of non-bore well farmers. Ensuring the acreage of bore well owner and creating general fund for maintenance of pipeline, repairs, etc.

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COMMUNITY SEED BANKS: Methodological Approaches and Sustainability

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INTRODUCTION

Farmers need seed because without viable seed the survival of their household is endangered. In fact, the ways that farmers obtain seed are as old as agriculture, and most small-scale farmers in developing countries routinely save their seed from one harvest to the next. Nowadays, some 60-70 per cent of seed used by these farmers is still saved on farm. Most of the remaining seed is obtained off-farm, from local sources (Louwaars, 1994; Cromwell, 1996a). This seed is usually stored in some form of seed bank, providing seed storage for farmers, and in many case in situ conservation of plant genetic resources. Nevertheless, these community systems of seed supply are increasingly coming under pressure. In the first instance, factors such as droughts, crop failure, conflict, difficult storage conditions, and poverty are eroding both the quantity of seed, and number of plant varieties available to farmers. Second, as a result of agricultural modernization, farmers are increasingly purchasing more of their seed requirements (Berg, 1996a). Not only does this mean that local seed storage could become less important, but as this bought-in seed replaces older, local varieties, these varieties become increasingly unavailable in many communities. In consequence, interventions to strengthen informal seed supply systems, such as establishing seed banks, and seed breeding and multiplication are gaining popularity among NGOs and public sector institutions engaged in the area of seed supply. Community Seed Banks (CSBs) are places of storage where indigenous seed varieties are conserved and managed by community members. Community seed banks are collections of seeds that are maintained and administered by the communities themselves. These ex-situ conservation sites provide farmers with free and easy access to traditional seeds under the condition that a farmer returns twice the amount of seeds he or she borrowed. They not only reduce farmers' dependence on seed companies but also help conserve the agro-biodiversity of their villages. These seed banks form biodiversity conservation through community empowerment. Managed mostly by women, CSBs have successfully harnessed the role of women in Indian agriculture as custodians of biodiversity traditionally, it has been women who select and store seeds after every harvest. In CSBs their understanding as resource persons is used to good effect, empowering them with a sense of pride and accomplishment that raises their footing in the community over time, CSBs have proved to be more than just seed repositories. They have provided a platform for community members to set up alternate income generating schemes. The information sharing that often takes place at seed bank meetings raises awareness of sustainable agriculture within a community.

When setting up a seed bank, members of existing women's Self Help Groups within a community are invited to a meeting. A group is then selected from among these members to manage the bank. Meetings are held regularly in order to carry out the seed bank functions of a CSB include: storing seeds in the proper manner, lending seeds to those who request them and keeping records of seeds returned. A very

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important duty of CSB members is promoting traditional agricultural practices through the use of local seeds. These members are responsible for maintaining the purity of seeds by monitoring the farming methods of members who contribute to the seed bank and ensuring that they employ organic farming method.

Depending on management capabilities, governance modality and types, and level and duration of external support, CSBs withered rapidly or endured. "As a community owned and managed activity, with integrated additional activities like local financial resource mobilization, the creation of a conservation fund, and other income generation activities, the CSB was found to be effective and sustainable." Shrestha et al. 2008: 108 (Nepal case) .An enabling policy environment can legitimize CSBs & provide a stimulus to grow. There are most likely other socio-economic, environmental, and political factors, but given the lack of detailed documentation of the evolution of community gene/seed banks, it is hard to offer very solid evidence about sustainability.

- Seed saving initiatives at community level have been around for about 30-35 years
- Designed and implemented to conserve, restore, revitalise, strengthen and improve local seed systems, especially, but not solely focussed on local varieties
- These efforts have taken various forms and names:
- Community Gene Bank (Mali, Uganda, Burundi)
- Farmer Seed House (France)
- Seed Hut (Bangladesh)
- Seed Wealth Centre (Bangladesh)
- Seed-savers group (Trinidad and Tobago), association or network (Nicaragua, Spain)
- Community Seed Reserve (Nepal)
- Community Grain Bank (Brazil)
- Seed Library (Canada) and
- Community Seed Bank (India, Nepal)

Definitions of Community Seed Banks: Community seed banks range from a single farm family seed bank to a community seed bank. They could deal with local landraces, introduced landraces or improved cultivars. (Lewis and Mulvany 1997; Lipper et al. 2010; the Development Fund 2011)

Sthapit (2012) defined community seed bank as a community driven and community-owned effort to conserve and use both local and improved varieties for food security and to improve the livelihoods of farmers.

Three types of community seed banks can be identified:

1. Community gene bank (solely conservation of local varieties as PGR in small quantities)
2. Community seed bank (solely concerned with access and availability of cultivars) and
3. Community gene cum seed bank (carries out functions of both (i) and (ii)).

The term 'community seed bank' should not be used if conservation and sustainable use of plant genetic resources for food and agriculture are not the major objectives.

Although not all community gene/seed banks were strictly conservation focused when first set up. Later, over time, they got to play other roles: seed production, seed provision to farmers and crop improvement.

Why do we need CSBs?

Farmer have been buying high yielding seeds every year, often with borrowed money. They have stopped conserving and saving our own traditional seeds so they have no stocks. What will happen if, for some reason, big seed companies are unable to supply seeds so we need to worry about the most critical need of every farmer that access to good quality seeds? Across India, farmers converted to the cultivation

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of exotic seed varieties in the hopes of increasing yields and incomes. Today, they are heavily dependent on large companies to provide them with seeds. For small scale and marginal farmers who make up more than 83% of India's agricultural sector, access to good quality indigenous seeds can often mean the difference between sustainability and food insecurity.

Typology of Community Seed Banks: All community seed banks store seed destined for crop production. Yet seed banks vary according to storage methods, and the institutional arrangements. Seed banks are typically considered to fall into two broad categories:

Individual seed storage: seed is retained on-farm by millions of separate farming households throughout the world.

Collective seed storage: this type of seed storage occurs when farmers, either self-organised, or assisted by outside organisations, NGOs to coordinate the storage of the seed they need for planting.

There has been an increase of NGO-led, farmer-participatory collective seed storage projects in the last decade or so (Berg, 1996a).

A typology of community seed banks is provided which includes five categories:

De facto seed banks- the sum of all seed storage in a community. They have been in existence for a long time, operate informally, and are made up of separately stored, locally multiplied, farmers' and modern varieties of seed, kept in individual households.

Community seed exchange- organised exchange of some stored seed from de facto community seed banks. They operate semi-formally and are made up of individually stored, locally multiplied, farmers' and modern varieties. Some are traditional institutions, while others have been formed recently.

Organised seed banks- new institutions of organised collection, storage and exchange of seed. They operate formally and are made up of individually and collectively stored, locally multiplied, modern and farmers' varieties of seed.

Seed savers' networks- new networks organised storage and distribution of seed, mainly farmers' and non-commercial varieties, between individuals and groups in a wide spread of geographical locations.

Ceremonial seed banks- sacred groves and reserves. The seed (usually vegetative) is a common property resource, collectively managed and exchanged according to local (often religious) customs and traditions. Seed conservation is not the primary function of these systems but does occur as a consequence of their existence.

Maintenance of seed purity at farmer's field and at CSBs Precautions at farmer's field

(a) Maintaining isolation
(b) Rouging

1. **Precautions at seed banks**

(a) Physical purity
(b) Freedom from weed seeds

2. **Seed handling, cleaning and grading**

(a) Cleaning
(b) Grading

3. **Seed storage procedures for CSBs**

(a) Natural drying
(b) Artificial drying
(c) Seed processing
(d) Seed storage

4. Treatment of seeds and storage containers
5. Monitoring seed quality and health
6. Monitoring seed germination, viability and vigour before seed distribution

Sustainability of Community Seed Banks: Depending on management capabilities, governance modality and types, and level and

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duration of external support, CSBs withered rapidly or endured.

- Farmers' interest and leadership
- Availability of local facilitator and interlocutor with other organizations
- Responsiveness to crop diversity decline/loss
- Possibility to respond to climate change stresses
- Potential to develop into a broader community organization
- Availability of sound technical support; technical capabilities of farmers
- Possibility to link with crop improvement activities and to national gene bank
- Supportive policy and legal environment

Recognition: Importance of traditional varieties and related knowledge in smallholder farmers' livelihoods, Community seed banks as part of: national conservation strategy (South Africa)/agrobiodiversity policy (Nepal)/PGRFA policy (Uganda). Access and benefit sharing: financial and technical support, access to 'new' seeds and knowledge, connections to the national gene bank, crop improvement, improved extension service

Future Challenges:

- Community seed banks still face many challenges. Among them are:
- Lack of markets for farmers' varieties
- Inadequate capacity and knowledge in marketing seeds
- Inadequate storage facilities
- Lack of manpower during peak seasons
- Insufficient seed quality
- Late distribution of seeds and
- Late payments for the seeds loaned
- As well as high dependence on NGOs or a few dedicated farmers.
- The different farming committees running the seed banks meet these challenges in different ways.

CONCLUSION

Community Seed Banks (CSBs) are places of storage where indigenous seed varieties are conserved and managed by community members. Community seed banks are collections of seeds that are maintained and administered by the communities themselves. These ex-situ conservation sites provide farmers with free and easy access to traditional seeds under the condition that a farmer returns twice the amount of seeds he or she borrowed. They not only reduce farmers' dependence on seed companies but also help conserve the agro-biodiversity of their villages. These seed banks form biodiversity conservation through community empowerment. Managed mostly by women, CSBs have successfully harnessed the role of women in Indian agriculture as custodians of biodiversity. Traditionally, it has been women who select and store seeds after every harvest. In CSBs their understanding as resource persons is used to good effect, empowering them with a sense of pride and accomplishment that raises their footing in the community over time, CSBs have proved to be more than just seed repositories. They have provided a platform for community members to set up alternate income generating schemes. The information sharing that often takes place at seed bank meetings raises awareness of sustainable agriculture within a community. Through these meetings, many more farmers are persuaded to adopt organic farming practices.

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Role of soybean in diet and its health promoting characteristics

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INTRODUCTION

Healthy mind lives in a healthy body. Health is the most important factor for the progress of any country. Unfortunately overall health of our population is not up to the mark. Indian population is mostly vegetarian and depends on pulses for protein source. Being the basis for life, food is of prime importance and is vital for body functioning. The goal of a food is to supply the minimum requirements of both macro and micro nutrients. Dietary and nutritional surveys carried out during the past several decades have shown occurrence of several dietary deficiency diseases. In the opinion of the Nutrition Society of India (NIN), nearly two-thirds of our population is on imbalance diet. About 35% people live below poverty line, 55% children are malnourished, and 60-70% women are anemic. There is a heavy economic loss due to inefficiency caused by protein-calorie malnutrition. As per the survey reports India has achieved the food security but it is yet to achieve nutritional security. Protein calorie malnutrition is one of the major and serious deficiency diseases among the masses. The skyrocketing prices of protein sources and poverty resulting in lower purchasing power is major causes for this. Legumes are the traditional source of plant protein but these are becoming expensive day by day. Person with low purchasing power is likely to select the cheapest food constituent irrespective of its nutritional demerits. Hence identification of an alternate source of good quality protein for enhancing protein and calorie of their diet at affordable cost is necessary and of prime importance. Soybean has considerable potential for such supplementation to combat the prevailing protein calorie malnutrition.

History of Soybean

Soybean has become one of the most important crops of the world and is also known as Golden Bean. It is native to Asia and its cultivation and use of could be traced back to the beginning of China's agricultural age. Historically, soybean has played an important part in Asian culture, both as a food and as a medicine. Chinese medical compilations, dating back 6,000 years, mention its utilization for human consumption. It originated 4000-5000 years ago in the north and central regions of China and has been consumed throughout Asia for more than 1000 years in a variety of traditional food products. The populace of China, Japan, Korea, Manchuria, Philippines, and Indonesia has used soybean in their daily diets for centuries. The food products used in their diet can be typically divided into two categories: non-fermented and fermented. The non-fermented foods include fresh green soybeans, whole dry soybeans, soy nuts, soy sprouts, full fat soy flour, soymilk, tofu, okara in soup, and yuba whereas the fermented foods include soy sauce, tempeh, natto, miso, sufu (fermented tofu) and other fermented soymilk products. Asian countries still utilize soybeans largely for traditional soy food products. Though soybean used to be a sacred grain in ancient China but it got the impetus for use & commercialization by USA. Now it is now grown worldwide. China was the world's largest soybean producer and exporter during the first half of the 20^{th} century. In 1950s, soybean production developed rapidly in the USA and the

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USA (41%) is now the largest soybean producing country of the world. In 1970s, soybean production developed in Brazil, and this country is now the 2nd largest soybean-producing country (26%). Since then, soybean production developed in Argentina and now it is the 3rd largest soybean producing country (14%) of the world. These countries have highly mechanized system of soybean cultivation. The 4th and 5th largest soybean producing counties of the world are China (7%) and India (4%) followed by Paraguay (2%) and others (6%). Above 80% of the global soybean output is crushed worldwide to obtain oil and meal. The processed soybean is the largest source of protein feed and second largest source of vegetable oil in the world.The production and utilization of soybean is growing globally. Soybean has been and continues to be a major source of wellbeing for people in different regions of the world. Soybean use has increased in human nutrition & health, edible oil, livestock feed, bio fuel, industrial and pharmaceutical applications. Soy food products are gaining popularity on account of its unique characteristics and unmatched nutritional superiority nutritional superiority.

Nutrition security in India

In spite of striking agricultural progress and food grain production to the tune of over 250 million metric tonnes, poverty and poverty-induced malnutrition are widespread at least among the Indian population living below poverty line. Nutrition security of nutritionally poor population would be possible only through availability of nutritious food at affordable cost. Being a major source of good quality protein, oil and health promoting phytochemicals, soybean is emerging as boon to Indian society. Properly processed soy-products are nutritious, economical and health promoting. This situation provides an opportunity to make these nutritious soy products available to the vulnerable sections of the society Majority of our population, who are in low-income group, spends about 60 per cent of their income to meet the food needs of family and yet remain under nourished. This situation is likely to worsen with increasing population and food demand. Soybean, being a low cost source of quality nutrition is recognized as a solution to help meet nutritional security. Therefore, need is to develop soy food enterprises to make available nutritious soy products to meet nutrition requirements of our population at low cost.

The major soybean growing states are Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, Andhra Pradesh, and Chattisgarh. Introduction of soybean has helped in improving the socioeconomic conditions of large number of small and marginal farmers. Madhya Pradesh since beginning has been the major contributor to the soybean area and production, currently contributing 59 % of area and production followed by Maharashtra with a contribution of 28 and 26 % in terms of total area and production of the country. The crop has potential to eliminate protein malnutrition prevailing in poor sections of society in the country. The utilization of soybean for food uses in India is still meagre, and work needs to be done in terms of production of acceptable soy food products and its inclusion in daily diet of Indian masses to mitigate the widespread energy-protein malnutrition. India activated its development programme for soybean in the 1960s and the expansion during 1972 to 1984 was exceptionally rapid. Around 770 thousand hectares of land were brought under soybean during the period which was almost 24-fold increase. The Government of India as well as private sector took aggressive approach to increase the food use of soybean in the country.

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In addition, technologies for the processing of soybeans for wider utilization contributed to the expansion.

Table 1.Percentage of total soybean production in various states of India

State	Total production (%)
Madhya Pradesh	59.2
Maharashtra	27.1
Rajasthan	7.5
Karnataka	1.8
Andhra Pradesh	1.5
Chhattisgarh	1.6
Other States	1.3
Total	100.00

The need of the hour is to give greater emphasis on processing and utilization of whole-bean as food products and make it available at an affordable cost to economically under-privileged population, 40% or so in India. It could be processed at domestic level also and thereby help in combating protein calorie malnutrition (PCM) at household level at a very low cost. Promotion of soy fortified diet should become an integral component of programme to achieve the Millennium Development Goals and other similar initiatives aimed at reducing global hunger and malnutrition.

Soybean and Food Value

Soybean is an excellent source of nutrition and health promoting phytochemicals and has tremendous potential to be transformed into a number of healthy foods, suiting to individual requirements, across the globe. Soy protein is the least expensive and best plant protein. In 1993, the US Food & Drug Administration (FDA) adopted the Protein Digestibility Corrected Amino Acid Score (PDCAAS), a new and more accurate method for evaluating protein quality. The highest PDCAAS value that any protein can receive is 1.00. The PDCAAS value of soy protein is 1.00 and that of egg white, casein and meat are 1.00, 1.00 and 0.92 respectively. Traditionally soybean has never been a component in the Indian dietary system. But it was occupying an important place in the daily diet of South East Asian Countries from thousands of years. Main reasons for introduction of soybean as protein source (Table 1) in India are its superior protein quality with rich content which is almost twice of pulses, its adaptability towards a wide range of population,eco-friendly process, ability to fix nitrogen. However it cannot be utilized as a pulse *(dal)* to which the Indian population is accustomed due to very poor cooking ability on account of presence of low starch / carbohydrate. It has to be therefore, processed appropriately for other food uses. In order to maximize the potential of soybean in the world as protein food source, it is necessary to provide the food in a form that is acceptable to the culture for which it is intended (Meyers, 1972). Lack of acquaintance with soy food and unawareness with the nutritional and health benefits has kept away the common man from utilization of soybean in India. Hence efforts were made to develop and popularize the soy based nutritious food products suiting to the Indian taste and pallet in Indian sub-continent.

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Table 2. Nutritive composition of soybean and its constituents (%)

Constituent	Age seed (%)	Protein (%)	Fat (%)	Carp (%)	Ash (%)
Soybean (Whole)	100	40	20	34	4.9
Cotyledon	90	43	23	29	5.0
Hull	8	9	1	86	4.3
Hypocotyls	2	41	11	43	4.4

Soybean was targeted to be used in India, as major protein source to meet nutritional requirements. Soybean contains, other than 40% protein, 19.5% fat, 21 % carbohydrate and provides 432 kcal per 1.00 g (Table -2 and 3). Soybean can make significant nutritional contribution if typical traditional foods are supplemented with properly processed soybean in combination with cereals. All the traditional products being of regular consumption pattern, no extra efforts are needed as such for their introduction.

Table 3. Nutritive value of soybean as compared to other pulses per 100 g

	Protein	Fat	Calcium	Carbohydrat	Energy
Pulses	**(g)**	**(g)**	**(mg)**	**(g)**	**(kcal)**
Bengal gram dhal	20.8	5.6	56	59.8	372
Green gram dhal	24.5	1.2	75	59.9	348
Lentil	25.1	0.7	69	59.0	343
Dry peas	19.7	1.1	75	56.5	315
Rajrnah	22.9	1.3	260	60.6	346
Soybean	40.2	19.	240	20.9	432

Major health benefits on regular eating of soy foods

Soybean being rich in protein and calorie has a great potential to tackle the problem of protein-calorie malnutrition (PCM) prevalent in India and other developing countries of the world. Soybean contains twice as much protein as pulses, groundnut, meat & fish; three times as much as egg and more than 10 times that of milk. Protein is the most vital nutrient for the body. It is required for the proper growth of the body, for hormonal secretions within the body, for efficient functioning of our systems, for muscle repair etc. To fulfil these needs, it is important to have around a gram of protein per kg of your body weight daily. A survey has revealed that about 80 percent Indians lack protein in their diets and 9 out every 10 Indians are protein deficient. Hence, a reliable protein supplement is of outmost importance and soy protein serves the purpose. Soy milk does not have lactose. Hence, soymilk and other dairy analogs are best suited to lactose-intolerant persons. Soybean is also a very good source of food for diabetics. The major health benefits from the regular use of soybean in the daily diet are presented in Table 4.

Table 4. Major health benefits from the regular use of soybean in the daily diet

Nutrients	Major health benefits on regular eating
Protein	Lowers blood cholesterol
Carbohydrates	Relaxes constipation, Good for diabetics and lactose intolerants

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Fat	Prevents cardio-vascular diseases
Mineral	Overall health promotion
Vitamin	Overall health promotion
Phyto chemicals	Prevent cancer, helpful in menopause and osteoporosis

Incorporation of soy foods in the daily diet is a superior way to improve human nutrition and health. After initial research the US Food & Drug Administration has (October 26th 1999) endorsed a health claim on relationship between consumption of soy protein. USFDA has also approved the health claim stating that 25 g of soy protein a day *as part of a* daily diet low in saturated fat and cholesterol can help reduce total and LDL cholesterol and thereby may reduce the risk of heart disease. Soybean has now become a preferred vegetable protein for food applications due to its multiple functional properties. Majority of the Indian population is vegetarian and derive their edible proteins from plant sources like cereals, pulses and to some extent from oil seeds. In this respect, soybean has a tremendous potential to be transformed into a number of traditional local foods. The primary interest in soybean in India has been oil and besides oil, textured vegetable protein/meat analogues and lecithin were in use. Initially there was a difficulty in promotion of soybean for food uses. Earlier people were reluctant in accepting soy products but currently increasing attention is being paid towards the potential of soybean as a major protein source. Soy oil is mainly used as cooking medium and soy meal was used earlier as feed but now finding ways for high value products. It is a cost effective and high quality ingredient that can replace dairy, egg and meat proteins as consumers search for ever increasing variations to diet staples. The nutritional and health benefits of soybean at affordable cost have played a crucial role. Now it has penetrated the market and being accepted on health and economic grounds. Properly processed, soybean can be used for supplementation of all the traditional food products for protein and calorie enhancement.

Future prospect of soybean foods in India

The role of soy in preventing a wide range of diseases and nutritional requirement is need of present time. The consumer demand for soy-based foods and food ingredients are increasing day by day. Protein calorie malnutrition is a serious health concern among Indian masses as our diets are cereal based. Cereals incorporated in the daily Indian diets individually do not supply adequate good quality protein and calorie for satisfactory growth, body repair and maintenance. Therefore, protein supplementation of these diets is necessary to overcome the problems associated with the nutritional deficiencies. It has been reported that among all plant proteins soy protein is most attractive due to its abundance, affordable cost, better functional properties and excellent nutritional quality. In response, major food companies are increasingly finding new ways to incorporate soy protein into mainstream food products and beverages. Soy is now commanding an unprecedented position as a preferred ingredient in these products. Soybean helps people feel better & live longer with an enhanced quality of life. Soybean, therefore, has an excellent future and it will have a significant impact on human nutrition and health globally, and thereby, on its economy. Production and utilization of soybean need to be encouraged worldwide as it is in the interest of greener globe and better human health resulting into happiness and longevity.

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Seed dormancy

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Seed dormancy:

- Seed dormancy refers to a state in which viable seeds fail to germinate when provided with conditions normally favourable to germination i.e. adequate moisture, appropriate temperature regime, a normal atmosphere and in some cases light.
- Dormancy has evolved as a strategy to avoid germination under conditions where seedling survival is likely to be low.
- Dormancy may occur within the embryo (Ground nut) or in the seed caot (Sunflower). The period of dormancy varies from a few days to several months depending on the plant species.

Quiscence:
It is the phenomenon in which the seeds fail to germinate for want of a particular environmental factor.

Types of dormancy:

1. Primary dormancy:
This is otherwise called as innate dormancy. These seeds enter in to dormancy much before they are harvested i.e. when they are still on their mother plant itself.
eg. 2-3 months in Virginia runners of Groundnut
Up to 40 days after seed is formed in sunflower

2. Secondary dormancy:
This is called as induced dormancy. These seeds are non dormant when they are harvested from the mother plant. However when they are exposed to brief periods of unfavourable environmental condition they show dormancy.
Eg: Mustard seed exposed to high concentration of CO_2
Wheat stored in high moisture content in air tight containers at 50^0C

Advantages and Disadvantages of dormancy:

Advantage:

1. Prevents seeds from germinating during storage and other handling procedures
2. Induction of dormancy, for ex by drying and dark storage generally promotes storability.
3. Seeds with no dormancy like recalcitrant seeds of rain forest species are very difficult to handle, e.g. because germination may begin already during transport and temporary storage.
4. Equips organisms to escape the detrimental effects of adverse natural environments, thereby enhancing their chances of survival.
5. In Viviparous seeds (premature germination of seeds within ears/pods) a wet weather is favourable for germination just before harvest. In such cases, a pre-harvest rain leads to deterioration in the quality of crop produce, eg: wheat, it reduces seed quality and vigor, milling and baking quality and even grain yield. Therefore, a certain degree of seed dormancy is often deliberately selected for in order to prevent pre harvest sprouting in cereals.
6. A brief period of dormancy provides adequate time to farmers to harvest, thresh and store the seeds, thereby avoiding considerable losses.

Disadvantage:
The seed with dormancy cannot be used immediately after harvest for seed purpose

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Causes for dormancy

Seed coat factors

(a) Seed coat impermeable to water: common in seeds of leguminaceae, Malvaceae, Convolvulaceae and chenopodiaceae. Seed coat with thick waxy cuticle, lignin and suberin barriers makes seeds impermeable to water.

(b) Seed coat impermeable to oxygen: Any disturbance to the entry of oxygen and exit of CO_2 decreases respiration and there by remains in dormant condition.

(c) Mechanically resistant seed coat: Hard seed coats of nuts make it difficult for embryo to germinate and break the seed coat. High salt concentration in water aids to cause mechanical resistance to germination.

Embryo factors

Immature/rudimentary embryo: Ranunculus plantago. These embryos require after ripening though their growth is completed morphologically. This is also called as physiological dormancy.

Inhibitory factors

The inhibitors (coumarin, caffeic acid, ferulic acid and ABA) may present in the embryo, endosperm or seed coat or pericarp. These inhibitors deactivate enzymes like amylase, protease and phytase. This will limit the supply of simple substances like sugars, fatty acids and P necessary for germination. If the ratio of these inhibitors is higher than that of endogenous hormones especially GA the seeds remain dormant till a balance between them is reached in favour of growth promoters.

Methods to break dormancy/ Pre-treatment

Pretreatment is a 'pre-sowing-treatment' carried out in order to enhance rapid and uniform germination of seed sown in the nursery, field or for testing.

The various treatments for overcoming dormancy may be divided into the following three groups:

(i) Seed coat treatments
(ii) Embryo treatments
(iii) Miscellaneous approaches

Seed coat treatments

Mechanical scarification
Chemical scarification
Acid pretreatment

Embryo treatments

Stratification

High temperature treatment

Incubation at 40-50^{0}C for few hours to 1-5 days at less than 15% Eg: Rice

Chemical/Hormonal treatments:

- GA (100ppm), Kinetin (10-15 ppm), Benzyl adenine (2 ppm), Ethrel (250 ppm) for sunflower.
- Ethrel 75ppm and GA 60-75 ppm in groundnut

Priming and Fluid Drilling:

- Priming is a method to promote rapid and uniform germination of seeds, by controlling imbibition to an extent where germination is initiated, but insufficient to cause radicle emergence.

Seed-coating and Pelleting

- Coating and pelleting are practices of covering seeds with an inert substance prior to sowing.

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Role of Robotics in Food Processing

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The food processing industry in India is a rising sector. India's agricultural production base is reasonably strong, but wastage of agricultural produce is also sizeable, still processing of fruits and vegetables is low as 2%, around 35% in milk, 21% in meat and 6% in poultry products. Food industries in India are mostly small scale industries, and having old machines operated by human intervention. Food processing and packaging sector make significant use of robot. It ranges from handling of unpacked foodstuffs such as cheese, meat, poultry, to bottles, trays, carton and other food and beverage containers. In fact, robots are capable of performing their functions with greater accuracy and precision, and they take less time compare to human. In India, operator control the activities of the machine which cause hindrance in working of machine, if self-operated machines (Robots) are used they can helps in increasing the production and productivity in food processing industries. It is required to design and configure robot in such a way so it can work with manual operation staff very close to each other with high level of safety.

The food manufacturing industry is one of the largest, manufacturing sectors in most countries and is a vital strategic element in all national economies. It is a diverse and somewhat fragmented industry, the vast majority of which can be classified as small-to-medium sized enterprises (SME). Manufacturing operations are mainly manual in nature, particularly in the SME sector and the use of state-of-the-art automation are increasingly common. The availability of highly effective machines, such as the Delta class of robot, has allowed automation to move upstream and undertake rapid pick-and-place operations with food products on the production lines. Numerous impressive systems are currently installed, generally focused on the high-volume, long-life and single-product lines. These robots are optimized for fast operation (typically 100–120 picks per minute) with lightweight payloads (typically 1–2 kg) and have been particularly successful in processing food products. Mainly robots and electro-mechanical devices are used in food processing production line where precise, safe and high-volume production products with higher degree of automation are required. If the product is regular in shape and well located on the line, then simple electro-mechanical solutions will suffice. Poor line localization will usually involve visual-serving robotic procedures, particularly if the product is also irregular in shape. It has been demonstrated that a combination of robotics and electro-mechanical processes can address the automation of most food products of either regular or irregular shape. Initially in the sector, standard industrial robots were used for end-of-line tasks including packaging and palletizing. These were gradually moved up the line to undertake simple product placement tasks and demonstrated their abilities in a range of applications such as batch processing on a bakery assembly line, high-speed processing on a high-volume pancake line. The term robot has been traditionally used to describe a multi-degree of freedom manipulator, capable of being re-programmed through the use of a high level language. The use of a variety of tools, with appropriate software, enables robots to perform different tasks. The robotic arm may be a three to seven-axis arm with a serial or parallel configuration. Each joint can be actuated by an electric, hydraulic or pneumatic drive system, under computer control. A central controller provides a means by which the joints of the robot can be actuated for the execution of specific movements. The controller can be interfaced to other devices or systems, such as a computer vision system, through the use of an input/output unit or a serial/parallel communication line. The main controller also provides a means for operator/ programmer interaction with the system.

In food processing, the robot arm, its controller and the ancillary devices must be made to withstand the environment and the conditions for cleaning. Cleaning often involves the use of high pressure hot water and various chemical agents. The design of the system should meet with all the required standards and legislation for food processing machinery. This is an essential requirement which is now being seriously considered by robot manufacturers. Flexible automation systems for food processing can now be purchased from some specific robot suppliers. The main limitation, however, is the immediate use of such robots in tasks currently performed by the skilled labour force. To cope with the range of tasks and the variability in shape, size and properties of the products, novel end-effectors and sensors need to be introduced. Through the integration of these technologies and the implementation of intelligent software with some learning capability, the more demanding or highly skilled tasks may be automated. More skilled robots will need to be developed thus enabling the many tasks that we take for granted to be automated. For the more varied products, the choice of end-effector (grippers, cutting tools, etc.) and the capabilities of sensory technology with the corresponding software and strategies for manipulator control, play a major role. In almost every case integration can lead to viable solutions but applications in food processing have yet to be exploited. Meat, fish and poultry accounts for a considerable portion of the food consumed worldwide, but their production does not easily lend itself to automatic methods. The main problems are due to the variability and flexibility of the products, as well as the concerns for hygiene, quality and consumer safety. Robotics is desirable as there are increasing difficulties with the manual procedures in food production. Some of the driving influences encouraging the development of robotics and automation in meat production stem from human contact with the product and, more importantly, the removal of people from hazardous work conditions. Production control and consistency in output, as well as increased productivity, are tangible reasons for using robots in this sector. Before robots were used only for downstream application such as packaging, palletizing and transporting. With application of vision system, improved computing power and matching software solutions now they are used in processing line (upstream application). Nowadays 50% of robots are used in automotive industries and only 3-4% used in food processing industries. In 2013, 1.78 lakh industrial robots were sold worldwide, of which 6200 (3.5%) were destined for the food and beverage industry. South Korea, Japan and Germany are the countries with highest 'robot density' i.e. 437, 323 and 282 respectively ('Robot density'– number of robots in use for every 10,000 workers). In 1990s, the first application in direct food handling in the bakery industry was seen. These robots were able to perform simple pick and place operation at a reason able rate of 55-80 cycles per minutes. India imported 1.5% of industrial robots sold world widely in 2013.

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Growth-defense trade-off mechanisms in plants

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INTRODUCTION

World population is increasing exponentially and to feed this bulging population there is a need of increase in agricultural productivity. But, various abiotic and biotic stresses are major limiting factors, among these biotic stress is an additional challenge inducing a strong pressure on plant and plant production. For survival plants have developed various mechanisms to detect pathogens and pests. Plant growth rate and reproductive performance is linked to the availability of photo assimilates and other vital resources obtained from the environment. These resources, however, are also used to produce defense compounds and physical structures that protect tissues from destruction by herbivores and pathogens. Therefore, understanding the defense-growth is important for boosting plant productivity, and the insights into these trade-off mechanisms which is crucial for agricultural productivity.

Defense mechanisms in plant

To survive under adverse conditions, plants have evolved intricate mechanisms to perceive external signals. Phytohormones such as salicylic acid (SA), jasmonic acid (JA), ethylene (ET), and abscisic acid (ABA) are primary regulator of protective responses in plants against both biotic and abiotic stresses via synergistic and antagonistic actions, which are referred to as signaling crosstalk and help in reprogramming of the genetic machinery results in adequate defense reactions and increase in plant tolerance in order to minimize the biological damage caused by the stress.

Trade-off between growth and defense

Photosynthesis in plant converts light energy into chemical energy in the form of photoassimilates. These photoassimilates are then allocated towards growth or defense, depending on the presence or absence of specific stresses. This process is facilitated by hormone crosstalk and is referred to as the growth-defense tradeoff. The growth-defense tradeoffs are thought to occur in plants due to resource restrictions, which demand prioritization towards either growth or defense. These trade-offs have profound implications in agriculture and natural ecosystems, as both processes are vital for plant survival, reproduction, production, plant fitness. During stress conditions plant possesses a limited pool of resources that can be invested either in growth or in defence.Induced plant resistance depends on the production of specialized metabolites that repel attack by biotic aggressors and is often associated with reduced growth of vegetative tissues. While the deployment of defense mechanisms is imperative for plant survival, defense activation generally comes at the expense of plant growth. Hormonal crosstalk mechanisms have a fundamental role in fine tuning the growth-defense process.

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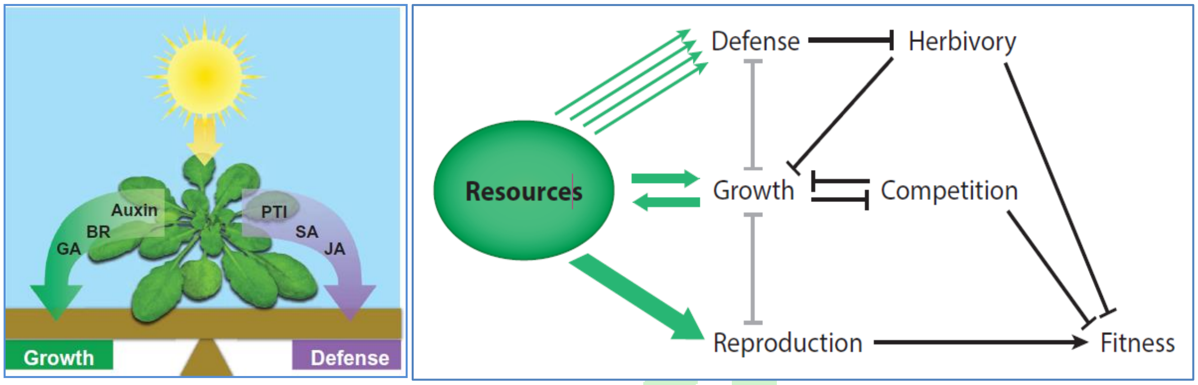

Fig.1 An overview of defence-growth trade off in plants (Zust et al., 2017). BR, brassinosteroid; GA, gibberellin; PTI, pathogen-associated-molecular- pattern-triggered immunity; SA, salicylic acid; JA, jasmonates.

Implementation of defense imposes a substantial demand for resources, which resulted in reduced growth. This negative impact on growth could result from diminished photosynthesis, which would decrease the overall pool of energy reserves, and or from a diversion of resources away from growth and towards defense. In support of the growth-defense trade-off theory, diversion of plant resources has been shown to occur at all levels, including machinery involved in transcription, translation, and protein secretion from cells as well as prioritization of carbon and nitrogen towards production of defense compounds. Pathogen or herbivore activity that results in damage to photosynthetic machinery, loss of photosynthetic tissue, and or disruption of the vasculature affecting water and sugar transport has been shown to negatively impact photosynthesis. In addition, pathogen or herbivore attack has been shown to suppress components of photosynthesis at the levels of gene expression.

CONCLUSION

An increased understanding of growth-defense tradeoffs is expected to inform research aimed at producing plants in which metabolic resources are optimally allocated to growth and defense, thereby enhancing productivity in a given environment. Additional research is needed to determine how the relevant metabolic and signal transduction networks can be rewired to uncouple, or at least minimize, tradeoffs to produce plants that exhibit robust growth and defense at the same time. Understanding of the trade-offs mechanisms between immunity and yield used by plants to balance growth and defense can enrich plant breeding and engineering strategies for rapid and efficient selection of highly resistant cultivars without yield penalties to feed the increasing world population

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Potential of trap cropping in pest management

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INTRODUCTION

The concept of trap cropping fits into the ecological framework of habitat manipulation of an agroecosystem for the purpose of pest management. Trap crops have been defined as "plant stands grown to attract insects or other organisms like nematodes to protect target crops from pest attack, preventing the pests from reaching the crop or concentrating them in a certain part of the field where they can be economically destroyed". The fundamental tenet of this definition involves differential pest preference between plant species, the plants that function as trap crops and those to be protected. One example of the limitation of this definition is that the same species of plant that serves as a trap crop can also be used as the crop to be protected if it is grown in a particular spatial or temporal manner or with a particular added trait. Therefore, a broader definition of trap crops has been proposed as plant stands that are, per se or via manipulation, deployed to attract, divert, intercept, and/or retain targeted insects or the pathogens they vector in order to reduce damage to the main crop. This broader definition encompasses the inherent characteristics of the trap crops themselves as well as their deployment.

TYPES OF TRAP CROPS

Trap crops can be classified based on spatial distribution and characteristics of trap crops.

A. Based on characteristics of trap crop-

1. Conventional trap crop- It is most common practice. Growing of trap crops next to a higher value crop is naturally more attractive to a pest as either a food source or oviposition site than is the main crop, thus preventing or making less likely the arrival of the pest to the main crop and/or concentrating it in the trap crop where it can be economically destroyed. Ex: Castor and Marigold in Ground nut crop, Alfalfa as a trap crop for Lygus bugs in Cotton.

2. Dead end Trap cropping- Trap crops which are highly attractive to insects but they or their offspring's can't survive. Dead-end trap crops serve as a sink for pests, preventing their movement from the trap crop to the main crop later in the season Ex: Indian mustered for Cabbage diamond back moth, Sun hemp for Bean pod borer.

3. Genetically modified trap cropping- Crops are genetically modified (i.e., the deliberate manipulation of genes through the use of biotechnology) to attract pests. Ex. Genetically engineered (Bt.) Potato for Colerado Potato beetle.

B. Based on spatial distribution-

1. Perimeter trap cropping- Growing trap crops around the borders of the main crop. For example borders of early-planted potatoes have been used as a trap crop for Colorado potato beetle, which moves to potato fields from overwintering sites next to the crop, becoming concentrated in the outer rows, where it can be treated with insecticides, cultural practices.

2. Sequential trap cropping- Growing trap crops earlier or later than the main crop to attract the pest.

Ex. Indian mustard as a trap crop for diamond back month in Cabbage.

3. Multiple trap cropping- Planting of several species simultaneously as trap crops with the purpose of either managing several insect pests at the same time or enhancing the control of one insect pest by combining plants for attracting pests. For ex. use of a mixture of castor, millet, and soybean to control Groundnut leaf miner and the use of corn and potato plants combined as a trap crop to control wireworms in sweet potato fields.

4. Push – Pull trap cropping- Growing combination of trap crop and repellent crops. The trap crop attracts the insect pest and, combined with the repellent intercrop, diverts the insect pest away from the main crop. **Ex.** Marigold and Onion in Chilli. A push-pull strategy based on using either Napier or Sudan grass as a trap crop planted around the main crop, and either Desmodium or Molasses grass planted within the field as a repellent intercrop, has greatly increased the effectiveness of trap cropping for stem borers.

System of planting some trap crop: - Ex.

- Planting Indian mustard as a trap crop for management of Diamond Back Moth**.** Sowing of two rows of bold seeded Mustard in every 25 rows of Cauliflower/Cabbage.
- Planting Cow pea as intercrop for management of *Heliothis sp.* Sowing of one rows of Cow pea in every 5 rows of cotton.
- Planting Tobacco as trap crop for management of *Heliothis sp.* Sowing of two rows of Tobacco in every 20 rows of Cotton.
- Planting African marigold as trap crop for management of Fruit borer. Sowing of two rows of marigold in every 14 rows of Tomato.
- Planting Coriander or Fenugreek as trap crop for management of shoot and fruit borer. Sowing of one rows of Coriander or Fenugreek in every two rows of Brinjal.
- Planting Coriander or Marigold as a trap crop for management of Gram pod borer**.** Sowing of one rows of Coriander or Marigold in every 4 rows of Gram.
- Planting Corn as trap crop for management of *Heliothis sp.* Sowing of two rows of Tobacco in every 20 rows of Cotton.

CONCLUSION

The most important insect characteristics that determine whether an insect may be subject to management by trap crops are the insect stage targeted by the trap crop and the insect's ability to direct its movement, its migratory behavior and its host-finding behaviour (Abate, 1988). The insect stage to be controlled by the trap crop is of critical importance in designing an effective trap crop strategy. In general, the attractiveness of the trap crop and the proportion of trap crops in the field are important factors in the arrestment of the insect and in the success of a trap cropping system. In situations in which trap cropping has been successfully implemented, it has provided sustainable and long-term management solutions to control difficult pests. Successes have occurred in both developed (e.g., Lygus bugs on cotton) and developing countries (e.g., use of push-pull trap cropping to control stem borers in corn) (Banks and Ekbom, 1999).With the advent of biotechnology, new opportunities for trap cropping have arisen, as illustrated by the examples of Bt potatoes. Organic growers and those farmers interested in biologically based pest management programs have especially shown increased interest in trap cropping, as have nongovernmental organizations and other educational organizations working in developing countries where access to effective insecticides is limited.

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Procedure of protecting plant varieties and farmer rights

Article id: 21835

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INTRODUCTION:

Legal Rights granted for a fixed period to exclude others from imitating, manufacturing, using or selling a protected matter or process is called Intellectual Property Rights. The main purpose of intellectual property law is to encourage the invention of a broad variety of intellectual goods. The law gives people and businesses property rights to the information and intellectual goods they create, usually for particular period of time. It will bring economic incentive for their creation, because people getting profit from the information and intellectual goods they created. These economic incentives are helps to stimulate innovation and contribute to the technological improvement of the nation, which depends on the extent of protection granted to creator.Legislations covering Intellectual Property Rights (IPRs)in India:

- The Patents Act,1970
- The Design Act,2000
- The Trademark Act,1999
- The Copyright Act,1957
- The Semiconductor Integrated Circuits Layout Design Act,2000
- The Geographical Indications of Goods (Registration and Protection) Act,1999
- The Protection of Plant varieties and Farmers' Rights Act, 2001.

The Protection of Plant Variety and Farmers Right Act, 2001 (PPVFR Act) is enacted by the Parliament of Indiathat was to provide an effective system for protection of plant varieties, the rights of farmers and plant breeders, and to encourage the development and cultivation of new varieties of plants. This act received on the 30 October 2001 from President of India. The government of India enacted PPVFRA adopting "*sui-generis*" system for plant variety protection.To fulfil obligation under Article 27(3) (b) of TRIPS and to harmonize with UPOV system: PPV&FR Act, 2001 was enacted. The time period for protection of field crops is 15 years & trees and vines is 18 years. Then the notified varieties are 15 years from the date of notification under section 5 of Seeds Act, 1966.

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Objectives of PPV & FR Act, 2001:

- To provide an effective system for protection of plant varieties and rights of farmers and plant breeders.
- To identify the farmers in respect of their contribution made at conserving, improving and making available PGR for development of new plant varieties.
- To protect plant breeders' rights to stimulate investment for Research & Development and development of new varieties
- To facilitate the growth of seed industry to ensure production and availability of high quality seed / planting material.

Rights under the Act:

Breeder rights : An exclusive right on the breeder or his successor, his agent or licensee, to produce, sell, market, distribute, import or export the variety.a breeder may authorize any person to produce, sell, market or otherwise deal with the variety registered under this act. Breeder shall enjoy provisional protection of his variety against any abusive act committed by any third party during the period between filling of application for registration and decision taken by authority.

Researcher Rights: The use of any variety registered under this act by any person using such variety for conducting experiment or research. The use of a variety as an initial source of variety for the purpose of creating of other varieties. Provided that the authorization of the breeder of a registered variety is required where the repeated use of such variety as a parental line is necessary for commercial production of such other newly developed variety.

Farmer Rights:

A farmer is entitled to save, use sow, re-sow exchange, share or sell his farm produce including seed of a variety protected under the Act in the same manner as he was entitled before the coming into force of the Act and farmer is entitled to sell non-branded seed of a variety protected under the Act. Farmer engaged in conservation of genetic resources of land races and wild relatives of economic plants, improvement through selection and preservation shall be entitled for recognition and reward from Gene Fund provided that the said material has been used as donors of genes in varieties registered under this Act. A farmer is entitled to claim compensation in case of failure of expected performance by registered varieties-Where any variety registered under the Act has been sold to a farmer or a group of farmer or organization of farmers, the breeder of registered variety shall disclose the expected performance under given conditions. If such material fails to provide such expected performance under given conditions, a farmer or a group of farmer or organization of farmers may claim compensation from the registered breeder.

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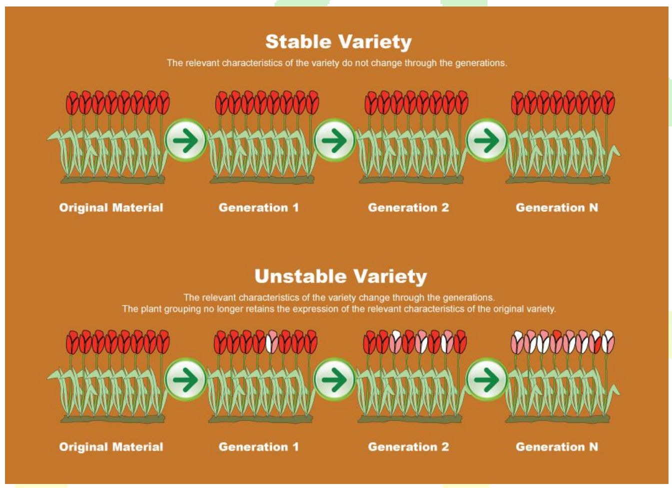
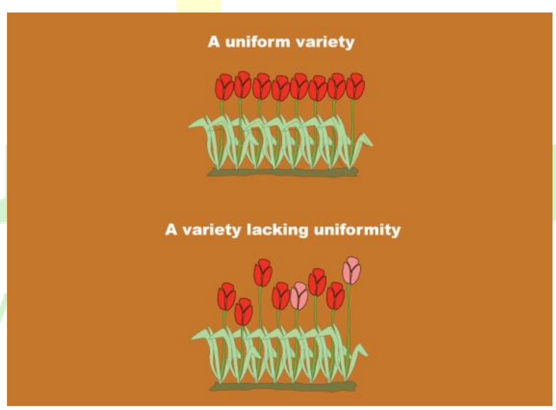
A farmer is protected under innocent infringement where in if farmer who at the time of such infringement was not aware of the existence of such right and a relief in an infringement suit shall not be granted by court against a farmer who proves at the time of infringement he was not aware of the existence of the right so infringed.The farmers are exempted from payment of any fees in respect of any proceedings before the Registrar or Authority or Tribunal or High Court exempted from payment of any fee for inspection of any document or obtaining any decision or order or document under the Act or Rules. Farmers have the right to access seed of registered varieties at a reasonable and remunerative price. When this condition is not met, the breeder's exclusive right over the variety is suspended under the provision concerning compulsory licensing, and the breeder is obligated to license the seed production, distribution and sales of the variety to a competent legal entity. When farmers' varieties, whether extant or new, are used by a third party as source material for the development of an essentially derived variety, the farmers need to provide prior authorization for its commercialization. Such a process can allow farmers to negotiate the terms of authorization with the breeder, which may include royalties, benefit-sharing, etc.





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Registration

For registration of a plant variety under the act it will follow prerequisites of essential criteria. The variety must have the novelty, distinctiveness, uniformity and stability. Variety does not contain any gene or gene sequences involving anti-traitor technology. It need complete data of parental lines (its geographical location or farmer, village, community involved in development of variety).A declaration that the genetic material used for breeding of such variety has been lawfully acquired. A breeder or other person making application for registration shall disclose the use of genetic material conserved by any tribal or rural families for improvement of such variety.

The application for registration of a variety is to be made in the form prescribed by the PPV & FR Authority. Form I - for registration of new variety, extant variety and farmer's variety and Form II - for essentially derived varieties (EDVs) and transgenic varieties. Technical Questionnaire attached with Form I and Form II – for detailed information of the concerned variety. These filled application forms must be accompanied by the fee prescribed by the Authority

Sl.no.	Type of variety	Fee for Registration
1	**Extant variety** notified under Section 5 of the Seeds Act, 1966.	Rs- 2000/-
2	New variety/Essentially Derived Variety/ Variety which are there common Knowledge (VCK)	Individual Rs-7000/- Educational Rs-10000/- Commercial Rs- 50000/-
3	Farmer Variety	No fee

Certificate of Registration:

Application fulfills the all essential requirements and it have been accepted by register of the registration. The issued certificate will be valid for nine years for tree and vine crops, six years in case of other crops. It will be renewed and reviewed for the next remaining period on payment of fee. The total period validity should not exceed 15yrs for crops and 18 years for tree and vine crops from the date of notification under seed Act, 1966.

Functions of protection of plant varieties & farmers' rights authority (ppv&fra), established: November 11, 2005.

Registration of new, extant and farmers' plant varieties. Developing DUS (Distinctiveness, Uniformity and Stability) test guidelines for new plant species. Characterization and documentation of registered varieties. Ensuring availability of seeds of registered varieties to farmers by provision of compulsory license. Maintenance of National Register of plant varieties. Recognition and reward to farmers/farming communities for their contributions towards conservation of PGR for development of new plant varieties.Cataloguing facility for varieties of plants.

Benefit sharing

Section 26 provides benefit sharing in the farmer rights. The breeder of any registered variety has ignored the valuable contribution of any village or local community which contributed significantly in the evolution of a variety, they may claim for benefit sharing**.** Depending upon the extent and nature of the use of genetic material of the claimant in the development of the variety along with commercial utility and demand in the market of the variety, breeder will deposit the amount in the Gene Fund. In case of

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failure within a period of three months the registrar shall make reference to district collector. Amount deposited will be paid to the claimant from the Gene Fund.

Rights of community

Any person on behalf of any village community can file any claim for compensation if the village or local community has contributed significantly to the evolution of the variety which has been registered under the PPV&FR Act, 2001. The Authority upon receiving objection from the registered breeder shall give an opportunity to breeder and determine the compensation which should be deposited in the Gene Fund within a period of two months.

Awards, Rewards and Recognitions

To support and reward farmers, particularly the tribal and rural communities engaged in conservation, improvement and preservation of genetic resources of economic plants and their wild relatives, particularly in areas identified as agro-biodiversity hotspots.

Plant Genome Saviour Community Awards (maximum 5, consisting of a citation, memento and cash of Rupees Ten lakh each).

Plant Genome Saviour Farmer Reward(maximum 10, consisting of citation, memento and cash of Rupees one lakh fifty thousand each.

Plant Genome Saviour Farmer Recognition(maximum 20, consisting of citation, memento and cash of Rupees one lakh each).

CONCLUSION:

Protection of Plant Variety and Farmers Right Act is an effective system for the protection of plant varieties, the rights of farmers and plant breeders and to encourage the development of new varieties of plants it has been considered necessary to recognize and to protect the rights of the farmers in respect their contributions made at any time in conserving, improving and making available plant genetic resources for the development of new plant varieties.

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Productivity of wet-seeded rice (*Oryzasativa* L.) And weed control

Article id:21836

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Rice (*Oryza sativa* L.) is the most important crop of south-east Asia popularly referred to as the rice bowl of the world. In India rice is cultivated in 45 million hectares with production of 124.40 million tonnes having productivity of 2930 kg/ha (Anonymous, 2019). Although India has the largest area under rice in the world yet it ranks second in production falling far behind China, which has production of about 200 million tonnes.

In India the demand for rice is going to increase considering population growth. Accordingly, the production target for 2025 is 140 million tonnes, which can be achieved only by increasing the rice production by over 2 million tonnes per year in coming decade.

There are three principal methods of rice establishment; dry seeding consists of sowing dry seeds on dry soil; wet seeding, involves sowing pregerminated seeds in wet puddled soils; transplanting involving replanting of rice seedlings grown in nursery in puddle soils. The major advantage of wet seeding is to save labour cost required for transplanting.

The reasonfor very low productivity, the fact that rice cultivation is mostly rain dependent. Both raising nursery and transplanting seedlings are on the mercy of monsoon, which is extremely erratic in onset, distribution, intensity and cessation. Invariably the seedlings overgrow in the nursery waiting for rains adequate to perform puddling operations. As a result of use of overgrown seedlings, at times, the crop starts flowering soon after flowering reducing the yield tremendously.

Sometimes it becomes even difficult to raise seedlings due to very delayed and erratic monsoon. Even in areas considered to be irrigated ones, the puddling operation is mostly undertaken after heavy precipitation. The canal areas are capable of releasing water for irrigation only after heavy rains in the catchment areas. So far as deep tube well is concerned they may take care of transplanted crop, but most of the puddling operations are carried on only after receipt of substantial rains. Thus, whether it is an irrigated areas or unirrigated area everyone has to depend upon rains for transplanting rice. The importance of rice in India is such that even a minor fluctuation in productivity brings about major change in Indian economy. Thus, if the productivity of rice in India in general is raised by cultural methods, it can bring about tremendous change in agricultural scenario and on rural economy. Thus, it is of paramount importance to search out ways and means to eliminate loss in rice yields due to delayed and erratic monsoon.

Bringing entire area under irrigation is a dream, which may or may not be accomplished even in centuries. Under the circumstances the only alternative feasible is to opt for wet-seeding of rice. Once the monsoon breaks, generally there is enough of moisture in soil for land preparation and seeding during rainy season. So, the farmers may sow their wet-seeded crop in puddled fields. Wet seeding can be practiced as an alternative to transplanting in irrigated and rainfed lowlands, as it holds promise for saving labour, time and energy and ensures efficient water use and increased benefit-cost ratio.

For a wet seeded rice crop there are two ticklish problems. The first one is to maintain the seed rate of a variety of a particular maturity group and secondly to undertake adequate measure for control of weeds, which grow rake and luxuriantly under wet seeded conditions. In kharif, *Echinochloa crusgalli, Dactyloctenium aegyptium, Brachiaria reptans, Panicum reptans* among grasses, *Eclipta alba, Alternanthera sessilis, Caesulia auxillaris* and *Commelina benghalesis* among BLWs, *Cyperus difformis, C. esculentus* and *Fibristylis miliaceae were observed along with some other weeds.* Gogoi (1995) summed up that the loss in grain yield due to weeds may be to the tunes of 20 to 95 per cent. On the other hand scientists are of the opinion that if weeds are kept under control, wet seeded crop will not yield less than a transplanted crop. It is a fact that rice plants are semi-aquatic in nature and love to grow under submerged conditions, but it is equally true that the root zone of rice prefers aeration imparted through periodical drainage so that excessively reduced condition may not develop in any stage of rice growth (De Datta, 1989, Madhu and Nanjappa,1996).

A wet seeded rice crop may be sown at the start of monsoon or after a few weeks when soil is more saturated. Seed rate plays an important role which is kept usually to minimize weed menace in increasing rice productivity. Higher seed rate may produce frail and taller rice plant with lower number of panicle per unit area owing to intra plant competition for nutrient, light and moisture while lower seed rate may opportune weed occurrence besides less plant density, thereby producing low yield. Most farmers use seeding rate up to over 200 kg seed/ha under wet seeding although the recommended seed rate is only 60 to 80 kg/ha (Guyer and Quadranti,1985) but Castin and Moody,1989 opined that it is not necessary to use high seeding rates to suppress weeds if an effective herbicide is used.

A very large number of herbicides are there which have been observed to have effective control of weeds in wet seeded rice. However, selecting a particular herbicides or its combination with mechanical weed management require thorough probe. While selecting a weed control measure it is equally important to keep economic aspects under consideration.

- Pendimethalin (stomp 30% EC) at 3.3 lit/ha applied at pre-emergence (0-2 DAS) is effective to control annual grasses and BLWs. Sufficient moisture is required in the upper soil layer to make herbicide effective. In the later stage, 2,4-D at 500 g ai/ha (80WP formulation at 625 g/ha) is applied to control annual broad leaf weeds.
- Bispyribac-Na (nominee gold) applied at 25 gha^{-1} at 25-35 day after sowing control all type of weeds.
- Almix at 4 g/ha (20 g/ha formulation) applied at 20-25 DAT is being used for controlling only annual grasses and BLWs very effectively.
- Oxadiargyl (Topstar 80 WP) at 70-80 g/ha applied at 0-3 DAS/DAT or pretilachlor (Refit 50% EC) at 1500 g/ha applied at 3-7 DAS/DAT are being used to control annual grasses and BLWs.
- 2,4-D (80% formulation) at 625 g/ha applied as post emergence is recommended to control broad leaf weeds and sedges.
- Bispyribac –Na at 25 g ha^{-1} applied at 25-30 DAT of rice controlled almost all type of weeds very effectively.

Among weed control methods, application of pyrazosulfuron 0.02 kg/ha (PoE) reducing grassy, broad leaved and sedges weeds throughout growing period with maximum effective tillers/m2 (310), filled grains/panicle (57.4), panicle length (20.00 cm), grain (27.26 q/ha) and straw (35.48 q/ha) yield with higher net return (Rs 17,115/ha) and benefit-cost ratio (1.10).

Future Research:

The research carried out on IWM in rice in India was mostly herbicide based. However, majority of the farmers have not been benefited by herbicides in India. Herbicides must be made economically and ecologically affordable to farmers by innovatively integrating with other components of IWM. There is significant scope of growth in herbicides, as a component of IWM, specifically as exports and domestic consumption of food grows. Need to step up coordinated extension efforts to educate farmers on judicious use of herbicides in India, in integration with other weed management methods.

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Beneficial of Ridge Gourd cultivation

Article id: 21837

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Scientific name :*Luffa acutangula* L. (Roxb.)
Chromosome number : $2n = 2x = 26$
Family : Cucurbitaceae
Edible portion : Whole Fruit
Type of fruit: Fruit
Origin : Tropical Asia and Africa

INTRODUCTION

Ridge gourd or ribbed gourd, locally known as ‘*kali tori* or *jhinga’* is a vigorous climbing plant trained on supports. The fruits are dark green, 15-40 cm long and are characterized by ten raised ridges, which run along the length of the fruit. The flesh is spongy but the skin is coarse. Ridge gourd is grown for immature and tender fruits. Delayed harvesting renders the fruits highly fibrous.

Distribution

Ridge gourd has originated in India and had been cultivated since ancient times. From India, it had spread to the whole of Southeast Asia and the Caribbean. In India, the important ridge gourd growing states include Andhra Pradesh, Tamil Nadu, Karnatka, Gujarat, Maharashtra, Assam and West Bengal. Neverthless the estimated area under all the gourds is the 4.05 lakh hectares in our country.

Food Value

Ridge gourd is low in saturated fat and cholesterol, high in dietry fibre, vitamin C, riboflavin, zinc, thiamin, iron, magnesium and manganese. Fresh fruit weighing 100 g contains 95.2 g moisture, 0.5 g protein, 0.1 g fat, 0.5 g minerals (18 mg calcium, 26 mg phosphorus, and 0.5 mg iron), 0.5 g fibre, 3.4 g carbohydrates, 0.01 mg riboflavin, 0.2 mg niacin and 5 mg vitamin C.

Uses

Ridge gourd is grown for its immature fruits that are eaten cooked or raw. The quality of sponge that develops inside the fruit is inferior compared to that of sponge gourd and is therefore, rarely grown for sponge purpose.

Breeding methods of ridge gourd

The flowers of ridge gourd like those of bottle gourd start anthesis (opening) in the evening and remain open throghout the night and are ready for selfing and pollination in the next morning/ forenoon. The flowers of ridge gourd open in early morning hours (4.0-8.0AM) and are suitable for selfing/crossing almost throghout the day. The important breeding methods used for improvement of ridge gourd include:(i) inbreeding and selection and (ii) hybrization – crossing of complementory parental lines and handling of segregating generations throghout pedigree/bulk/backcross/single seed descent method.

Improved Varieties

Pusa Nasdar (IARI, New Delhi)

It is a selection from the local material collected from Madhya Pradesh. Flowering starts 60 days after sowing. The fruits are club shaped and light green in colour. Average yield is 150-160 quintals per hectare.

Co 1 (TNAU, Coimbatore)

It is an early maturing variety developed by selection from the local material. First picking is

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possible 55 days after sowing. The fruits are 60-75 cm long, about 3.0 cm in diameter and are prominently ribbed. Average fruit weight is 250-300 g and yield is 140 quintals per hectare.

Konkan Harita (KKVP, Dapoli)

It is an early maturing selection from the local material. First picking is possible 45 days after sowing. The fruits are dark green, straight, 30-45 cm long and tapered at both the ends. Average yield is 170 quintals per hectare.

Arka Sujat (IIHR, Bangalore)

It is developed from the cross IIHR 54 × IIHR 18. Fruits are light green, cylindrical and 50-65 cm long with prominent ridges. Average fruit weight is 350 g and yield is 525 quintals per hectare. It is moderately tolerant to downy mildew.

Arka Sumeet (IIHR, Bangalore)

It is developed from the cross IIHR 54 × IIHR 24. The fruits are 55 cm long and 2.5 cm thick, light green and cylindrical with prominent ridges. First picking is possible 55 days after sowing. Average fruit weight is 380 g and yield is 500 quintals per hectare.

Deepthi (KAU, Vellanikkara)

It has been developed by a single plant selection from the local material. Fruits are green with intermediate lusture and tapered stem end, medium sized (23 cm long and 15 cm in girth) with finely wrinkled surface. First picking is possible 53 days after sowing. Average fruit weight is 165 g. It possesses field resistance to mosaic virus and downy mildew diseases.

Climate

Ridge gourd is adapted to tropical and sub-tropical climates. They require a humid and warm growing season. A temperature of 25-27°C is optimum for vegetative growth and fruit development. Too low temperature in beginning of the crop season delays germination and retards early growth. The proportion of male flowers is increased naturally by long days and high temperature.

Soil

Ridge gourd can be grown on a variety of soils but well-drained loamy soils with good water holding capacity and having pH between 6.0-7.5 are ideal. Sponge gourd is more tolerant to waterlogged conditions than ridge gourd.

Sowing Time

In north Indian plains, the summer crop of ridge gourd is sown in February – March and the rainy season in June-July. In riverbeds, sowing is done in October to November. In south India, sowing is done in October. Sowing is done on one side of the beds.Sow the seeds (5 seeds / pit) and thin the seedlings to two/pit after 15 days.

Spacing

Planting is done on 2.0-2.5 m wide beds at a spacing of 60-90 cm between plants for ridge gourd. If the vines are to be trained vertically, the row spacing is reduced to 1.5-2.0 m. Three to four seeds are sown per hill and two seedlings per hill are retained when the plants attain 2-3 leaf stage.

Seed Rate

3.5-5.0 kg seed of ridge gourd is sufficient for planting one hectare. Luffa seeds require special handling to ensure uniform germination. To make seeds more permeable to water and air, their sides are roughened with sandpaper or emery board. The seeds are then soaked in water at room temperature for 12-24 hours before sowing. Depending upon the soil temperature, the seedlings emerge 4-7 days after sowing.

Manures and Fertilizers

Apply 15-20 tonnes FYM at the time of field preparation. In north Indian plains, apply 50

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kg each of nitrogen, phosphorus and potash per hectare before bed making. The fertilizers are applied in two parallel bands along the lines marked for bed spacing. Another doze of 50 kg nitrogen per hectare is applied as top dressing, one month after sowing. Excessive nitrogen application coupled with high temperature results in reduced female flower production.

Irrigation

First irrigation is given just after seed sowing. Subsequent irrigations during summer months are given at 7-10 day intervals. In rainy season, irrigation may not be required if rains are well distributed.

Weed Control

Ridge gourd is widely spaced crops and weeds can be controlled by tractor drawn tillers, especially in early stages of crop growth. From spaces in-between the plants from within the plant rows, weeding is done manually. In later stages of the crop, weeds remain suppressed due to dense coverage by the crop itself.

Training

The *Luffa* species are vigorously growing and respond favourably to training. The yield and quality of fruits is improved if the vines are trained over the trellises, arbors or pandals at a height of 1.5-2.0 m. The training starts when the seedlings are about 15 cm tall. Training is especially required for rainy season crop to improve fruit quality.

Harvesting

Ridge gourd takes 5-7 days to reach edible stage after anthesis and 70-90 days after sowing. The fruits are harvested when they have attained marketable size (10-15 cm long and 2-5 cm thick) but are still tender. Tenderness of fruits is judged by their bright green colour and notching of fruit skin with thumbnails. The over-mature fruits develop purgative chemicals, become fibrous and are unfit for consumption. Harvesting is done at 3-4 day intervals. Sponge gourd for sponge production is harvested when the fruits become fully ripe and the seeds rattle inside. It takes 4-5 months from sowing to reach seed maturity

Yield

Since most fruits in *Luffa* species are borne on the lateral shoots, pruning the main stem to encourage lateral branch growth improves the fruit yield. Application of ethepon @ 100 ppm in sponge gourd at 2 and 4-leaf stages and NAA @ 200 ppm in both the species of Luffa increases female flower production and consequently, the fruit yield. Like other cucurbits, keeping beehive colonies in the production fields increase cross pollination and fruit yield. Average yield varies from 80-120 quintals per hectare.

Post-Harvest Handling

After harvesting, the produce is immediately shifted to a cooler place. The fruits are cleaned of dirt etc. but not washed. Grading of fruits is done according to their size. Before marketing, fruits are packed in baskets properly padded with live grass etc to prevent bruising of thin and tender fruit skin. For refrigeration, fruits are packed in low-density polythene bags and stored at 10°C and 90 per cent relative humidity. The basic method of preparing the sponge material is to immerse the dry, mature fruits in water for a few days to soften the skin and flesh so that it can be easily removed. Other processing methods include freezing or using boiling water. After getting rid of seeds, skin and flesh, the fibrous material is dried and cut into pieces of required size.

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Seed Production

Ridge gourds are highly cross-pollinated. To produce their genetically pure seed, a minimum isolation distance of 500 m is required between two varieties. A minimum of three inspections at vegetative growth stage, flowering and fruiting stage; and mature fruit stage are necessary to rogue-out off-type and diseased plants. For seed production of ridge gourd and sponge gourd, the fruits are allowed to ripen and dry on vines. At seed maturity the luffa fruits become dry and light in weight. The seeds rattle inside the shell. Cutting off the blossom end and shaking the fruits with cut end downwards extract the seeds. The seed is dried to 7 per cent moisture level or less and stored. Average seed yield is 4.0-5.0 quintals per hectare.

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Salinity stress and its effects on plants

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Earth is the salty planet; water present on earth contains 30g of sodium chloride per litre. Salinity is one of the most wide spread soil degradation processes on the Earth. According to the estimation, total area of saline soil is about one billion hectares. In India about 9.38 million ha area is occupied by saline soils out of which 5.5 million ha are salt affected soils (including coastal) and 3.88 million ha alkali soils .It is estimated that about 20% of all irrigated lands have saline soil (Pitman and Läuchli, 2002). About 17% of the cultivated land is under irrigation and irrigated agriculture contributes more than 30% of the total agricultural production (Hillel, 2000).

Several investigators have reported that plant growth reduction as the result of salinity stress. Growth of the plants is dependent on photosynthesis and therefore, environmental stresses also affect growth and photosynthesis (Salisbury and Ross, 1992; Dubey, 1997). In several studies by a number of authors with different plant species showed that photosynthetic capacity is decreased by salinity (Dubey, 1997; Ashraf, 2001; Romero-Aranda et al., 2001). Changes in the activities of antioxidant enzymes in plants exposed to salinity have been observed. The activity of antioxidant enzymes was reported to increase under salinity stress in shoot cultures of rice wheat and pea but decline in wheat roots .

The major efforts to control salinity in the past have been directed towards soil reclamation and water desalinization practices that are expensive. For improving biomass production and yield in salt affected soil, it is necessary to improve the intrinsic salt tolerance of the plants. Although several mechanical and chemical methods have devised to reclaim the salt-affected soils, they are expensive and have not feasible. Hence, identification of plant species/varieties that can be tolerating high salt levels is presently considered as important for utilization of saline soils. The efforts must, therefore, coincide with measures to improve the salt resistance of crops through genetic modification.

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1. INTRODUCTION

A wide range of environmental stresses like high and low temperature, drought, alkalinity, salinity, UV stress and pathogen infection are potentially harmful to the plants (Van Breusegem et al. 2001). Abiotic stress affects animals as well as plants, but plants are especially dependent on environmental factors, so it is particularly constraining. Abiotic stress is the most harmful factor in contrast to the growth and productivity of crops, worldwide. Generally abiotic stress often causes a series of, physiological, morphological and biochemical molecular changes that unfavourably affect plant growth, development and its productivity. Soil and water resources are too saline for most of the economic crops, in many arid and semi-arid regions worldwide which highly affects the plant osmotically. (Sekmen et al., 2007). The total area of salt affected soil in India is about one billion hectares, but the total global area of salt-affected soils has recently been estimated to be approximately 830 million hectares (Martinez-Beltran and Manzur, 2005).High salt concentration in parent material or in ground water results into accumulation of more salt in the affected plant. Moreover, salinity is caused by human interventions such as inappropriate irrigation practices, e.g. with salt-rich irrigation water and/or insufficient drainage. Salinization is often associated with the irrigated areas with low rainfall, high evapotranspiration rates or soil textural characteristics impede the washing out of the salts which subsequently build-up in the soil surface layers. According to Dubey (1997) and Yeo (1998) salt causes both osmotic and ionic effects on plants and most of the known responses of plants to salinity are linked to these effects. The initial and primary effect of salinity, especially low to moderate concentrations, is due to its osmotic effects.

2. Salinity effects on plants

According to Dubey (1997) and Yeo (1998), lowering of the soil water potential due to increasing solute concentration in the root zone as a result of osmotic effects. This condition interferes with the plant's ability to extract water from the soil and maintain turgor pressure at very low soil water potentials. Thus, salt stress may resemble drought stress in some species. However, plants adjust osmotically (accumulate internal solutes) and maintain a potential for the influx of water, at low or moderate salt concentrations (high soil water potentials). Under such conditions, plant growth may be moderated but unlike drought stress, the plant is not water deficient (Shannon, 1994). At high level of salinity, some specific symptoms such as necrosis and leaf tip burn due to Na^+ or Cl^- ions, of plant damage may be recognized. High ionic concentrations in plants may disturb membrane integrity and function; interfere with internal solute balance and nutrient uptake, causing nutritional deficiency symptoms similar to those that occur in the absence of salinity (Grattan and Grieve, 1999). Levitt (1980) has observed that Sodium and chloride ions usually the most prevalent ions in saline soils or water and accounts for most of the deleterious affects that can be related to specific ion toxicities. The degree to which growth is reduced by salinity differs greatly with species and to a lesser extent with varieties (Bolarin et al., 1991). The severity of salinity response is also mediated by environmental interactions such as temperature, relative humidity, air pollution and radiation (Shannon et al., 1994). Premature senescence, reducing the supply of assimilates to the growing regions followed by decrement in plant growth is due to the salt stress. Moreover, Salt stress affects all the major processes such as growth, water relations, photosynthesis and mineral uptake.

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2.1 Effects on plant growth

Several investigators have reported plant growth reduction as a result of salinity stress, e.g. in tomato, cotton and sugar beet. However, there are differences in tolerance to salinity among species and cultivars as well as among the different plant growth parameters recorded. For instance, found that the optimum growth of *Rhizophora mucronata* plants was obtained at 50% seawater and declined with further increases in salinity while in *Alhagi pseudoalhagi* (a leguminous plant), total plant weight increased at low salinity (50 mM NaCl) but decreased at high salinity (100 and 200 mM NaCl). In sugar beet leaf area, fresh and dry mass of leaves and roots were dramatically reduced at 200 mM NaCl, but leaf number was less affected (Ghoulam et al., 2002). Fisarakis *et a*l. (2001), reported that particularly at high NaCl concentration, recorded a higher decrement in accumulation of dry matter in shoots than in roots, indicating partitioning of photo assimilates in favour of roots and this is due to a greater ability for osmotic adjustment under stress by the roots.

2.2 Effects on leaf anatomy

Changes in leaf anatomy in number of plants have also observed due to salinity. For example, leaves of cotton, bean and Atriplex were reported to increase in epidermal thickness, palisade cell length, palisade diameter, mesophyll thickness and spongy cell diameter with increasing salinity (Longstreth and Noble, 1979). According to Parida et al (2004) both epidermal and mesophyll thickness as well as intercellular spaces decreased significantly in NaCl-treated leaves of the mangrove *Brugueira parviflora*. Intracellular spaces in leaves of spinach salinity were found to reduce while in tomato plants, a reduction of stomatal density occurred (Romero-Aranda et al., 2001).

2.3 Effect on Photosynthesis

Environmental stress indirectly affects the photosynthesis process (Salisbury and Ross, 1992). Studies conducted by a number of authors with different plant species showed that photosynthetic capacity was suppressed by salinity (Dubey, 1997; Ashraf, 2001; Romero-Aranda et al., 2001). A positive relation between photosynthetic rate and yield under saline conditions has been found in different crops such as *Gossypium hirsutum* and *Asparagus officinalis*. Fisarakis et al. (2001) found that inhibition of vegetative growth is due to marked inhibition of photosynthesis in plants having salinity stress. In contrast, Rogers and Noble (1992) and Hawkinsand Lewis (1993) studied that little or no association between growth and photosynthetic capacity, in *Triticum repens* and *Triticum aestivum*.

The effect of salinity on photosynthetic rate depends on salt concentration and plant species. It has been also reported that low salt concentration of salinity may stimulate photosynthesis. For instance, in *B. parviflora*, Parida et al. (2004) reported that photosynthetic rate increased at low salinity and decreased at high salinity, whereas stomatal conductance was unchanged at low salinity and decreased at high salinity. High salt concentration in soil and water creates high osmotic potential which reduces the availability of water to plants. Decrement in water potential causes osmotic stress, which reversibly inactivates photosynthetic electron transport via shrinkage of intercellular space. Salt toxicity caused particularly by Na^+ and Cl^- ions. Cl^- inhibits photosynthetic rate through its inhibition of $NO3^-$ uptake by the roots. The reduced $NO3^-$ uptake combined with osmotic stress may explain the inhibitory effect of salinity on photosynthesis.

Closure of stomata causes' reduction in CO2 supply as a result restricted availability of CO2 for carboxylation reactions (Brugnoli and Bjorkman, 1992). Iyengar and Reddy (1996) reported that stomatal closure minimizes loss of water by transpiration and this affects chloroplast and energy-conversion and light-harvesting systems thus leading to alteration in chloroplast activity. Higher photosynthetic rates were favoured by higher stomatal conductance in plants and are known to increase CO2 diffusion into the leaves. There are also reports of non-stomatal inhibition of photosynthesis under salt stress. Iyengar and Reddy (1996) reported that this nonstomatal inhibition is due to increased resistance to CO2 diffusion in the liquid phase from the mesophyll wall to the site of CO2 reduction in the chloroplast, and reduced efficiency of RUBPC-ase. Iyengar and Reddy (1996) showed that enhanced senescence induced by salinity, changes of enzyme activity induced by changes in cytoplasmic structure, negative feedback by reduced sink activity.

2.4 Effects on ion levels and nutrient content

High salt (NaCl) uptake competes with the uptake of other nutrient ions also, such as K+, Ca2+, N, P resulting in nutritional disorders and eventually, reduced yield and quality (Grattan and Grieve, 1999). Increased NaCl concentration has been reported to induce increment in Na^+ and Cl^- and decrement in Ca^{2+}, K^+ and Mg^{2+} level in a number of plants. While Ghoulam et al (2002) observed an increase in Na^+ and Cl^- content in the roots and leaves of sugar beet with increasing NaCl concentration in the rooting medium. The K^+ content of the leaves decreased in response to NaCl, but in case of roots, it was not affected by the salt treatment. A significant increase in Na^+ and Cl^- content in stem, root and leaves, of the mangrove (*B. parviflora*) has been reported without any significant alteration of the endogenous level of Fe^{2+} and K^+ in leaves (Parida *et al.*, 2004). Decreases of Ca^{2+} and Mg^{2+} content of leaves have also been reported due to salt accumulation in this species.

Under salt stress conditions, the uptake of nitrogen by plants is generally affected. A number of studies have shown that salinity can reduce nitrogen accumulation in plants Pardossi *et al.*, 1999; Silveira *et al.*, 2001). An increase in Cl^- uptake and accumulation has been observed to be accompanied by a decrease in shoot NO_3^- concentration as in eggplant (Savvas and Lenz, 1996) and sultana vines (Fisarakis et al., 2001). Several authors have attributed this reduction to Cl^- antagonism of NO_3^- (Bar et al., 1997) while others attributed the response to salinity's effect on reduced water uptake (Lea-Cox and Syvertsen, 1993). The nitrate influx rate or the interaction between NO_3^- and Cl^- has been reported to be related to the salt tolerance of the species. Kafkafi *et al.* (1992) found that the more salt-tolerant melon and tomato cultivars had higher NO_3^- flux rates than the more sensitive cultivars. Salinity stress has inhibitory as well as stimulatory effects on the uptake of some micronutrients by plants .According to Vîllora *et al* (1997) ,Grattan and Grieve (1999) and Yadav et al (2011), nutrient imbalances may result from the effect of salinity on nutrient availability, transport or partitioning within the plant, competitive uptake or may be caused by physiological inactivation of a given nutrient resulting in an increase in the plant's internal requirement for that essential element.

2.5 Effect on antioxidative enzymes

All environmental or man-made stresses have been reported to lead to the production of reactive oxygen species (ROS) that causes oxidative damage (Smirnoff, 1993; Schwanz et al., 1996). Antioxidative enzymes are key elements in the defense mechanisms of the plants. Garratt et al (2002) has listed some of these enzymes as catalase (CAT), , superoxide dismutase (SOD) , glutathione reductase (GR) and glutathione-S-transferase (GST). Cell damage is protected by superoxide dismutase which metabolizes oxygen (O_2) radicals to hydrogen peroxide (H_2O_2).Ascorbate peroxidase; catalase and a variety of Peroxidases catalyze the subsequent breakdown of H_2O_2 to water and oxygen (Chang et al., 1984; Garratt et al., 2002).

2.6 Effect on plant hormones

The levels of plant hormones such as cytokinins and Absscisic acid increase with high salt concentration. ABA is responsible for the alteration of salt-stress-induced genes, and these genes are predicted to play an important role in the mechanism of salt tolerance in rice. The inhibitory effect of NaCl on photosynthesis, growth and translocation of assimilates has been found to be alleviated by ABA. Although the nature of ABA receptor(s) remains unknown. Leung and Giraudat (1998) pointed out that there is substantial evidence of the involvement of ABA in reversible protein phosphorylation and modification of cytosolic calcium levels and pH. Chen et al. (2001) reported that the increase of Ca^{2+} uptake is associated with the rise of ABA under salt stress and thus contributes to membrane integrity maintenance, which enables plants to regulate uptake and transport under high levels of external salinity in the longer term. ABA has been reported to reduce ethylene release and leaf abscission under salt stress in citrus probably by decreasing the accumulation of toxic Cl^- ions in leaves (Gomezcadenas et al., 2002).

Other plant hormones found to be accumulating in the presence of salt include jasmonates. Higher levels of jasmonates were found to accumulate in salt-tolerant tomato cultivars rather than the salt-sensitive ones. Asmonates have been reported to have important roles in salt tolerance and considered to mediate signalling, such as defence responses, flowering, and senescence. However, these factors involved in the jasmonate signal-transduction pathway remain unclear (Tarun et al., 2012).

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Role of different nutrients in crop growth with their deficiency symptoms and corrective measures

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Agriculture is the backbone of economy for most of the developing countries as they needs sustainable production of food grain to support their increasing population. Growth in the agricultural sector is marred by abiotic and biotic threats which take toll not only on productivity but also on quality of the farm produce. Grain production, on the other hand directly depends on soil physical and chemical properties and soil atmosphere. Besides these, soil nutrients play a major role in determining grain productivity of crop plants and regulate their vegetative growth and development.Later, it is important to address the challenge of malnutrition in humans and animals. In present article, we have reviewed different essential nutrient, their role and function, deficiency symptoms and its corrective measures for better growth and development of crop plants.

INTRODUCTION:

Crop plants requires 17 essential nutrient elements viz. C, H, O, N, P, K, Ca, Mg, S (macronutrients) and Fe, Cu, Mn, Zn, B, Mo, Cl, Ni (micronutrients) for completing their life cycle (Arnon and Stout, 1939). Micronutrients are essential for plant growth, play an important role in balanced crop and human nutrition. The total micronutrient content is adequate in most Indian soils, but the micronutrients' concentrations in the soil solution is essentially poor to meet the demand of growing crops in many soils (Singh *et al.*, 1998) and that deficiency of Zn, Fe, Cu, Mn, B, Mo have been noticed respectively in 48, 12, 4, 5, 33, 13 per cent of the Indian soils (Singh *et al.*, 2001). Therefore, it is necessary to maintain the nutrient availability to crop plants for their productivity, subsequently increase crop economical yield.

Mineral nutrients deficiency symptoms on crop plants:

Nutrient deficiency symptoms may be classified as follows:

1. Complete crop failure at the seedling stage
2. Severe stunting of plant
3. Specific leaf symptoms appearing at varying times during the season
4. Internal abnormalities such as clogged conductive tissues
5. Delayed or abnormal maturity
6. Obvious yield difference with or without leaf symptoms
7. Poor quality of crops including differences in protein, oil or starch content and storage quality

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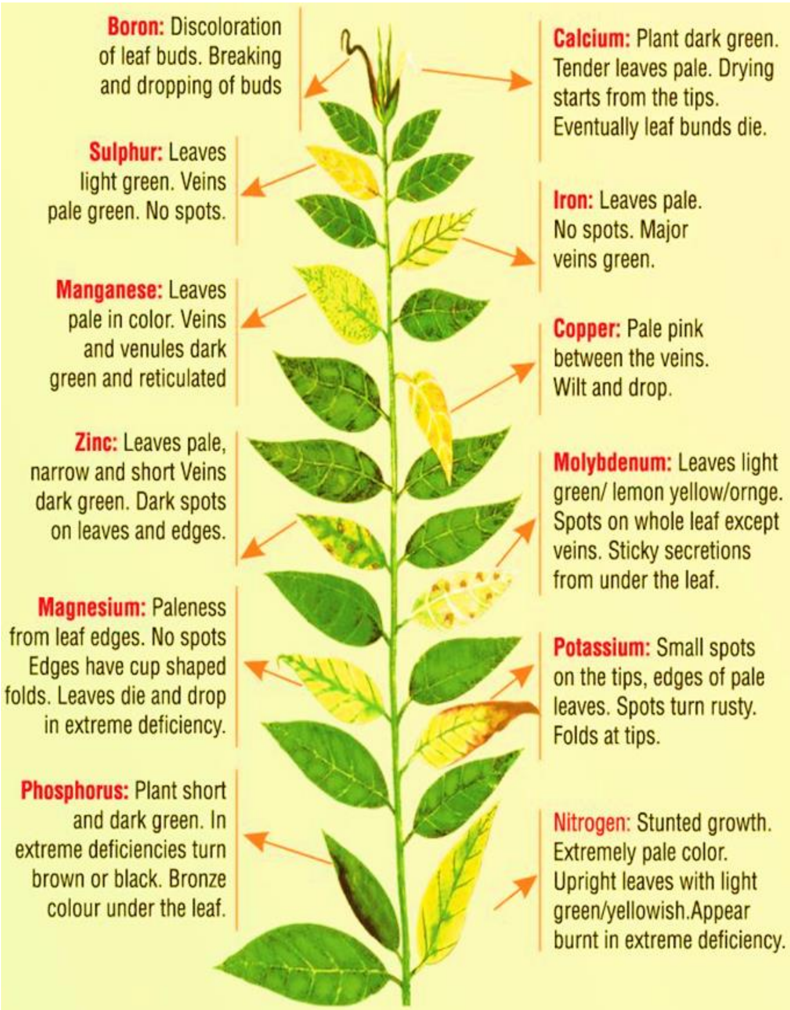

Appearance of deficiencySymptom:

- ✓ **Old leaves:** N, P, K, Mg, Mo
- ✓ **New Leaves:** Fe, Mn, Cu, S
- ✓ **Old and New Leaves:** Zn
- ✓ **Terminal Buds:** Ca, B
- ✓ **Moltting:** N, Mg, P, S
- ✓ **Necrosis:** Mo, K, Ca, Zn, Mg
- ✓ **Chlorosis:** N, S, Mg, Fe

Mineral nutrients role, deficiency symptoms in plant and their corrective measures:

Mineral Element	Role/Functions	Deficiency Symptoms	Corrective Measures
Nitrogen (N)	Constituent of protein, nucleic acid, chlorophyll, coenzyme	'V' shaped chlorosis on older leaves, slow growth, stunted plant	Application of N fertilizer, legume in crop rotation, foliar spray of 0.25-0.5% solution of urea
Phosphorus (P)	Sugar phosphate, ATP, nucleic acid, energy transfer, phospholipid	Dark greenish purple colour and bronzing of older leaves	Maintain soil reaction to near neutral in acidic soils; application of phosphorus fertilizer
Potassium (K)	Osmoregulation, stomata movement, maintain cell turgor, cofactor for enzymes	Scorching & burning on margins, Inverted 'V' shaped chlorosis of older leaves	Application of potassium fertilizers, incorporation of crop residues, manures

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Sulphur (S)	Constituent of cysteine and Methionine, lipoic acid, Biotin, coenzyme	Yellowing (Chlorosis) of leaves initially occur at younger or mature leaves	Use of fertilizers containing sulfur such as ammonium sulfate; single super phosphate
Calcium (Ca)	Constituent of middle lamella of cell wall, act as a secondary messenger	Terminal bud leaf becomes chlorotic white with base remains greens, tips hooking, terminal bus death	Liming (addition of CaCO3) of acid soils; addition of gypsum or other soluble calcium source where lime is not required
Magnesium (Mg)	Constituent of chlorophyll, cofactor for enzymes, binding of ribosome subunit	Interveinal chlorosis on older leaves	Foliar application of magnesium sulfate or magnesium nitrate solutions
Iron (Fe)	Heme protein, ferrodoxin, chlorophyll, biological nitrogen fixaction, cytochrome	Interveinal chlorosis on younger leaves and leaves become white	Foliar spray of 2% iron sulfate
Zinc (Zn)	Synthesis of auxin, RNA synthesis, cofactor for many enzymes	Plant appear bushy due to reduced intermodal elongation, chlorosis on midrib of new leaf	Addition of zinc sulfate to soil; foliar spray of 0.1-0.5% solution of zinc sulfate
Boron (B)	Translocation of sugar, pollen germination, N/CHO metabolism	Terminal bud die, black necrosis at base of leaf blade	Soil application of boron source or foliar spray of 0.1-0.25% solution of borax,(not exceed 0.5 ppm)
Molybdenum (Mo)	Constituent of nitrate reductase, nitrogenase	Older become chlorotic, whiptail like structure	Liming of acid soils, soil application of sodium ammonium molybdate, foliar spray of 0.07-0.1% solution of ammonium molybdate
Manganese (Mn)	O_2 evolution complex in PS-II, act as a cofactor	Interveinal chlorosis on younger leaves but not towards whiteness	Foliar application of 0.1% solution of manganese sulfate
Copper (Cu)	Part of plastocyanin, act as a cofactor for enzyme	Dark green of young leaf, chlorosis	Soil application of copper source of fertilizer or foliar spray of 0.1-0.2% solution of copper sulfate
Chlorine (Cl)	H_2O splitting and O_2 evolution in Pn	Chlorosis and leaf bronzing on new leaves	
Nickel (Ni)	Contistuent of urease, hydrogenase enzyme	Leaf tip necrosis, accumulate urea in leaf	

Nutrition intervention strategies:

Balanced food diet require various nutrient and other macromolecules in food which can be enhanced by supplementation, fortification, diet diversification, biofortification. Biofortification, conventional breeding and transgenic approaches are adopted to challenge micronutrient malnutrition (Bouis *et al.*, 2003). Biofortification is the process of increasing the content and bioavailablity of essential vitamins and minerals in staple crops, through plant breeding or agronomic practices, to improve nutritional status (Bouis *et al.*, 2011).

CONCLUSION:

Nutrient deficiency is one of the most serious problem of Indian agriculture which ultimately reduces grain nutrient quality. The root mediated nutrient uptake mechanisms assume a greater significance under conditions of low nutrient availability in the cultivable soils. Again not to forget that soils in India are highly depleted of nutrients and that the deficiency of micronutrients such as Zn, Fe, Cu, Mn, B, Mo and S have been noticed in more than 48, 12, 4, 5, 33, 13 and 41 percent of the cultivable soils. Therefore, increase in nutrient availability the region of rhizosphere is required, for that purpose nutrient management is necessary. Nutrient management in soil, play is crucial role in maintaining nutritional quality of food grain and reduces the malnutrition of human being.

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Cryogenics for spices grinding

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INTRODUCTION:

Spices have pungent flavour, taste and the medicinal properties. These are essential ingredients imparting taste and flavour to various food preparations. India is the leading producer and exporter of various spices i.e. fenugreek, turmeric, black pepper, coriander, and cinnamon etc. Grinding is a process of increasing the surface area of solid materials by splitting into smaller particles. The accessibility of constituents such as oil inside the cells, fragrance and flavouring components that are presented in the material is increased due to increase in their surface area. The fat in spices generally poses extra problems and is an important consideration in grinding. During grinding, the temperature of the product rises to a level in the range of 42±95°C, which varies with the oil and moisture content of the spices, but spices lose a significant fraction of their volatile oil or flavoring components due to this temperature rise. The losses of volatile oil for different spices have been reported to be in the range of 37% for nutmeg, 14% for mace, 17% for cinnamon and 17% for oregano. The loss of volatile oil during grinding of caraway seed has been reported to be 32% with an increase in grinding temperature from 17°C to 45°Celsius.

The temperature rise of the product can be minimized to some extent by circulating cold air or water around the grinder. But this technique is not sufficient to significantly reduce the temperature rise of the product.

The loss of volatile oil can be significantly reduced by a cryogenic grinding technique. Liquid nitrogen at -195.6°C provides the refrigeration needed to precool the spices and maintain the desired low temperature by absorbing the heat generated during the grinding operation. In addition to maintaining the low temperature, vaporization of the liquid nitrogen to the gaseous state, in effect, creates an inert and dry atmosphere for additional protection of spice quality. Precooling of the raw spice and the continuous low temperature maintained within the mill reduces the loss of volatile oils and moisture thereby retaining most of the flavor strength per unit mass of spice.

Cryogenic grinding process

In the process of cryogenic grinding the material is fed into the feeder hopper and dropped into a conveyor where the material to be processed enters the pre-chilled conveyor. Liquid nitrogen is then sprayed and blended directly onto the material. The material is conveyed via a stainless steel special design auger. The auger not only transports the grinding media but also mixes with the liquid nitrogen for greater cooling efficiency. Liquid nitrogen is added until the temperature of the material is reduced to a predetermined set point. The set point is the glass transition temperature of the material. The extremely low temperature in the grinder solidifies oils so that the spice become brittle, they crumble easily permitting grinding to a finer and more consistent size. Finally, the brittle materials enter an impact mill where it is ground to a desired particle size. Computer controls the entire process. The cryogenically ground powder is quickly packed in aluminum foil packets using sealing machines and opened at the time of analysis. Several factors need to be considered while designing a cryogenic grinding process. The

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retention time of seeds in liquid nitrogen and gas zone should be accurately proportionalised. Appropriate insulation should be given in the chamber.

Mantling and dismantling of the assembly should be easier along with it the cool down losses should be kept minimum by keeping the size low.

Gains from the technology of cryogenic grinding

The extremely low temperature in the grinder solidifies oils so that the spices become embrittled, they crumble easily permitting grinding to a more consistent size. Thus considerably smaller particle size can be obtained under cryogenic conditions. The finely ground spices spread their flavor uniformly throughout the product body in which they are used, thereby reducing the problem of large specks appearing in the food products. With cryogenic grinding, the temperature of the products can be as low as-195.6°C. But such a low temperature is not required for all spices. In practice, it is regulated anywhere from -195.6°C to few degrees below ambient temperatures. The temperature to be used is determined by parameters, viz., the final product size, color required etc. of the product. For removing the required heat from a particle prior to its feeding into the grinder, cryogenic pre coolers are used. The cryogenic pre coolers can be combined with impact, attrition, or air swept mills. It is ensured that the particle during grinding is at or below its brittle point. Provisions are made to control the precooler temperature and feed rate to the mill. The design, development and introduction of the precooling unit were to prevent the material from being heated up during grinding. The unit would precool the material before the actual starting of the grinding operation. This would minimize the loss of quality of the final powdered material.

The loss of volatile oil can significantly be reduced by cryogenic grinding technique using liquid nitrogen that provides the refrigeration needed for pre-cooling the spices and to maintain the desired low temperature by absorbing the heat generated during the grinding operation. As the volatile oil loss is reduced in the cryogenic process it leads to a better aroma in the ground spices.in the conventional grinding techniques high temperature may lead to catching of fire in the inflammable components, by use of cryogenic grinding we can eliminate any such risks. The extremely low temperature in the grinder solidifies oils so that the spices become brittle, they crumble easily permitting grinding to a finer and more consistent size. The high quality of ground product would have domestic as well as International market.

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Physio-biochemical traits: Important bases for yield improvement in sugarcane

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Sugarcane is an important commercial cash crop which is genetically complex polyploid belonging to the family Poaceae, and tribe Andropogoneae.Inter-specific crosses between the noble cane *S. officinarum* (2n = 80) and the wild species *S. spontaneum* (2n = 40-128) result in development of modern sugarcane varieties. The complexity of genome of this crop is largely associated with its polyploidy/aneuploid nature with variation in chromosome number. This genomic complexity added to the multigenic and/or multi-allelic nature of most agronomic traits makes sugarcane breeding a difficult task. Sugarcane is one of the most efficientphotosynthesizers in the plant kingdom and the photosynthetic efficiency of sugarcane is 0.38%, having an ability to convert up to 1 percent of incident solar energy into biomass.

At cellular level the relationship between photosynthesis and respiration are basic processes for carbon income. At organism level the plant growth could be related to net assimilation rate and the partitioning and allocation of the carbon gained. Physiological and morphological traits related with plant productivity could be very valuable not only to plant physiologists but to Agronomists and plant breeders.

At global perspective, sugarcane is defined as one of the most productive plant species known, since it can potentially produce from 41.1 to about 65 tonnes of dry weight per ha per year. Crop growth duration can vary from 9 months to 36 months. Being a C_4 plant, sugarcane produces multiple tillers, each having numerous nodes separated by internodes. The internodes consist of sucrose storing parenchyma cells and vascular tissue, with the stem being the major sink for photosynthates (sucrose). The situation is quite contrast at national perspective especially when sub-tropical part of the country is taken into account where the average cane yield is around 55 to 60 t/ha (fresh weight) and also the crop duration is less. The most important challenging task is to how to convert tillers maximally into millable canes.

The most economical value of sugarcane is sucrose (sugar) which is accumulated in its stalk and a mature sugarcane culm has the capacity to store up to 62% sucrose on a dry weight basis or 25% sucrose on a fresh weight basis. The percentage of sucrose in sugarcane juice (with a pH of 4.9–5.5), usually referred to, in the sugar industry, as the polarization value (Pol), varies from 8 to 15%. Studies of carbon partitioning in sugarcane have focused primarily on the sugar pool, and have revealed that a cycle of a rapid sucrose synthesis and degradation exists in sugarcane. Others non-sucrose metabolic pathways have also proved to be significant sinks. These include the water insoluble compounds (assumed to be primarily fiber) and the respiratory pathway. It has been suggested that total allocation to these pathways decreases with the tissue maturation and at the same time a concomitant rise in partitioning of sucrose to the stem parenchyma occurs. In not mature tissue, proteins and fibre are the competing sinks with sucrose for incoming carbon.

Efficient uses of resources for both high cane yield and sucrose accumulation are primary concerns of sugar industry. Cane and sucrose yields are often below potential for reasons about which we can only speculate. In the past, researches have been directed at opportunities for raising limitations to yield and efficiency of resource use at the gene and enzyme level. The characteristic of low specific leaf N in ageing cane has been noted. Factors such as lodging, reduced leaf N content and stalk death may be difficult to control through management but they could be avoided to some extent by harvesting crops soon after growth slows down. Breeding and selection for more erect crops, with higher leaf N content and better tiller survival could help to overcome this problem. Identifying physiological processes that are most suitable for manipulation in order to improve sucrose production and efficiency of resource use should be taken up at larger perspective.

Sugarcane stalk is made up of internodes and nodes. A new internode is initiated shortly after the formation of a new leaf primordium at the apical meristem. The development of the internode consists broadly of two phases, maturation and ripening. Maturity is an indicator of realized growth potential, while ripeness is an indicator of realized sucrose storage potential. Sucrose accumulation becomes the main activity once internode growth is completed. To maximize economic return from a sugarcane crop, it must be harvested at the point in its life cycle when its sucrose level is highest. However, largely harvesting does not coincide with the period when the crop sucrose content is highest because of capacity constraints imposed by harvest machinery and the sugar mill. In such situations, commencing the harvest early is preferable to finishing the harvest late, as the crop may lodge and the sucrose concentration deteriorate toward the latter part of the season. Withholding irrigation (a greater proportion of photo assimilate is stored as sucrose because water stress has a greater impact on growth than it has on photosynthesis) before harvest and applying various chemical ripeners are some of the major steps usually taken to advance the mature of the crops. Most chemical ripeners act by temporarily arresting vigorous growth in the immature upper internodes of the culm thereby causing accelerated deposition of sucrose in those internodes. Ethylene releasing compound 2-chloroethylphosphonic acid (CEPA) or ethrel/Ethephon is the most sought chemical for this purpose. At high concentrations it may inhibit growth, whereas at low concentrations it may stimulate growth. The response to CEPA also depends upon the stage of plant development. Thus, CEPA is also used to enhance the sprouting of seed cane, to promote vigorous tillering, and to prevent flowering.

Various forms of growth suppression favour the partitioning of photo assimilate to sucrose storage.

1. Shading or partially defoliating sugarcane increases the proportion of sucrose in total dry matter.
2. Transferring sugarcane from a high- to a low-temperature environment causes an increase in sucrose content.

Thus, it is conceivable that some varieties accumulate sucrose faster as a natural response to unfavourable growing conditions such as cooler temperatures or soil nitrogen and moisture deficits. Also, it has been observed linkage of some growth characteristics with faster sucrose accumulation. Smaller leaves have been associated with early-ripening sugarcane. The culms of some early-ripening varieties elongate faster, start elongating earlier, and have more internodes that are characteristically shorter. This suggests that faster culm development may facilitate earlier accumulation of sucrose. However, contrary reports have been also reported. This inconsistency may be due to the practice of comparing different sugarcane genotypes where the diverse genetic backgrounds tend to confound the interpretation of the results. Thus it is possible that rapid internode development lead to faster sucrose accumulation while higher photosynthesis and reduced leaf expansion may favour faster sucrose accumulation.

The physiological basis of dry matter partitioning can be explored through the SLA, which is a practical measure of the material cost of producing leaf area. The significantly higher SLA for leaf two in the treated plants indicates that a smaller amount of dry weight was used to produce each unit of leaf area. Hence, less photo assimilate was incorporated into leaf dry matter and more was potentially partitioned to sink tissue.

As sugarcane leaves respire faster than the culm on a dry weight basis and the respiration rate is generally dictated by leaf growth rate, it is possible that less foliage in the CEPA-treated sugarcane reduced respiratory carbon losses from the system. In addition, there was less leaf area and it was constructed more efficiently using less photo assimilate. This implies less carbon was invested in foliage infrastructure. Coupled with the higher photosynthesis to offset the lower leaf area available for CO_2 capture, this resulted in more carbon partitioned to the culm and sucrose. Some benefit may have also accrued from the change in light interception pattern. In CEPA-treated plants, the lower leaves would capture more sunlight because the upper leaves were smaller.

Higher sink strength has been simulated in sugarcane by reducing the leaf area through shading or defoliation. This had the effect of increasing leaf photosynthesis and lowering sucrose levels in the culm. Those studies concluded that decreased assimilate availability at the sink tissue may invoke the upregulation of source tissue photosynthesis. Sink demand and source photosynthetic activity has been observed linked through a kinase-mediated sugar signalling mechanism that controlled the expression of metabolite transporters and photosynthesis-related genes. Clearly, further investigations are needed to fully unravel this aspect of the source–sink relationship in sugarcane.

Leaf area, leaf area index, leaf area ratio, net assimilation rate and leaf area duration and yield of cane:

Several physiological parameters related to growth namely total leaf area (L), leaf area index (LAI), leaf area ratio (LAR), net assimilation rate (NAR), leaf area duration (LAD) have been studied at different stages of the sugarcane and conclusions have been made about their impact on overall growth and yield of the crop.

A positive and significant correlation coefficient (0.80**) between leaf area of individual stalks and leaf area index have been reported. In case of sugarcane high LAI at early stage of growth manifest better light interception and set the tone for better yield. Leaf area ratio (LAR), which relates leaf area to total plant biomass and is a measure of the relative size of assimilatory apparatus, usually decrease with time. Cultivars attaining early and higher LAR would fetch more yields. Net assimilation rate (NAR), which indicates the rate of biomass increases per leaf area unit per day, is usually observed high and relatively stable during all growing period in better yielder variety. Those cultivars where lower leaves in the canopy receive more light (improve efficiency to use the incoming radiation), will better photosynthesize. Drastic increases in duration of leaf area (LAD) and biomass (Z) have been reported during sugarcane ripening. The number of vascular

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bundle cells per mm is usually observed higher in better variety.

Radiation use efficiency:

Increases in crop yield may be achieved either through an increase in resource input, or the more efficient use of present resources. However, once water and nutrients are supplied in sufficient quantities, the solar radiation receipt will ultimately determine the productive potential of an environment. The efficiency of a crop grown with sufficient water and nutrient resources can therefore be expressed as the relationship between biomass accumulation and the amount of solar radiation intercepted and assimilated into dry matter.

Radiation use efficiency (RUE) index (photosynthetic efficiency of a crop) =

$$\frac{\textbf{Net above-ground crop biomass}}{\textbf{Intercepted radiation}}$$

It is used as a measure of agricultural productivity. The value of RUE varies with species. Although there are some important exceptions, there is a general trend for crops utilising the C4 photosynthetic pathway, such as maize and sugarcane, to display the highest maximum values of RUE at approximately 1.65 and 2 g/MJ intercepted solar radiation, respectively. C3 crops, including wheat, barley and rice, generally display comparatively lower values of maximum RUE, at approximately 1.46, 1.3 and 1.39 g/MJ intercepted solar radiation, respectively. Non-leguminous species tend to display slightly lower levels of RUE than other C3 crops, with the lowest RUE values recorded for leguminous crops. RUE is measure of photosyntheses and is therefore dependent on leaf photosynthetic rate, which itself is related to nitrogen content per unit leaf area (referred to as specific leaf nitrogen, SLN). Leaf photosynthesis and RUE are not responsive to SLN at high levels but with decreasing levels of SLN, the rate of leaf photosynthesis becomes increasingly depressed and RUES values show a high degree of sensitivity to further changes in SLN once levels fall below saturation. Maximum values for plant and ratoon crops are parameterized as 1.8 and 1.65 g/MJ intercepted solar radiation, respectively. However, many studies show a clear trend for cane yield to display a slowdown in growth well before crop harvest, or in the second year of a two-year crop cycle despite conditions that are assumed to be favourable for further growth. The slowdown in growth, referred to here as the reduced growth phenomenon (RGP), results in levels of production being well below those predicted. RUE values in sugarcane may not remain constant throughout growth.

(A) Enhancing sugarcane productivity

- Improving sprouting and emergence (germination) through chemical applications
- Reducing volume of seed cane by STP, bud chips and single node cane etc
- Enhancing number of tillers *vis-a-vis* number of millable canes. Cane yield is contributed approximately 70% by NMC, 27% by cane length and 3% by the cane girth.

(B) Increasing average cane weight

- Prevention of flowering
- Inducing tolerance to abiotic stress conditions
- Inducing tolerance to pests and diseases
- Improving stubble sprouting in winter-initiated ratoons

(C) Enhancing sugar productivity

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- Morpho-physiological and biochemical characteristics related to sugar accumulation
- Pre-harvest evaluation of the ripening status
- Amelioration of ripening
- Reducing post- harvest sucrose losses
- Nutrient management for improving cane and sugar yield and recovery
- Management of over stand

Biochemical significance:

In many countries, including India the improvement of sugarcane have been primarily from the angle of cane yield rather than sucrose content, which is one of the major constraints in improving sucrose productivity. Several authors have opined accumulation of sucrose in sugarcane is principally regulated at the level of sink (cane stalk/culm). Furthermore, cycle of degradation-synthesis of sucrose occurring in culm is also one factor which controls and regulate the sucrose concentration, hence all these cellular activities account for variable accumulation of sucrose in the cane stalk. A better understanding of sucrose synthesis and accumulation in sugarcane and its modulation through exogenous or endogenous means leading to higher sucrose productivity would be a boon for sugarcane farmers, millers and associated industries. The regulatory enzymes, namely three invertases viz., soluble acid (SAI), cell wall bound (CWAI), neutral (NI); sucrose synthase (SS) and sucrose phosphate synthase (SPS) play important role in sucrose metabolism.

The maximum level of accumulation of partitioned carbon into sucrose is 0.7M in sugarcane culm. Normally the observed sucrose content on dry matter (SCd) basis is 350-400mg/g, however, the capacity of some lines to accumulate 500 to 560 mg/g sucrose (SCd) has also been reported. Physio-biochemical processes like rate of photosynthesis, partitioning of carbon pools other than culm storage (respiratory demand of carbon and demand for water insoluble compounds), loading and unloading of sucrose in leaf and culm, three phasic metabolic activity of sucrose in parenchymatous cells (apparent free space, metabolic space and vacuolar storage space), developmental constraints such as duration and timing of maturation (temperature, drought dependent maturation and use of ripeners) may accentuate the ceiling of apparent sucrose concentration in the culm. Thus, the physiological threshold of sucrose in culm may be seen in context of feedback regulation by bio-sensors like hexoses, as well as energetic limitations imposed by continuous cleavage and synthesis within the storage pool.

Immature internodes of early ripening variety depicted higher level of sucrose synthase activity, growth rate as well as sucrose accumulation while mature internodes of late ripening variety showed high sugar accumulation and sucrose synthase activity. With the growing season, these varieties differ in their ripening behaviour but interestingly did not differ in activities of sucrose synthase, acid and neutral invertase activities. Relatively lesser activity of SAI in early ripening variety CoJ 64, as compared to a mid-late (CoS 767) and late (BO 91) variety. A rapid decline in the activity of SAI in CoJ 83 has been attributed to its early ripening and higher sucrose contents. Higher activity of SPS in an early ripening/ high sugar variety, Co 89003 was observed as compared to a low sugar one, CoS 96260.

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Counterbalance of CO_2 emission and mitigating climate change by afforestation

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INTRODUCTION

The concentration of carbon dioxide (CO_2) in the atmosphere has increased from approximately 277 parts per million (ppm) in 1750 the beginning of the industrial era, to 415.70 ppm in 2019.Daily averages went above 400 ppm for the first time at Mauna Loa station in May 2013 which holds the longest running record of direct measurements of atmospheric CO_2 concentration (Dlugokencky and Tans, 2015). The atmospheric CO_2 increase above pre-industrial levels was, caused by the release of carbon to the atmosphere from deforestation and other unsustainable land-use-change activities. While emissions from fossil fuelsstarted before the industrial era, they only became the dominant source of anthropogenic emissions to the atmosphere from around 1925, and their comparative share has continued to increase until now. Anthropogenic emissions occur on top of an active natural carbon cycle that circulates carbon between the atmosphere, ocean, and terrestrial biosphere pools on timescales from days to millennia, while exchanges with geologic reservoirs occur at extended timescales.

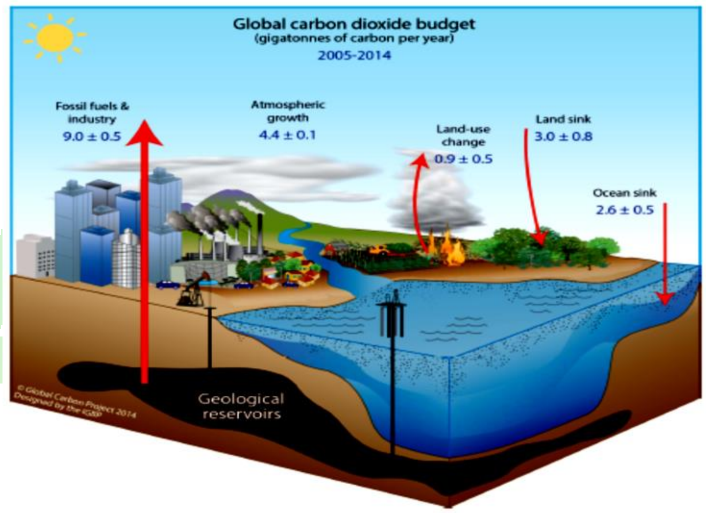

Fig.1: Schematic representation of the overall perturbation of the global carbon cycle caused by anthropogenic activities (Le Quéré, 2009)

Importance of afforestation

When it comes to fighting global warming, forest trees have emerged as one of the most popular weapons. With nations making little progress controlling their carbon emissions, many governments have advanced plans to plant vast numbers of trees to absorb CO_2 from the atmosphere in an attempt to slow climate change.Forest schemes got a big boost from the 2015 Paris climate accord, which for the first time counted all countries' efforts to offset their carbon emissions from fossil-fuel use and other sources by planting or protecting forests. To judiciously manage and reduce source and enhance sinks of carbon can be effectively done by land –based biological methods. In Indian context also biotic fixation of CO_2 through plant is an important one. Degraded land restoration by afforestation and reforestation is important for strengthen existing soil and ecosystem carbon sink. In India, forest biomass have a high Soil organic carbon (SOC) pool ranging from 37.5 Mg ha^{-1} in tropical dry deciduous forest to 92.1 Mg ha^{-1} in littoral and swamp forest. The average SOC pool ranges from 70 Mg ha^{-1} to 162 Mg ha^{-1} to 1m depth (Lal. 2015). It indicated

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that afforestation and reforestation of degraded soil has multiple benefits, including carbon sequestration in biomass and soil.

Impact on environment

According to the study, 43 percent of the total emissions reductions that could be achieved from reforestation depend on reducing pasture land, including by reforesting all grazing land in forested ecoregions. This scenario may be difficult to fully realize given the growing demand for food, including a projected 95 percent increase in meat demand between 2006 and 2050. Instead, we will need to find ways to increase productivity on pasture lands to concentrate food production on a smaller amount of land and free up land for restoration. Other countries like Brazil aims to restore 22 million hectares (54 million acres) of land by 2030, including boosting productivity on 5 million hectares (12 million acres) of degraded pasture land by 2020. Forest-based products from restored forests—such as nuts, fruits and wild game—promote food security, while the trees absorb carbon dioxide. And research supports the business case for investing in restoration.

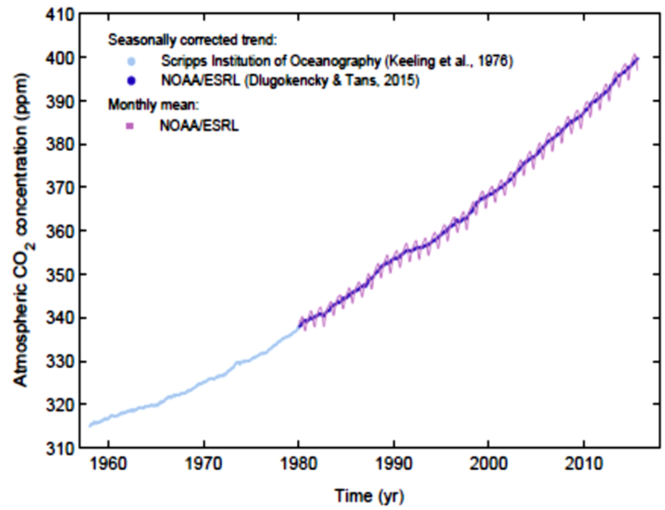

Fig.2: **Surface average atmospheric CO_2 concentration, deseasonalised (ppm). The 1980–2015 monthly data are from NOAA (Dlugokencky and Tans, 2015)**

Indian scenario

In Indian condition establishment of plantation of *prosopis juliflora* can reclaim saline soil and improve quality, fertility and microclimate of the area along with enhancing SOC sequestration in soil. Agroforestry system in India can improve degraded land and also enhance SOC sequestration in India's agroecosystem. In Punjab, SOC pool and aggregation under poplar-based agroforestry systems, are known to increase SOC pool over a 6-year period compared to sole cropping system. In Himalayan region, establishment of forest plantation has a large potential for enhancing the ecosystem carbon pool. Having a large carbon sink capacity, restoring 40 Mha of surplus degraded land in India by afforestation at 5.5 Mg C ha^{-1} yr^{-1} in forest productivity, could sequester 3.32 Pg Cover 50 years. Afforestation of middle and lower Himalayas can also mitigate flood and drought problems which has been plagued the nation for decades and even centuries.

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CONCLUSION

Global tree cover loss reached a record high in 2016, with tropical countries especially struggling to curb emissions from deforestation. In the top-emitting tropical countries, meet production, agricultural crops such as soy, and large industrial oil palm plantations are the main drivers of tree cover loss. Avoided deforestation could deliver more than 40 percent of total emissions reductions offered by low-cost solutions (Low-cost can be as defined in the study means it would take less than $100 a year to reduce a ton of carbon dioxide emissions). Protecting forests also offers the greatest potential to mitigate climate change based on land area. Long-term initiatives for reforestation can create jobs, business opportunities, alleviate poverty, bring peace and prosperity while mitigating climate change and improving the environment.

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Weeds - Threat or safe to human health

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According to Jethrotull weeds are the plants, which grow where they are not wanted. Weeds compete with crops for resources like water, nutrients, light and space which leads to reduction of yield of crops. Weeds germinate earlier to weeds because of their presence in upper layers. Weeds are adaptable to adverse environmental conditions. Weeds account for 45% loss of agriculture produce.Weed competition at critical stages leads upto 85-90% reduction of upland rice. Weeds compete for resources when there is deficit of resources. In dry land conditions, water is very crucial. So weeds compete for water in dry lands. In irrigated conditions, weeds compete for nutrients. Weeds not only decrease yields but also harmful to health of mankind. It causes diseases and allergies to humans.Besides harmful effects, there are many beneficial effects of weeds to mankind. Weeds can be used in many ways like food, teas, medicines etc. They acts as source of protein, minerals etc.It is used as medicine in Ayurveda. Many people have been using weeds for curing various diseases. Weeds are also used as food sources like salads, food decoration, leafy vegetable etc. Weeds used for medicinal purpose normally have biologically active compounds. All parts of weeds like roots, leaves, shoots and flowers can be used for consumption as well as medicinal purpose. These are also used in pharmaceutical industries for formulation of drugs.

Harmful effects of weeds to mankind:

- Pollen of *Ambrosia artemissifolia* causes hay fever and asthma.
- *Partehniumhysterophorus*causes dermatitis.
- Some aquatic weeds like *Pistialanceolata*, *Salviniaarticuata*, *Alternanatherasps* acts as alternate hosts of malaria, dengue fever and filariasis.
- *Argemonemexicana* causes blindness and in extreme cases lead to death of people.
- Milk of animals fed with Mexican poppy causes Glaucoma in humans.

Beneficial effects of weeds to mankind:

- Roots of *Chicoriumintybus* are used for adding flavour for coffee powder.
- *Chenopodium album, Medicagodenticulata, Amaranthusviridis* used as leafy vegetable.
- In China and Japan people consume *Chlorella pyrenoides* acts as protein supplement.
- *Leucasaspera* cures snake bite, *Calotropisprocera* cures gastric troubles, *Argemonemexicana*cures skin disorders, *Phyllanthusniruri* cures jaundice, *Strigaorobanchioides* control diabetes.
- Wild spinach is rich in minerals.
- Small, tender leaves of wild spinach are used as salads. Large leaves can be used as leafy vegetable. Leaves can cure tummy aches, diabetes.
- *Chloris barbata* cures diabetes.
- Juice from leaves of *Chenopodium album* cures leukoderma or disappearance of white spots.
- *Trianthemaportulacastrum* leaves cures mouth ulcers, rheumatic pains.*Mimosa pudica* yields novel chemotherapeutic compounds.
- Mimosine, an alkaloid in Mimosa have anti-proliferative and apoptotic effects.

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- Eventhough*Euphorbia lathyris* is poisonous to human beings but also used as antiseptic and purgative.
- *Trifoliumalexandrium* is a high protein source food.
- *Xanthium strumarium* is used in Chinese medicines but poisonous to livestock.
- *Allium vineale* is an antioxidant inhibits peroxynitrite induced diseases.
- *Taraxacumofficinale*is used in herbal medicines. It also nourishes liver. Leaves and roots are used for tea preparation. Young leaves are used as salad. Juice from flowers used in jelly, wine, cookies and also as oil which relieves muscle pains.
- Solanum is used as diuretic in herbal medicine. The berries of solanum are edible when cooked.
- *Portulacaolaracea* is used as a medicine in china to prevent bleeding of genito-urinary tract and dysentery. It can also applied to relieve sores and insect bites.
- Young roots of *Daucuscarota* are edible. It is also used as a herbal contraceptive.
- Seeds and leaves of Brassica are edible.
- *Stellaria media* is full of antioxidants. Used for skin infections.
- *Malva spp*. eases sore throats, heart burn and constipation.
- *Abutilon indicum* is used for piles, tuberculosis, cough, toothache and stomach pain.
- *Acalyphaindica* is used for asthma, bronchitis, ulcers, wounds, pneumonia, headache and pneumonia.
- *Achyranthesaspera* is used for bleeding piles, cough, bronchitis, skin diseases and vomiting.
- *Amaranthusviridis* is used as blood purifier, digesting agent. *Argemonemaxicana* cures ulcers.
- *Dactylocteniumaegyptium*is antipyretic.
- *Digeraarvensis* cures urinary discharge troubles.
- *Euphorbia hirta* cures bronchitis, cough and vomiting.
- *Vernoniacinerea* prevents cough, fever and headache.

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An alternative approach of plant defense mechanism through SAR

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INTRODUCTION

Systemic acquired resistance (SAR) is a mechanism of long-lasting protection by inducing defense against a broad spectrum of microorganisms. Systemic Acquired Rresistance (SAR) plays an important role in the ability of plants to defend themselves against pathogens through a signal transduction pathway. After the formation of a necrotic lesion the SAR pathway is activated, plants have evolved a number of inducible defense mechanisms against pathogen attack. Recognition of a pathogen often triggers a localized resistance reaction, known as the hypersensitive response (HR) which is characterized by rapid cell death at the site of infection or as a symptom of disease. Salicyclic Acid is used as a signal molecule in SAR which is associated with accumulation of pathogenesis-related proteins that contribute to resistance. In plant *Arabidopsis*, it was discovered that the isochorismate pathway is the major source of SA during SAR.

NATURE OF THE SYSTEMIC SIGNAL

Salicylic Acid

The detection of increased SA levels in systemic leaves and in the phloem led many researchers to believe that SA might be a systemic signal for SAR studies in TMV-infected tobacco showed that most of the SA (69%) accumulating systemically was made and exported from the inoculated leaf. A more recent study suggests that signaling might occur through the conversion SA to the volatile compound methyl salicylate, which could induce resistance not only in the uninfected parts of the same plant but also in neighboring plants

Reactive Oxygen Species

Early studies could detect no reactive oxygen species (ROS) production in systemic tissues during the onset of SAR. However, it has since been discovered by Alvarez *et al.* that H_2O_2 accumulates in small groups of cells in uninoculated leaves of *Arabidopsis* after infection with an avirulent strain of *P. syringae*. This leads to an initial oxidative burst with microbursts within two hours in the inoculated tissue followed by the formation of microscopic HR lesions. Using catalase to scavenge H_2O_2, or DPI (*Diphenylene iodonium*) to inhibit the NADPH oxidase, it was demonstrated that both the primary and secondary oxidative bursts are required for the onset of SAR.

The role of SA in SAR

In many plants SAR is preceded by an increase in SA concentration. However, some plants such as potato and rice have high endogenous levels of SA under non-inducing conditions. Indeed, application of SA to potato does not protect it against *Phytophthora infestans*. However, expression of *nahG* in potato blocks resistance to *P. infestans* induced by arachidonic acid. This suggests that after treatment with arachidonic acid, instead of SA levels rising, the potato plants become more sensitive to SA. Thus, SA is an essential signal for SAR across a range of plants, although the mechanism by which SA induces SAR might differ.

SA Synthesis

It was previously assumed that SA for SAR is synthesized via the shikimatephenylpropanoid pathway, although this was never proven. It has recently been shown that, like bacteria, plants can also synthesize SA from chorismate via isochorismate. Expression of bacterial enzymes, isochorismate synthase 1 (ICS1) and isochorismate pyruvate lyase 1 (IPL1), in tobacco and *Arabidopsis,* catalyzing these reactionsresults in increased SA accumulation and pathogen resistance.

NPR1-dependent SA signaling

To identify components involved in SA signal transduction, a number of mutant screens were performed that identified multiple alleles of a single gene, *NPR1/NIM1*. NPR1 is important for restricting the growth of pathogens at the site of infection. NPR1 is required for another induced resistance response, known as induced systemic resistance (ISR), which is triggered by nonpathogenic root colonizing bacteria and confers resistance to bacteria and fungi in aerial parts of the plant. NPR1 also mediates cross-talk between the SA signaling pathway and the jasmonic acid (JA) and ethylene (C_2H_4) signaling pathways that confer resistance to insects and some necrotrophic pathogens.

Gene expression changes during SAR

There is ample evidence indicating that SAR is conferred by expression of a collection of genes. The phenotype of *dth9* is a good example, showing that SAR can be blocked without affecting the induction of *PR-1* and *PR-2*. The sequencing of the *Arabidopsis* genome has allowed global analyses of gene expression changes during SAR to be conducted using DNA microarray technology. The genes in this *PR-1* regulon are strongly induced in systemic tissue during SAR and this induction is NPR1-dependent. They are also induced by infection with virulent *P. parasitica*, suggesting that activation of SAR-related genes in local tissue can limit infection by compatible pathogens. This is consistent with the enhanced susceptibility to virulent pathogens observed in *npr1* mutants. Upon activation of SAR, NPR1-dependent derepression would occur possibly through the inactivation of SNI1.

CONCLUSION

Our understanding of SAR has increased considerably over recent years as we have begun to elucidate the molecular mechanisms underlying this response. In Figure 1, we present a summary of the data discussed in this review. Many of the processes contributing to SAR are clearly required in both local and systemic tissues and contribute to basal disease resistance. In local tissue, the trigger for these changes is the recognition of the invading pathogen, whereas in systemic tissue they are induced by perception of a systemic signal. There is evidence for negative and positive feedback of SA signaling and cross-talk between different signaling pathways, adding to the complexity of the defense response. As well as the central role played by NPR1-mediated signaling, there is growing evidence for an NPR1-independent pathway(s) that contributes to defense gene induction.

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Nanotechnology in agriculture

Article id: 21845

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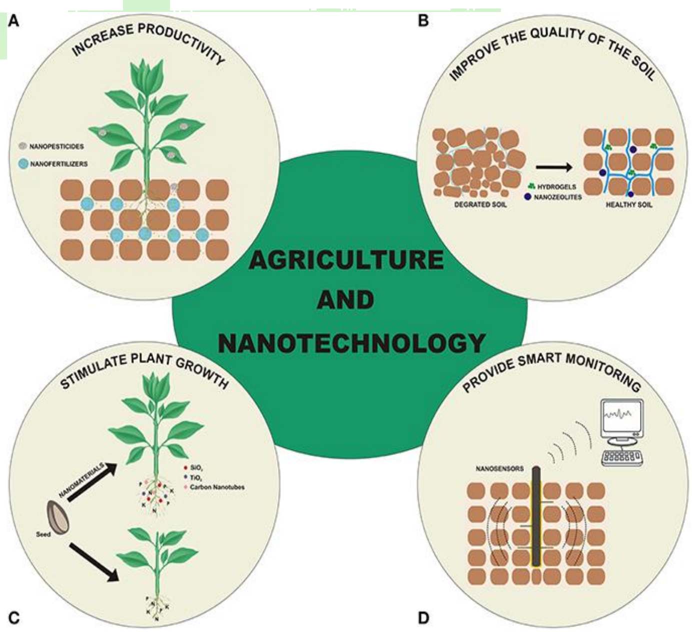
INTRODUCTION:

Agriculture is considered the backbone of most developing countries, with more than 60% of the population dependent on it for their livelihood. In the same times there are many challenges facing agriculture sector, like climate change, non-reasonable use of resources and usage too much chemical fertilizer.

Nanotechnology:

"Nanotechnology is the art and science of manipulating matter at the nanoscale" the design, characterization, production, and application of structure, device, and system by controlling shape and size at nanoscale. Nanotechnology is working with the smallest possible particles which increase hopes for improving agricultural productivity through encountering problems unsolved conventionally, the nanotechnology applications have the potential to change agricultural production by allowing better management and conservation of inputs of plant and animal production (Raliya, 2017) Nanotechnology provide a great scope of novel applications in the plant nutrition fields to achieve the future request of the rising population because nanoparticles have exclusive physicochemical characters i.e. high surface area, high reactivity, and tunable pore size.



Some unique features of nanoparticles:

In nano-world, materials less than 100-nanometer size behave completely different, the rules that manage the behavior of the elements of our known world start to give way to the rules of quantum mechanics, and everything changes. There are various advantages that nanotechnologies offer due to the unique functional properties of nanoparticles and materials like:

1. Higher charge density and higher reactivity of nanoparticles due to small size
2. As the surface area increases in comparison to volume, the activity of the atoms on the surface of the particles becomes more than the inside the particles.

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3. As a result of large surface to volume ratio, the nanoparticles had more strength, increased heat resistance, decreased melting point and different magnetic properties of Nano-clusters
4. Differences in the exposed surfaces of different nanoparticles lead to variances in atomic distribution across the nanoparticles, this, in turn, affect the electron transfer rate kinetics between metal nanoparticles and corresponding adsorbed species.
5. Nanoparticles have higher catalytic activity when they are present in tetrahedral structure followed by cubic and spherical structure, recognized for the improvement of chemical reactivity at the sharp edges and corner of the former.

Nanomaterials and Agriculture:

Nanomaterials often have chemical, physical, or biological properties that are different from those of their larger counterparts and due to their different properties, nanomaterial may pose different safety issues than their larger counterparts. There has been main attention in using nanotechnology in agriculture and the food system due to great potential as it can improve the quality of different products, also, with the rapid advancement of nanotechnology since the last decade of last century, controlled preparation of Nanomaterials with desired morphology and size, and newly established concepts and methodology have underpinned the solid bases to solve the unsolved questions in nutrient uptake.

Nanomaterials usage in agriculture:

Nanomaterials have many usages in all stages of agricultural production, in different forms and various procedures such as:

1. Nano-fertilizer for balance crop nutrition (Roberts, 2009)
2. Crop improvement (Zinc Nano fertilizer used to enhance crop production of Pennisetum *americanum*)
3. Plant protection ingredients (pesticides, fungicides, weedicides)
4. Weed management.
5. Nano pesticides
6. Nano sensors
7. Post-Harvest Technology
8. Bioprocessing (bio synthesized) nanoparticles for agricultural use
9. Bio sensors for Aqua culture
10. Nano biotechnology (Analysis of gene expression and Regulation)
11. Monitoring the identity and quality of agricultural produce
12. Precision agriculture: Precision agricultural techniques might be used to promote increase crop yields but not damage soil and water, decrease nutrients loss due to leaching and emissions, in addition to enhance nutrients long-term incorporation by soil microorganisms.
13. Seed technology.
14. Water management
15. Plant growth regulators
16. Soil management
17. Agricultural engineering aspects
18. Food technology

CONCLUSION:

Nanotechnology consider a novel key to growing agricultural production through implementing nutrient efficiency, improve plant protection practices, also, nanotechnology may have real solutions for various agriculture problems like improved crop varieties, plant protection, detect diseases and monitor plant growth.

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The status of Kinnow production in Rajasthan and needs of processing industries

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INTRODUCTION:

In the horticulture sector, India is becoming one of the leading producers of many important fruits and vegetable crops in the world. In recent years, the overall horticultural production exceeded agricultural production. India stands third in term of production of citrus fruits after mango and banana. The citrus fruits belong to the plant family Rutaceae. The particular family includes several economically important fruits like lemon, lime, orange, grapefruit, sweet lime and kinnow. Among these fruits, kinnow fruits have enormous market potential, as the fruits of this crop have a unique taste, high juicy content and high productivity. The fruit is likened by the masses and popularly grown in Haryana, Punjab and adjacent parts of Rajasthan.

What is Kinnow?

Kinnow is the type of hybrid plant, developed by the Howard b. frost of the University of California in the year 1915. The hybrid was made by crossing two popular citrus variant namely King and Willow leaf.

The status of Kinnow fruit crop in Rajasthan

Two major districts in Rajasthan offers a suitable growing condition for kinnow. The soil and climatic condition of Sriganganagar and Hanumangarh promote the production of high qualities kinnows. The kinnow was introduced in these respective regions in the 1950s, since then the area of cultivation is expanded in these areas.

The unique feature of Kinnow fruit

The fruits of kinnow have a soothing appearance, rich in juicy content and good shelf life. The fruits contain essential minerals, vitamins and fibres content. The fruit is a rich source of Ascorbic acid, calcium, iron and phosphorous. Apart from these certain characteristics like unique taste, easiness in peeling, aroma, attractive appearance are the few attributes of these fruits which make it suitable for export to the international market.

Cultivation conditions of Kinnow fruit

Mostly kinnow is grown by budding method upon the rootstock of rough lemon. The planting is done in the field upon onset of monsoon, in the mid of July month. Nowadays, high-density planting is exceeding in the area because of the reduction in the cost of overall production in term of application of nutrients, fertilizers, irrigation and other protection measures.

Hindrance to the farmers for fetching effective prices

The masses which prefer these fruits spread across the domestic and international level. The productivity of this crop is high but the income returns to the farmers remain low

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because of lack timely selling of the produces, minimum rates in the competitive market and presence of a large number of middle traders.

Needs for processing industries

There is an immediate need to develop a processing industry into the area to protect the farmer's interest. In the lack of proper transportation and industry, most of the produce is sold at minimum prices or remain unworthy to sell. If the processing industry is raised, then the farmer can sell their produce at good prices to them, in return these processed fruits can be sent to export to the international markets. Sidewise farmer should be trained to learn about fruit grading. As most of them sell their fruits at the same rate irrespective of knowing the best grade or least grade. Because the best grade fruits fetch more return in the international market.

Summary:

The dream of enhancing or doubling the farmer cannot be fulfilled without the development of processing units or large scale food and fruits processing industries. Most often the horticultural and agricultural produces got rotten in lack of proper storage facilities or due to abrupt weather. These problems can be overcome with a unique solution for developing processing industries on a crop basis. The crop-specific area should be identified firstly, its market potential should be studied and following the processing industry should be developed. The state of Rajasthan has huge potential for kinnow crop, the problems and constraints faced by the farmers should be identified and rectified for the prosperity of the farmers belonging to the respective region.

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Root-Knot Nematode a Peril/Imperil in Tobacco Production

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INTRODUCTION

India is third in production of tobacco in the world. It belongs to the genus *Nicotiana* and family Solanaceae (nightshade). Seventy species of tobacco are known, but *N. tabacum* is most commercial. Tobacco crop has affected by different biotic factors among all the factors plant parasitic nematodes namely; root-knot nematode (*Meloidogyne incognita*), root-knot nematode (*M. javanica*) and peanut root-knot nematode (*M. arenaria*) have been most important biotic factor in tobacco. They are ubiquitous in tobacco fields and often more than one species is present. In addition to direct effects on tobacco, root-knot nematodes can make the crop more susceptible to other diseases such as brown spot and black shank. Nematode-infected tobacco crops have been known to lose up to 1,500 lbs/acre. This crop is highly susceptible to nematode damage and as such, high priority must be given to nematode management each time tobacco is grown.

Symptoms

Nematode damage include plant stunting and poor growth in oval patterns in a field during early season of the crop. Leaves of the tobacco plant may or may not show typical yellowing, and root galls are very small at the early stage. Within two months after transplanting, leaves of tobacco plants suffering from root-knot disease turn pale-green then yellow in a process of early maturation. In severe stages of infection, a condition known as 'rimfiring' (Figure 1) occurs that includes necrosis of leaf tips and leaf margins. These symptoms are caused by lack of water and nutrient uptake and can be misdiagnosed. Examination of roots for nematode-induced galling (knots) is an easy and accurate method to diagnose the disease.

Figure 1: Severe root-knot nematode damage in maturing tobacco, leaf margin necrosis "rimfiring" is common.

(Source: Google web)

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Biology and life cycle

- Most species of plant parasitic nematodes have a relatively simple life cycle consisting of the egg, four larval stages and the adult male and female.
- Development of the first stage larvae occurs within the egg where the first molt occurs.
- Second stage larvae hatch from eggs to find and infect plant roots or in some cases foliar tissues.
- Under suitable environmental conditions, the eggs hatch and new larvae emerge to complete the life cycle within 4 to 8 weeks depending on temperature.
- Nematode development is generally most rapid within an optimal soil temperature range of 70 to 80°F.

Survival and spread

Primary: Egg masses in infected plant debris and soil or collateral and other hosts like Solonaceous, Malvaceous and Leguminaceous plants act as sources of inoculums.

Secondary: Autonomous second stage juveniles that may also be water dispersed.

Favourable conditions: Loamy light soils.

Interaction with other micro-organisms

Damage caused by nematodes are difficult to estimate because damage to roots may not be apparent in above ground symptoms, yet significant reductions in yields can occur with moderate levels of nematodes. Nematodes may increase the incidence of other diseases such as black shank, bacterial wilt and Fusarium wilt. The reduced use of fumigants during wet springs always results in dramatic increases in nematode damage and demonstrates the importance of soil fumigation.

MANAGEMENT

Crop Rotation

Rotation of a tobacco crop for three to four years with non-hosts, or less susceptible hosts, such as bahiagrass, bermudagrass, millet, and sorghum are among the most effective crops in reducing soil populations of root-knot nematodes and should be grown for at least one year before planting tobacco. Cotton is not a favorable host for Javanese and peanut root-knot nematodes and is an acceptable rotational crop. However, cotton is very susceptible to southern root-knot nematode and tobacco cultivars resistant to this nematode should be grown when tobacco follows cotton production. Peanut is a host to the peanut root-knot nematode but not other species of root-knot nematodes. Tobacco should not be grown in years following root-knot susceptible crops such as lupine or other winter legumes nor following summer legumes as soybean, cowpea, or alyce clover, etc., which are highly susceptible to root-knot nematodes.

Crop Destruction

After harvesting of Tobacco crop, it grows continually even after mowing, and hence, can survived several months before a killing due to frost or low temperature. Plant parasitic nematode will be continue to feed and reproduce on these plants debris and associated weed hosts. This will help for increases soil population of nematodes. Therefore, roots should be exposed and destroyed with a middle-buster or turn plow immediately following tobacco harvest to help eliminate these breeding sites. Bare fallowing after a tobacco crop should not be practiced since it can seriously deplete soil organic matter and contribute to soil erosion. It is recommended that tobacco land following post-harvest plowing be planted to a winter cover crop.

The cover crop must be a poor or non-host for the nematode. Managing root-knot nematodes are most suitable with winter cereals. Use of crop rotation systems that includes bahiagrass has been increasing, and this perennial grass is a non-host for nematodes affecting tobacco. However, weeds must managed in the bahiagrass or nematode populations will maintained in such a system resulting in damage to the following tobacco crop. A two-year bahiagrass rotation of two or more years will greatly reduce nematode populations providing broadleaf weeds are controlled early and regularly in the first year

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bahiagrass and this continued through the life of the rotation.

Resistant Varieties

Root-knot nematode resistant tobacco varieties are available grows the following resistant / tolerant varieties: Burley BRK4 /Flue cured AFH1, AFH2, AFH3 and FH4.

Fumigation

Tobacco transplants in field plant beds should do so only in fumigated soil to reduce the risks of carrying nematode or other soil-borne diseases into the field. Bedding sites should be selected that have not been planted to tobacco or other root-knot nematode susceptible crops for several years. Sites should have good drainage and be easily accessible for irrigation. Prior to fumigation, the beds should be worked until free of clods, stones, and plant debris. Fumigation should be performed when soil temperatures are between 50 - 80° F, and the soil is neither very dry nor very wet. Fumigation with methyl bromide have been the choice of most growers over the years for management of nematodes. However, methyl bromide supplies are becoming limited because of environmental issues. Other fumigants may also be used for tobacco transplanting beds, and these include Telone C-17, Telone C-35, Busan, Vapam, and Cholorpicrin.

Nematicides

Pre-plant soil fumigants are generally superior for the management of root-knot nematodes than non-fumigant nematicides. Telone C17 and Telone C35 are multi-purpose fumigants with fungicidal properties in addition to the solely nematicidal property of Telone II. The latter is the least expensive product, and it is generally more economical to use Telone II for nematode management coupled with a separate and specific fungicidal treatment.

Very recently innovation using application from pressure sealed containers is available that provides less environmental and personal exposure to the fumigant. Consult with fumigant dealers who have been trained in proper equipment and application methods for further information. Fumigation should be completed two to four weeks before transplanting tobacco. Heavy, wet, and cold soils will require longer waiting periods before transplanting tobacco. Failures in nematode management from non-fumigants generally can be traced to leaching of the nematicide from an overabundance of rain too soon after application. A good rotation program and root-knot resistant tobacco varieties should be used in conjunction with non-fumigant nematicide treatments.

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Procedure of Evaluation, identification and release new crop varieties in India

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INTRODUCTION:

The main aim of any breeding programme is to develop variety superior to the existing ones in yielding ability, disease and insect resistance and other characteristics. The different methods of breeding are designed to assist the breeder in developing such superior cultivars for commercial cultivation and these strains need to be released as a variety by the state or central variety release committee. But before nominating any strain as variety it has to pass few stages of evaluations so as to prove its strength over the existing cultivars. This release is based on demonstration of superioriority of new strains over the best existing varieties in yielding ability or in some other features of economic importance in multilocation trials conducted by All India Coordinated Research Project on various crops. The All India Coordinated Research Projects (AICRPs) is landmark organized system for technology testing in agricultural research and the first AICRP on maize has been established in 1957. The mandates of AICRP on different crops are to 1) evaluate new genetic material in multi-location trials to identify cultivars with broad and specific adaptation. 2) It reduces time required in identification/release of new varieties by generating data at several locations in few years and to share experience, knowledge and genetic material among the associated institutes working in different parts of the country. 3) Initially this trials were formulated for the improvement of food crops only and later it extended to horticulture, agricultural engineering, natural resources management, animal sciences and home science. 4) The coordinated trial system were brought together different partners working in ICAR Institutes, SAUs, State Departments, and other agencies to address and resolve complicated agricultural problems of national and regional significance. The various activities and operation in the release of new strain as a variety includes evaluation, identification as well as release and notification of new strains/entry.

Introduction of test entries into trial:

- The data generated in pre-coordinated testing such as station and other trials, help to send the test entries in to the coordinated trials.
- Superior performance for yield and/or other desirable traits such as resistance/ tolerance to important biotic/abiotic stresses, superior quality parameters, etc.
- Considered by a high level of phenotypic uniformity and genotypic stability.
- Germination and physical purity standards of testing entry must follow to the minimum seed certification standards of particular crop.
- Selected entries different/ distinguishable from the varieties of common knowledge through their distinct diagnostic features.
- All information about the pedigree/parentage of the entry.
- Entries from the private organizations with established R & D units can be introduced.

I) Evaluation of test entries:

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The newly developed material is evaluated under All India Coordinated Crop Improvement Projects of different crops with three major stages (years) of testing includes,

First year	Initial Varietal Trial (IVT)	All India trial
Second year	Advanced Varietal Trial I (AVT-I)	Zonal trial
Third year	Advanced Varietal Trial II (AVT-II)	Zonal trial

A) Initial Varietal Trial (IVT)

This trials is comprised of new entries provided by cooperating breeders/institutions together with the specified number of check varieties, including latest identified/released varieties. The number of entries (including checks) shall be reduced to an extent where implementation of appropriate experimental design becomes otherwise challenging. A minimum of three check varieties, includes national check, zonal check and local check shall be used. Genetically pure and true-to-type seeds, meeting the requirements to minimum seed certification standards, will be used in trials. The same set of IVT for each specified situation shall be across all zones (where ever applicable) of the country in different regions, where the crop is predominantly grown.

Monitoring of the trials: All the trials will be monitored by a team of scientists to be assigned by the Project Director (PD)/Coordinator (PC) which includes,

i. PD/PC/ZC/PI/Senior most member of team - Team Leader
ii. Plant Breeder – Member
iii. Agronomist - Member
iv. Pathologist /Entomologist – Member
v. Scientist of any other specified discipline – Members

The team shall visit the trial sites at crop stage of full flowering to maturity and record observations on quality of the trial conduct like plot uniformity within replications and test plots, crop stand, disease and insect-pest incidence, bird damage etc., and management as per specified norms and comment on the reliability of data likely to be generated. The monitoring team shall also indicate an overall estimate of yield of the trial on the basis of its observations, and give clear-cut recommendation whether the trial data should be accepted or rejected.

Data produced:

- Data on produce of economic importance, observations on agronomic features like days to flowering and maturity, plant height, lodging, threshability; reaction to important diseases and insect-pests; easily measurable grain quality attributes such as grain colour, grain appearance, grain weight, etc. are also recorded.
- Additional data under artificial test conditions and hot spots for important diseases and insect-pests are also produced by the respective discipline scientists by organizing separate set of screening nurseries/trials.
- All cooperators need to record observations strictly according to guidelines provided and ensure the supply of one set of data- books to the coordinator by the specified date.

All the data received at the coordination cell will be critically examined to decide suitability for inclusion for statistical processing. The trial data may be considered for rejecting or acceptance for further processing on the basis of the following. (a) Recommendations of the monitoring team (b) Suggestions by the Zonal Coordinator/concerned breeder (c) Deviation from the specified range of sowing date, specified crop management practices for the trial such as fertilizer doses, irrigation levels etc. (d) Any other serious flaw in

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conducting of trial/data recording/reporting (e) Damage by animals/birds/natural calamity (ii) All the trials considered acceptable on the basis of the above may be statistically analyzed and examined for the following before pooling of the results.

General yield levels:

Under the irrigated conditions, trials with extremely low yields (less than state/region/district average as per standard fixed by the workshop), normally attributable to poor crop management, or remarkably high yields, which can be considered unlikely and probably arising out of various types of errors, are need to be rejected. In case of trials under restrictive environments such as rainfed, waterlogged, salt- affected conditions etc., the above measure should not be applied, and all trials where the check entries have produced reasonable yields should be considered for analysis, even though there is report of poor performance of any test entry of trial .

C.V. (Coefficient of variance) levels:

Irrigated trials showing highly erratic behavior of genotypes over replications (resulting in non- acceptable high CV levels), arising from extremely heterogeneous fields, patchy plant stands, hazards like bird/animal/hail-storm damages, may be discarded. In case of trials under rainfed/restrictive environments, all those showing significant genotypic differences and reasonable yield level of the checks should be considered. Trials with extremely low/negligible CV should be considered cautiously.

Norms for promotion of entries for testing in the second year

The entries from IVT to AVT will be promoted strictly based on the overall performance/merit of the test entries with the following criteria,

- Variety should pass minimum standards for reaction to pests and diseases.
- Outstanding performance of the entry for yield of economic importance by a margin of 15 to 20% over the best performing check.

OR

- Superiority or 10% higher yield/main produce of economic importance over the best performing check and stable performance across locations in along with specific promising attributes like high degree of resistance/tolerance to diseases, insect-pests and other biotic/abiotic stresses relevant to the region with adequate produce quality traits.

OR

- Yield/main produce of economic importance at par with the best performing check but significant superiority in some features of specific importance such as disease/insect-pest resistance/or some specific quality trait.

OR

- Sometimes yield marginally lesser than the best performing check but outstanding in one or more strategic features relevant to the crop such as extra earliness, export quality, specific industrial product property, nutritional superiority etc., which will increase the income per unit area of farmers.

B) Advanced Varietal Trial (AVT-I)

All conditions are same as mentioned in IVT for conduct of these trials while it is conducted on Zonal basis and the plot size is larger than IVT. Data recorded on field reaction to important diseases/insect-pests are under artificial epiphytotic conditions by the respective disciplines at suitable locations including hot-spots. Data on pathotype/biotype variations, the level of virulence, etc. shall also be generated.

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C) Advanced Varietal Trial (AVT-II)

All conditions are same as in AVT-I for conduct of these trials.

Additional data from AVT-II

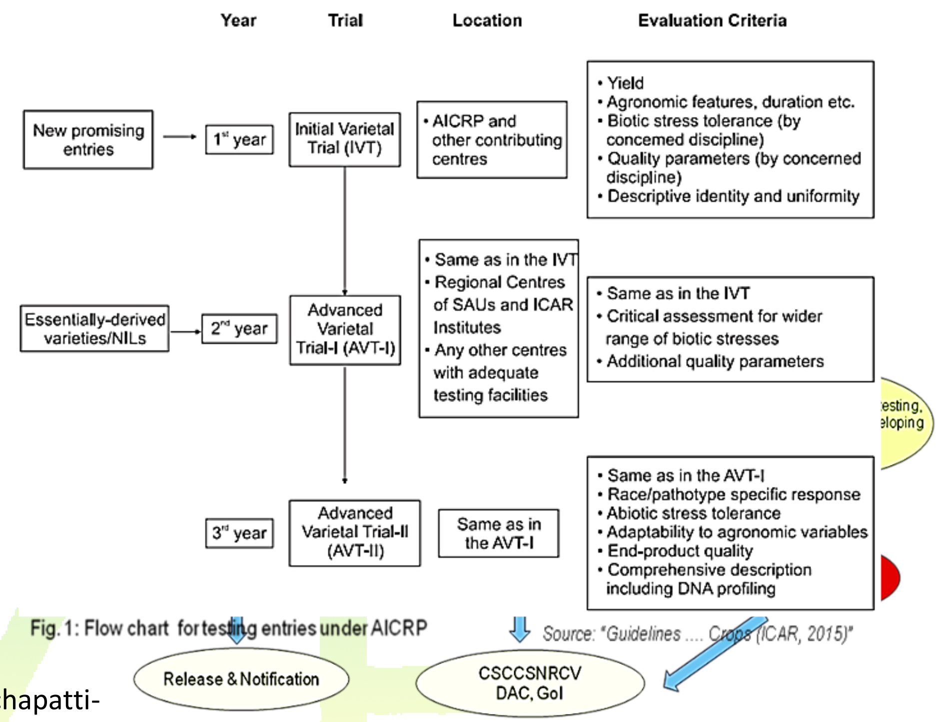

Fig. 2: Flow chart for development, evaluation and release of crop cultivars through AICRP
Source: "Guidelines .... Crops (ICAR, 2015)"

- Response to the agronomic variables such as different dates of sowing, population densities in terms of spacing, levels of fertilization and irrigation etc.
- Response to popular and emerging new weedicides.
- Reaction to additional diseases and insect-pests of relatively lesser importance to the crop, including nematodes and bacteria will be checked.
- Efforts should be made to locate genes responsible for resistance/tolerance in the new entry wherever possible.
- Intensive evaluation for specific quality parameters relevant to the crop, like oil recovery in oilseed crop/processing properties/actual chapatti-/noodle-/bread-making quality in wheat, cooking quality in rice/pulses, protein quality and micronutrients in food grain crops.
- Response to relevant abiotic stresses and other important characters are to be recorded.
- Additional information on farmer/consumer/market acceptance.
- Amenability of the variety to commonly used farm machinery.

II) Procedure for variety identification

After completion of three years of testing, the concerned breeder will propose variety for identification during Annual AICCIP Group meeting/workshop. At the time of making proposal for variety identification, breeder has to ensure the availability of test stock seed (pure high quality seed produced by the concerned breeder/Institute) for sowing in 5 ha for seed production/demonstrations/adaptive trials and nucleus seed for 0.50 ha (except sugarcane).

III) Variety Release and Notification

Central release:

Once the variety/hybrid is identified in workshop, seeds of variety/hybrid/parental lines are to be deposited with the NBPGR for conservation in gene bank.

After getting the acknowledgment with IC No. from the NBPGR, the release and notification proposal of the variety/hybrid needs to be submitted to the Central Sub-Committee on Crop Standards, Notification and Release of Varieties along with DNA fingerprinting data (*where ever available*) and good photographs of seed, single plant and of field view**.**

State release:

Genotypes tested in the AICCIP trials for at least one year or those which could not be identified on the zonal basis in the workshop but adequate information on disease and insect-pests reactions of them are available from the coordinated testing. The variety has to be first cleared by the Institutional Variety Identification Committee of the concerned organization and then proposed to the State Seed Sub-Committee for release. Once the variety is released by the State Seed Sub-Committee, proposal is required to be submitted to the Central Sub-Committee on Crop Standards, Notification and Release of Varieties for its notification.

CONCLUSION

The multilocation testing by AICRP in India is unique model of multi-disciplinary approach which facilitate the rapid generation and identification of suitable high-yielding varieties and development of improved package of practices for diverse agro-ecologies in India. This system is so robust as it has been developed more than 3,000 high-yielding varieties/hybrids of field cropstill 2014 and combining desired levels of resistance to biotic/abiotic stresses, adaptation to diverse agronomic variables and cropping systems. The international nurseries and trials, which is organized worldwide by the CGIAR institutes, are basically modeled on the lines of AICCIPs.This system is meeting the prescribed quality standards in testing the new strains and the production from released cultivars support the changing crop production pattern in country.

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Weed management in vegetables

Article id: 21849

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INTRODUCTION

A number of new cultivars of vegetable crops with high yield and quality potential have been evolved and are being cultivated on commercial scale. Similarly, various production technologies have been developed for various agro-climatic regions of the country. In spite of all these developments, vegetable production suffers to a great extent by weeds. The vegetable fields are usually infested by a wide spectrum of weeds. Weeds compete with vegetable crops for nutrients, moisture, light, space and other essential requirements. Therefore, yield is reduced in various proportions. The extent of yield reduction depends on the density and competitiveness of weed flora and availability of nutrients, moisture, space and light. The dry matter production of weed is negatively correlated with crop yield. The weeds are better adapted to adverse weather conditions, therefore they dominate over crops. The total annual losses of agricultural produce from various agencies are; weeds 45%, insects 30%, diseases 20% and other pests 5%. However, losses caused by weeds vary from crop to crop. The severity of losses is reported up to as much as 100%.

WEED

The weeds are the uncultivated (volunteer) plants that are not desired by man with respect to place and time of occurrence. All weeds are unwanted plant but all unwanted plants may not be weeds. Finally, weeds can be defined as all that vegetation which are unwanted, self growing, harmful and persistent, interfere with agricultural operation reducing the fertility of the soil along with yield are said to be weeds.

Harmful effects of weeds

1. Weeds compete with vegetable crops for nutrient, soil moisture, light and space. 2. Weeds reduce crop yield and quality of produce as well as increase the cost of production.
3. Weeds reduce human efficiency causes allergy, irritation and eczema, like; *Argemone mexicana*, *Prathenium* and *Heliotropium indicum*. Some weeds such as; *Mimosa pudica, Tribulus terrestris, Centipedaminima* and *Datura stramonium* cause wounds, headache, sneezing, giddiness and vomiting.
4. Weeds increase cost of insect and disease control because they work as host for them. *Datura stramonium* L. serves both as an alternate host and collateral host for Epilachna beetle. It also thrives on Amaranthus caudatus L. Vectors like aphids, white flies, leafhoppers and thrips feed and multiply on number of weed hosts. Convolvulus arvensis acts As a host for potato top roll virus, potato leaf roll virus and potato virus Y. Datura metal L. acts as host of purple top roll virus of potato, potato leaf roll virus, potato virus Y, potato phyllody and witches broom.
5. Weeds impair the purity of the varieties. Cross-pollination with compatible weed plants,impairs the genetic purity of the crop seeds.
6. Weeds cause allelopathic effects. *Parthenium hysteiophorus* release certain toxic substances in the environment, which impair the germination and growth of crop plants.
7. Some weeds reduce the quality of the produce due to presence of toxic substances that either cause direct metabolic damage or interfere with some phase of digestive utilization.

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Advantages of weeds

1. Many weeds prevent soil erosion,
2. Weeds is a potential source of fodder,
3. It add nutrient to the soil,
4. Some weeds like; *Chenopodium* and *Amranthus* has prominent place in human diet,
5. Many weeds are utilized for preparation of Ayurvedic medicines,
6. Weed also work as an indicator plant for the incidence of disease, nutritional deficiency disorder and frost,
7. Weeds are sometime valued as a potent source of genetic material in crop improvement program,
8. Weeds such as; *Argenione mexicana, Cynodon dactylon* etc. help to reclaim the alkalinity of soils,
9. Some weeds act as alternate host of pollinating insects such as, honeybees and butterfly.
10. Some aquatic weeds such as, *Eichhornia crassipes* absorbs heavy metals and other toxic substances from water, and thus improves water quality,
11. Some weeds have religious and ritual values such as,.*Cynodon dactylon, Eragrostic cyanofuroides and Ocimum sanctum*,

Classification of weeds

Almost all weeds that belong to the family Graminae are known as 'grasses'. The weeds that belong to the family Cyperaceae are known as 'sedges'. All dicotyledonous weeds are known as 'broad-leaved' weeds. There are several ways to classify the weeds as given under:

According to life cycle

A.Annuals. Those weeds, which complete their life cycle within a year, and generally propagated by seeds. Annuals may be further subdivided as per their season of prevalence.

(i) Kharif or warm season weeds.

They grow and complete their life cycle during the warm wet season (June-October). Examples are: *Trianthema portulacastrum, Amranthus spinosus, Euphorbia thymaefolia, Echinochoa crusgalli, Leusa aspere, Ageratum conyzoides, Eclipta alba, Portulaca oleracea, C,perus rotundus and Cynodon dactylon.*

(ii) Rabi season weeds.

Those, which grow and complete their life cycle during the cool dry season (October-February). Such weeds are; *Anagalis arvensis, Convolvulus arvensis, Asphodelus tenufolius, Chenopodium album, Alaunea asplenifolia, Melilotus albaand Desmodium trifolium.*

(iii) Summer season weeds.

Weeds that grow and complete their life cycle during hot dry season (February-June) are grouped under summer season weeds. However, most of the weeds of kharif and summer season are common. Examples are; *Portulaca oleracea, Argemone mexicana, Eragrostic tenella, Echinochloa crusgalli, Polygonum plebeium, Cynodon dactylon, Cyperus rotundus* etc.

(iv) Multi-seasonal weeds.

These weeds are capable to grow and complete their life cycle almost any time of the years i.e., it have not strict preference for any season. In general, they are thermo and photo-insensitive. They may complete their life cycle in more than one season or year. Therefore, they•are multi-cyclic and multi-seasonal annuals. Examples are; *Echinochloa colonum, Eclipta alba, Eleucine indica, Digitaria sanquinalis, Phyllanthus niruri* etc.

B.Biennials. Those weeds, which complete their life cycle almost in two year, are considered as biennial. They are propagated either by seeds or vegetative parts or both. Generally, they do not grown up in annual crop fields, but in perennial

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crop fields, lawns, gardens and orchards. Biennial weeds are; Blumea spp. Daucus carmta and Zingiber casumunar.

C.Perennials. Those weeds, which live for three or more years and produce seeds more than once in their life cycle, are perennial. They may propagate by seeds and also by underground stem or root suckers. Perennial may be of the following types, (i) simple perennial— they may reproduce slowly by seeds, e.g., Lantana camara and Ipomoea cornea, (ii) Bulbous perennials—these are propagated by bulbs, bulblets as well as by seeds, and (iii) Corms—it is a modified shoot and fleshy stem. The reproduction is through corm and seeds.

According to the site of predominance

1. Obligate weeds

Those Weeds, which grow only in association with man and agricultural practices, and never had been in wild form such as, Chenopodium album and Anagallis arvensis.

2. Facultative weeds

Weeds that grow both wild and in cultivated habitats, such as, Argemone mexicana and Euphorbia hirta.

According to the origin

1. Alien (foreign in origin):

Argemone mexicana, Parthenium hysterophorus, Lotium temulentum etc.

2. Apophytes (indigenous): Sacchurum spontaneum, Melilotus indica, Acalypta indica etc.

3.Entophytes (introduced by man): for example; Phalaris minor, Corchorus acutangulus etc.

A list of major weed species found in vegetable crops is given below:

Improved Production Technologies in Vegetable Crops

i) Cauliflower:*Chenopodium album, Anagalis arvensis, Fumaria parviflora, Amaranthus spp., Polygonum spp., Rumex crispus, Cyperus rotundus, Portulacaquadriftda, Melilotus alba, Solanum nigrum etc.*

ii) Okra*a. Spring: Echinochoa colonum, Cyperus rotandus and Portulaca quadifida. b. Kharif: Echinochloa colonum, Cynodon dactylon, Cyperus rotundus, Sorghum halepense and Ageratum conyzoides, Amaranthus spp., Tribulus terrestris, etc. c. Seed crop: Cyperus rotundus, Echinocloa crusgalli, Amranthus viridis, Cynodon ductylon, Tribulus terrestris and Portulaca quaarifida.*

iii) Onion*: Cyperus rotandus, Cyitodon dactylon, Echinochloa crusgalli, Chenopodium album, Trianthema portulacastrum, Amranthus viridis and Portulaca olerac'ea.*

iv)Potato*: Chenopodium album, Digitaria adscodense, Setaria glauca, Poa annum, Echinochloa spp., Anagalis arvenisis, Spergula arvensis, Ocalis corniculata, Polygonum aletum, P cardata, Galinganga parviflora, Cynodon dactylon and Elusine indica.*

v) Sweet pepper*: Cyperus rotundas, Cynodon dactylon, Cammelina nudiflora, Digitaria sanguinalis, Echinochloa colonum, Setaria olio ma and Elusine indica.*

vi) Fenugreek*: Chenopodium album, Chenopodium murale, Melilotus alba, Gyanandropsis gynandra, Anagalis arvensis, Cynodon dactylon and Cyperus rotundus.*

vii) Brinjal*:Triantherna portulacastrum, Cyperus rotundus and Chenopodium album.*

viii) Cauliflower*: Sorghum halepense, Chenopodium album, Cyperus rotundas, Melilotus spp., Amranthus viridis, Portataco quadrifida, Polygonum spp., Cynodon dactylon, Rumex crispus, Fumaria parviflora and Anagallis arvensis.*

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ix) Pea:*Imagalis arvensis, Chenopodium album, Convolvulus arvensis, Fumaria parviflora, Launea pinifida and Spergula arvensis.*

x) Tomato: *Chenopodium album, Anagallis arvensis, Fumaria parviflora, Melilotus indica, Cyperus rotundas and Echinochloa crusgalli*.

Method of weeds control

(A) Cultural methods

Manipulation of soil conditions to meet optimum requirements of crop growth, selective placement of manures and fertilizers, maintaining high plant population to smother weeds and minimum tillage are some of the measures of weed management.

a. Cropping and competition. Crops with different growth habits, adaptabilities and competitive abilities may prevent, suppress or reduce weed intensity. Crops that grow most rapidly have an advantage over slow growing or late emerging weeds. They grow more rapidly and cover the inter row space with their canopy faster than weeds such as, cowpea, okra, palak etc. This gives a smothering effect on weed growth.

b.Crop rotation. Each crop has its own specific weeds, and they thrive well when the same crop is grown successively. Continuous growing of cereal after cereal and vegetable following vegetable has led to serious problems of grass weeds. By rotating fields among different families of crops, growers may avoid weed problems. Continuous growing of one crop could result in an increase in the population of associated weeds. An ideal crop rotation should be such that keeps variety of weeds under control.

c. Plant population. Closer planting gives higher plant population and have competitive advantage over weeds. It produces smothering effect and reduces weed emergence and establishment. This method could be useful in crops where plant spacing is wide to allow prolific weed growth.

d. Tillage operation. Frequent shallow ploughing given before planting are very effective in controlling' annual weeds. The, technique of sowing or planting crop in the relatively weed-free soil is termed as `stale seed be I or dab technique. Being less expensive, this forms an important component of integrated weed management system. However, other flush of weeds may appear. Alternatively, a very low dose of a contact herbicide may take care of weeds without disturbingthe soil further. Deep ploughing, particularly in summer months is very effective against deep-rooted perennial weeds, as it would expose the underground vegetative parts to hot scorching sun.

e. Intercropping. Inter row space is a potential place for weeds which can be put to better use by intercropping. Intercropping in broad spaced crops such as brinjal, tomato, cabbage etc. with fast growing plants (radish, spinach beet) can reduce the weed emergence and competition substantially.

f. Time of planting. Late planting of garden pea can reduce infestations of important weeds such as *Chenopodium album* and *Phalaris minor*. However, alteration in planting time may not always beneficial for obtaining higher yields.

g. Water management. Planting of crops on raised bed has proved very effective in water economy and consequently lesser weed emergence. The water is applied only in furrows therefore, weeds emerge only in furrows and very less weed population on raised beds. Drip irrigation, by virtue of providing water at the base of the plant, results in less weed problem than the other methods of irrigation.

h. Balance fertilization and pest management. Balance fertilization and effective insect and disease management provide vigorous and healthy crops that are more, competitive against weeds.

i. Soil solarization: A mulching with clear polythene sheets for period of 2-6 weeks is effective against many annual weeds. A light irrigation prior to solarization treatment has a complementary effect, as moisture-imbibed weed seeds are more sensitive to heat than dry seeds. The limitation however is that normally weed seeds up to about 5cm depth are only affected. Deep preparatory cultivation would nullify the effect. It can be successfully used in controlling weeds, especially in nursery areas and under high value crops.

(B) Mechanical or Physical methods

The mechanical methods include tillage, hoeing, hand weeding, digging, sickling, mowing, burning, flooding, mulching etc.

(a) Tillage. 'Village removes weeds from the soil, resulting in drying out. Tillage is done with implement drawn by animal or machines. These implements include, plough, harrow, cultivators etc.

(b) Hoeing. Hoeing is the most appropriate and widely used weeding tools for centuries. Hoeing is particularly more effective on annual and biennial weeds as weed growth can be completely destroyed. Hoeing is usually done manually.

(c) Hand weeding. Hand weeding is done by physical removal or pulling out of weed by hand or khurpi (shovel). It is very effective against annual and biennial weeds.

(d) Digging. Digging is applied in the case of perennial weeds to remove the underground propagating parts of weeds from the deeper layer of the soil. It is labour intensive and slow process.

(e) Sickling and mowing. Sickling is also done by hand with the help of the sickle to remove the top growth of weeds to check the seed production and also to, starve the underground parts. Mowing is a machine-operated process mostly done along roadsides and in lawns.

(f) Burning. Burning or fire is often an economical and practical means of controlling weeds. It is used to dispose off accumulated vegetation, kill green weed growth where other methods are impracticable to destroy the buried weed seeds and other propagating plant pails.

(g) Flooding. Flooding is sometimes used for weed control in rice. It is not possible in case of vegetables, except weed control in fallows lands.

(h) Mulching. Mulching has smothering effect on weed control by excluding light. It is very effective against annual weeds and some perennial weeds like *Cynodon dactylon*, *Sorghum helpense* etc. It provides an effective barrier to weed emergence. Organic mulches of 5-7cm thick prevent light penetration, thus reduce weed growth. Organic mulches must be free of weed seeds and other noxious pest organism. Black and opaque plastic films also prevent weed growth: black polythene has the higher potential to control weed growth than other colours.

(i) Laser control. This method of weed control was developed in USA. In this method laser beams are used to destroy weeds. It is chiefly employed in case of aquatic weeds.

(C) Biological weeds control

In biological control, there is always a fear that the biological agents may also attack on crop plants. Because of this specificity, the attempts have been made primarily to control the weeds in forest areas, aquatic environments and parasitic weeds. Bio-agents, directly or indirectly weaken the weeds by working as parasites, predators and pathogens. Biological weed control methods are divided into-(a) plant pathogens (b) by insects (c) use of bio-pesticides, and (d) use of allelochemicals.

(a) By plant pathogens. It exploits the host parasite relationship between plants and pathogens. Pathogenic organisms damage the host plants through enzymatic degradation of cell constituents, production of toxins, disturbance of hormone systems, obstruction of translocation of food materials and mineral nutrients, and malfunctions of physiological process. As a result, the whole plants or part of the plant may die. Fungi *Aitemaria macrospore* is known to check the growth of spurred anode (*Anoda cristata*) and fungal pathogen *Cercospora rodmanii* may be used for the control water hyacinth.

(b) By insects. Insect provides a wider range of natural enemies suited to a particular ecological situation. Insects kill the weeds through destruction of photosynthetic parts. Lantana camera, a shrub weed can be controlled effectively by larvae of *Crocidosema lantana*, larvae of *Agromyza lantanae*, larvae of *Thecla echion* and larvae of *T bazochi* (lycaenid butterflies). In India, Opuntia is controlled by Cochinial insects (mealy bugs) Dactylopius indicus and D. *tomentosus*. *Orseoliella javanica* has been identified as a- potential natural enemy of thatch grass (*Imperata cylindrica*) and *Bactra vermosana* of nut grass (*Cyperus rotundus*).

(c) Use of biopesticides. In India, research on use of bio-pesticides for weed control is under progress. Some developed countries like; USA, Japan etc. are widely using bio-pesticides for weed control. Two mycoherbicides (fungi that kills weeds) have been registered in the USA for commercial use of weed control. One is the formulation of soil-borne fungus *Phytophthora palmivora* for selective control of stranger vine (*Morrenia odorata*) in citrus groves. It is marketed under the trade name 'De Vine'. It cause lethal root rots of its host plant and persists saprophyticaily in the soil for extended periods of time. Another commercially developed mycoherbicides is marketed under the trade name `College' which is a formulation of *Collectotrichum gloespomides*, an endemic anthracnose fungus for the selective control of Northern joint vetch (*Aeschynomene virginica*) in rice and soybean.

(d) Use of allelochemicals. Extensive research during the last two decades has demonstrated that several plant secondary metabolites (allelochemicals) as well as fungal and microbial toxins have good pesticidal activity. Bilophos is a natural phytotoxin isolated from Streptomyces hygroscopius and S. viridochromogenes and exhibits strong herbicidal activity against a wide range of grass and broad-leaved weeds. It is currently being marketed in Japan under the trade name 'Herbiaccae'. The other promising natural compounds which exhibits herbicidal activity is tentoxin, produced by Alternaria alternata. The phenomenon of allelopathy; the inhibition of growth of weed plants by chemicals released by crop plant has not been extensively explored, but it may have a great potential. Superior weed suppressing types have been reported in cucumber (*Cucumis sativus*), sunflower and soybean.

(D) Chemical method of weed control: In horticultural crops, herbicides were introduced in India during 1960 and steadily it is gaining momentum. In India, the hand tools and animal drawn equipments are still most practical and widely adopted method of weed control. However, manual weeding is not possible many times owing to unfavourable weather conditions. It is also realized that there is peak demand for labour during cropping season for various purposes, hence shortage of labour for weeding. The farmers cannot afford to lose time on tedious manual weed control under intensive and multiple cropping systems. This signifies the use of chemical for weed control. The chemicals that are used in weed control are known as

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herbicides. It saves time and labour. For most of the vegetable crops, there are several choices of herbicides, depending on crop species. For selection of suitable herbicides, identification of weeds and their history play an important role.

Classification of herbicides:

Herbicides may be classified on the basis of theirselectivity, mode of action, time of application and chemical composition.

(a) On the basis of selectivity

(i) Selective herbicides: Selective herbicides kill or retard the growth of certain selected weeds without causing any damage to others. These are pendimethalin, alachlor, oxadinzone, simazine, propanil and metribuzin. (ii) Non-selective herbicides.These herbicide kill or retard the growth of all plant species e.g., diquat, paraquat, glyphosate etc.

(b) On the basis of mode of action

(iii) Contact herbicides. A contact herbicide kills only those plant species to which it comes in direct contact e.g., propanil and paraquat. The mode of action of contact herbicides is the weakening and disorganization of cellular content of plant by leakage. Acute toxicity kills the weeds.

(iv) Translocated herbicide. A translocated herbicide when applied to a plant/soil gets absorbed by the foliage or roots and translocated into the plant system and cause death to that plant e.g., 2, 4-D, simazine etc. Systemic herbicides generally interference with the normal functioning of one or more physiological and biochemical process of plant e.g., respiration and mitochondrial activities, photosynthesis, protein and nucleic acid metabolism and enzymes. Chronic toxicity kills the weed.

(c) On the basis of time of application

(v) Pre-plant incorporation: The herbicide is applied before sowing/planting of the crop and incorporated into the root zone of germinating weed seeds.

(vi) Pre-emergence: These are applied after the sowing/transplanting of crop, but before the emergence of either the weeds or crop seedling or both. These include; alachlor, butachlor, simazine, pendimethalin etc.

(vii) Post-emergence: Such type of herbicides are translocated in plant through the foliage and applied after the emergence of weeds e.g., 2, 4-D, paraquat, dalapan etc.

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The dawning era of nanotechnology: concept and applications

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INTRODUCTION

Nanotechnology is the science of synthesis, application and exploitation of nano scale particles in various fields of utility. Nanotechnology culminates researchers from Chemistry, Physics, Biology and Engineering. Agriculture, soil science in particular proposes wider scope for taking advantage of the present knowledge of nanotechnology. The nanotechnology aided applications for example; nano-nutrients, nano-pesticides, insect repellants, nano- sensors, nano-composites, nano-films, nano-hormones, etc. have the potential to change agricultural production by allowing better management and conservation of inputs.

The most widespread usage of engineered nano particles (ENP) in soil science have been mentioned below in subsequent bullet points:-

- **Nano-fertilizers-** Nano-fertilizer technology is a very innovative approach towards increasing nutrient use efficiency of micronutrients specifically. Significant increase in yields has been observed due to foliar application of nanoparticles as fertilizer. It was shown that 640 mg ha-1 foliar application of nano P gave 80 kg P ha-1 equivalent yield of cluster bean and pearl millet under the arid environment. Currently research is underway to develop nano-composites to supply all the required essential nutrients in suitable proportions through smart delivery systems. Fertilizers encapsulated in nanoparticles will increase the uptake of nutrients. In the next generation of nano fertilizers the release of nutrients can be triggered by an environmental condition or simply at desired specific time.
- **Nano-clay-** Nano clay polymer composites have been a much talked topic among the soil scientists from around the world. It has provided scope to act as a carrier for nutrients and enable their slow and controlled release such that it is available to crop plant over a longer period of time.
- **Biosensors-** Nanotechnology is playing an increasingly important role in the development of Biosensors. The sensitivity and performance of biosensors is being improved by using nanomaterials for their construction. The use of these nanomaterials has allowed the introduction of many new signal transduction technologies in biosensors. The nano-biosensors are effective devices to detect the composition of the soil, i.e. the nutrients and also the toxic substances in the soil. In this way, we can plan techniques such that the composition of soil is suitable for the respective crops and the toxic substances such as metals are dealt with properly.

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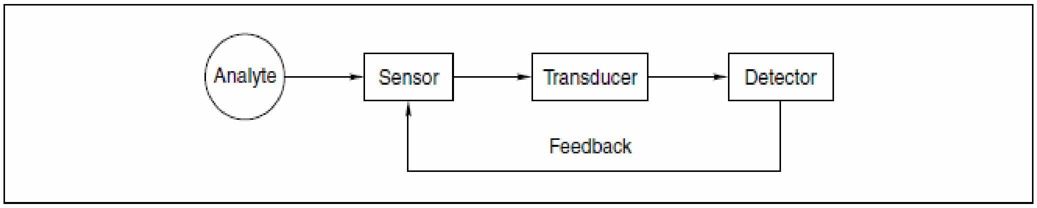

Figure 1- Schematic view of a sensor

- **Smart delivery systems-** A smart delivery system for agriculture should consider the factors or combination of factors such as time controlled, specifically targeted, highly controlled, remotely regulated/ pre-programmed and multifunction characteristics to avoid biological barriers for successful targeted release of required nutrients. The nanoscience has greatly impacted the conventional delivery systems by eliminating the limitations such as leaching, degradation by photolysis, hydrolysis and bio- instability in atmosphere. This results in repeated use of pesticides and insecticides causing higher cost of cultivation and environmental pollution. Nano-encapsulated agrochemicals should be designed in such a way that they possess all necessary characteristics like effective concentration, stability, solubility, time-controlled release in response to certain stimuli, enhanced targeted activity and less eco-toxicity with safe and easy mode of delivery thus avoiding repeated applications. There are various means through which this delivery system can be put to use.
- **Nano Herbicides-** Herbicides are chemicals used to kill weeds especially when the moisture content in the soil is not as per required by the crop. Nano-herbicides (usually coated material) provide better penetration in the soil and allow slow and controlled release of active ingredients in reaching the targeted weed causing minimum environmental damage.
- **Nano Insecticides-** The insecticides are also a concern for agricultural purpose as they induce death to insects and other pests that try to harm the crops. Nano insecticides like surface modified hydrophobic nanosilica have been put to use instead of conventional insecticides as they are safe for plants and cause less environmental pollution.
- **Nano Fungicides-** Fungal pathogens are a major part of the pesticides which harm the crops hence fungicides are prepared to tackle them separately. The small size of nanoparticles puts them to use in nano-fungicides as they penetrate easily and colonize the fungal spores which are a source of fungal pathogens. For example Ag-NPs are a common source of nano-fungicides but if used in very high concentration can produce chemical injuries in crops such as cucumber.
- **Rhizosphere studies-** Controlled foliar application of nanoparticles (P, Zn, Mg) as nutrients may trigger enzymes and growth promoting substances to release through roots resulting influence on microbial population in the rhizosphere. Nanosensors can help in tracing particular microbial activity in the rhizosphere.
- **Precision Farming-** Precision farming is a farming management concept based on maximizing output (i.e. crop yields) while minimizing the input (i.e. fertilizers, pesticides, herbicides, etc.) through managing

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environmental variables and applying targeted actions. With the help of technologies like global satellite positioning system (GPS), remote sensing devices, we can determine whether the crops are growing at their maximum efficiency, and if not, determining the respective problems. Various factors like soil composition, weather, plant development, fertilizers used, chemicals and water provided, are analyzed such that the production costs can be minimized and production potentially increased. Nanotechnology provides with a variety of devices which can reduce the cost of precision farming manifolds. For example, nano-devices and sensors are developed which can penetrate the soil and can inform about the any environmental changes taking place so that we can act accordingly.

CONCLUSION

Nanotechnology has greatly impacted the modern world. It has proved to be a gateway of new applications in agricultural as well as other fields. Due to the small size, nanoparticle acts as an excellent catalyst in many chemical reactions taking place in industries. Their small size also allows them to penetrate into the soil and through the plants more readily making them extremely viable in the field of Soil Science. We have seen how nanotechnology extends its scope into foods, medicine, tissue engineering with optimized outputs. Besides all its advantages, it has its limitations too. These NPs produce waste toxic materials which if contacted with soil and aquatic environment can cause contamination/ pollution. These NPs also depend on environmental factors like temperature, pH, solubility, etc. hence if these factors are altered, it may alter the function of NPs. Apart from these there are many reasons which have limited the applications of nanotechnology. If these limitations are countered or overcome, then nanotechnology will become a revolutionizing technology of 21st and 22nd century.

Possible roles of termites in agroecosystems

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INTRODUCTION-

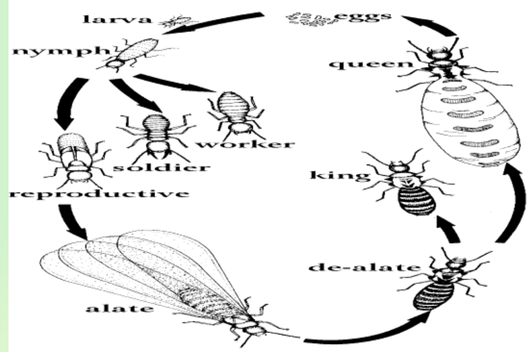
Termites are eusocial insects with overlapping generations. Being insects, they have three body parts head, thorax, abdomen, and six legs. They are eusocial as many overlapping generations are living together in the same nest. Termites are mainly distributed in tropics between 45^{o} north and 45 ^{o} south latitude. Termites belong to the group of insects called Isoptera. Order isoptera originated from Greek words, 'isos' means equal and 'pteron' means wing and refers to the fact that termites have wings that look very much alike. They are generally called as white ants but, the features which differentiate them from ants is that, termites have straight antennae and a broad waist while ants have elbowed antennae and a narrow waist. There are >2700 different types of termites now recognized. Agroecosystem is ecosystem in which humans have exerted a deliberate selectivity on the composition of the biota, i.e. the crops and livestock maintained by the farmers, replacing to a greater or lesser degree the natural flora and fauna of the site. Biotic components in ecosystem play a major role. Among the soil ecosystem engineers are of greater importance.

Soil ecosystem engineers- Soil ecosystem engineers are organismsthat directly or indirectly modulate availability of resources to other species, by causing physical state changes in biotic or abiotic materials (Jones *et al,* 1994).

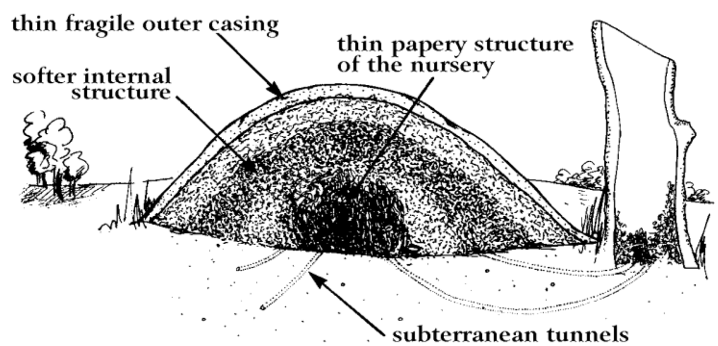
Types of soil ecosystem engineers

1. **Extended phenotype engineers:** Organisms that creates structures or effects that directly influence fitness of own individuals e.g.- social insects (Termites, honey bees)
2. **Accidental engineers:** Organisms that creates biogenic structures that have no direct positive effects on themselves e.g.- earthworms

Life cycle of termites:



Termite mound:



The queen, the brood and most of the colony's individuals live in a so-called termitarium (plural: termitaria). It is composed of mud that is sometimes as hard as concrete and a paper-like substance made from chewed wood.

Termites feeding groups

Wood-feeders (Xylophagous): Termites of this group feed on live wood material. e.g.- Kalotermitidae, Nasutitermitinae, some Termitinae

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Ecosystem	Number of individuals per m^2		
	Earthworm	Termite	Spider
Natural forests	**97.6**	**1542.4**	**9.6**
Agro forestry	**83.2**	**40.0**	**1.6**
Plantations	**116.8**	**70.4**	**3.2**
Annual crops	**24**	**16.0**	**1.6**
Chi-square value	**13.8**	**81.9**	**24.1**

Wood/soil interface-feeders: They feed on dead or partially decayed wood materials. e.g.- Termitinae, sub families Apicotermitinae and Nasutitermitinae

Soil-feeders (Geophagous) : Termites under this group mainly feeds on surface soil with preferential selection of fine grained particles. e.g.- Termitinae (Capritermes-group) , some Nasutitermitinae

Grass-harvesters: They predominantly feed on the dead or live grasses. e.g.- family Hodotermitidae

Litter-feeders (Humivorous): They feed on the soil humus, small organic litter items. *e.g.* -some subterranean and mound building Macrotermitinae (with fungal association), as well as certain Nasutitermitinae.

Termite abundance in different agroecosystems of India

Termites are the most dominant arthropod decomposers in the tropical forests that to in semiarid tropics. The areas of higher altitudes and extreme temperatures have restricted the distribution of termite fauna in India. Out of 337 species of termites known so far from India, about 35 have been reported damaging agricultural crops and buildings. *Odontotermes is the major* mound-builder. In general, termite damage is seen more (20–25%) in rain-fed crops than irrigated ones (10%) (Paul *et al*., 2017).

Abundance of common soil invertebrates in different ecosystems

(Mujinya *et al*., 2010)

Significance of termites in agroecosystem

Termites' play both beneficial and detrimental roles in agroecosystem. Their valuable ecosystem services are as follows.

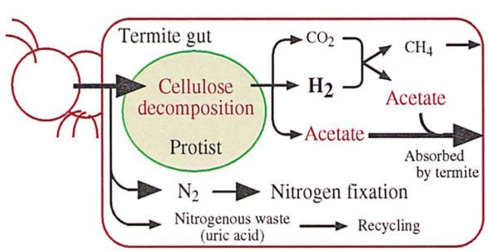
1. Termites and litter decomposition

In the truly metabolic terms the decomposition of plant materials is mainly done by the free living bacteria and fungi. Under arid climate, short duration of rainfall and high temperature impede development of these (bacteria and fungi). So such ecological niche is occupied by the termites due to their capacity to tolerate high temperature and dry season. Termites are main decomposers of organic matter in the dry tropical and subtropical climate. A diverse range of termite species processes a variety of plant matters present in the various stages of decomposition. They also feed on carcasses of dead companions. Termites increase the surface area accessible of plant material to soil organisms as well as their own symbionts, so hastens the decomposition of material.

Mechanism of degradation of plant biomass

Plant biomass is composed of highly lignocellulosic material. Termites have dual cellulolytic system for decomposition of such a complex structure.

1. Endoglucanase of termite origin, secreted from salivary glands or gut of termites
2. Cellulases produced by symbiotic gut micro flora.



2. Termites and pedogenesis

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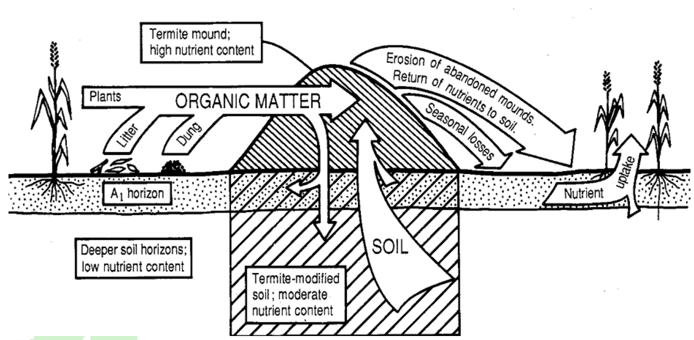
Although many termite species have influence on pedogenesis but, mound building termites are of greater importance as they translocate huge amount of soil from deep soil horizons to the surface soil. Abe *et al,* 2011 estimated that the total soil mass stored in mound of *Macrotermes bellicosus* at maturity was 6,166 kg / mound. They estimated that in 35 year duration, on complete erosion, the mound will supply 14,235 kg soil mound $^{-1}$, thus greatly affect the soil formation.

3. Termites and soil structural stability

- Termites are soft bodied insect, they are mutually dependent on each other for their diverse requirements. The whole colony depends on workers for their food demands, on soldiers for the protection of colony against predators like ants.
- Termites live for 15 years or more in the colony structure.
- Termite mound or nest structure under open sky faces various abiotic vagaries such as heavy rainfall, speedy wind.

4. Termites, soil organic matter and nutrient cycling

The organic material consumed by termites is utilized for building their own biomass and some of its amount is gets fixed into the different nest structures. Brossard *et al,* (2007) reported that mounds of *Trinervitermes geminatus* have more clay, organic carbon and exchangeable cations than surrounding soil. So termites'nest (including biomass) can be considered as sinks of organic matter and nutrients.



The return input of organic matter and mineral nutrients to the soil environment occurs via faeces, salivary secretions, corpses and predators. Mortality, particularly from ant predation, and mound erosion are important contributors to the turnover and redistribution of the organic matter and mineral nutrients in the ecosystem.

5. Termite and biodiversity

The heterogeneity created in soils by the demarcation of the termite functional domain is a major generator and regulator of soil biodiversity. Termite nest and mound works as foci for nutrient distribution into surroundings thus creates contrasting fertility islands with high content of fine grain soil particles. These contrasting islands support the growth vegetations differing in their nutritional and water requirement. Gilot *et al,* (1995) in rubber plantations observed significant changes in composition and abundance of macro invertebrate communities after the occurrence of the area by the wood feeding lower termites.

6. Termite and soil aeration

Termites by creating biogenic structures, improves soil aeration. In mound of *M. michaelseni* with the volume of 5-7 m^3, about 80% soil is excavated from deep soils. The underground network of foraging tunnels (*Macroterme spp.)* can radiate for 50 m or more from nest. Such biological macro pores increase the soil aeration as well as infiltration. Termites can go up to 10-12 m deep into the soil for soil excavation, called such area as *zone of extensive modification of soil.*

7. Termite and bioremediation

Exo symbiotic fungi *Termitomyces(white rot fungi),* alsouses various pollutant chemicalmolecules as their C, N or energy source. White rot fungi (*Termitomyces*) produces extracellular phenoloxidases such as lignin peroxidase, manganese peroxidase and laccase which can degrade various pollutant molecules present in soil.

Termites as a pest in agroecosystem

Termite attacks on annual and perennial crops, especially in the semi-arid and sub-humid tropics, cause significant yield losses. In general, damage by termites is greater in rain-fed than irrigated crops, during dry periods or droughts than periods of regular rainfall, in lowland rather than highland areas, and in plants under stress (lack of moisture, disease or physical damage), rather than in healthy and vigorous plants. In particular, exotic crops are more susceptible to termite attacks than indigenous crops.

Factors favoring for Termite Attack in Crops

- Unsuitable cropping site and climatic conditions; the crops would be stressed and weakened and are more liable to be attacked by termites.
- Accumulation of crop refuge, viz. stubbles, straw, uprooted dry weeds, etc., serves as additional food resources of termites.
- Unhealthy nursery raising practices, resulting in poor-quality crops.
- Non-removal of damaged bark would allow the termites to colonize the pruned dead ends.
- Root damage due to intercultural operations/infection caused by soil borne pathogens, attracts termites.
- Any stress caused by drought, etc. favors termite attack. (Paul *et al.*, 2017)

Cause and control of termites

- The drought was identified by farmers as the main factor favoring termite attacks.
- Demolition of termite mounds in the fields was the most commonly reported control method.
- Susceptibility of crops to termites is due to their high-water content and sweet taste.
- Sustainable termite management includes conservation of non-pest termite species and the utilization of termites and associated resources.
- Termites live well hidden in the wood of a tree or in the soil. Therefore Attempts to introduce pathogens or to apply insecticides usually fail.
- The only effective remedy to the termite problem is to prevent termite attack.
- Entomopathogenic fungus: *Metarhizium*.
- Insecticides: Dieldrin, benzene hexachloride (BHC), Fipronil, Chlorpyriphos, Imidacloprid etc.,
- Manual measures; digging out subterranean nests or removing arboreal nests and destroying the termite queen.(Paul *et al.*, 2017)

CONCLUSION

Termites are dominant soil fauna in tropical and subtropical region farmers perceived termites as pests of several agricultural crops and apply various indigenous control practices whose efficiency need to be verified. Utilization of termites and termite mound soil as food and medicinal resources underlines the importance of termites. Termites especially mound builders, help in pedogenesis by their deep excavating and transporting activity through soil profile. The sensitization of farmers on the importance of termites as well as the development of an integrated control method to combat termite pests proved necessary.

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SPALT and It's Potential Use in IPM

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INTRODUCTION:

SPLAT (Specialized Pheromone & Lure Application Technology) is a proprietary base matrix formulation of biologically inert materials used to control the release of semiochemicals and/or odors with or without pesticides. This product is a valuable weapon in the IPM arsenal that can be used against many economically important pests. Splat is a revolutionary product that facilitates and automates the dispensing of semiochemicals and attractants; by simplifying the delivery of these chemicals in the field. Mating disruption with splat is now a viable and extremely effective pest management strategy. Designed to optimize and modulate the release of odors over time, splat works with any labile and/or volatile compound. Although originally designed for the dispensing of semiochemicals, short lived environmentally friendly toxicants can also be incorporated in splat to increase their field life and efficacy creating an Attract & Kill pest management strategy.

SPLAT vs. Traditional Pheromone Dispensers:

• **Multiple methods of application:** Having a wide range of viscosities and application methods (e.g. applicator sprays, aerial applicator sprays, caulking gun type tubes, etc.) SPLAT increases productivity by mechanizing the application of pheromone dispensing points.

• **Easy Application for Small-scale & Large-scale Operations:** The amorphous and flowable quality of this highly adaptable product allows for an easy transition from smallscale manual applications to large-scale mechanical applications.

• **Adjustable strategies same amount of AI:** A fixed quantity of this material can be applied differently depending on the pest population pressure. The application of this matrix can be tailored by the user to best match the pest distribution and density in the field. Using a fixed amount of SPLAT per area, one can choose: 1. A high density of small point-sources, thus maximizing the mating disruption effect (recommended for high pest pressure). 2. A low density of larger point-sources, thus increasing the longevity of the application (recommended for lower pest population pressure).

• **Rain Fast Formulation**: Once cured, SPLAT will not wash off of vegetation

• **Season-long Protection & More:** SPLAT can remain effective in managing pest populations up to a six month duration.

• Mixes with Kairomones and Feeding Stimulants: SPLAT can be mixed with a variety of feeding stimulants or attractants including liquids, solids and oils to enhance attraction or stimulate feeding.

Uses:

Mating disruption:

Mating disruption is a pheromone mediated control strategy used on lepidopterous insects (moths) that prevents the mating and reproduction of adult pests. Since the worm or larva is the stage that damages fruit, prevention of this stage is the goal in any pest management

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program. This control strategy requires the use of dispensers which provide a sustained release the pheromone a long time interval. These dispensers are placed throughout an orchard so as to saturate the area with the pheromone scent. Male insects normally cue in on a plume of pheromone emitted by an unmated female. By saturating an area with the same scent, males are prevented from locating the females and mating never takes place.

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Soil moisture determination methods

Article id: 21853

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INTRODUCTION

Soil water content (SWC) has an important impact on many fundamental biophysical processes. It affects the germination of seeds, plant growth and nutrition, microbial decomposition of the soil organic matter, nutrient transformations in the root zone, as well as heat and water transfer at the land–atmosphere interface. The quantification of SWC is necessary for different applications, ranging from large-scale calibration of global-scale climate models to field monitoring in agricultural and horticultural systems.SWC measurements help optimize irrigation volumes and schedule, as well as plant nutrition. SWC is also a key variable in determining the rate of decomposition of the soil organic matter, which can affect, for example, the rate of soil respiration and soil carbon sequestration. Moreover, SWC plays a key role in the physicochemical transformation of fundamental nutrients (e.g., nitrogen), such as mineralization, volatilization, and nitrification.

Need of soil moisture measurement

- In agriculture & Plant science field to determine best time to Sow & plow the field.
- Various physical & chemical properties of soil changes with amount of moisture present in soil.
- To measure changes in infiltration, irrigation.
- To study ground water recharge & Evapo-transpiration.
- It is also important in the fields like Hydrology, Forestry, Agrology.
- To study & determine the parameters like soil profile, surface tension related with civil & soil engineering.

Soil moisture is estimated both by direct and indirect method. Direct methods involves the determination of moisture in the soil while indirect methods estimate amount of water through the properties of water I the soil. In direct methods moisture is estimated thermo-gravimetrically either through oven – drying or by volumetric method.

A). Direct Methods

i) Gravimetric method (weight basis)

Principles

Soil sample is collected in a moisture can and wet weight of the sample is recorded. The soil sample is dried in hot air oven at 105 ^{o}C until constant weight is obtained and dry weight of the sample is recorded (Black C.A. 1965).

Materials

Soil auger, Moisture Cans, Top Pan Balance, Drying Oven.

Procedure

Take a composite sample of soil about 100 g in a moisture can and cover it immediately with its lid. Cover the cans with a wet gunny bag in the field to avoid heating due to insulation if numbers of samples are large. Carry the samples to the laboratory. Weigh the sample on a top pan balance (WS_1 g). Dry the sample in an oven to a constant weight at 105 ^{0}C. This takes about 48 hours. Weigh the dried sample (WS_2, g).

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Observations

1. Fresh weight of soil (WS_1)
2. Oven dry weight of soil (WS_2)
3. Weight of empty moisture box

$$\text{Moisture content (on weight basis)} = \frac{\text{Wet weight}(WS_1) - \text{Dry weight } (WS_2)}{\text{Dry weight } (WS_2)} \times 100$$

(ii)Volumetric method

Soil sample is taken with a core sample or with a tube auger whose volume is known. The amount of water present in the soil sample is estimated by drying in the oven. The volumetric moisture content can also be estimated from the moisture content estimated on dry weight basis.

Materials - Sampling tube or a core sampler, moisture cans, balance and hot air oven.

Procedure

Take a sample of soil with a core sampler or a tube auger whose volume is known (VS1). Weigh the sample in a moisture can (WS1). Dry it in an oven to a constant weight at 105 ^{0}C (WS2). Calculate the moisture percentage by the relationship

$$\text{Moisture content (on volume basis)} = \frac{WS_1 - WS_2}{\text{Density of water X Volume of auger}} \times 100$$

Direct methods for moisture estimation is the most accurate, but is not practical for farm use. Its accuracy depends on the number of sample taken and in their mixing. It is primarily used in experimental sites and is a standard against which other methods of moisture determination are compared.The most common instrument used for estimating soil moisture by indirect methods

1. Tensiometer,
2. Gypsum Block,
3. Neutron Probe, Pressure Plate
4. Pressure Membrane Apparatus.

B). Indirect Method

1. Measuring soil moisture with Tensiometer

A tensiometer measures soil water suction (negative pressure), which is usually expressed as tension. This suction is equivalent to the force or energy that a plant must exert to extract water from the soil. The measurement of capillary pressure or moisture tension can be used to determine moisture deficiencies and irrigation requirement after suitable calibration. (Smajstrla Allen G and. Harrison Dalton S. 1998)

Construction

Tensiometer is a sealed, airtight, water-filled tube (barrel) with a porous ceramic cup filled with water tip on one end which is buried in the soil at desired depth and a vacuum gauge on the other, as shown in Figure 1

Installation and method of determination

Before placing in soil at particular depth,the porous tip should be soaked in water overnight. The tube should then be filled with boiled (air-free) water, and the gauge and tip should be tested using a small, hand-held vacuum pump (available from tensiometer manufacturers).The vacuum pump should also be

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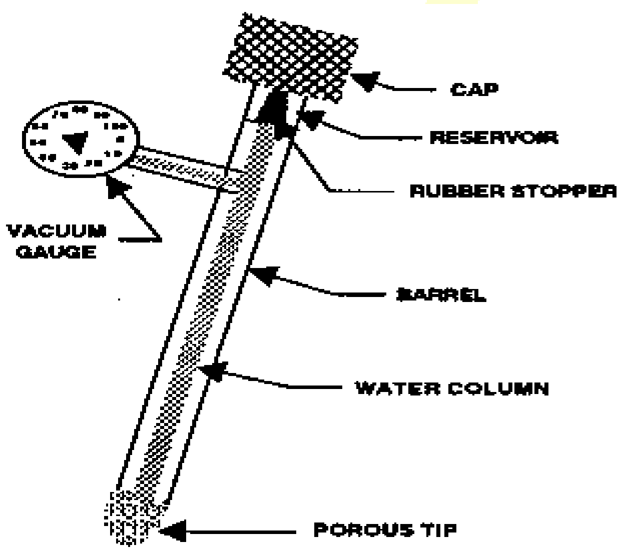
equipped with a vacuum gauge for creating vacuum in the tensiometer. While fixing, the cup must make a good contact with soil. When the saturated porous cup is installed in soil, water from cup moves through the tip until pressure inside and outside the ceramic cup is equal. As the soil water is depleted by root action or replenished by rainfall or irrigation, corresponding changes in reading on the tensiometer occurs. The pressure developed in complete system is measured with the help of mercury manometer or vacuum gauge. At a particular pressure, water content is measured only by calibration and irrigation is practiced at pre-decided depletion of available water at particular depth if tensiometers are installed at different soil depths.

Limitations

1. Working range of tensiometer is only up to 0.85 bar, when tension increases beyond this, air begins to enter the cup and it becomes useless. Hence, it is suitable to use in sand, loamy sand, sandy loam, and the coarser-textured range of loam and sandy clay loam soils
2. Necessity for recharging after entry of air in the cup,
3. The tendency for roots to become concentrated around the porous cup.
4. Small air pockets may develop periodically if deaerated water is not used

Precautions

1. Before installation, tensiometer should be filled with deaerated water to avoid air pockets.
2. A hole prepared for ceramic cup at particular soil depth should be such that the diameter of cup andhole is same and having good contact between soil and cup. In loose soil, it may be inserted without making hole.
3. Taking observations in early morning is desirable as water movement in plant and soil is practically negligible. After installation stable reading may be obtained after 24 hours.



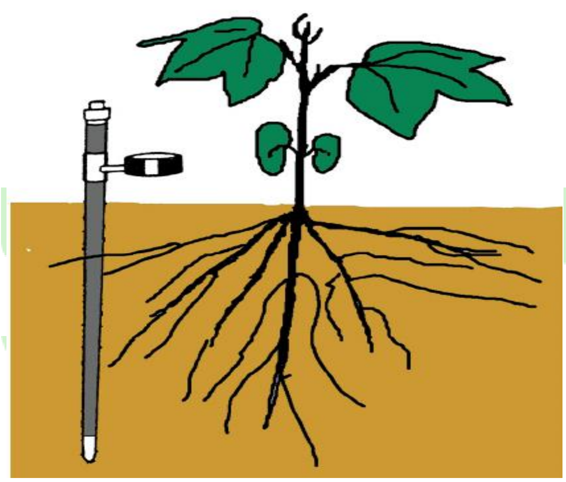


Figure:Tensiometer

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Tensiometers are best suited for use in soils that release most of their plant-available water (PAW) at soil-water suctions between 0 and 80 cb. Tensiometers are quite affordable for scheduling irrigation. The cost ranges from $25 to $50 each, depending on length of the barrel, which ranges from 6 to 72 inches. Tensiometers are easy to use but may give faulty readings if they are not serviced regularly.

II). Measuring soil moisture with Gypsum blocksor Electrical resistance blocks

Principle of working

It works on the principle of conductance of electricity of water. When two electrodes are placed parallel to each other in a porous non-conducting medium and then electrical current is passed, the resistance to the flow of electricity is inversely proportional to the moisture content in the medium. Thus, when the block is wet, conductivity is high and resistance is low. The resistance blocks read low resistance at field capacity and high resistance at wilting point. The readings are taken with a portable AC wheatstone bridge.

Bouyoucos and Mick (1940) proposed this electrodes model. Electrical resistance blocks consist of two electrodes enclosed in a block of porous material. The block is often made of gypsum, although fiberglass or nylon cloth, ceramics is sometimes used.The electrodes are connected to insulated lead wires that extend upward to the soil surface. The water content in the block changes with corresponding changes in water content in the soil, and changes within the block are reflected by changes in resistance between the electrodes. Electrical resistance blocks are often referred to as gypsum blocks or moisture blocks. Block units are used for indirect measurement of soil moisture in situ.

Installation of resistance blocks

- Like tensiometer, electrical resistance blocks should be soaked overnight before they areinstalled in the field
- Sink a bore with a post-hole auger to the depth of installation of blocks.
- Place the block inside and fill back the bore in small depths by tamping the soil with awooden rod.
- After placement ensures that there is an intimate contact of the block with the soil. Thereshould not be any root pieces. pebbles etc. near the block.
- When more than one block is to be installed in a bore, label them near their terminals carefully with their depths before installation.
- Heap the soil to a height of about 3 cm near the surface at the bore spot to prevent any water stagnation. Irrigate the field and record the readings.
- Check the resistance reading at the field capacity. While installing in a crop, ensure that these are placed in the root zone. The convenient spot for installation is in a row and in between two plants, which avoids any disturbance during inter-cultivation etc.

Standardization and calibration of resistance blocks

Lower the blocks gradually in a bucket of water and allow them to saturate for about half an hour. Take the blocks out, expose them to the atmosphere for about 10 minutes and again lower them in the bucket. The object is to remove the entrapped air if any, in this step. Record the resistance reading with a AC operated wheatstone bridge by connecting the wire leads to the bridge while the block is in water. Record the difference in readings of different blocks. Reject the blocks which show deviations. greater than 5 per

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cent of the mean resistance reading. Calibrate the blocks by installing them in a garden pot filled with soil. Irrigate the pot

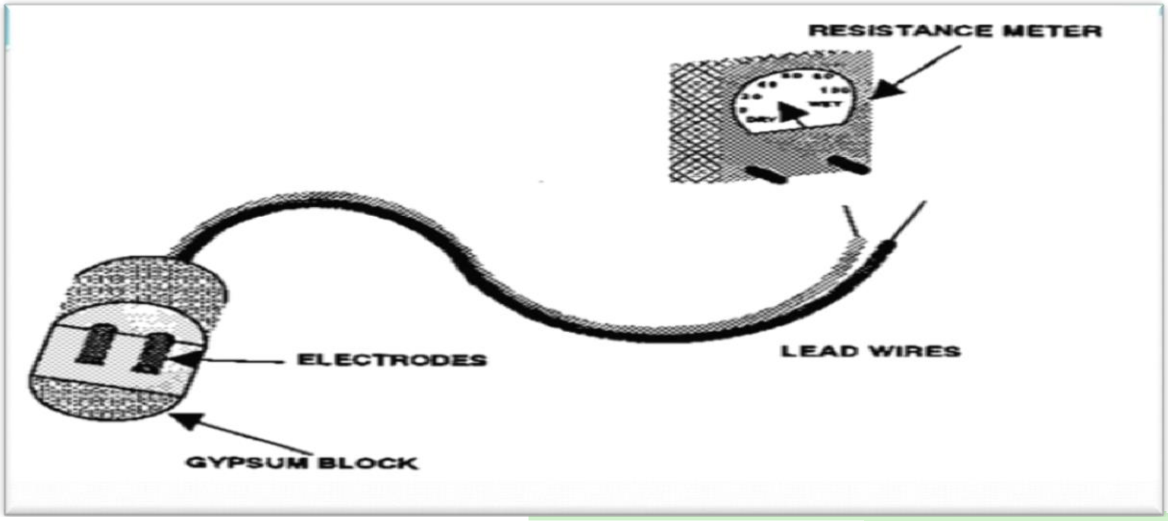

Figure: Resistance Blocks

As the soil dries, record the resistance readings periodically with a wheats tone bride and also determine the soil moisture content of the samples taken from the block depths. Plot the data of resistance readings and soil moisture percentage during the drying cycle, on a graph paper. Repeat the process two times and draw the curve. As these resistance units can be used for direct measurement of soil moisture tension, calibration with respect to soil moisture tension could be done in a suitable pressure membrane extractor.

Limitations

1. Resistance blocks are not useful for saline soils since resistance reading is affected by salt concentration.
2. Electrical resistance blocks are not reliable for determining when to irrigate sandy soils where over 50 percent of the plant-available water is usually depleted at suctions less than 0.5 bar.
3. Their readings are also affected by concentration of fertilizer.
4. Short life of gypsum blocks in wet soil.
5. Calibration is required for each soil and each block.
6. Calibration may drift with time.

III). Measuring soil moisture with Neutron moisture meter

Principle of working

Soil moisture can be estimated quickly and continuously with neutronmoisture meter without disturbing the soil. Another advantage is that soil moisturecan be estimated from large volume of soil. This meter scans the soil about 15cm diameters around the neutron probe in wet soil and 50 cm in dry soil. Itconsists of a probe and a scalar or rate meter. This contains a fast neutronsource which may be a mixture of radium and beryllium or americium andberyllium. Access tubes are aluminum tubes of50-100 cm length and are placed in the field, when the moisture has to be estimated. Neutronprobe is lowered in to access tube to a desireddepth. Fast neutrons are released from the probewhich scatters in to soil. When the neutronsencounter nuclei of hydrogen atoms of water,their speed is reduced. The scalar or the ratemeter

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counts of slow neutrons which are directlyproportional to water molecule. Moisture contentof the soil can be known from the calibrationcurve with count of slow neutrons (Van *et al.,* l963).

Installation of Neutron Probe

- The access tube is inserted into the soil by drilling a hole with the help of an auger.
- It is few centimeters above the soil and converted with an inverted case.
- The neutron probe is inserted into the access tube by carefully lowering down cable to the desired depth.
- Then the counting rates are determined.
- Initially the probe is to be adjusted and calibrated against volumetric determination of soil moisture content

Limitations

- Expensive
- Neutron probe consist radioactive material which is not safe
- Handling is not easy

However nutron probe gives reliable and accurate measurement of soil water at different depths in the soil profile.

IV). Time Domain Reflectometer

Principle

Dielectric constant of soil is the function of content of moisture present in soil. Traveling time of a EM wave changes as velocity of traveling wave is affected by the dielectric constant of soil (Whalley W.R. 1993)

$Ka = (c/v)^2 = [(c \times t)/(2 \times L)]^2$

Methodology

The time domain reflectometer (TDR) is a new device developed to measure soil-water content. Two parallel rods or stiff wires are inserted into the soil to the depth at which the average water content is desired. The rods are connected to an instrument that sends an electromagnetic pulse (or wave) of energy along the rods. The rate at which the wave of energy is conducted into the soil and reflected back to the soil surface is directly related to the average water content of the soil. One instrument can be used for hundreds of pairs of rods. This device, just becoming commercially available, is easy to use and reliable.

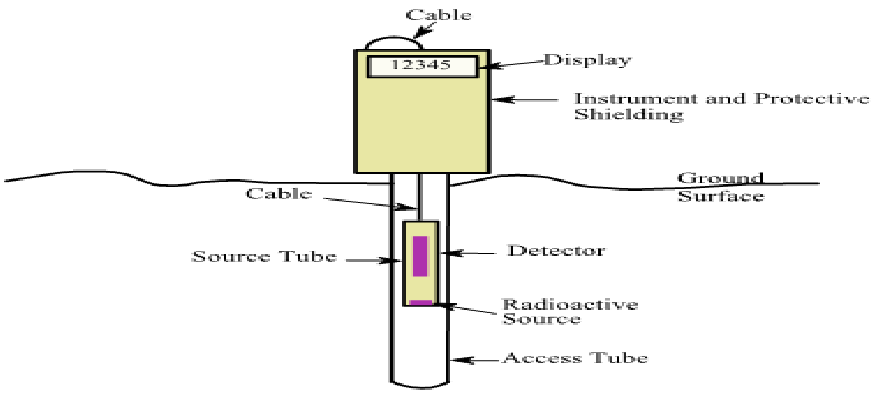

Figure: Nutron Probe

Determines the apparent dielectric (Ka) of the soil matrix and this is empirically related to the volumetric soil moisture content. The method is quick, relatively independent of soil type, non-destructive, suited for surface and profile measurements, and allows repeatable in situ measurement. The TDR is a portable unit that can be carried allowing point soil moisture measurements or linked to a multiplexer to measure an array of buried wave guides. The moisture content determined by the TDR is the average moisture along the length of the waveguides. Therefore, to measure at depth of 20 cm, waveguides are placed in the soil horizontally at that depth. If 30 cm waveguides are placed vertically into the soil, the moisture content determined by the TDR will be the integrated moisture content from the soil surface to a depth of 30 cm. The technique is based upon cable testing technology, with a broad-band Electromagnetic step pulse generated and propagated along a coaxial cable (Fig. 1.). At the end of the cable stainless steel rods (waveguides) are inserted into the ground. The time of travel of the EM wave is determined by the apparent dielectric (Ka) of the medium (in this case soil). Water with a high dielectric (Ka = 80), compared to soil (Ka = 3 to 5) and air (Ka = 1), dominates the measured Ka. Thus, if the soil is saturated the Ka is high (due to the presence of increased water) and the travel time of the EM wave along the waveguides is long. If the soil is dry the travel time along the waveguides is short and the Ka is therefore low. Eq. 1 shows the relationship of Ka to travel time (Δt).

$$Ka = (c\Delta t / 2L)^2 \qquad \text{eq. 1.}$$

Where;

c - velocity of light (3 x 108 ms-1)

L - length of the wave guide (m).

Δt- Travel time

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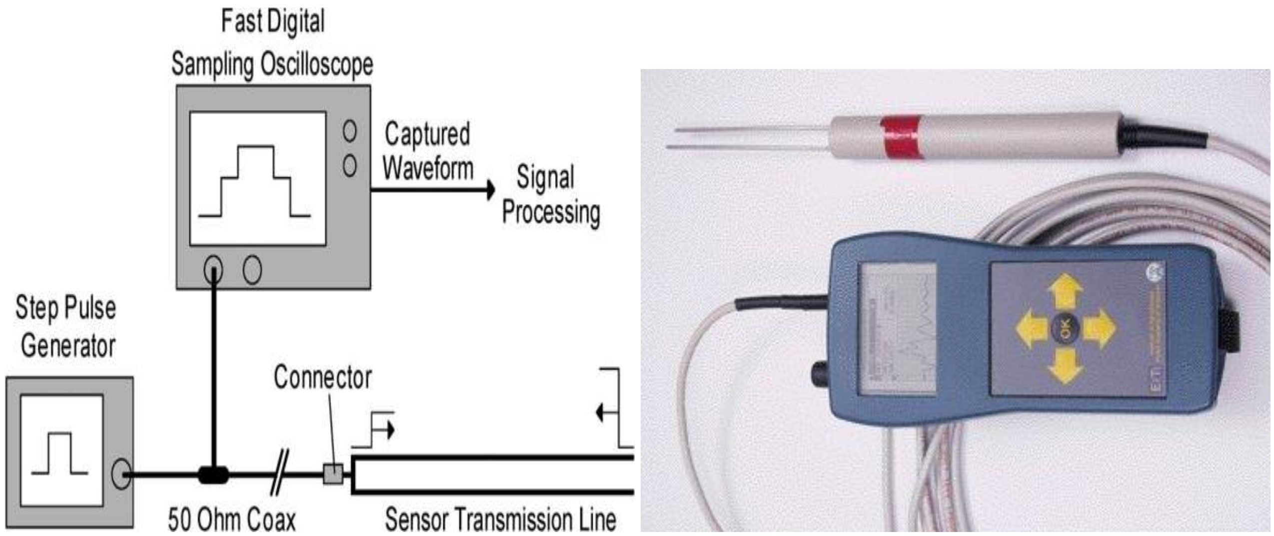

Figure: **Time Domain Reflectometer**

V). Phene Cell

The Phene cell works on the principle that a soil conducts heat in relation to its water content. By measuring the heat conducted from a heat source and calibrating the conductance versus water content for a specific soil, the Phene cell can be used reliably to determine soil-water content. Because the Phene cell is placed at the desired soil depth, a separate cell is needed for each depth at each location to be monitored.For irrigating small acreages, the total cost of using the Phene cell is less than that of the neutron probe. For large acreages, the neutron probe may be more cost effective.

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Phenolic compounds and antioxidant activity in cereal grains

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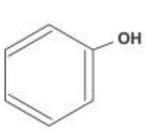
Earlier phenolics in cereal grains were considered antinutrients as they bind proteins, carbohydrates and minerals, affecting the nutritional and functional properties. But recently cereal grains have received a lot of attention in recent years for their potential health benefits due to the presence of phenolic compounds which possess antioxidant activity. A lot of study has been conducted for the estimation of different kinds of phenolic compounds and their antioxidant activity in vitro. However, their metabolism and bioavailability is not known and need to be assessed.

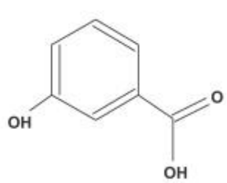
INTRODUCTION

At present, cereals have received increased attention from nutraceutical perspective owing to their potential health benefits. Epidemiological studies have shown that regular consumption of whole grains could help protect against the development of certain chronic diseases (Slavin, 2004; Okarter and Liu, 2010). In addition to dietary fibre, whole grain foods offer a broad range of phytochemicals with an array of health benefits that are recently being recognized. There is also an increasing evidence that modest long-term intakes can have favorable effects on reducing the incidence of cancers and chronic diseases (Rio *et. al.,* 2013). The unique phytochemicals in whole grains are proposed to be responsible for the health benefits of whole grain consumption.

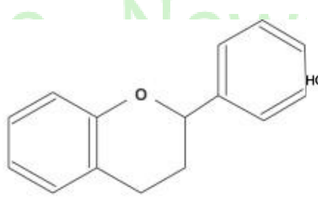
Phenolic compounds, also known as polyphenols, are phytochemicals well known for their health benefits related to antioxidant activity. Total phenolic content is a parameter that provides an indirect measure of antioxidant activity. These compounds are considered to have many potential beneficial health effects, e.g. in reduction of the risk of cardiovascular diseases, cancers, neurodegenerative diseases, diabetes, and osteoporosis. Phenolic compounds have at least one benzene ring with one or more hydroxyl groups attached. The most common phenolic compounds found in whole grains are phenolic acids, flavonoids and tannins (Liu, 2007). The concentrations of phenolic compounds in whole grains is influenced by the type of grains, varieties, and the part of the grain sampled. Phenolic compounds are present mainly in the bran/germ fraction and impart health benefits when consumed in a diet, and help reduce the risk of chronic diseases. These compounds mainly exist as glycosides linked to various sugar moieties or as other complexes linked to organic acids, amines, lipids, carbohydrates, and other phenols.



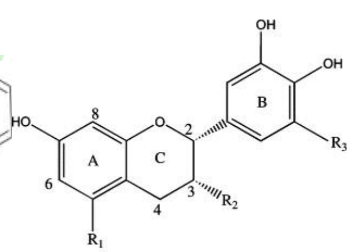
Phenols



Phenolic acids



Flavonoids



Condensed tannins

Phenolic acids

Phenolic acids can be classified into hydroxybenzoic acid and hydroxycinnamic acid derivatives, and are present in all cereals. They are commonly present in the bound form typically a component of complex structures such as lignins and hydrolyzable tannins, linked to cell wall structural components such as proteins, lignin, and cellulose. Food processing techniques, such as cooking, fermentation, and freezing releases these bound phenolic acids. Ferulic acid, vanillic acid, caffeic acid, syringic acid, and *p*-coumaric acid are some common phenolic acids found in whole grains. Phenolic acids are abundantly found in the aleurone, pericarp, and embryo cell walls of various grains, but occur only in trace amount in the starchy endosperm.

Flavonoids

Flavonoids are compounds with two aromatic rings joined by a three-carbon link. They include anthocyanin, flavanols, flavones, flavanones and flavonols. Anthocyanins are a group of intensely coloured water soluble pigments responsible for the orange, brown, red, blue, and purple colours of many plants. It is the most studied flavonoids in cereals, reported in the pericarp of pigmented varieties of rice, maize, barley, rye and wheat. The bran concentrates the anthocyanins when milled. Other flavonoids present in fruits and vegetables are also found in cereals too. Flavanones, for example which are mainly reported in citrus are also reported in cereals such as sorghum and oats. Flavonoids are reported to have antioxidant, anticancer, anti-allergic, anti-inflammatory, anticarcinogenic and gastroprotective properties.

Tannins

Tannins, also known as proanthocyanidins or procyanidins are complex water soluble phenolic compounds with molecular weights ranging from 500-3000 Da. They have the property of combining with proteins, cellulose, gelatin and pectin to form an insoluble complex. They are found in plants, particularly pulses and some other food grains. These compounds are found in sorghum with pigmented testa layer, finger millets and barley. Tannins decrease the digestibility of protein, carbohydrates and minerals. However, they have high antioxidant activity in vitro compared to monomeric phenolic compounds. In addition, these compounds may have anti-carcinogenic, cardiovascular, gastro-protective, anti-ulcerogenic, cholesterol lowering properties and also promote urinary tract health.

Phenols and antioxidant activity

Phenolics have good redox potential and their phenoxyl radical are relatively stable thereby it has antioxidant potential. Phytochemicals and antioxidants in grains have not received as much attention as the phytochemicals in fruits and vegetables. Relatively low levels of antioxidant activity reported in grains might be due to phenolic compounds tightly bound to cell wall materials and not readily extracted in the solvents. However, more exhaustive extraction techniques may release bound phytochemicals from whole grains thereby providing results that whole grains contain more phytochemicals than was previously reported. Results of the study conducted by Adom and Liu (2002) on analyzing and comparing the phytochemical profiles of corn, wheat, oats, and rice clearly showed that most grain phenolics were in the bound form. Bound phenolics contributed 85% of the total in corn, 76% in wheat, 75% in oats, and 62% in rice. Therefore, it is clear that the total phenolic contents of whole grains have been previously underestimated in the literature without including the bound phenolics. Studies conducted by Jun *et. al.,* (2012) have reported antioxidant activity of pigmented rice bran as high as 83.6% DPPH-RSA at 500µg/ml concentration.

Many naturally occurring simple phenolics scavenge radicals as effectively as vitamins A and E in vitro. However, more complex phenolics such as proanthocyanidins are reported to be more effective than simple phenolics. In general, tannin containing grains and pigmented cereals have the highest levels of phenols and antioxidant activity whereas non-pigmented cereals have the least. It has also been reported that condensed tannins and pigment-contributing compounds such as the anthocyanins have more antioxidant activity (Dykes and Rooney, 2007). Many studies have shown strong correlation between total phenols and antioxidant activity suggesting that phenolic compounds contribute to the antioxidant activity (Butsat and Siriamornpun, 2010, Hung, 2016). Furthermore, there is emerging evidence that the metabolites of dietary phenolics, which appear in the circulatory system in nmol/L to low µmol/L concentrations, exert modulatory effects in cells by selective actions on different components for cellular functions such as growth, proliferation and apoptosis (Crozier et al, 2009).

CONCLUSION

Phenolics in cereal grains include a diverse group of secondary plant metabolites. Cereal phenolics are primarily located in the grain outer layers and they are found to have antioxidant activity. Since cereal grains have low moisture content, can be stored and processed easily, taking the benefit of antioxidant capacity from phenolic compounds of grains and cereals has advantage. Maximum benefit of these health promoting compounds can be achieved by consuming cereals grains that are pigmented and by consuming whole grains.

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Plant Phenomics: An advanced technology for phenotyping wide range of traits

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INTRODUCTION

Global agriculture is facing major challenges to ensure global food security, such as the need to breed high yielding crops adapted to future climates and the identification of desired genotypes adapted to present and future climate change situations. Plant phenomics offers a suite of new technologies to accelerate progress in understanding gene function and environmental responses. This will enable breeders to develop new agricultural germplasm to support future agricultural production.

Why phenomics?

Automated plant phenotyping has been established as a powerful new tool in studying plant growth, development and response to various types of biotic or abiotic stresses. Plant phenomics facilities mainly apply noninvasive imaging based methods, which enable the continuous quantification of the dynamics of plant growth and physiology during developmental progression. However, especially for plants of larger size, integrative, automated and high throughput measurements of complex physiological parameters remain a challenge.

Phenomics and phenotyping

Plant phenomics is the nondestructive, non invasive, automated, high throughput phenotyping of a plant population. Plant phenotyping is an emerging area of science acquiring plant traits, especially those relevant for biomass formation and yield, for resistance to stresses, and for resource efficiency, in an automated, non-invasive and high throughput manner. This enables the association of these important features of plants to genomic information in order to identify genetic components underlying trait expression. In this context it is obvious that successful crop improvement strategies rely on the integrated assessment of genomic and phenomic data with the latter comprising a comprehensive set of plant traits accurately quantified in large plant populations, as an essential prerequisite for linkage mapping or genome wide association mapping of quantitative trait loci (QTL). The implemented high throughput protocols are applicable to a broad spectrum of model and crop plants of different sizes and architectures. The deeper understanding of the relation of plant architecture, biomass formation and photosynthetic efficiency has a great potential with respect to crop and yield improvement strategies.

CONCLUSION

The implementation of phenomic technologies is a welcome change toward reproducibility and unbiased data acquisition in basic and applied research. A successful approach requires integrating sensors with wavelength and image acquisitions that will allow the proper identification of the items under analysis.Plant phenomics is an emerging technology in plant biology research in identifying and phenotyping crop genotypes for wide range of traits to cope of with the changing environment, and to have a better understanding of interactions between genotype and environment.

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Role of zinc in crops and human health

Article id: 21856

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Zinc deficiency in soils and crops

Zinc has emerged as the most widespread micronutrient deficiency in soils and crops worldwide, resulting in severe yield losses and deterioration in nutritional quality. It is estimated that almost half of the soils in the world are deficient in zinc. Since cereal grains have inherently low concentrations, growing these on the potentially zinc deficient soils further decreases grain zinc concentration. India is not an exception. About 50 per cent soil samples analysed for available zinc were found deficient in India. There is a significant response to applied zinc in the soils deficient in zinc. In India, zinc is considered the fifth most important yield limiting nutrient after N, P, K & S in upland crops whereas in lowland crops like rice, it is next to N. The reasons responsible for the increase of incidences of zinc deficiency include large zinc removals due to high crop yields and intensive cropping systems, lesser application of organic manures, use of high analysis fertilizers and increased use of phosphatic fertilizers resulting in P induced zinc deficiency Prasad 2006. Diagnosis of Khaira disease in rice in Tarai soils of Pantnagar is the first catalogued zinc deficiency in India by Dr. Y.L. Nene in 1965. Since then, there has been considerable research in India on zinc under the All India Coordinated Research Project on Micronutrients of the Indian Council of Agricultural Research (ICAR). The zinc deficiency in India is expected to increase from the present level of around 50 per cent to 63 per cent in 2025 if the trend continues. This is also because more and more areas of marginal lands are brought under intensive cultivation without adequate micronutrient supplementation.

Zinc – Essential for life

Zinc is an essential nutrient for human health. There is no life without zinc. Recently, zinc deficiency - especially in infants and young children under five years of age - has received global attention. Zinc deficiency is the fifth leading cause of death and disease in the developing world. According to the World Health Organization (WHO), about 800,000 people die annually due to zinc deficiency, of which 450,000 are children under the age of five. It is estimated that 60- 70 per cent of the population in Asia and Sub-Saharan Africa could be at risk of low zinc intake. There is a high degree of correlation between zinc deficiency in soils and that in human beings. It is estimated that about one third of the world's

Population suffers from zinc deficiency. Zinc is vital for many biological functions in the human body Das and Green 2011**.** The adult body contains 2-3 grams of zinc. It is present in all parts of the body, including: organs, tissues, bones, fluids and cells. It is vital for more than 300 enzymes in the human body, activating growth - height, weight and bone development, growth and cell division, immune system, fertility, taste, smell and appetite, skin, hair and nails, vision. Some of the reported symptoms due to zinc deficiency in humans, especially in infants and young children, are diarrhoea, pneumonia, stunted growth, weak Immune system, retarded mental growth and dwarfism, impaired cognitive function, behavioural problems, memory impairment, problems with spatial learning, and neuronal atrophy.

Zinc malnutrition - Possible solution

The possible solution to zinc malnutrition in the humans may be, i) Food Supplementation, ii) Food Fortification, and iii) Bio fortification. The former two programmes require infrastructure, purchasing power, access to market and health care centres and uninterrupted funding, which have their own constraints. In addition, such programmes will most likely reach the urban population, which is easily accessible, especially in the developing countries. Alternatively, the latter programme, bio fortification - fortification of crops especially cereals crops with zinc - is the best option for alleviating zinc deficiency. It will cater to both the rural and urban populations. It could be achieved through two approaches, Genetic Bio fortification and Agronomic Bio fortification. There is a developing field of research on the bio fortification of plant foods with zinc. This involves both the breeding of new varieties of crops with the genetic potential to accumulate a high density of zinc in cereal grains (genetic bio fortification) and the use of zinc fertilizers to increase zinc density (agronomic bio fortification). Although the plant breeding route is likely to be the most cost effective approach in the long run, the use of fertilizers is the fastest route to improve the zinc density in diets. In order to replenish the zinc taken up by the improved cultivars, higher and sustainable use of fertilizers is inevitable.

Zinc in balanced fertilizer use – Challenges

5. Availability of zinc fertilizers at the time of need of the farmers
6. Quality of zinc fertilizers available in the market
7. Soil – plant – animal – human continuum study on zinc
8. Lack of awareness of the extension and promotional workers
9. Lack of awareness of the farmers – last mile delivery

Way forward

- Balanced fertilizer use with micronutrients including zinc is inevitable for higher crop yields
- Urgent need to increase awareness among farmers and extension workers for increased use of zinc fertilizers
- Fertilizer industry to ensure timely availability of quality zinc fertilizers at the time of need of the farmers.
- Zinc deficiency in crops and humans is a critical issue and a global challenge. We need to ensure food security and nutritional security. The viable solution in addressing zinc deficiency is – higher use of zinc fertilizers.

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SAFENER – Antidotes to herbicides, protectors of crop plants

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Herbicide safeners are molecules used in combination with herbicides to make them "safer" - that is, to reduce the effect of the herbicide on crop plants, and to improve selectivity between crop plants vs. weed species being targeted by the herbicide. Herbicide safeners can be used to pretreat crop seeds prior to planting, or they can be sprayed on plants as a mixture with the herbicide.Herbicide safeners selectively protect crop plants from herbicide damage without reducing activity in target weed species.

Herbicide safeners, formerly referred to as herbicide antidotes, are chemical agents that increase the tolerance of monocotyledonous cereal plants to herbicides without affecting the weed control effectiveness. Safener also known as antidote or crop protectant is a sort of physical barrier (externally active) or a chemical (internally active), which protects a crop from being injured on application of a herbicide normally non-selective to it.

Father of safener- Otto L. Hoffman.

List of safeners

Chemical class	Name	Herbicide	Crop	Application method
Anhydride	1,8-Naphthalic anhydride (NA)	Thiocarbamates	Maize	Seed treatment
Dichloroacetamide	Dichlormid	Thiocarbamates, chloroacetanilides	Maize	PPI,PRE
	Furilazole	Acetochlor, Halosulfuron-methyl	Maize	PRE
	AD-67	Acetochlor	Maize	PRE
	Benoxacor	Metolachlor	Maize	PRE
Oxime ether	Cyometrinil	Chloroacetanilides (metolachlor)	Sorghum	Seed treatment
	Oxabetrinil	Chloroacetanilides (metolachlor)	Sorghum	Seed treatment
	Fluxofenim	Chloroacetanilides (metolachlor)	Sorghum	Seed treatment
Triazole carboxylic acid	Flurazole	Alachlor	Sorghum	Seed treatment
Dichloromethyl-ketal	MG-191	Thiocarbamates, Chloroacetanilides	Maize	PRE
Phenylpyrimidine	Fenclorim	Pretilachlor	Rice	PRE
Urea	Dymron	Pyributicarb, Pretilachlor, pyrazosulfuron-ethyl	Rice	PRE,POST
Piperidine-1-carbothioate	Dimepiperate	Sulfonylureas	Rice	POST

Benefits:

i) Non-selective herbicides could be used for selective weed control
ii) Higher dose of a herbicide can be used since antidotes normally increase the safety/selectivity margin of a herbicide
iii) A composite culture of weeds similar or dissimilar to crops can be controlled
iv) Ready-mix/in-built combination of antidotes in the formulation or their tank-mixes may save crops from damage of the non-selective herbicides applied accidentally
v) Antidotes offer greater insurance/reliance against crop damage particularly under situations like susceptible crop varieties, soil conditions or adverse weather conditions, where crops are likely to receive phytotoxicity

Limitations:

i) Using herbicide antidotes may increase the cost of weed control in particular and the cost of crop cultivation in general since antidotes incur some cost
ii) Their antagonism with certain herbicide may protect some important weeds of a crop.
iii) The chemical antidotes are not phytotoxic, but toxic to other organisms including humans. Therefore, their use with herbicides increases the toxicity load to the environment
iv) The effect of antidote is not constant/uniform, but varies across climates and soils based on temperature, moisture, texture etc.

Methods of Antidotes application:

Externally active antidotes:

i) Root dipping or stem application of seedlings/transplants into the slurry of charcoal is effective before their transplanting in herbicide treated soils in case of transplanted crops (rice, vegetables and forest/plantation crops). It gives protection against 2,4-D. atrazine, propazine
ii) Crop seed coating before sowing: coating with charcoal improves selectivity of herbicides like EPTC to maize and cowpea and chloramben, butachlor and EPTC to rice. For seed pelleting rate is 5g/kg seed.
iii) Band application over crop seed rows at the time of sowing: Charcoal as a uniform 2.5 cm uniform band over partially covered seed rows is effective aginst 2,4-D. Rates are 130kg charcoal per hectare in clayey loam soil and 390 kg/ha or more on sandy soils. Charcoal requirement for root dipping and seed hole application is quite low than in furrow or band application.

Internally active herbicides:

i) Tank-mix/Ready-mix Ex: R-25788 @ 0.6 kg/ha with EPTC
ii) Seed treatment Ex: R-25788, NA @ 0.5g/kg, CGA 43089 @ 1-1.5g/kg
iii) Soil treatment Ex: NA

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Diverse methods of controlling pests

Article id: 21858

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In 1959, the integrated control concept recognized the many ecological and practical advantages of integrating chemical and biological control strategies for pest management. The concept of Integrated Pest Management (IPM), a corner stone of Integrated Production (IP), appeared in the 1970's, when it became evident that the overuse of chemical pesticides can have serious negative consequences on the environment and human health. The Food and Agriculture Organization of the United Nations (FAO) defines IPM to be a "careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment".

INTRODUCTION

Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment (Abrol and Shankar, 2011). The IPM approach can be applied to both agricultural and non-agricultural settings, such as the home, garden, and workplace. IPM takes advantage of all appropriate pest management options including, but not limited to, the judicious use of pesticides. In contrast, *organic* food production applies many of the same concepts as IPM but limits the use of pesticides to those that are produced from natural sources, as opposed to synthetic chemicals. The IPM practices include following different methods as discussed below:

1. **BIOLOGICAL CONTROL:** Most pests found in agricultural settings will have various natural enemies that will control or suppress the pest effectively in many situations. These natural enemies will act as biological control agents to manage insects, mites, fungal pathogens and/ or weeds. Biological control can be an effective tool in pest management. Biological control is often targeted against pests that are not native to the geographical area. These non-native or introduced pests can easily become a problem because they lack natural enemies that control or suppress populations to levels that do not pose a risk to the crop being grown. To establish biological control programs, researchers will locate the native home of the introduced pest and then find its natural enemies. Once these natural enemies are found, extensive testing and evaluation is conducted to ensure they do not pose a risk to the sites where they will be released to control the introduced pest. The biological control agent will be reared and then released within a large area to reduce the introduced/targeted pest populations. If the new introduced

biological control is well adapted to the new area, additional releases may not be needed. This entire process is highly regulated to prevent organisms that may themselves become introduced pests. Maintaining sufficient populations of natural enemies after their introduction by avoiding detrimental production practices or the excessive use of broad-spectrum pesticides is an important consideration. When selecting a pesticide to apply in your farming operation, choose a product or products that pose the least amount of risk to the natural enemies to minimize damage to their populations or have negative environmental impact.

2. **MECHANICAL CONTROL**: Mechanical control is simply using devices, traps, machines or other physical methods to control or alter the environment where the pest may be found. These devices are used to prevent the pest from entering a given area or to aid in the ability to catch the pest and allow its removal. For weeds, cultivation is a mechanical control technique that is economical, but only temporary as it must be repeated with each new emergence of weeds. Cultivation techniques will destroy most weeds, control their growth or disrupt the soil condition impacting their survival. If cultivation is not conducted frequently enough, seed production from uncontrolled weeds will increase future weed pressure by increasing the seed bank in the soil. A disadvantage to mechanical cultivation is that it can damage roots of the desirable crop, increase soil erosion potential and may not be effective for deep-rooted perennial grasses like Bermuda, torpedo or bahia grasses. Mechanical devices like fences can exclude the pest from getting into an area if the pests are large. Exclusion devices can include screens on windows or patching cracks to prohibit entry. Fences work well on keeping many vertebrate pests from entering areas as long as the wire material is of a mesh density to prohibit entry of the pest. Traps physically catch the pest. A trap can be physical in nature or simply a sticky surface which causes the pest to become stuck on it, allowing the pest to be eliminated from the selected area. A mouse trap is an effective trap method for small vertebrate pests.

3. **CULTURAL CONTROL:** When using cultural control, you alter the environment, condition of the host or site to prevent/suppress the pest infestation. By disrupting the normal relationship between the host, site and pest, you make it less likely for the pest to survive, grow or reproduce. Cultural practices which influence the survival of the pest can also include management actions such as selection of varieties, planting and harvest times, irrigation, crop rotation and/or the use of trap crops to keep the pest away from the desirable crop. In some crops, the use of mulches (plastic, shredded bark or wood chips) may also suppress pests, when properly used. Sanitation can also be an important cultural practice whereby you eliminate the food, water, shelter or other necessities that are important to the pest's survival. In locations where weeds are the pest, removing them before they produce seeds or harbor pest insects may effectively improve crop conditions or the value of the desirable crop for future sale.

4. **PHYSICAL/ENVIRONMENTAL MODIFICATION:** In some cases, pests can be controlled and/or reduced by modifying

the environment where they may be found. We all use this environmental method for storing food in our home with refrigerators. The refrigerated environment will aid us in keeping food longer and pest free. Just think of all the pest problems you would have at home without a simple refrigerator. In other cases, the use of modified temperature, humidity and/or air movement can greatly impact the ability to produce or store crops in an enclosed environment like greenhouses or storage bins/silos.

5. **HOST PLANT RESISTANCE:** Plant breeders frequently use natural host resistance or genetic traits when breeding plants to produce a new variety that has desired attributes which make it resistant or tolerant to a given pest or disease. Host resistance can also be enhanced by keeping the host plant healthy. Plants stressed by the lack of water or nutrients will not be able to resist pests as well as healthy plants.
6. **CHEMICAL CONTROL:** Pesticide is a broad and general term used for all chemicals used to control pests. Pesticides are usually toxic to some stage(s) of the pest. Pesticides can be used to control insects, nematodes, diseases and weeds. Pesticides can be selective or nonselective. Selective pesticides kill certain organisms while not killing others. Non-selective pesticides kill a very broad range of pests indiscriminately. Pesticides are frequently used because they are effective, fast-acting and easy to use as compared with other control options. By being fast-acting, the damage from insect pests usually stops quickly, as soon as a few hours or a few days for many weed pests. Many pesticides (fungicides) may need to be applied as a preventative spray as they may not be very effective once the disease is well established. Pesticides are commonly grouped according to the type of pest controlled, i.e. fungicides for fungi, herbicides for weeds, insecticides for insects, etc. Pesticides within a given class have similar chemical structures, properties or share a common mode of action (MOA). The MOA is how the pesticide works. It is important to rotate between MOA when repeatedly applying pesticides to minimize the risk of a pest developing resistance to a pesticide or an entire class of pesticide. Pesticides that are absorbed and move within the plant are called systemic. Systemic pesticides are absorbed through the plant's leaves and/or roots and then translocated within the plant to provide pest control. On the other hand, contact pesticides are not absorbed or translocated within the plant. Contact pesticides must directly contact the pest to provide control. Pesticides will vary in their length of control. Persistent pesticides remain active to control the pest for a long period of time, frequently measured in months or years. Non-persistent pesticides may only provide pest control for a short period of time and can be measured in a few hours to days.
7. REGULATORY METHODS If a pest poses a serious danger to the public health or threatens to cause damage to agricultural crops, animals, forests or ornamental plants, then regulatory control methods would be set by local, state or federal agencies. Quarantine or eradication programs are directed by governmental agencies based upon federal and state laws that are intended to prevent the introduction and spread of pests.

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Quarantines are designed to prevent pests from entering a pest-free area. When an area is under quarantine, produce or plants must be treated in a manner to minimize the movement of the pest out of that area with the use of fumigation or other methods to destroy the pest before shipment.

Conclusion

According to the Food and Agriculture Organization (FAO) of the United Nations*, IPM means considering all available pest control techniques and other measures that discourage the development of pest populations, while minimizing risks to human health and the environment. For farmers, IPM is the best combination of cultural, biological and chemical measures to manage diseases, insects, weeds and other pests (Basappa, 2003). It takes into account all relevant control tactics and methods that are locally available, evaluating their potential cost-effectiveness. IPM does not, however, consist of any absolute or rigid criteria. It is a flexible system that makes good use of local resources and the latest research, technology, knowledge and experience. Ultimately, IPM is a site-specific strategy for managing pests in the most cost-effective, environmentally sound and socially acceptable way. Implementation of IPM lies with farmers, who adopt practices they view as practical and valuable to their activities.

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Cissus quadrangularis Linn: A useful Indian medicinal plant

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Cissus quadrangularis Linn. is a important medicinal perennial plant of the grape family (Vitaceae) commonly known as Veldt Grape or Devil's Back bone. *C. quadrangularis* is an unusual and attractive plant which is both easy to grow, and fast growing. It is a fleshy, cactus-like liana widely used as a common food item in India. The plant is prescribed in the ancient Ayurvedic literature as a general tonic and analgesic, with specific bone fracture healing properties. The plant is commonly known as Vajravalli in Sanskrit, Hadjod in Hindi, Kandvel in Marathi, Haddjor in Punjabi, Hadbhanga in Oria, Vedhari in Gujrati, Perandi in Tamil, Nalleru in Telugu and Veldgrap, Edible Stemmed Vine in English. The plant Found throughout the hotter parts of India alongside hedges, neighbouring countries like Bangladesh, Pakistan, Shrilanka and Malaysia.

Figure. A Plant of *Cissus quadrangularis*

Cultivation

Cissus quadrangularis Linn is an important medicinal plant found in India and Africa, commonly known as “Hadjod and bone setter”. *C. quadrangularis* is a succulent shrubby climber with 4-winged internodes and a tendril at the nodes and reaches a height of 1.5 m approximately. Stem jointed at nodes, internodes are 8 to 10 cm long and 1.2 to 1.5 cm wide. Flowering is very rare and flowers are small, greenish white, bisexual, tetramerous and opposite to the leaves. Fruit globose/obovoid fleshy berries. *Cissus quadrangularis* is propagated by seeds and stem cuttings. It is vegetatively propagated mainly in the month of May to July. It requires warm tropical climate. Propagation through seeds is unreliable because seeds are rare and not viable. It can be cultivated in plains coastal areas, jungles and wastelands up to 500 m elevation. The plant is propagated using stem cuttings. Plant flowers in the month of June to December. Planting material occurs as pieces

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of varying lengths; stem quadrangular, 4-winged, internodes 4-15 cm long and 1-2 cm thick. The vines of established plants scramble on the ground and climb vegetation, and will eventually spread to at least several yards, and possibly to over 20 feet.

Medicinal properties of *Cissus quadrangularis* L.

The plant contains calcium oxalate, β-carotene, ascorbic acid, β-sitosterol and 3-ketosteroids, also flavonoids such as quercetin, and kaempferol. The stem contains two unsymmetrical tetracyclic triterpenoids, onocer-7-ene-3α, 21β-diol and onocer- 7-ene-3β, 21 α –diol, two steroidal principles I and II, δ-amyrin, δ-amyrone. The roots and stems are most useful for healing of fracture of the bones. The C. *quadrangularis* has been documented in Ayurveda and Siddha systems of medicine for the treatment of various ailments like syphilis, gouts, piles, leucorrhoea, veneral diseases, diarrhoea and dysentery. The entire plants are of medicinal properties like bone healing, anti-inflammatory, analgesic, antimicrobial, antiulcer, antiosteoporosis, antioxidant and antiobestity properties. The stem juice of the plant is used to treat scurvy, menstrual disorders, otorrhoea, and epistaxis.

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Refrigerated Retail Van: An Important Component in Cold Chain Management

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INTRODUCTION

India ranks second in the production of fruits and vegetables after China with the production of 90.2 million metric tonnes of fruits and 169.1 million metric tonnes of vegetables as per the report of National Horticultural Board, 2015-16 (APEDA). Despite being one of the largest producers, the post-harvest losses are also high accounting worth Rs 2.0 Lakh crore every year (ASSOCHAM, 2013). Fruits and vegetables are perishable in nature and have less shelf life compare to other crops.

Moreover, the chances of losses and deterioration increase at every step of handling, transportation, and storagedue to its short shelf life and perishable nature. The post-harvest losses of fresh produce during transportation and storage are one of the prominent issues in supply chain management (Singh et al., 2009; Negi and Anand, 2015). The concept of cold-chain management may help in reducing such bulk amount of losses.

The cold chain is a logistics system that provides a series of an ideal environment for the produce during transportation and storage from the point of origin till consumption point in the food supply chain. Ideal environment for fruits and vegetables in cold chain includes maintaining temperature and humidity during storage and refrigerated transportation. The cold chain is reported of preserving freshness and quality of the fresh produce (Negi and Anand, 2015; ASSOCHAM, 2018). Food miles or food mileage refers to the distance travel by the food from the location of origin until it reaches to consumers, i.e., farm to plate. Food miles is one of the main factors to understand the inefficiency of the food supply chain. The lesser the food miles, the better would be the product as it reduces the wastage by supplying the produce at a minimum possible time (Rajkumar and Jacob, 2010).

Importance of Refrigerated Retail Van

The wastage of 10-12% occurs when fresh produce moves from grower to consumers due to the long transport process and uncontrolled temperature of the transport vehicle; thus, simultaneously increasing cost and reduction in quality. The primary constraints in cold chain are inadequate transport facilities, no clean policy guidelines from the government, non-availability of large scale cold storage, and fragmented small farmers (Tolani and Hussain, 2013).
On the other hand, the demand of cold chain in fruits and vegetables has been increasing due to changing lifestyles, globalization, nuclear families, working women, demand of fresh produce and rise of organized retails. Furthermore, high fluctuation in demand and supply, price fixation, and concern for food safety and quality is reported due to its perishable and seasonal nature (Vorst and Beulens, 2002, Negi and Anand, 2015). Therefore, refrigerated retail van as a part of supply chain management can help in maintaining the price and quality of products in the market.

Quality loss in fruits and vegetables during storage and transportation is a function of temperature, humidity, and time. Even for a short period, a considerable amount of quality losses may occur during loading and unloading and in transit by the time the product reaches its destination. Hence, maintaining the ideal holding temperature and humidity are the major factors to reduce wastage and quality loss during storage and transportation. To achieve efficient temperature control and maintenance, nowadays, refrigeration units are controlled and monitored through automation and control systems. In the past, multi-temperature trailers have been using for food delivery operations, especially for fast food and independent grocery stores (Ashby, 2006).

Trends in India

India, despite being largest producers, does not have a comprehensive cold-chain network. More than 50% of produce is transported using bullock carts and (or) trucks with no packaging or packaged in gunny bags (Negi and Anand, 2015). Therefore, to reduce the loss impact, it is also necessary to deliver a good quality of fruits and vegetables at a minimal time to the consumers.

Most of the Indian fruits and vegetable retailers use roadside open vending cart with or without refrigeration unit. Many researchers, scientists, and academician have developed improved vending carts for fruits and vegetables. Some of them include solar assisted vending cart (Potdukhe at el., 2018), off-grid autonomous solar powered refrigerated vending cart by IIT Kanpur (dora.iitk.ac.in/funds/spa-vending-cart.php), pushcart with low energy storage system using different evaporative cooling structures (Venu S.A.,2012) and solar-powered evaporative cooled vegetable vending cart (Samuel et al., 2016). In these entire street vending carts, the maximum temperature that can be reduced up to 10-15 °C from ambient conditions and 15-25% relative humidity can be raised. However, these vending carts have low capacity, more tedious, less hygienic, and laborious for the seller.

ICAR-IIHR, Bengaluru has developed an improved fruit and vegetable vending van based on the principle of evaporative cooling and misting along with solar assisted to supply power for electrical gadgets (Annual report of ICAR-IIHR, 2017-18). Many other mechanical refrigerated vans for the retail of fruits and vegetables are available in different business marketing websites in the context to improve the supply cold chain management. However, these technologies maintain fruits and vegetables at a constant temperature. On the contrary, different fruits and vegetables need to be stored and transported at a particular temperature to retain freshness and maintain quality. Moreover, the energy required for refrigeration is supplied from the vehicle engine itself, which are less energy-efficient and high operating cost. A cold storage chamber with phase change material based thermal storage system has been developed by NISE having lower capital cost and ten times longer life than lead-acid battery (Annual Report of MNRE-NISE, 2017-18).

CONCLUSIONS

Development of efficient retail van for mobile markets in the form of buses, trucks, and semi-trailers outfitted with refrigeration as well as the facility of cash registers, credit and electronic transfers retailing equipment can provide quality and safe food access to multiple locations. Under the light of cold chain management, refrigerated van for the retail of fruits and vegetables may play a significant role in reducing post-harvest losses, increasing farmer’s income, employment generation, and supplying a quality product to the consumers.

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Seasonal Management of Beekeeping

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INTRODUCTION

Beekeeping may be defined as (apiculture) the maintenance of bee colonies and commonly in man-made hives by humans. A location where bees are kept is called an apiary or "bee yard". The honey bees in the genus *Apis*, but the honey-producing bees such as *Melipona* stingless bees are also kept. A beekeeper keeps bees in order to collect their honey products. It is the hive produce products like-Beeswax, Propolis, Flower pollen, Bee pollen, and Royal jelly), to the mostly pollinate crops, or produce bees for sale to other beekeepers.

History

The humans collecting honey from wild bees date to 10,000 years ago. The beekeeping in pottery vessels began about 9,000 years ago in North Africa. It is the domestication of bees is shown in Egyptian art from around 4,500 years ago. The simple hives and smoke were used and honey was stored in jars, some of which were found in the tombs of pharaohs such as Tutankhamun. It wasn't until the 18th century that European understanding of the colonies and biology of bees allowed the construction of the moveable comb hive so that honey could be harvested without destroying the entire colony. The modern bee keeping became possible after the discovery of movable frame hive in 1851 by Rerd. L.L. Langstroth. In India bee keeping was introduced 1882 in Bengal.

Origin

There are more than 20,000 species of wild bees. Many species are solitary (e.g., mason bees, leafcutter bees (Megachilidae), carpenter bees and other ground-nesting bees). Many others rear their young in burrows and small colonies (e.g., bumblebees and stingless bees). Some honey bees are wild e.g. the little honeybee (*Apis florea*), giant honeybee (*Apis dorsata*) and rock bee (*Apis laboriosa*). Beekeeping, or apiculture, is concerned with the practical management of the social species of honey bees, which live in large colonies of up to 100,000 individuals. In Europe and America the species universally managed by beekeepers is the Western honey bee (*Apis mellifera*). This species has several sub-species or regional varieties, such as the Italian bee (*Apis mellifera ligustica*), European dark bee (*Apis melliferamellifera*), and the Carniolan honey bee (*Apis mellifera carnica*). In the tropics, other species of social bees are managed for honey production, including the Asiatic honey bee (*Apis cerana*).

Some General Principles

1. Ensure that space in the hive is available.
2. 1/3 for brood - 1/3/ stored honey - 1/3 empty honey frames.
3. Make sure bees are packed, i.e. working all the frames of the hive. Add or remove space to suit conditions.
4. Keep notes and build up knowledge of your locality - its flora and honey flows. Keep a history of your hives.

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5. Re-Queen hives that show undesirable characteristics; (a) aggressiveness (b) low production (c) poor wintering (d) swarms often (e) failing queen (too many drones)
6. Keep your hives in good condition. Have equipment in reserve.
7. Keep yourself informed - attend meetings, field days and read newsletters and magazines, search the internet, there are some fabulous sites to explore.
8. Use your product in the kitchen as a sweetener, in cooking and drinks.
9. Honey is an insulator. In winter have a frame of honey either side of the brood. In summer, if the hive is full of honey, the bees will not be hot and hang out of the entrance.
10. Hive beetle management must continue year-round. Inspect and replenish traps at recommended intervals: oil traps every 3-4 weeks in summer, every 4-6 weeks in winter. Other methods follow recommendations. The different parts of the country although the basic management methods are as following:

Summer Season Management

The peak bloom for many nectar plants is early summer in the northern United States. When this happens, it's time to see whether all the bees' and your hard work getting populations up to their optimal level will pay off. Don't be surprised, however, if it doesn't work out the way you planned it. Conditions vary greatly from year to year. It takes several years' experience in a location to get a sense of how consistent it will be. The litany of potential problems is long: it might be too hot, too cold, too dry, too windy, too wet, and so on. Bees and the vegetation they depend on can be affected greatly by shifting environmental conditions, even on a day-to-day basis.

The visits of apiary in summer are made mainly to look at storage issues. Plan to visit every two weeks. It may be time to add and perhaps take off supers as previous ones become filled and capped. Some beekeepers begin to extract honey early; others wait until the season is over. As part of this, continue to monitor the adult population. A good way to estimate what's going on is by using a hive scale to monitor weight changes. In the South, the major nectar flows may be over, having peaked in late spring. Summer in this region can be extremely hot with no appreciable nectar. In some locations, colonies can even be hungry, especially if the beekeeper has been too anxious to take off a honey crop. Afternoon thundershowers can wash away a nectar flow quickly, and the bees might become prickly without warning. It provides the shade to hives.

- It provides the fresh and clean water.
- Provides the sugar syrup to honey bees.
- Proper management of pest and diseases.
- Sprinkler cold water over hive.
- Proper inspection of bee hive.
- Keep the colony strong.
- Re-queening.

Spring Season Management

The spring management varies from locality to locality and year to year depending on weather conditions and the available nectar sources in the area. The following sequence of spring management practices might have to be modified slightly for some areas.

Early Spring (late March to early April)

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1. Tilt each hive back and clear the bottom board of dead bees and debris. When finished, replace the entrance reducer.
2. Proper check for a good egg and brood pattern. This shows the queen is laying well. She should have begun in late February or early March. If the queen is missing or not laying in a good pattern, plan to requeen in April when some nectar is coming into the hive.
3. Check for sufficient stores. The supply should never get below 10 pounds. The bees can exhaust this amount in a week if no nectar is coming in.

Mid-Spring (the period of fruit bloom)

1. Re-queen the hives according to your plans.
2. Continue to watch for poor queens in other hives, i.e., spotty or sparse egg laying. Re-queen immediately if needed.
3. Provide free access to the hive entrance by removing the entrance reducer and rank plant growth in front of the entrance.
4. As the fruit bloom period progresses, brood rearing might move up into the overwintering super. If so, reverse the hive body and super so the super is on the bottom.
5. If full frames of honey and pollen are next to the brood nest blocking its expansion, rearrange the frames in the brood chamber so an empty frame separates the brood from the food stores. As these frames fill with brood, provide more space in a like manner.

Monsoon and Autumn Season Management

In the tropical and sub- tropical regions of the country, June to September represents the monsoon or wet season. Bees face several problems of pests, predators, excessive humidity and starvation. Sometimes due to continuous rains, bees are confined to their hives for a long period. Honey bees become lethargic and may develop dysentery. The colonies need following management to keep them strong:

1. Weak colonies which have become queen less, should be united with queen right colonies, since during this period due to absence of drones new virgin queen cannot mate.
2. Avoid the brood lessness in colonies; if pollen stores and fresh pollen is not available, feed the colonies either pollen substitute or pollen supplement.
3. If colonies have poor food stores (below 5kg) provide sugar in the form of candy or dry sugar instead of sugar syrup.
4. To keep in check the attack of enemies like wax moth, ants, mites and wasps.
5. The hives are kept on stands sloping towards entrance in order to drain out water and prevent its accumulation inside the hive.

Autumn/Fall Management

The management practices during this period depend on the climatic and floral conditions where bees are kept. In some parts of Himachal Pradesh, there is a second honey flow season in autumn. The colonies in such places are managed as described earlier for availing honey flow. Near the end of honey flow, reduce the hive space to the needs of colony for winter. Restrict the food storage space to the lower hive body so that bees are forced to store their winter stores there instead of super. During this period many colonies make preparation for superseding old queens and raise few queen cells and this is natural replacement of failing queen in a colony. The new queen on emergence kills the old queen.

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For successful overwintering, which is the non-productive season, following management should be done.

1. Inspection of the colony has been vigorous and productive queen. An ideal queen is one whose egg laying rate is high and continues to lay well till late fall and thus provides population of predominantly young bees in sufficient number for wintering.
2. Colonies below average population or having scattered or less brood than the average colonies indicate failure of queens. Replace queens of such colonies by early fall so that these colonies produce desirable number of young bees.
3. Colonies for wintering should be free from disease.
4. Reduce the comb space by removing extra frames to such a level which can be covered by the bees well.
5. Under the moderate climatic conditions, colonies of bees on 3-5 frames can winter successfully, if the colonies have proper food stores. Unite the weak colonies with colonies of average bee strength.
6. It is the colonies have less honey stores, feed them with heavy sugar which is prepared by dissolving 2 parts of sugar in one part of boiling water and to avoid crystallization add 1 table spoon full of tartaric acid to each of 50kg of sugar. The fill syrup in combs and exchange for empty combs in the hive.

PRECAUTION

The sugar should be fed while outside temperature is sufficient for bees to take syrup and store in combs after reducing its moisture. To avoid robbing, feeding should be done only in the evening.

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Organic seed production of Niger

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INTRODUCTION:

Niger *(Guizotia abyssinica)* belongs to Asteraceae family is an erect, stout, branched annual herb, grown for its edible oil and seed. Niger, a minor oilseed crop i.e. important under rainfed conditions, coarse textured, poor soils especially on hill slopes.Niger seed is used as a human food. The seed contains 37-47% oil, which is pale yellow with nutty taste and a pleasant odour. The oil and seeds are free from any toxin and oil taste is similar to *desi* ghee. The oil is readily subject to oxidative rancidation rendering its keeping quality poor due to high content of unsaturated fatty acid (oleic acid 38% and linoleic acid 51.6%). The oil is used for culinary purposes, anointing the body, manufacturing paints and soft soaps and for lighting and lubrication

The niger oil is good absorbent of fragrance of flowers due to which it is used as a base oil by perfume industry. Niger oil can be used for birth control and treatment of syphilis. Niger sprouts mixed with garlic and 'tej' are used to treat coughs.

Niger seed cake is a valuable cattle feed particularly for milch cattle. Niger meal with 30% protein and 17% crude fibre in India could replace linseed cake in calf ration. It can also be used as a manure. Niger is also used as a green manure for increasing soil organic carbon.

Geographic Distribution:

India is the most important country accounting for more than 50% of world niger area and production. Niger constitutes about 50-60% of Ethiopian oilseed production, with an area of nearly 2 lakh ha and production of about one lakh tonnes with a productivity level of 500 kg/ha. In Ethiopia, it is cultivated on water logged soils where most crops and all other oilseeds fail to grow and contributes a great deal to soil conservation and land rehabilitation.

In India, niger is grown on an area of 0.52 million ha mainly during *kharif*. However, in Orissa it is a *rabi* crop. Madhya Pradesh, Maharashtra and Orissa contribute more than 80% of area and production. Other states where niger is grown are Andhra Pradesh, Bihar, Karnataka and West Bengal.

Origin and History:

The evidences suggest that niger originated in the highlands of Ethiopia, north of 10'N latitude. Cultivated niger might have originated from the wild species *Guizotia scabra* subsp. *schimperi* due to selection by Ethiopian farmers thousands of years ago. The genus *Guizotia* has 6 species. All species except *G. abyssinica* are wild and are endemic to East Africa especially Ethiopia. From Ethiopia, the cultivated niger is believed to have spread to India during third millennium BC along with other crops, such as finger millet. Niger's wide dispersal in India is indicated by the great variety of local names for the plant and seed.

The Plant :

Niger is an annual dicotyledonous herb. with epigeal germination. The root system is well developed , with a central tap-root and its lateral branching. The stem of niger is usually round, smooth to slightly rough, hollow and moderately branched. The fruit is an achene, small, 3-5 mm in length and 1.5mm in width, almost lanceolate in shape, without pappus. There are usually between 15 and 30 mature seeds/head; occasionally more, and a varying number of immature seeds or pops at the centre.

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Climate and regional growing requirements:

Niger is a crop of the cooler parts of the tropics. It grows well in mid altitude and highland areas (1600-2000 m), 500 and 2290 m above mean sea level in Ethiopia but can be found at lower (500-1600 m) and higher (2500-2980 m) altitude with adequate rainfall. Ethiopian niger types are short day and the Indian types are quantitatively short day in photoperiodic response. Ethiopian types flower best at 18 ^{o}C day and 13^{o}C night temperatures and 12 hours day length. Day length > 12 hours and temperatures of 23^{o}C and above delay flowering. No such effect of temperature on Indian types was observed on flowering.

A rainfall of 1000 - 1300 mm is considered as the optimum. Growth is adversely affected in areas receiving rainfall above 2000 mm, but the plants can withstand high rainfall during vegetative phase. Hence it is most suitable crop for hilly regions of high rainfall and humidity. The peak flowering period of the crop should not coincide with the rainy period as this would affect pollination by honey bees, resulting in poor seed setting. High wind or hail, when the seed is mature, it will cause severe shattering. The crop can also withstand drought.

Niger can grow on a wide range of soil types, but thrives best on clayey loams or sandy clays. The crop prefers well drained soils in the pH range of 5.2 to 7.3. Niger tolerates waterlogged soils, since it grows equally well on both drained soils or waterlogged clays. Niger is a salt tolerant but its flowering is delayed with increasing salinity.

Botanical description:

Niger is an annual dicotyledonous herb. Germination is epigeal and seedlings have pale green to brownish hypocotyls and cotyledons. The cotyledons remain on the plant for a long time. The first leaf is paired and small and successive leaves are larger. The leaves are arranged on opposite sides of the stem; at the top of the stem leaves are arranged in an alternate fashion. Leaves are 10-20 cm long and 3-5 cm wide (Fig. 1.1). The leaf margin morphology varies from pointed to smooth and leaf colour varies from light green to dark green, the leaf surface is smooth. The stem of niger is smooth to slightly rough and the plant is usually moderately to well branched. Niger stems are hollow and break easily. The number of branches per plant varies from five to twelve and in very dense plant stands fewerbranches are formed. The colour of the stem varies from dark purple to light green and the stem is about 1.5 cm in diameter at the base. The plant height of niger is an average of 1.4 m, but can vary considerably as a result of environmental influences and heights of up to 2 m have been reported from the Birr valley of Ethiopia. The niger flower is yellow and, rarely, slightly green. The heads are 15-50 mm in diameter with 5-20 mm long ray florets. Two to three capitulae (heads) grow together, each having ray and disk florets. The receptacle has a semi-spherical shape and is 1-2 cm in diameter and 0.5-0.8 cm high. The receptacle is surrounded by two rows of involucral bracts. The captulum consists of six to eight fertile female ray florets with narrowly elliptic, obovate ovules. The stigma has two curled branches about 2 mm long. The hermaphrodite disk florets, usually 40-60 per capitulum, are arranged in three whorls. The disk florets are yellow to orange with yellow anthers, and a densely hairy stigma. The achene is club-shaped, obovoid and narrowly long . The head produces about 40 fruits. The achenes are black with white to yellow scars onthe top and base and have a hard testa. The embryo is white.Niger is usually grown on light poor soils with coarse texture. Itis either grown as a sole crop or intercropped with other crops. When intercroppedit receives the land preparation and

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cultivation of the main crop. In Ethiopia it ismainly cultivated as a sole crop on clay soils and survives on stored moisture. Amore detailed description on the agronomy of niger is presented under Agronomy.

Mode of reproduction:

Flower development, the extent of cross- and self-pollination, and the time at whichfertilization occurs are important criteria for conducting breeding work. In Ethiopia capitulum buds open approximately 2 months after planting. Flower anthesis begins early in the morning at about 6.00 hours and dehiscence of pollen begins 2 hours later and continues up to 10.00 hours under conditions at Holetta, Ethiopia. The style emerges covered with pollen but the receptive part rarely or never comes in contact with that pollen, a phenom-enon that favours cross-pollination. A single head or capitulum takes 8 days and a field will require 6 weeks for completion of flowering. Niger is a completely outcrossing species with a self-incompatibility mechanism and insects, particularly bees, are the major agents of pollination. The self-incompatibility nature of niger complicates the production of selfed seed. At Holetta, 600 accessions were tested for their ability to produce selfed seed using muslin cloth bagging. Twenty-two out of the 600 accessions produced approximately 1 g of selfed seed per plant, indicating that niger germplasm with some level of self-compatibility exists within the Ethiopian genepool. For crossing of niger, the disk florets which are hermaphroditic are removed from the capitulum, after 1-3 days of opening and the female ray florets are dusted with pollen from the selected second parent. Pollination after the third day does not result in any seed set. After dusting, the capitulum is covered with a bag for 1 week to exclude any foreign pollen. This procedure produces a good quantity of crossed seed.

Isolation Distances:

Niger crops for Foundation status must be isolated by a distance of 400 meters (1312 feet) from other varieties of Niger or from a non-pedigreed crop of Niger.Niger crops for Certified status must be isolated by a distance of 200 meters (656 feet). The required isolation must be provided prior to the time of flowering and crop inspection.from other varieties of Niger or from a non-pedigreed crop of Niger.All crops for pedigree must be free of Prohibited noxious weeds.All crops for pedigree should be free of Primary noxious weeds. Very weedy crops may be declined pedigreed status.Some vetches (Vicia spp.) produce seeds that are difficult to separate from Niger seed. Seed crops with excessive numbers of difficult to separate weeds or other crop kinds may be declined pedigreed status.

Seed rate and spacing:

Niger is a small seeded crop and seed rate varies from 5-8 kg/ha for sole cropping. Row widths varies from 20 to 30 cm and intra-row spacing from 10-20 cm. In Andhra Pradesh, Karnataka and Madhya Pradesh, a spacing of 30 x 10 cm is adopted. However, in Bihar and Maharashtra, wider intra row spacing (15 cm) is adopted keeping a row spacing of 30 cm. In Orissa, 20 x 20 cm spacing is recommended

Selection and Roguing:

One form of selection that can be practiced by the grower is roguing. Roguing is the process of removing off-type plants. Varieties are never static and are always changing. For that reason there is no such thing as “variety maintenance”. Selection is always happening, whether we have a hand in it or not. There are environmental factors (climate, weather, soil, diseases, pests, occasional crosses, etc.) and genetic factors (mutations, genetic drift due to population size) which are continually changing the variety. Thus you have to practice roguing to maintain desirable variety characteristics.

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Roguing is done throughout the growing season, from seedling stage through fruiting stage, whenever the need occurs. If possible, plants should be rogued before flowering so that the undesirable traits don't pass into the seed.

Roguing is done by inspecting the entire plant, not just the fruit or seed. When roguing plants, pay special attention to earliness, foliage color, leaf shape, flower color, growth form, trueness-to-type, vigor, and disease and insect resistance. When pod production begins consider for example, productivity, size, color, shape, and eating quality. Your focus should be on the whole plant, not on individual pods. Finally, roguing can be done again on the seed itself. If you find off-types at this stage you may have to evaluate the purity of your seed crop.

Conversion Requirements:

Organic agriculture means a process of developing a viable and sustainable agroecosystem. The time between the start of organic management and certification of crops and/or animal husbandry is known as the conversion period.The whole farm, including livestock, should be converted according to the standards over a period of three years.The establishment of an organic management system and building of soil fertility requires an interim period, the conversion period. The conversion period may not always be of sufficient duration to improve soil fertility and re-establish the balance of the ecosystembut it is the period in which all the actions required to reach these goals are started.

Method of sowing:

The most usual method of sowing is broadcast. However, line sowing using seed drills is recommended. When mechanical planters or drills are used, the seed should be sown 1-3cm deep, depending on soil type and the amount of soil moisture. Seed could be placed in soil up to 10 cm depth in loose soils provided the drill furrow should not be completely filled. The seed should not be mixed with fertilizer, nor placed in contact with it in theseed-bed. Seed must be sown into moist soil.

Nutrient management:

Plant root system is always in close association with multitude of microorganisms and other nutrients. The microbes in root zone are maintained due to a variety of secretions from the roots and constitute what is often described as '**rhizosphere'**. These microbes in their turn supply nutrients to the soil system through their heterotrophic activity. Maintenance of these microbes in the rhizosphere, therefore, is also necessary for soil health. Crop productivity and nutrient cycles, however, are integral parts of the exploitation of soil health and have led to soil degradation through nutrient depletion and erosion, so that long term strategies are needed to avoid the use of chemical fertilizers without adversely affecting crop productivity. The use of organic manures, composts, Biofertilizers has received increased attention in our cropping systems. Following are the components in Nutrient management system- Biodynamic Farming, Biofertilizers Technology, Composting, Vermicompost, Coir Compost, Panchakavya, Dasakavya And Effective Microorganism etc.

Weed management:

Niger grows rapidly once the seedlings are established, and its vigorous growth allows it to compete with annual weeds, provided majority of weeds are removed in pre-planting operations. Two weedings are generally adequate. The first weeding should be done at the time of thinning (15 days after sowing), and if required, second weeding is done before top dressing of N or just before appearance of first bud. In Orissa, dodder (Cuscuta chinensis L.) has become a problematic parasitic weed bringing down the seed yield by

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60-65%. As a precautionary measure, seeds should be obtained from cuscuta free areas.

Water Management:

Niger, a kharif crop, is seldom irrigated. Seedling stage is most critical for irrigation. However, established niger plants can withstand high soil moisture levels and recover to produce a good seed yield. Irrigation must be given at the seedling stage for proper growth of the crop. Check basin or border strip system of irrigation is ideal for niger.

Harvesting and Threshing:

Niger normally matures in about 80-145 days after emergence. Correct time of harvesting of niger is important to avoid shattering. In India, the crop is harvested when the leaves dry up and the head turns blackish. After drying in the sun for about a week by stacking on the threshing floor, the crop is manually threshed or threshed by bullocks.

Yields:

In India, 250 to 400 kg of Niger seed per hectare (223 to 357 lb. per acre) are common, with 1000 kg/ha considered a good yield. According to Purseglove, pure stands of Niger yield 392 to 448 kg/ha (350 to 400 lbs per/acre). In northern Thailand, Alea Santya has observed that the typical upland farm in his district can produce 15 *tang* (1 *tang* = 20 liters) of seed per *rai* (1,600 m^2). Depending on growing conditions, he estimates that local yields generally range between 8 to 20 *tang* per *rai*.

Seed Storage:

The dried seeds can be stored 2 to 3 years in a cool location. Niger has orthodox seed storage behavior (meaning seeds can tolerate drying and/or freezing) and can be stored for many years, assuming low seed moisture content. Because of its seed storage longevity, there is no need to express the entire harvest of Niger seed into oil at once

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Ashwagandha a safe supplement for daily routine

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Withania somnifera (Linn.) family Solanaceae commonly known as Ashwagandha, Asgandh, Punir etc in India is a medicinal plant its roots, leaf and seeds are used to make medicine. Grows in dried parts of subtropical regions like Rajasthan, Punjab, Haryana, Uttar Pradesh, Gujarat, Maharashtra and Madhya Pradesh etc. Ashwagandha is one of the most important herbs in Ayurveda, a form of alternative medicine based on Indian principles of natural healing. It has been used for over 3,000 years to relieve stress, increase energy levels and improve concentration. But so far, there isn't enough information to claim whether it is effective or not.The name Ashwagandha is taken from the Sanskrit language ashva, meaning horse, and gandha, meaning smell. The root has a strong aroma that is described as "horse-like."In Ayurvedic, Indian and Unani medicines, ashwagandha is described as "Indian ginseng." Ashwagandha is used in traditional African medicine for a variety of ailments.Ashwagandha and Physalis alkekengi both are known as winter cherry but both are different. The ashwagandha plant is a small shrub with yellow flowers native to India and North Africa.

Ashwagandha is used to treat tumors, arthritis, anxiety, bipolar disorder, attention deficit hyperactivity disorder (ADHD), obsessive-compulsive disorder (OCD), insomnia, tuberculosis, asthma, leukoderma in which skin is marked by white patchiness, bronchitis, backache, fibromyalgia, menstrual problems, hiccups, Parkinson's disease, and chronic liver disease reduce levels of fat and sugar in the blood. It is also used to reduce side effects of cancer and schizophrenia treatments. Ashwagandha improving thinking ability, decreasing pain and inflammation, and prevent aging, one-sided paralysis (hemiplegia), backache can be applied on wounds. By reducing cholesterol and triglyceride levels it improve heart condition. In chronically stressed adults taking the highest dosage of standardized ashwagandha extract experienced a 17% decrease in “bad” LDL cholesterol and an 11% decrease in triglycerides, on average in 60 days. In humans have found that it increases the activity of natural killer cells i.e immune cells that fight infection. It has also been shown to decrease markers of inflammation, such as C-reactive protein (CRP). This marker is linked to an increased risk of heart disease. Taking ashwagandha regularly as a supplement increases reproductive health it leads to a significant increase in testosterone levels. The researchers also reported that by taking the herb increases antioxidant levels in blood.

Cortisol is known as a "stress hormone" release by adrenal glands in response to stress, and lower blood sugar levels. Unfortunately, in some cases, cortisol levels may become chronically elevated which can lead to high blood sugar levels and increased fat storage in the abdomen. Studies have shown that ashwagandha may help reduce cortisol levels. In one study in chronically stressed adults, those who supplemented with ashwagandha had significantly greater reductions in cortisol, compared to the control group. Those taking the highest dose had a 30% reduction, on average.

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It also impedes the growth of new cancer cells in several ways. First, ashwagandha is believed to generate reactive oxygen species (ROS), which are toxic to cancer cells but not normal cells. Second, it may cause cancer cells to become less resistant to apoptosis.

Also, several human studies have confirmed its ability to reduce blood sugar levels in both healthy people and those with diabetes. Additionally, in a four-week study in people with schizophrenia, those treated with ashwagandha had an average reduction in fasting blood sugar levels of 13.5 mg/dL, compared to 4.5 mg/dL in those who received a placebo. In another study people with type 2 diabetes, supplementing with ashwagandha for 30 days lowered fasting blood sugar levels as effectively as an oral diabetes medication.

In addition, studies have found decreases blood fats in animal significantly.Another study on rats found that it lowered total cholesterol by as much as 53% and triglycerides by nearly 45%. Several other animal studies have shown that ashwagandha decrease inflammation. Animal studies suggest that it may help treat several types of cancer, including breast, lung, colon, brain and ovarian cancer. In one study, mice with ovarian tumors treated with ashwagandha alone or in combination with an anti-cancer drug had a 70–80% reduction in tumor growth. The treatment also prevented the spread of cancer to other organs.

Precautions

Ashwagandha is a safe supplement. However, certain individuals should not take it, including pregnant and breastfeeding women.People with autoimmune diseases should also avoid ashwagandha unless authorized by a doctor. This includes people with conditions like rheumatoid arthritis, lupus, Hashimoto's thyroiditis and type 1diabetes.Additionally, those on medication for thyroid disease should be careful when taking ashwagandha, as it may potentially increase thyroid hormone levels.It may also decrease blood sugar and blood pressure levels, so medication dosages should be taken with care.The recommended dosage of ashwagandha depends on the type of supplement. Extracts are more effective than crude ashwagandha root or leaf powder. Remember to follow instructions on labels.Standardized root extract is commonly taken in 450–500 mg capsules once or twice daily.It's offered by several supplement manufacturers and available from various retailers, including health food stores and vitamin shops.There's also a great selection of high-quality supplements available online.

Fig. Ashwagandha

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The role of ancient knowledge in the development of modern industrial biotechnological sciences

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INTRODUCTION:

The term industrial biotechnology might be modern but the inception of innovative biotechnological approaches based on using microbes is well documented. These beneficial microbes are catering to the needs of society even before their proper scientific diagnosis. Since ancient time, a lot of processes were discovered to convert raw material into the essential products by using microbes, but the real identity of these microbes was not known. There were a lot of mysterious effects of this microorganism which were decoded at much later with the progress of modern science.

The mystery of the microbes:

In the ancient time, a lot of unknown microbes were used to preserve perishable fruits and vegetables, milk, to produce cheese, bread and beverages. In Greek literature, the conversion of sugars to alcohol by yeasts was mentioned as early in 7000BC. The ancient researches used the yeasts in baking bread and cheeses.

The ancient discoveries, which laid the foundation stone of industrial biotechnology:

S.no.	Event	Place	Historical period
1	Sugar to alcohol conversion by yeasts	Sumeria, Babylonia	7000 BC
2	Bread leaven by Yeast's CO_2	Egyptians	4000 BC
3	Fermented wine	Assyria	3500 BC
4	Use of vinegar in disease treatment	Assyria	400 BC
5	Moulds to saccharify the rice	Rome	700AD

The prevalence of unknown facts and confusions in the ancient era:

There were a lot of confusions were existing among the ancient scientists regarding microorganism. In the lack of knowledge of biological sciences, there were strong assumptions that these microorganisms are self-generated from the nonliving matter. One other theory was also prevalent which suggested that these microorganisms were born from their preexisting forms and present universally in air and stabilized when they found substrate. Subsequently, Pasteur and Tyndall disapproved the aforementioned theories.

The concomitant era of organic chemistry:

In the early 1900s, the scientists claimed that the fermentation of alcohol is due to microbes or involves microbes in its processes. But these claims were made at that time when the organic chemistry science was flourishing and the chemists falsified the above claims and stated that the fermentation is purely a chemical reaction in nature.

Fighting against the diseases:

Subsequently, the science was moved further and the scientist Robert Koch, who identified the cause of anthrax disease and explained it is transmittable. Later on, the role of microbes in typhoid and diphtheria were decoded by Gaffky and Loeffler.

The decoding of the cause of sourness in fermented products:

Meanwhile, there was confusion among the distillers about why their fermented products were getting sour. Finally, it was explained by the Pasteur that other than yeasts cells in fermented products, bacterial cells are too present, which is the main cause behind the sourness. Later on, Pasteur established much different fermentation by using different microbes.

These above events were the major throwback in the history of industrial biotechnology. Where the scientist discovered the role of various microbes in various product generation. The identification of these microbes took decades to scientists to find their identity and their exact role.

Initiation of the Golden age of industrial biotechnology:

The golden age of biotechnology was initiated by the discovery of Penicillin. The further periodical discoveries which boosted the development of industrial biotechnology.

1. The discovery of penicillin, produced by the microbe *Penicillium notatum*
2. The discovery of cephalosporin , produced by the microbe *A. chrysogenum*
3. The discovery of streptomycin , produced by the microbe *Streptomyces griseus*
4. The discovery of neomycin , produced by the microbe *Streptomyces fradiae*
5. The identification of 180 secondry metabolites, produced by *Streptomyces hygroscopicus*
6. The development of mutational biosynthesis technique for strain improvement by university of Illinois
7. Production of avermectin by, *Streptomyces avermitilis*
8. The development of semisynthetic drugs to combat multiple disease e.g. Synercid
9. Production of primary metabolites by fermentation processes
10. The production of a flavoring agent, Monosodium glutamate (MSG)
11. The artificial production of essential amino acids
12. Development of auxotrophic mutants of the glutamic acid producer, *C. glutamicum*, which helps in nucleotides production artificially
13. Production of vitamins by microbes, e.g. riboflavin by *Eremothecium ashbyi* and *Ashbya gossypii*
14. Organic acid synthesis by the microbes lilke, *A. niger, Candida* yeasts, *Acetobacter* , *Gluconoacetobacter ,* and *Frateuria*
15. Ethanol production by the *S. cerevisiae*
16. Development of biopolymers like xanthan by *Xanthomonas campestris* and polyhydroxybutyrate by *Alcaligenes eutrophus*
17. Production of specialty sugars and oligosugars,
18. Production of novel extracellular polysaccharides,
19. Production of biopigments
20. Production of cosmetics including fragrants,
21. Microbial enzymes for chiral synthesis and other applications

CONCLUSION:

The current sciences of developments of drugs, vaccines, enzymes, enzymatic inhibitors, single-cell proteins, growth regulators, hormones, biopesticides, bio-fertilizers, biosensors and many other microbes' related things were not possible without the ancient knowledge of the uses of microorganism. The statement "The practice of industrial biotechnology has its roots deep in antiquity fits true, as the current biotechnological inventions have their roots in past significant researches. This saw a substantial growth period of industrial biotechnology from unknown facts to current innovative applications. Still, this area has to be explored a lot for the benefits of society.

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Biological weed control

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Biological control of weeds involve the use of living organisms such as insects, herbivorous fish, disease causing organisms and competitive plants etc to suppress the growth and development of weeds. There are two approaches practiced tot control the target weeds by using suitable bioagent.

1. Classical biological weed control approach
2. Mycoherbicidal/bioherbicidal biological weed control approach

The biological weed control aims at restoring the balance between between target weed and its natural enemies in the ecosystem by the introduction of suitable bioagent. The objective of the biological weed control methods are the tsrget weed should not eliminate completely from the field but it should be under below economicthreshold limits.

Criteria for selection of successful bioagent or good qualities of bioagent:

1.Host specificity: Bioagent should be host specific and they should not attack on economic crop plant.

Ex: *Telenomiascrupulosa*introduced for the control of *Lantana camara* but it damages the teak plantations and sesamum crop.

2.BioagentHardiness: Bioagent should withstand extremities of the environment

3.Rapid feeding environment: A good bioagent must be able to continue to feed on large quantities of foliage within a short time. The bioagent should preferably damages the flowers and seeds of the target weed.

4.Faster or easy multiplication: Easy and high rate of natural reproduction of bioagent is compulsory in case of all bioagents except herbivorous fish.

Kinds of bioagents:

1. Insects:

a. *Crocedo semalantana*- bioagent to suppress the growth and development of *Lantana camara* introduced from Hawaii during 1902.
b. *Eriococus orariensis*-bioagent to control the Manuka weed *Leptospermum scopiorum*

2. Fishes (Herbivorous fish):

a. Chinese grass carp *Ctenophary gronidella*is a most common sps for aquatic weed control
b. *Tilopoia mossambica* feeds on roots of aquatic weeds

3. Snail:

a. Fresh water snail *Marisa cornuarieties* feeds on several aquatic weeds especially on water hyacinth and water fern
b. *Limnea acuminate* feed on roots of *Salviniamolesta*

4. Mites:

a. **Spider mite**: *Tetranynchus desertorum* is used as a bioagent to control the *Opuntiasps*
b. **Gall mite**: *Aceria chondrilla* is used as a bioagent to control the skeleton weed *Chondrillajuncea*

5. Fungi

a. *Acacia glauca* can be controlled by using fungi *Cephalosporiumzonatum*
b. Skeleton weed *Chondrillajuncea* can be controlled by a fungus *Pucciniachondrillina*

6. Competitive plants

a. *Panicumpurpurascens* is found to be highly competitive for *Typhasps*.
b. *Cassia seratia* and *Tagetussps* are competitive for *Partheniumhysterophorus*

Outstanding examples for classical biological weed control methods:

Lantana: Lantana is the first weed successfully controlled by using insects as a bioagent in Hawaii during 1902 by using *Crocedosema lantana*.

Opuntia: It can be controlled by using moth *Coctoblastis coctorum* which was introduced from Argentina. In India about 40,000 ha in TamilNadu, Maharashta and some parts of Andhra Pradesh infested with *Opuntiadilleni* and it was effectively controlled by releasing cochineal scale insect *Dactylopiustomentosus* during 1925.

Alligator weed: Alligator weed thrips*Anynothripsandersonii* is used as a bioagent to control the Alligator weeds

Water hyacinth: World wide aquatic weed and it can eb controlled by inducing hyacinth weevils *Neochetinabruchii, Neochetina eichhorneae*

Water fern: *Cytrobagoussalvinae* is used for the management of water fern in paddy fields.

Parthenium: leaf eating caterpillar- *Zygogramm bicolorata* and gall insect- *Epeblem asternuana*

Cuscuta- Shoot fly- *Melanogromyzacuscutae*

Bioherbicides in weed control:

- Bioherbicides are pathogens cultured artificially and made available in spray able formulations just like a chemical herbicide
- The bio-herbiicdes are also sometimes called mycoherbicides due to fungal organisms involved in such herbicides
- The bio-herbicide philosophy differs from the biocontrol philosophy in certain ways as below:

1. Bioherbicide remains active only on the current weed population, without any chance of cyclic perpetuation of the weed (or of the bioagent). Each new flush of the weed thus remaining re-treatment with it.
2. Bio-herbicide can be developed for selective for selective control of weeds in a crop just loke any other selective herbicide, which is not the case with the bioagents
3. The development of bio-herbicides is of great interest to industrialists since it involves every season requirement of the product for field use. In variance with it, the biological control approach has no incentive to the private, profit-oriented organizations; it must depend solely upon public sector support.

Table: Some of the commercial bioherbicides available in market

Sl. No.	Product/Trade Name	Organism/ Cotent	Weed controlled
1	Devine	*Phytophthorapalmivora* causes root rot in weed available in the market as a liquid suspension. 1st bioherbicide available in market	*Morreniaodorata* in citrus orchard
2	Collego	*Colletotrichumgleosporoides f sp. Aeschynomone* available in the market as a wettable powder and it causes leaf blight on weed foliage	Joint vetch – *Aeschynomonevirginica*in rice fields in rice fields
3	Biomal	*Colletotrichumgleosporoides f sp. Malvae*	Round leaf mallow *Malvapusilla*
4	Velgo	*Colletotrichumcoccodes*	*Abutilon theophrasti*
5	Bipolaris	*Streptomyces hygroscopicus* the microbial toxins are extracted from the fermentation process	Non specific weed management
6	Biosedge	*Pucciniacanalicuta*	*Cyperusesculentus*
7	Casst	*Alternariacassiae*	*Cassia accidentalis*
8	ABG 5003	Cercosporaradmonii	Eichorneacrassipae

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Biofertilizers for sustainable agriculture

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INTRODUCTION

Since the beginning of the “Green Revolution” in the late sixties in India, which focused on increasing food crop production by growing high-yielding varieties, use of chemical fertilizers agrochemicals and irrigation system? Fertilizer was alone contributing as much as 50 per cent of the yield. In fact, India become world’s largest user of chemical fertilizers, consuming each year around 16 per cent of the world’s N consumption, 19 per cent of phosphatic and 15 per cent of potassic nutrients of the global total (Anonymous, 2008). Total fertilizer consumption in the country was 28.3 million tonnes upto 2010-11. Importance of fertilizers in yield improvement, which is essential for achieving increased agricultural production, will further increase because there is little scope for bringing more area under cultivation and majority of Indian soils are deficient in many macro and micro-nutrients (Fertiliser Association of India, 2011). The emphasis on chemical fertilizers, which sometimes led to injudicious application, has meant that the soil be regarded as an inert substrate for plant roots, instead of a living biosphere, the rhizosphere, containing a myriad of organisms. It is now realized that in agricultural lands under intensive cropping system, including cereals, which receives heavy application of chemical fertilizers alone, productivity slowly declines and environmental quality starts to deteriorating (Rakshit *et al*. 2015). In the light of these problems, the use of organic fertilizers, biofertilizers and other microbial products are crucial to make the agriculture industry a viable component of a healthy and pleasant ecosystem. Biofertilizers are the sourceto meet the nutrient requirement of crops and to bridge the gaps between potential yield and actual yield. Further, knowing the ill effect of using only the chemical fertilizers on soil health, use of biofertilizers become more important as simply adding microbial population does not have any harmful effects on soil and plants. Such integrated approach will help to maintain soil health and productivity.

Exploring biofertilizer – for sustainability in agriculture

Biofertilizers have important role to play in improving the nutrient supplies and their availability to crop. Use of biofertilizers in crop production is another factor to help in buildup of soil biological properties under organic farming, besides other organic manure applications. Bio-fertilizers include selective soil microorganisms, like bacteria, fungi and algae. These organisms are capable of fixing atmospheric nitrogen and solublization of native and added nutrients in the soil and convert them into available forms and early available to crop plants. They are ecofriendly, cost effective and renewable source of plant nutrients. The biofertilizer organisms can play a vital role in maintaining long term soil fertility and sustainability (Mishra *et al.* 2015). The bio-fertilizers are important to ensure a healthy future for the generations to come because it preserve soil biological properties and soil health. Long term use of bio-fertilizers is eco-friendly, more efficient, productive, cost effective and accessible to marginal and small farmers over chemical fertilizers.

Concept of biofertilizer

Biofertilizers are the microbial inoculation which are capable of mobilizing nutritive elements required for the plants by fixing, solubilizing and enhancing uptake of soil nutrient and stimulating plant growth through synthesis of growth promoting substances and also help build up the micro-flora and in turn improve soil health. Biofertilizers are nothing but selected strains of beneficial soil microorganisms cultured in the laboratory and packed in a suitable carrier, which can be used either for seed treatment

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or soil application. Biofertilizers are environment friendly, non-bulky, low cost, renewable sources of plant nutrients and play an important role in improving nutrient supplies and their availability to crop in the years to come. Biofertilizer is a ready-to-use live formulation of such beneficial microorganisms, which on application to seed, root or soil, increase the availability of nutrients by their biological activity. Biofertilizers generate plant nutrients through their activities in the soil and make available to plants in a gradual manner. Biofertilizers are gaining momentum in organic as well as conventional agriculture due to its role in maintain soil health, minimize environmental pollution and cut down the use of chemicals in crop production. In rainfed agriculture, these inputs gain added importance in view of their low cost, as most of the farmers are resource poor and cannot afford expensive chemical fertilizers (Bisen *et al*. 2015). Biofertilizers are also ideal input for reducing the cost of cultivation and for practicing organic farming.

Need of biofertilizer in agriculture

With the introduction of green revolution technologies the modern agriculture is getting more and more dependent upon the steady supply of synthetic inputs (mainly fertilizers). Adverse effects are being noticed due to the excessive and imbalanced use of these synthetic inputs.

This situation has lead to identifying harmless inputs like biofertilizers. Use of such natural products like biofertilizers in crop cultivation will help in safeguarding the soil health and also the quality of crop products

Types of biofertilizer

Biofertilizers comprise microbial inocula or assemblages of living microorganisms, which exert direct or indirect benefits on plant growth and crop yield through different mechanisms. These microorganisms are able to fix atmospheric nitrogen or solubilize phosphorus, decompose organic material, or oxidize sulphur in the soil properties that are beneficial to agricultural production in terms of nutrient supply. One type of biofertilizer is the arbuscular mycorrhizal fungi, which are probably the most abundant fungi in agricultural soil. The inocula improve crop yield because of increased availability or uptake or absorption of nutrients, stimulation of plant growth by hormone action or antibiosis and by decomposition of organic residues.

The following types of biofertilizers are available to the farmers in India for use in agriculture:

- Nitrogen fixer (*Rhizobium, Bradyrhizobium, Azospirillum* and *Azotobacter*).
- Phosphorous solubilising biofertilizers or PSB (*Bacillus, Pseudomonas, Aspergillus*, *Penicillium*, *Fusarium, Trichoderma*, *Mucor*, *Ovularopsis*, *Tritirachium* and *Candida*).
- Phosphate mobilizing biofertilizers (*Mycorrhiza*).
- Plant growth promoting biofertilizers (*Pseudomonas*).
- Biofertilizers for enriched compost = Cellulolytic fungal cultures (*Chaetomium bostrychodes, C. livaceum,Humicola fuscoatra, Aspergillus flavus, A. nidulans, A. niger, A. ochraceus, Fusarium solani* and *F. oxysporum*).

Advantages of biofertilizer

As it is well known that synthetic fertilizers are made from nonrenewable fossil fuel resources, create nutrient imbalance in the soil and often used in excessive amounts. Soils and plants are becoming dependent on the synthetic fertilizers, which increases their negative effects. Biofertilizers are the natural way to get the benefits of synthetic fertilizers without risking the quality of soil health and crop products. Biofertilizers are known to play a number of vital roles in soil fertility, crop productivity and production in agriculture as they are eco-friendly but cannot replace chemical fertilizers, which are indispensable for getting maximum crop yields. Biofertilizers can increase the crop yield by 20 to 30 per cent. In addition, biofertilizers are cost effective, when compared to synthetic fertilizers.

Some of the important functions or roles of biofertilizers in agriculture are:

- Phosphate mobilizing or phosphorus solubilizing biofertilizers / microorganisms (bacteria, fungi, mycorrhiza etc.) converts

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insoluble soil phosphate into soluble forms by secreting several organic acids and under optimum conditions, can solubilize / mobilize about 30-50 kg P_2O_5/ha and crop yield may increase by 10 to 20 per cent.

- Mycorrhiza or arbuscular mycorrhiza, when used as biofertilizer enhance uptake of P, Zn, S and water, leading to uniform crop growth and increased yield and also enhance resistance to root diseases and improve hardiness of transplant stock (Pal *et al*. 2014).
- Liberate growth promoting substances and vitamins and help to maintain soil fertility.
- Act as antagonists and suppress the incidence of soil borne plant pathogens and thus, help in the bio-control of diseases.
- Plays important role in the recycling of plant nutrients.
- Supplement chemical fertilizers for meeting the integrated nutrient demand of the crops.
- Renewable source of nutrients.
- Sustain soil health.
- Supplement chemical fertilizers.
- Replace 25-30 per cent chemical fertilizers.
- Increase the grain yields by 10-40 per cent.
- Decompose plant residues and stabilize C:N ratio of soil.
- Improve texture, structure and water holding capacity of soil.
- No adverse effect on plant growth and soil fertility.
- Stimulates plant growth by secreting growth hormones.
- Secrete fungi static and antibiotic like substances.
- Solubilize and mobilize nutrients.
- Eco-friendly, non-pollutants and cost effective
- Increase crop yield by 20-30%.
- It increase germination percentage.
- It proliferates useful soil microbes *i.e.* biological properties of soil. .
- Cost effective.

How biofertilizer are applied to crops ?

1) Seed treatment:

200 g of nitrogenous biofertilizer and 200 g of Phosphotika are suspended in 300-400 ml of water and mixed thoroughly. 10 kg seeds are treated with this paste and dried in shade. The treated seeds have to be sown as soon as possible.

2) Seedling root dip:

For rice crop and vegetables, a bed is made in the field and filled with water. Recommended biofertilizers are mixed in this water and the roots of seedlings are dipped for 8-10 hrs.

3) Soil treatment:

4 kg each of the recommended biofertilizers are mixed in 200 kg of compost and kept overnight. This mixture is incorporated in the soil at the time of sowing or planting.

Constraints in bio-fertilizer use

Despite significant improvement and progress in biofertiliser technology over the years, the progress in the field of its production technology is below satisfaction. Further, there do exist limitations for biofertilizer use. These are not only technical problems, but also socio-economic and human resource obstacles. The technical problems can be addressed through a comprehensive programme of basic and applied research up to a certain extent. Overcoming the socioeconomic and human resource obstacles, would require an emphasis on farmer awerness, training and the promotion of private-enterprise. The difficulties to expand the use of biofertilizer by farmers in India are as follows:

- Difficult handling of biofertilizer
- Problems with distribution
- Low quality of biofertilizer
- Cannot be stored for longer period
- Lack of demonstration and low visual effect of biofertilizer
- Low in public relation and technology transfer
- Low knowledge of farmer on sustainable agriculture and environmental effect of biofertilizer

What precaution should be taken for using biofertilizer?

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1. Biofertilizer packets need to be stored in cool and dry place away from direct sunlight and heat.
2. Right combinations of biofertilizers have to be used.
3. Some biofertilizer are crop specific, it should be use for the specified crop only.
4. Other chemicals should not be mixed with the biofertilizers.
5. Certified packet should be used
6. The packet has to be used before its expiry.
7. It is important to use biofertilizers along with chemical fertilizers and organic manures.

Table 1: *Rhizobium* species suitable for different crops

Sr. No	*Rhizobium* sp.	Crops
1	*R. legumenosarum*	Pea, Lentil
2	*R. trifoli*	Berseem
3	*R. phaseoli*	Bean group
4	*R. lupine*	Lupinus, Ornithopus
5	*R. japonicum*	Soybean
6	*R. meliloti*	Lucerne, Melilotus
7	*Cowpea miscellany*	Cowpea, Gram, Ground nut, Stylo etc.

Reddy *et al.* (2002)

Sustainability and Role of Bio-fertilizers in agriculture

SUSTAINABLE AGRICULTURE:

Sustainable agriculture is the successful management of natural resources for agriculture to satisfy changing human needs, while maintaining or enhancing the quality of the environment and conserving the natural resources.

Causes of Declining Crop Productivity:

1. Imbalanced and indiscriminate use of chemical fertilizers .
2. The crop yield is falling and not in proportionate to fertilizer consumption.
3. Occurrence of multi-nutrients deficiency such as Zinc, boron, sulphur etc. besides NPK.
4. Rain dependent agriculture - About 2/3 area.
5. Inadequate irrigation facilities.
6. Continuous fragmentation of land, unfavorable for adoption of technology.
7. Land holding pattern and Predominance of marginal and small farmers.
8. Increase crop productivity through balanced use of Fertilizers.

Sustainable agriculture consist four dimensions:

1. It should be biologically feasible.
2. It should be ecologically stable.
3. It should be economically viable.
4. It should be socially acceptable.

Aspects of sustainable agriculture:

1. Achieving yield stability.
2. Reducing input use.
3. Conserving natural resources.
4. Changing the environment.

Achieving Sustainability:

(a) Minimize external input use Energy, fertilizer, agro chemical.
(b) Maximize benefits from natural processes Photosynthesis, nitrogen fixation, biomass break down.
(c) Optimize the use of internal resource Water, soil, perennials and native crop varieties.

Increase crop productivity through balanced use of Fertilizers:

- Use of Balanced inorganic Fertilizers, organic fertilizers and Bio-fertilizers can provide viable leverage to increase crop productivity.
- It enriches the soil with important nutrients.
- Bio-fertilizers have potential to generate additional income to farmers from the same size of land.

CONCLUSION:

From the foregoing discussion it can be concluded that, the biofertilizers are not a replacement to fertilizers, but can supplement plant nutrient requirements. Nitrogen and phosphorus can be saved by about 25% by treating the seeds/seedling with nitrogen fixing biofertilizers (*Rhizobium, Azotobacter*, BGA, etc.) and phosphorus solublizing biofertilizers (*Pseudomonas, Bacillus*, VAM fungi etc.) respectively.

Biofertilizers help build up the micro-flora and in turn the soil health in general. It stimulates the plant growth, provides the protection against drought and some soil borne diseases and proliferates useful soil microbes. Thus the biofertilizers are the eco-friendly, technologically feasible and socially acceptable input to the farmer.

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Biology and control of parasitic weeds

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Parasitic weeds are the crop bound weeds which usually parasitice the host crops. They depend on their host plantsfor nutrition partially or fully where as crop associated weeds also crop specific but for different reasons like

1. Need for specific microclimate: Chicorium in Berseem/Lucerne
2. Mimicry: *Oryza sativa, Avena fatua*
3. Ready contamination of crop seeds: wild onion or garlic in winter crop.

Both the crop bound and crop associated weeds are recognized separately and they can control by crop rotation

1. *Cuscuta* sp (Dodder):

Cuscuta is a complete stem parasite, golden yellow in colour, rudimentary scaly leaves, twining and wiry stems with bell shaped flowers. Only limited photosynthesis is possible due to carotenoid pigments in stems. Lucern is the main host crop. Recently Niger and Blackgram are also susceptible. It reproduce mainly by seeds and emerges along with germinating crop seedlings and draws the nutrients from the host plants for their sustainance. It putforth dense growth that drastically retard the growth and vigour of the host plant lead to reduction of grain yield by 35-50%.

The intensity of damage caused by cuscuta depends upon its capacity to parasite the host crop. Cuscuta pose a serious problem especially in rice fallow pulse crop. It forms a mat like appearance within 50-60 days after sowing of leguminous crop.

Management:

- Planting or sowing of cuscuta free crop seeds will help in preventing its infestation and spread.
- Uproot the weed as soon as they appear in the fields
- Growing of clusterbean as intercrop in greengram/blackgram suppress the growth and development of cuscuta
- Pulse-cereal crop rotation will break the life cycle of cuscuta as if cannot parasite the graminaceae crops.
- Spary pronamide a soil applied herbicide @ 1-2 kg a.i./ha in field crops before sowing or paraquat @ 0.1% as high volume spray on trees and perennial hedges
- Post emergence application of Imazethapyr @ 75-100 g/ha

2. *Orobanche* sp (Broom rape):

It is complete root parasite. In India losses due to Orobanche in tobacco alone are estimated at 30-35%. It is endemic in every year and epidemic in certain areas. It is yellowish brown, unbranched herb growing to a height of 60 cm with scale like leaves are sessile and devoid of chlorophyll and flowers are 1-2 cm long with petals united into a tubular corolla. Life cycle is completed within 3 months of planting of tobacco.

Management:

- Manual removal is the best method but it is repeated many times.
- The most effective method of controlling orobanche is to grow trap crops in rotation with Tobacco.

- Trap crops stimulate germination of orobanche seeds but the seedlings of orobanche dies without producing flowering shoots or at vegetative stage itself.
  Ex: Sunflower, Sesamum. Cotton. Soybean and Ragi
- Pre-emergence or Post-emergence application of Imazethapyr @ 20-40 g/ha glyphosate can also control the orobanche but it cannot be recommended due to limited selectivity.

3. Striga (witch weed):

It is partial root parasite in cereal crops. It is an erect annual herb growing to a height of 10-30 cm, leaves are narrow, linear, 2-3 cm long and sessile. Leaf surface is rough with small hairs. Stem is slender, rigid, simple branches and cover with white hairs. Inflorescence is terminal spike with 10-25 cm long, flowers varied in colours white, yellow, red, pink and purple. It is prolific seed producer and dormant. Striga seeds can germinate when suitable host comes in contact with response to a chemical stimulant secreted by the roots of host plants known as STRIGOL from cotton roots

Management:

- Repeated use of manual weeding or herbicide application is essential because the seeds are dormant for longer periods.
- Growing of catch crops and trap crops in rotation with tobacco will reduce the infestation
- Growing of sorghum in wet season adequately fertilized nitrogen plots and densly sown crops reduce the infestation of striga extraction of natural stimulant of strigol led to a new mechanism for striga eradication.
- The chemicals induce striga seeds to germinate but striga seedlings wither away in the absence of a suitable host. This mechanism is called suicidal germination. The artificial suicidal germination chemical used in USA is Ethylene @ 1.6 kg/ha. Ethylene is injected into the soil at 0.5-1.0 m spacing and 10-30 cm deep before planting the crop.
- Directed application of 2,4-D at 0.5-0.75 kg/ha 2-3 times during crop period destroy the striga populations.
- Pre-emergence application of Simazine, Atrazine, Propazine give effective control of this weed in sorghum and sugarcane.
- In Maize, linuron is effective for control of striga

4. Loranthus (*Dendropthoe* sp):

It is partial stem parasite on certain tropical and subtropical trees like teak, mango, citrus, sapota and tea. Loranthus seeds are spread by birds.

Management:

- Bore the two rows of holes down the infested tree reaching upto sapwood. In each hole a mixture of 8g cuso4 + 1 g of 2, 4- D is pushed in. This practice is supposed to free the tree from Loranthus for a period of upto 4 years.

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Brown manuring

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INTRODUCTION:

Under intensive agriculture, imbalanced and indiscriminate use of fertilizers is one of the main reasons for widespread multi-nutrient deficiencies and lower nutrient use efficiency of various nutrients. Adoption of site-specific integrated nutrient management (INM) practices can help in managing the declining fertilizer response and emerging nutrient deficiencies. Manuring is one of the major components of INM. Among the *in-situ* manuring options, green manuring is the most commonly practiced one. But, it has some limitations especially when it comes to green manuring in paddy. Generally, green manuring crops are grown by the farmers prior to rice cultivation and are incorporated during puddling before transplanting of rice seedlings. Once sown, about 45-60 days are required by these crops from seeding to their decomposition after incorporation under congenial temperature and moisture conditions. Their incorporation into soil requires more number of tillage operations which results into loss of soil moisture and extra irrigation water needs to be applied, too. Also, farmers have to bear additional fuel costs for incorporation. As, water availability may be scarce during peak summer, farmers have not been able to take full advantage of green manuring in rice growing season. Thus, brown manuring could be a better alternative.

What is brown manuring?

Brown manuring refers to the practice of growing green manuring crops *viz.,* dhaincha, sunnhemp *etc*., as an intercrop or mixed crop and afterwards killing them by the application of post-emergence herbicides for manuring. As after the spraying of herbicides, the colour of green crops changes to brown due to loss of chlorophyll, the process is called as brown manuring. It mainly differs from the conventional green manuring in terms of tillage. No tillage operations are required in this technique. Instead, an herbicide is used to desiccate the crop before flowering. Green manure crops are grown in standing cereal crops and then killed with the help of herbicide for manuring. Plant residues are left standing in the field along with main crop without *in-situ* ploughing until the residue decomposes itself in the soil.

Crops suitable for brown manuring:

Both leguminous and non-leguminous crops can be taken for the purpose of brown manuring. Leguminous crops provide additional benefit of fixing atmospheric nitrogen in the soil along with organic matter addition, so they are more preferred and commonly used. These include *Sesbania* (Dhaincha), *Crotolaria* (Sunnhemp), green gram, cowpea, lentil *etc.* Non-leguminous crops commonly used are niger and wild indigo.

Brown manuring in paddy:

For brown manuring in irrigated rice fields, *Sesbania* is most commonly grown. Generally, *Sesbania* crop seeds are broadcasted (20 kg/ha) three days after the sowing of paddy and is allowed to grow for about 30 days.

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Thereafter, ethyl ester of 2, 4-D (selective broad-leaf weedicide) is sprayed to dry them out. The dried leaves of *Sesbania* fall on the soil and decompose very fast to supply nitrogen, dry matter, soil organic carbon and other recycled nutrients to the paddy crop.

Sesbania (Dhaincha)

Sunnhemp

Fig. 1: Leguminous crops for brown manuring

Niger

Wild indigo

Fig. 2: Non-leguminous crops for brown manuring

Benefits of brown manuring:

1. **Effect on soil properties**

- The first and foremost benefit of brown manuring is the addition of organic matter into the soil. It increases soil organic C content.
- It improves soil structure. Soil physical properties *viz.* bulk density, hydraulic conductivity and moisture holding capacity are also positively influenced.
- There is decrease in the moisture evaporation from the soil surface due to enhanced crop cover.
- It affects soil pH as a result of decomposition of organic matter which releases organic acids. Thus, it is beneficial in alkaline soil conditions.
- Leguminous manure crops fix atmospheric N, thus, enhancing N content in the soil.

2. **Effect on weed density**

- Brown manuring can be an effective tool in integrated weed management.

- The crops used for brown manuring grow more vigorously than the weeds and thus, have smothering effect on emerging weeds.
- It has been reported that intercropping of brown manuring crops with rice reduced weed densities by about 40-50 per cent. (Rehman *et al.,* 2007)

Fig. 3: Paddy + *Sesbania* field after spray for brown manuring

CONCLUSION:

As a result of improvement in soil health and physico-chemical properties along with reduction in weed density, brown manuring enhances crop growth and productivity without adding to the total cost of production. In fact, it cuts the additional cost of tillage operations required for incorporation of green manuring crops as well as saves water. Thus, brown manuring can be a better cost-effective alternative to improve crop yield as well as sustain the production.

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Salinity stress and its effects on plants

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Earth is the salty planet; water present on earth contains 30g of sodium chloride per litre. Salinity is one of the most wide spread soil degradation processes on the Earth. According to the estimation, total area of saline soil is about one billion hectares. In India about 9.38 million ha area is occupied by saline soils out of which 5.5 million ha are salt affected soils (including coastal) and 3.88 million ha alkali soils .It is estimated that about 20% of all irrigated lands have saline soil (Pitman and Läuchli, 2002). About 17% of the cultivated land is under irrigation and irrigated agriculture contributes more than 30% of the total agricultural production (Hillel, 2000).

Several investigators have reported that plant growth reduction as the result of salinity stress. Growth of the plants is dependent on photosynthesis and therefore, environmental stresses also affect growth and photosynthesis (Salisbury and Ross, 1992; Dubey, 1997). In several studies by a number of authors with different plant species showed that photosynthetic capacity is decreased by salinity (Dubey, 1997; Ashraf, 2001; Romero-Aranda et al., 2001). Changes in the activities of antioxidant enzymes in plants exposed to salinity have been observed. The activity of antioxidant enzymes was reported to increase under salinity stress in shoot cultures of rice wheat and pea but decline in wheat roots .

The major efforts to control salinity in the past have been directed towards soil reclamation and water desalinization practices that are expensive. For improving biomass production and yield in salt affected soil, it is necessary to improve the intrinsic salt tolerance of the plants. Although several mechanical and chemical methods have devised to reclaim the salt-affected soils, they are expensive and have not feasible. Hence, identification of plant species/varieties that can be tolerating high salt levels is presently considered as important for utilization of saline soils. The efforts must, therefore, coincide with measures to improve the salt resistance of crops through genetic modification.

1. INTRODUCTION

A wide range of environmental stresses like high and low temperature, drought, alkalinity, salinity, UV stress and pathogen infection are potentially harmful to the plants (Van Breusegem et al. 2001). Abiotic stress affects animals as well as plants, but plants are especially dependent on environmental factors, so it is particularly constraining. Abiotic stress is the most harmful factor in contrast to the growth and productivity of crops, worldwide.

Generally abiotic stress often causes a series of, physiological, morphological and biochemical molecular changes that unfavourably affect plant growth, development and its productivity. Soil and water resources are too saline for most of the economic crops, in many arid and semi-arid regions worldwide which highly affects the plant osmotically. (Sekmen et al., 2007). The total area of salt affected soil in India is about one billion hectares, but the total global area of salt-affected soils has recently been estimated to be approximately 830 million hectares (Martinez-Beltran and Manzur, 2005).

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High salt concentration in parent material or in ground water results into accumulation of more salt in the affected plant. Moreover , salinity is caused by human interventions such as inappropriate irrigation practices, e.g. with salt-rich irrigation water and/or insufficient drainage. Salinization is often associated with the irrigated areas with low rainfall, high evapotranspiration rates or soil textural characteristics impede the washing out of the salts which subsequently build-up in the soil surface layers. According to Dubey (1997) and Yeo (1998) salt causes both osmotic and ionic effects on plants and most of the known responses of plants to salinity are linked to these effects. The initial and primary effect of salinity, especially low to moderate concentrations, is due to its osmotic effects.

2. Salinity effects on plants

According to Dubey (1997) and Yeo (1998), lowering of the soil water potential due to increasing solute concentration in the root zone as a result of osmotic effects. This condition interferes with the plant's ability to extract water from the soil and maintain turgor pressure at very low soil water potentials. Thus, salt stress may resemble drought stress in some species. However, plants adjust osmotically (accumulate internal solutes) and maintain a potential for the influx of water, at low or moderate salt concentrations (high soil water potentials). Under such conditions, plant growth may be moderated but unlike drought stress, the plant is not water deficient (Shannon, 1994). At high level of salinity, some specific symptoms such as necrosis and leaf tip burn due to Na+ or Cl- ions, of plant damage may be recognized. High ionic concentrations in plants may disturb membrane integrity and function; interfere with internal solute balance and nutrient uptake, causing nutritional deficiency symptoms similar to those that occur in the absence of salinity (Grattan and Grieve, 1999). Levitt (1980) has observed that Sodium and chloride ions usually the most prevalent ions in saline soils or water and accounts for most of the deleterious affects that can be related to specific ion toxicities. The degree to which growth is reduced by salinity differs greatly with species and to a lesser extent with varieties (Bolarin et al., 1991). The severity of salinity response is also mediated by environmental interactions such as temperature, relative humidity, air pollution and radiation (Shannon et al., 1994). Premature senescence, reducing the supply of assimilates to the growing regions followed by decrement in plant growth is due to the salt stress. Moreover, Salt stress affects all the major processes such as growth, water relations, photosynthesis and mineral uptake.

2.1 Effects on plant growth

Several investigators have reported plant growth reduction as a result of salinity stress, e.g. in tomato, cotton and sugar beet. However, there are differences in tolerance to salinity among species and cultivars as well as among the different plant growth parameters recorded. For instance, found that the optimum growth of *Rhizophora mucronata* plants was obtained at 50% seawater and declined with further increases in salinity while in *Alhagi pseudoalhagi* (a leguminous plant), total plant weight increased at low salinity (50 mM NaCl) but decreased at high salinity (100 and 200 mM NaCl). In sugar beet leaf area, fresh and dry mass of leaves and roots were dramatically reduced at 200 mM NaCl, but leaf number was less affected (Ghoulam et al., 2002). Fisarakis *et a*l. (2001), reported that particularly at high NaCl concentration, recorded a higher decrement in accumulation of dry matter in shoots than in roots, indicating partitioning of photo assimilates in favour of roots and this is due to a greater ability for osmotic adjustment under stress by the roots.

2.2 Effects on leaf anatomy

Changes in leaf anatomy in number of plants have also observed due to salinity. For example, leaves of cotton, bean and Atriplex were reported to increase in epidermal thickness, palisade cell length, palisade diameter, mesophyll thickness and spongy cell diameter with increasing salinity (Longstreth and Noble, 1979). According to Parida et al (2004) both epidermal and mesophyll thickness as well as intercellular spaces decreased significantly in NaCl-treated leaves of the mangrove *Brugueira parviflora*. Intracellular spaces in leaves of spinach salinity were found to reduce while in tomato plants, a reduction of stomatal density occurred (Romero-Aranda et al., 2001).

2.3 Effect on Photosynthesis

Environmental stress indirectly affects the photosynthesis process (Salisbury and Ross, 1992). Studies conducted by a number of authors with different plant species showed that photosynthetic capacity was suppressed by salinity (Dubey, 1997; Ashraf, 2001; Romero-Aranda et al., 2001). A positive relation between photosynthetic rate and yield under saline conditions has been found in different crops such as *Gossypium hirsutum* and *Asparagus officinalis*. Fisarakis et al. (2001) found that inhibition of vegetative growth is due to marked inhibition of photosynthesis in plants having salinity stress. In contrast, Rogers and Noble (1992) and Hawkinsand Lewis (1993) studied that little or no association between growth and photosynthetic capacity, in *Triticum repens* and *Triticum aestivum*.

The effect of salinity on photosynthetic rate depends on salt concentration and plant species. It has been also reported that low salt concentration of salinity may stimulate photosynthesis. For instance, in *B. parviflora*, Parida et al. (2004) reported that photosynthetic rate increased at low salinity and decreased at high salinity, whereas stomatal conductance was unchanged at low salinity and decreased at high salinity. High salt concentration in soil and water creates high osmotic potential which reduces the availability of water to plants. Decrement in water potential causes osmotic stress, which reversibly inactivates photosynthetic electron transport via shrinkage of intercellular space. Salt toxicity caused particularly by Na^+ and Cl^- ions. Cl^- inhibits photosynthetic rate through its inhibition of $NO3^-$ uptake by the roots. The reduced $NO3^-$ uptake combined with osmotic stress may explain the inhibitory effect of salinity on photosynthesis.

Closure of stomata causes' reduction in CO2 supply as a result restricted availability of CO2 for carboxylation reactions (Brugnoli and Bjorkman, 1992). Iyengar and Reddy (1996) reported that stomatal closure minimizes loss of water by transpiration and this affects chloroplast and energy-conversion and light-harvesting systems thus leading to alteration in chloroplast activity. Higher photosynthetic rates were favoured by higher stomatal conductance in plants and are known to increase CO2 diffusion into the leaves. There are also reports of non-stomatal inhibition of photosynthesis under salt stress. Iyengar and Reddy (1996) reported that this nonstomatal inhibition is due to increased resistance to CO2 diffusion in the liquid phase from the mesophyll wall to the site of CO2 reduction in the chloroplast, and reduced efficiency of RUBPC-ase. Iyengar and Reddy (1996) showed that enhanced senescence induced by salinity, changes of enzyme activity induced by changes in cytoplasmic structure, negative feedback by reduced sink activity.

2.4 Effects on ion levels and nutrient content

High salt (NaCl) uptake competes with the uptake of other nutrient ions also, such as K+, Ca2+, N, P resulting in nutritional disorders and eventually, reduced yield and quality (Grattan and Grieve, 1999). Increased NaCl concentration

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has been reported to induce increment in Na^+ and Cl^- and decrement in Ca^{2+}, K^+ and Mg^{2+} level in a number of plants. While Ghoulam et al (2002) observed an increase in Na^+ and Cl^- content in the roots and leaves of sugar beet with increasing NaCl concentration in the rooting medium. The K^+ content of the leaves decreased in response to NaCl, but in case of roots, it was not affected by the salt treatment. A significant increase in Na^+ and Cl^- content in stem, root and leaves, of the mangrove (*B. parviflora*) has been reported without any significant alteration of the endogenous level of Fe^{2+} and K^+ in leaves (Parida *et al*., 2004). Decreases of Ca^{2+} and Mg^{2+} content of leaves have also been reported due to salt accumulation in this species.

Under salt stress conditions, the uptake of nitrogen by plants is generally affected. A number of studies have shown that salinity can reduce nitrogen accumulation in plants Pardossi *et al*., 1999; Silveira *et al*., 2001). An increase in Cl^- uptake and accumulation has been observed to be accompanied by a decrease in shoot NO_3^- concentration as in eggplant (Savvas and Lenz, 1996) and sultana vines (Fisarakis et al., 2001). Several authors have attributed this reduction to Cl^- antagonism of NO_3^- (Bar et al., 1997) while others attributed the response to salinity's effect on reduced water uptake (Lea-Cox and Syvertsen, 1993). The nitrate influx rate or the interaction between NO_3^- and Cl^- has been reported to be related to the salt tolerance of the species. Kafkafi *et al.* (1992) found that the more salt-tolerant melon and tomato cultivars had higher NO_3^- flux rates than the more sensitive cultivars. Salinity stress has inhibitory as well as stimulatory effects on the uptake of some micronutrients by plants .According to Vîllora *et al* (1997) ,Grattan and Grieve (1999) and Yadav et al (2011), nutrient imbalances may result from the effect of salinity on nutrient availability, transport or partitioning within the plant, competitive uptake or may be caused by physiological inactivation of a given nutrient resulting in an increase in the plant's internal requirement for that essential element.

2.5 Effect on antioxidative enzymes

All environmental or man-made stresses have been reported to lead to the production of reactive oxygen species (ROS) that causes oxidative damage (Smirnoff, 1993; Schwanz et al., 1996). Antioxidative enzymes are key elements in the defence mechanisms of the plants. Garratt et al (2002) has listed some of these enzymes as catalase (CAT), , superoxide dismutase (SOD) , glutathione reductase (GR) and glutathione-S-transferase (GST). Cell damage is protected by superoxide dismutase which metabolizes oxygen (O_2) radicals to hydrogen peroxide (H_2O_2).Ascorbate peroxidase; catalase and a variety of Peroxidases catalyze the subsequent breakdown of H_2O_2 to water and oxygen (Chang et al., 1984; Garratt et al., 2002).

2.6 Effect on plant hormones

The levels of plant hormones such as cytokinins and Absscisic acid increase with high salt concentration. ABA is responsible for the alteration of salt-stress-induced genes, and these genes are predicted to play an important role in the mechanism of salt tolerance in rice. The inhibitory effect of NaCl on photosynthesis, growth and translocation of assimilates has been found to be alleviated by ABA. Although the nature of ABA receptor(s) remains unknown. Leung and Giraudat (1998) pointed out that there is substantial evidence of the involvement of ABA in reversible protein phosphorylation and modification of cytosolic calcium levels and pH. Chen et al. (2001) reported that the increase of Ca^{2+} uptake is associated with the rise of ABA under salt stress and thus contributes to membrane integrity maintenance, which enables plants to regulate uptake and transport under high levels of external salinity in the longer term.

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ABA has been reported to reduce ethylene release and leaf abscission under salt stress in citrus probably by decreasing the accumulation of toxic Cl^- ions in leaves (Gomezcadenas et al., 2002).

Other plant hormones found to be accumulating in the presence of salt include jasmonates. Higher levels of jasmonates were found to accumulate in salt-tolerant tomato cultivars rather than the salt-sensitive ones. Asmonates have been reported to have important roles in salt tolerance and considered to mediate signalling, such as defence responses, flowering, and senescence. However, these factors involved in the jasmonate signal-transduction pathway remain unclear (Tarun et al., 2012).

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Smart fertilizer technique for enhancing nutrient use efficiency

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The current global scenario of food production is not in tune with the increasing population worldwide. Agricultural productivity has become stagnant over time due to the limited availability of resources like arable land, water and nutrients. We know that nutrient management is one of the most important factors which regulate crop growth and productivity. N and P are the most important and irreplaceable nutrients for the plant growth and to maintain life on the earth. As a result of injudicious and imbalanced fertilizer application under intensive agriculture systems, nutrient use efficiency of these major nutrients has decreased. Hence, use of smart fertilizers and controlled nutrient release can be an option to overcome the problems of conventional chemical fertilizers. They have the potential to enhance nutrient use efficiency and food productivity as well as decrease the negative impact on environment by reducing soil pollution.

Smart fertilizers

Smart fertilizer is a product that is made with nanoparticles or uses nanotechnology and has slow release action. Smart fertilizer controls the release of nutrient and synchronizes demand of the plant and enhances the nutrient use efficiency. It is comprised of nanoparticles having1-100 nm size.

Properties of smart fertilizers

- ✓ Smaller size, larger surface area
- ✓ Increased surface area to volume ratio
- ✓ Slow release
- ✓ Specific release
- ✓ High mobility
- ✓ They can pass through the plant and animal cell

These characteristics of smart fertilizers can help in achieving the phenomenon of delivering the required quantity of nutrients at the cellular level. This makes nanotechnology advantageous over conventional system.

Approaches to increase nutrient use efficiency

- ✓ Encapsulation of fertilizer with nanoparticles
- ✓ Slow delivery
- ✓ Smart delivery system
- ✓ Nanobiosensor

Mechanism of smart fertilizers delivery

Smart fertilizers facilitates controlled release of fertilizers either by delaying its availability or making it available to the plant over a significantly extended period than normal, which opens up only when the desirable location or site is reached. This can be done through encapsulation. It means packaging of fertilizer in tiny envelop or shell. This shell decrease solubility and reduce the contact of active ingredient with the soil. Packaging material is made up of either advanced polymer, which can degrade under external stimulus *i.e.* temperature, pH or microbial encapsulation. When nanofertilizers are applied in the soil, they degrade under the effect of external factors (temperature, pH) and on combining with water, permeable encapsulation allows slow release of nutrients in the rhizosphere of the crop (Fig. A). On the other hand, microbial encapsulation, which is made up of carbon rich material which acts as a food

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source for microbes, is attacked by the microorganism. It is then broken down and thus, absorbs water and releases the nutrients in the soil ((Fig. B).

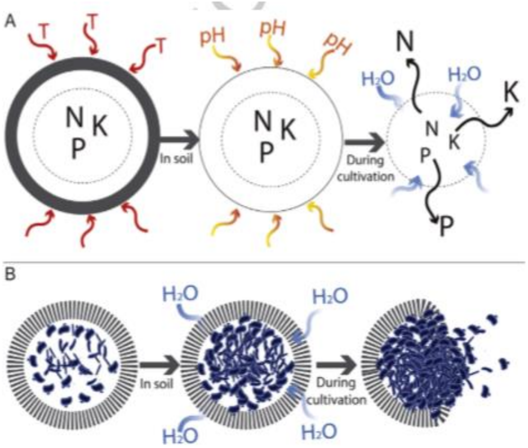

Fig.1 Schematic representation of smart delivery system (A): Advanced polymeric materials, degraded under external stimulus such as pH, temperature and with water permeability to slow nutrient release ;(B) Microbial encapsulation

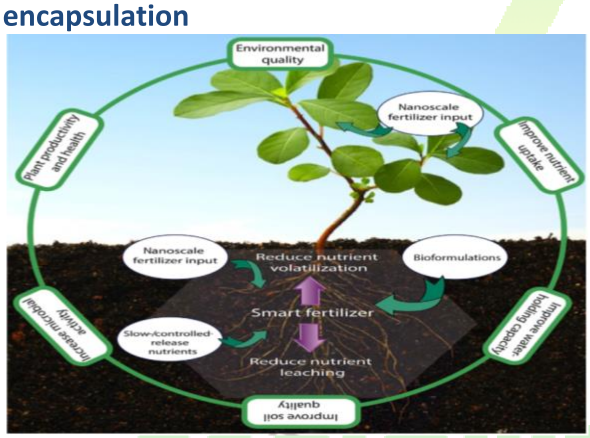

Fig.2 Schematic diagram of smart fertilizers effect in the soil-plant system

Advantages of smart fertilizers

- ✓ Improve the micronutrient solubility and dispersion of insoluble nutrient in soil
- ✓ Reduce soil adsorption and fixation and also increase the bioavailability
- ✓ Enhance the fertilizer use efficiency and uptake of soil nutrient by the crop and save fertilizer
- ✓ Can also reduce the loss of fertilizer in to the soil by leaching
- ✓ Can extend effective duration of nutrient supply of fertilizer in to soil
- ✓ Synchronizes the demand and supply of nutrient between plant and soil by controlling the release rate and release pattern of nutrient

CONCLUSION

Smart fertilizers based on controlled-release/slow release and/or carrier delivery systems have been found to improve crop yields and soil productivity as well as reducing nutrient losses and soil toxicity as compared to conventional fertilizers. Hence, Smart fertilizers can be a more sustainable alternative to improve nutrient use efficiency and agricultural productivity along with protecting the agro-ecosytem.

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Crop-Weed discrimination using digital image processing for herbicide application

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Weeds compete with the crop for water, nutrients, and sunlight and decrease its yield significantly. With the advancement in computer and electronics technology, digital image processing can be an effective approach for discriminating crops from weeds. This will fascinate Site-specific Weed Management (SSWM). Digital image processing discriminates crop from weeds via. Segmenting the vegetation from the background, extracting features i.e. morphological characteristics, visual texture and spectral features from vegetation and classifying it using threshold-based or machine learning or deep learning.

INTRODUCTION

India population is increasing at a tremendous rate of 1.2% every year. It proportionally demands an increase in agricultural production for their survival. Weed is one of the important factors that reduce crop yield significantly. Cavero et al., 1999 reported maize yield loss by 14%-63% and cotton by 60% by the presence of weeds in the field (Keeley and Thullen, 1989). There are various methods i.e. manual, mechanical and chemical for controlling the weeds. Manual methods like in-roe hand hoeing are energy-intensive, demands more labors and cost. Mechanical methods i.e. intercultural equipment's cultivators, spring and spike tooth harrow are not suitable for intra row weeding. Chemicals methods are most commonly used in Indian conditions i.e. knapsack sprayers, animal-drawn sprayers, and tractor-mounted boom sprayers. These involve applying chemicals to the entire field which nowadays polluting soil, contaminating ground and surface water and also polluting the environment (Savci, 2012). One alternative approach recently developed is Site-Specific Weed Management (SSWM). It involves the application of chemicals to only weed patches. It consists of a system mounted on off-road vehicles which sense the weed-crop field data, processes it and actuates the applicator mechanism. Sensing techniques are broadly classified into two categories airborne remote sensing and ground-based remote sensing. Airborne remote sensing i.e. unmanned aerial vehicle, sensors mounted on balloons and satellite-based have higher spatial resolution and are suitable for the only larger area. It develops a field map which fascinates later removal of weed. Ground-based sensing technique like optical sensing and spectrometers can sense the field data in real-time and their spatial resolution is higher. Optical imaging allows capturing/acquisition of image data, processes it through computers or microprocessors for crop-weed discrimination and facilitates the applicator mechanism to apply chemicals to only weeds. Digital image processing with suitable application technology has the potential to reduce chemicals consumption by 50% without affecting the crop.

The article provides an overview of the process of digital image processing for crop-weed discrimination.

General components of Digital image processing systems are Image sensor i.e. Cameras (RGB camera, an infrared camera or hyperspectral camera, etc.), input devices, computer (microprocessor), image processing software and output device. The image sensor captures and acquired the field data which transfers to the computer (micro-processor) through input devices than the image processing software in the computer process the field images having a crop, weed, and soil. The image processing software's had an algorithm on it, which distinguish crop from weed.

The overall crop-weed classification process is divided into four steps i.e. Image preprocessing, Vegetation segmentation, feature extraction and classification.

1. Image preprocessing

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Images captured from the cameras have noises, distortion, and ambiguity. It needs to be improved for increasing the efficiency of separation. Image pre-processing is a method which improves and enhanced image quality by removing the noise, modifying features and resizing the image. It facilitates the vegetation segmentation process. It involves color space transformation, normalization, resizing, contrast enhancement and de-noising, etc.

2. Vegetation Segmentation

In image processing, segmentation is defined as the process of grouping related pixels together to form connected objects. But with respect to vegetation segmentation, is the process of separation of vegetation (crop-weed) from the background soil. For efficient segmentation, effective features need to be employed to discriminate between plants and background. The color-based feature is quietly used. Color-based features include color based indices like Normalized Difference Index (NDI), Green chromaticity and Excess Green Index (ExG).These all separate green part from a dark background. Color-based features used RGB color space model, HIS, HSV, Lab. or combination of above. Final Separation was done using: threshold-based and learning-based approaches. In threshold-based segmentation image converted to grayscale and intensity values of each is compared with the pre-set threshold values, and then similar pixels are grouped into corresponding classes according to the comparison results. Otsu method is the most commonly used threshold-based technique of classifying data

Another method used is learning-based segmentation. In these methods, common properties of objects in the image are learned by using machine learning algorithms, through which pixels are classified into different categories. It is of 2 types i.e. supervised and unsupervised. Supervised machine algorithm use lightweight CNN (convolutional neural networks), decision tree random forest, Bayesian classifier and, Back Propagation Neural Network, etc. In this, initially, a training process is carried by feeding input images of crop and weed obtained from field to the model with known output and then final validation is done by using randomly selected images. While, in unsupervised classification, K-mean clustering, and particle swarm optimization (PSO) is used. It tries to find unknown patterns in image data and in this labeling is not required. It clusters groups of similar objects that have similar features or properties without a training procedure in advance. The learning-based segmentations are computation extensive and dependent on training samples, but with proper training, they can provide results with high accuracy.

3. Feature extraction

It is the most important steps in digital image processing. Weed can be distinguished from the crop by using four features: biological morphology, spectral features, visual textures, and spatial contexts.

a. Biological morphology is related to size, shape, and structure of the plant or any of its parts. As most of the crops differ in morphological characteristic from weed like maize and pigweed. In these various shape factors like perimeter, major and minor axis length, area and also shape indices (eccentricity and circularity), etc., can be measured for vegetated segmented regions of the image. The shape factors and shape indices for segmented regions are different for crop and weed.

b. Spectral features are applied to the image having a crop with a different color from weeds. The crop-weed can be segmented using spectral features like NDVI, Modified Chlorophyll Absorptance Reflectance Index (MCARI). These are not suitable for plants with a similar color to weed.

c. Textural features are the elements representing the arrangement of the gray levels of pixels in a region of a digital image. It is a widely used technique in image processing for extracting useful information. It provides measures of properties such as smoothness, coarseness, and regularity and identifies regions of interest in an image. It is broadly categorized into two types of i.e. statistical features and structural textures. Statistical features are computed from the statistical distribution of gray values by computing local features at each point in an image and deriving a set of statistics from the distributions of the local features. Example intensity histogram of an image or region is obtained and set as statistical features like skewness, flatness, and contrast of histogram. Structural based textures features refer to the composition of well-defined texture elements such as regularly spaced parallel lines. Crop and weed have different structural characteristics. Hence, can be used as a feature for segmentation

d. Spatial contexts: It is suitable for the crop that is sowed or planted in rows (wheat and barley etc.) with the prior pattern. In this, all the green plants between two adjacent crop plants are regarded as a weed. In this method edge line was prepared for row crops and as the edge distance between two crop plants reached in between species categorized as a weed. Also, sometimes different lines were prepared for crop and weed and depending upon the overlapping area on different line crop-weed can discriminate. Hough transform is a widely used method for estimating crop rows.

4. Classification

The final classification is done by combining several features for increasing efficiency. In this classification is done by setting the threshold or by using machine learning algorithm i.e. Artificial Neural Networks-Cultural Algorithm (ANN-CA), Particle Swarm Optimization (PSO)-based Differential Evolution, Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), Stepwise Linear Discriminant Analysis (SWLDA), etc. as discussed in vegetation segmentation. Machine learning algorithm selects suitable features with help from different classifiers. It generally refers to a group of computerized modeling approaches that can learn patterns from the data so as to make decisions automatically without programming explicit rules.

Way Forward

The digital image processing had the potential for developing a fully automatic system that can detect crops and weed in real-time on field. This automatic system can be mounted on an autonomous vehicle having an efficient variable-rate applicator for developing an SSSW technology that reduces the chemical consumption, labor demands, cost and allows timelines in operation. It will protect the environment, surface water, and groundwater by lowering downs the chemical consumption and helps in saving resources for the future generation.

CONCLUSION

Digital image processing with appropriate image processing algorithm can be an efficient way for segmenting crop from weed. It involves the four-step process image capturing, image segmentation using essential features i.e. texture, biological morphology, spectral and spatial and classification. The classification was done using a threshold or machine learning algorithm based.

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Role of Information and Communication Technologies (ICTs) in Agricultural Extension

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Out of around one billion global poor, 75 percent live in rural areas and most of these people depend on agriculture for livelihood. Enhancing farmers' and agricultural workers' livelihoods is thus key to addressing global poverty. There are many challenges which the small and marginal farmers face on a regular basis. Among those challenges, the most important are: 1) access to credit 2) access to better market prices and 3) access to credible and relevant information. The aspect of information access has received increasing attention, especially in terms of the potential role of Information Communication Technology (ICT) to connect farmers with the information they need.

Information and Communication Technologies (ICTs)

When used as a broad tool for providing local farming communities with scientific knowledge, ICT heralds the formation of knowledge societies in the rural areas of the developing world. Information and communication technology in agriculture (ICT in agriculture), also known as e-agriculture, focuses on the enhancement of agricultural and rural development through improved information and communication processes. More specifically, e-agriculture involves the conceptualization, design, development, evaluation and application of innovative ways to use information and communication technologies (ICTs) in the rural domain, with a primary focus on agriculture. ICT includes devices, networks, mobiles, services and applications; these range from innovative Internet-era technologies and sensors to other pre-existing aids such as fixed telephones, televisions, radios and satellites. Provisions of standards, norms, methodologies, and tools as well as development

ICT and Agricultural Extension:

ICT has many potential applications in agricultural extension (Zijp, 1994). With the advancement of science and technology in the country, ICT can address diverse needs of rural people in general and farmer in particular. Extension services include delivering information, disseminating knowledge, technological interventions and advisory services to farming community. But with the increasing competition and budding challenges, it becomes imperative to choose the best among the options/technologies/information available. However, extension has to escape from the narrow mindset of transferring technology packages to transferring knowledge or information packages. If this has to be achieved, with the help of ICT, extension will become more diversified, more knowledge-intensive, and more demand driven, and thus more effective in meeting farmers' information needs.

ICT plays a pivotal role in managing right information at right time to right people at right place. It can bring new information services to rural areas where farmers, as users, will have much greater control than before over current information channels.

Information needs of farmers that can be met through ICTs Marketing Information:Daily

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updates on price of agricultural commodities. Ex- ITC e-Choupal

- Advisory services: This type of services include ask your query with an expert and taking his consultation. Ex- Mango Expert System
- Facilitating access to land records and online registration – Bhoomi project
- Information about rural development programmes and subsidies
- Weather forecasting – Information related to rainfall, temperature, humidity etc.
- Latest package of practices
- Post harvest technology and value addition
- Early warning and pest and disease management- it includes outbreak of disease and pest infestation related information.
- Soil testing and soil sampling information

Extension services that can be supplemented through ICTs

- Diagnosis of pest and disease
- Collection of relevant information
- Link farmers to market
- Facilitate access to credit and inputs
- Assist in business planning
- Advisory services
- Collect and respond to farmers' feedback (**Bell & Payne, 2011).**

Some successful ICT initiatives in India:

- ITC e-Choupal
- Warana Wired Village
- Bhoomi Project
- Gyandoot
- Digital Green
- i-kisan
- Akash
- Friends

CONCLUSION:

ICT enabled extension services offers numerous opportunities in extension as it is helpful in bridging knowledge gap through need, purpose and target specific extension services. Furthermore, ICTs can strengthen weak linkages between research- extension and farmers.

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Organic farming: A step towards sustainability

Article id: 21873

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Organic farming is now receiving attention among growers, processors, exporters and consumers. Organic farming is an alternative for present agricultural system in which more chemicals are using by producers. Organic farming is a system which avoids or largely excludes the use of synthetic inputs (such as fertilisers, pesticides, hormones, feed, etc.) and to the maximum extent feasible relies upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilisation and plant protection. According to the International Federation of Organic Agriculture Movements (IFOAM), an international umbrella organization for organic farming organizations established in 1972, organic agriculture can be defined as: "integrated farming is a system that endeavor for sustainability, the enhancement of biological diversity and soil fertility whilst, with rare exceptions, excluding synthetic pesticides, antibiotics, synthetic fertilizers, genetically modified organisms, and growth hormones".

Common organic farming practices-

1. The important component of soil fertility is legumes, green manuring, green leaf manuring, crop rotations, inter and mixed cropping including legumes.
2. Application of organic materials or crop residues, farm yard manure and compost can be a good source of nutrients.
3. Use of bio-fertilizers, Azola, Blue green Algae etc.
4. Minimum tillage should be practiced.
5. Adoption of soil and water conservation techniques.
6. Control of weeds by biological and mechanical method.
7. The control of pest and diseases can be achieved by the choice of good quality seed, balanced crop rotation, mechanical cultivation procedure, protection of natural enemies of pest, balanced crop rotation, mechanical cultivation procedure, and protection of natural enemies of pest. The use of botanical and biological pest control methods can be also a alternate.

Basic Components- The basic components of organic farming are as follows:

(i) Organic Manures:

Organic materials may be a substitution for inorganic fertilizers such as farm yard manure (FYM), compost, slurry, bio-fertilizers, straw (crop residues) and green manure crops. Organic manures would also improve the quality of environment and soil health.

(ii) Weed Control:

In organic farming where zero application of chemicals are need there mechanical method of weed control is generally practiced to reduce the weed population. Hand weeding is one of the important method of weed control.

(iii) Biological Pest Management:

Natural enemies of pests can be a source to control the harmful pest without use of chemical pesticides. Some botanical pesticides such as these derived from tobacco, neem and other medicinal plants need popularization. Selective microbial pesticides, for example, *Bacillus thuringiensis* offer promise

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(iv) Agronomical Practices:

The physical and chemical properties of soil can be improved by crop rotation, mixed cropping, green manuring. Inclusion of leguminous crops in these practices adds to the soil fertility level.

(v) Alley Cropping:

Alley cropping may be defined as integration of perennial plants (mostly leguminous) in the farming system. Hedge row of perennial plants such as *sesbania egyptica*, perennial pigeon pea, Gliricida is planted at every two or three meters. These plants are allowed to grow undisturbed in the cropped fields. Between these hedge rows, crops are sown.

Principles of Organic Farming- Basically there are four principles of organic farming:

1. No Chemical Fertilizer:

The nutrient management in organic farming is achieved by using straw, green manure and farm yard manure, and one can get high yields without chemical fertilizer. Zero fertilizer use is not only maintain the soil fertility but also provide the quality product.

2. No Herbicide:

Herbicide is generally used for weed control but in organic farming no herbicides is used and weeds control done by straw mulch and hand weeding.

3. Zero Pesticides:

The best way to manage the pests in organic farming is conservation of natural enemies of pests and uses of botanical pesticides avoid the use of chemical pesticides.

4. Healthy Soil:

Soil health should be manage by cultivation of legumes, green manuring, green leaf manuring, crop rotation, mixed cropping and inter including legumes.

Advantages of Organic Farming:

(i) Organic farming is best for our environmental quality because it avoids use of chemical fertilizers and plant protection chemicals.
(ii) Incomparision to conventional agriculture less energy is used in organic farming.
(iii) Minimum mechanisation is needed in organic farming.
(iv) Less disturbance of soil, proper structure, high organic matter content will be maintained.
(v) Organic food is some costly so producers get more price than the produce obtained by conventional agriculture.

Problems-

1. **High Certification cost:**

The cost of inspection and certification is very high due to of limited number of certification and inspection agencies, which are mostly international agencies, recognized by accreditation body. So it can not be afford by most of the Indian farmers.

2. Limited availability of bio inputs:

The required quantity and quality of bio input is not available for crop production. With the decreasing population of cattle the availability of FYM which is the main organic fertilizer will be difficult, unless alternate bio-organic manures are produced on a large scale.

3. Lack of knowledge:

There are strict standards prescribed for organic products so its complete knowledge must be required. Most of the farmers and extension agencies are not fully convergent with the guidelines, which prescribed the long list of permitted and non permitted inputs.

4. Market intelligence:

The market information and network for organic products is still not fully developed. Information of premium prices that can be obtained for different products in international market is not easily

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Understanding the importance of nitrogen remobilization to enhance nitrogen use efficiency (NUE) in crops

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INTRODUCTION

Food security is dependent on nutrient availability for crop production, whereas its sustainability is associated with use efficiency to applied fertilizers of the crops. Among all, nitrogenous fertilizers contribute 60% because nitrogen is the most important macronutrient essential for crop growth, and major component of almost all fertilizers. But, the average N use efficiency (NUE) is about 30% to 40% only, and the unutilized N that accumulate in the environment causes pollution. One way to enhance the efficiency of applied fertilizers is to improve plant nitrogen economythrough manipulating nitrogen recycling, and especially nitrogen remobilization, from vegetative plant organs like leaf, stem, and also from roots in small proportions to grains.

Nitrogen remobilization (NRE)

N utilization in plants involves, uptake, assimilation, translocation, and remobilization to developing grains. Grain yield is dependent not only on N uptake before flowering but also on the remobilization of N during seed maturation. Improving N remobilization has the advantage of reusing the N from vegetative parts of the plant for grain filling. This would contribute to plant N economy and reduce exogenous N demand after flowering. The contribution of leaf N remobilization to grain N content is cultivar dependent, varying from 50% to 90%. Understanding the mechanisms of nitrogen uptake, its fate within the plant, and remobilization to grains is very important to improve nitrogen use efficiency (NUE) in crops.

Remobilization of nitrogen take place from nonsenescing parts, senescing parts, and also from the nitrogen stored in various storage parts like stem, leaf, petiole, and root. Glutamine synthetase (GS) enzyme plays a central role in nitrogen remobilization from source to developing grains. During the vegetative stage, the leaves are a sink for N, but later during senescence, this N is remobilized for reuse in the developing seeds, mainly as amino acids. The majority of remobilization occurs during senescence where to N is transported mainly in the form of amino acids via phloem tissue. 95% of seed protein is derived from amino acids that are exported to the seed after the degradation of existing proteins in leaves. Approximately 80% of total leaf N is located in the chloroplasts mainly in the form of proteins and this is an important N pool for remobilization. Among chloroplastic proteins, Rubisco seems to serve as the major protein subjected to proteolysis and responsible for most N remobilized during leaf senescence for grain filling. During the reproductive phase, senescence initiated in leaves, which sequentially instigate nitrogen mobilization towards the healthy parts of the plant due to the high demand for developing other parts, including seeds. N in leaves is recycled following protein hydrolysis and exported in the form of amino acids to grains, 60% to 95% of grain N comes from the remobilization of N stored in roots and shoots before anthesis. A less important fraction of seed N comes from post flowering N uptake and N translocation to the grain. Remobilization of the N stored before anthesis and N uptake after anthesis are generally estimated by calculating the difference between the amount of total N present at anthesis and the amount of total N present at harvest in the different parts of the plant. The major forms of nitrogen found in phloem sap are glutamine (Gln) and asparagines (Asn) which are transported from source to sink after degradation of proteins. In developing sink organs, the remobilized Glutamine (Gln) is reutilized for many biosynthetic reactions, via the GS/GOGAT pathway. Proteins are degraded before they are remobilized to developing organs, which occurs mainly by three pathways: the chloroplast degradation pathway; the vacuolar and autophagic pathway; and the ubiquitin 26S proteasome pathway. Autophagy is an important cellular degradation pathway wherein autophagosomes found in vacoules cause protein degradation and break down organelles and other materials to create free amino acids, which were resupplied into the cytosol

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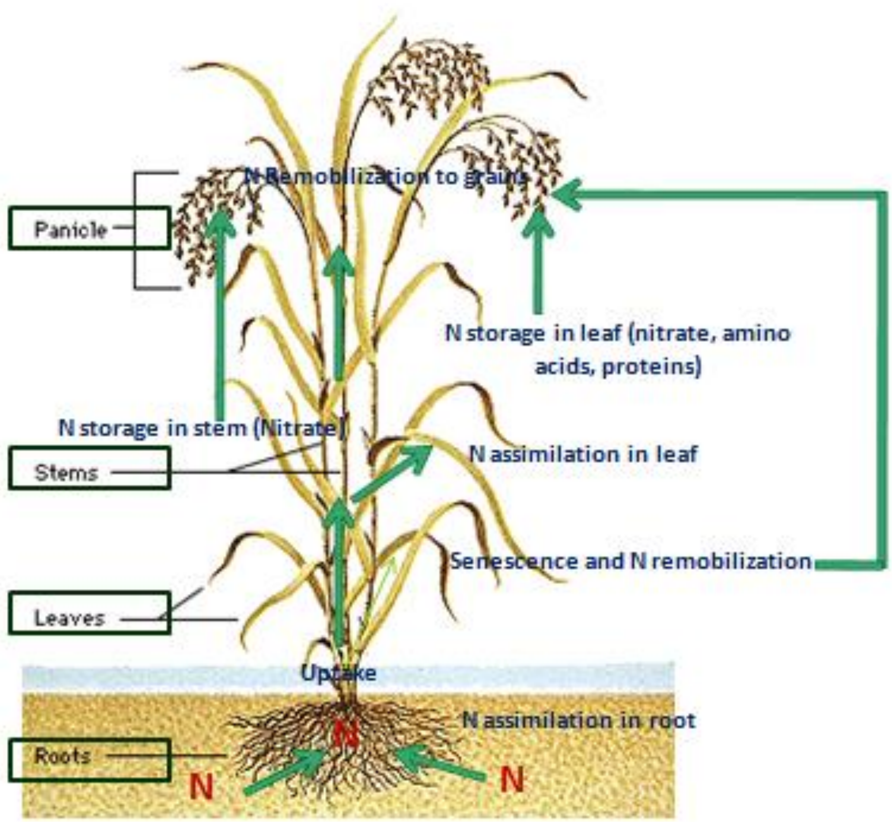

Figure 1. Nitrogen remobilization to grains through various means

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CONCLUSION

Nitrogen remobilization is fundamental for plant N economy since it controls a large part of the N fluxes from source to sink organs. Knowledge on the mechanisms controlling N remobilization during plant development and in response to stress is increasing, and is required to improve NRE and N fertilizer economy. The main challenge is, however, to detect the major limiting points. A combination of all the tools and approaches focusing individually on some aspects of NRE will be helpful in enhancing NUE in crops.

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Nitrogen deficiency tolerance and nitrogen use efficiency in rice

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INTRODUCTION

Nitrogen is a limiting nutrient and has to be exogenously supplied to many crops, to achieve high yield with significant economic and environmental costs, specifically for rice which is a major staple food for alarge part of the world's population. Although, plant can directly absorb the two forms of nitrogen, nitrate and ammonium, nitrate is the preferred source. Ammonium is the predominant form of N uptake in case of rice. But, some physiological experiments have shown that lowland rice was exceptionally efficient at acquiring nitrate formed bynitrification in the rhizosphere has been predicted that up to 40% of the total N taken up by rice roots grown under wetland conditions might be in the form of nitrate and the rates of nitrate uptake can be comparable with those of ammonium. Most of the agricultural soils are deficient in N and to compensate this large quantity of chemical fertilizers are applied. Therefore, identification of rice genotypes tolerant to low nitrogen (N) conditions will be useful in enhancing nitrogen use efficiency (NUE).

Nitrogen deficiency tolerance in rice

Rice is the important food crop worldwide and nitrogen is required in large quantity for rice production. About 30-70% of the applied N fertilizer is lost in rice field. Low N fertilizer efficiency and rapid losses of applied N through volatilization and leaching has been a crucial problem in irrigated rice production resulting not only in huge economic costs but also causes severe environmental pollution. Since fertilizer and input costs have been increasing more rapid than the price of rice, improving nitrogen use efficiency (NUE) of crop deserves appreciation. The modern agricultural production aims to achieve maximum grain yield potential with higher nitrogen application. However, the excessive use of nitrogen fertilizer resulted in decreased nitrogen use efficiency (NUE) and adverse effects on the environment. To resolve this problem, breeding of high N efficient rice varieties is very important.Nitrogen levels in soils that inexorably will induce low uptake and deprivation, resulting in low growth, commonly associated with reduced photosynthesis. In this N limiting situation, plants are able to remobilize part of stored N, especially for root growth and younger leaves, in detriment of mature tissues. Paradoxically, despite its importance, the physiological mechanisms in each one of these two extreme phases and their reflexes on other processes, such as photosynthesis, are scarcely understood. Such knowledge might contribute to an efficient N management in order to accomplish higher use efficiency. In parallel, these studies might also contribute to the development of accurate methods to determine the threshold levels of N status in plant tissues, in different nutritional circumstances and especially in those related to the improvement of NUE.Plants in natural field conditions face changing environmental conditions where N concentrations vary and frequently are limiting for growth due to many factors including surface run-off, soil erosion, leaching, gaseous losses by volatilization, and microbial consumption. Therefore, adaptation to limiting N conditions is an important survival strategy for plant successfully to complete their life cycle. For crops

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grown in developed countries, the use of large amounts of N fertilizer for many crops helps prevent fluctuating levels of N from impacting yield and, as a consequence, much is wasted to the environment. In developing countries, many farmers cannot afford to use much N fertilizer. Therefore, in either case developing crops that have improved genetics for yield in well under limiting N conditions would be very advantageous. Nitrogen response and grain yield and the difference between trait values at Normal N and Low N are commonly considered indices of NUE. Adaptation of rice to N deficient condition imparts Nitrogen deficiency tolerance (NDT) mechanism and which may lead to higher N use efficiency (NUE). It is reported that seedling stage nitrogen deficiency tolerance in rice could also lead to nitrogen deficiency tolerance (NDT) during vegetative and reproductive stage of rice. But, NDT and NUE are not always positively correlated. The reason could be that genotypes with higher biomass and nitrogen accumulation under normal N suffered more from low nitrogen stress than the ones with lower biomass and nitrogen accumulation, and also there is dilution effect of nitrogen on plant tissue. Plants alter a series of physiological, biochemical processes and gene expression for surviving under nitrogen deficiency conditions. For example, rice enlarges root system and deepens roots for acquisition of nitrogen in soil under LN. Therefore, improvement of NUE could come at a cost of balancing nitrogen deficiency tolerance, yield and nutrient content in grain. Nitrogen deficiency tolerance (NDT) traits are measured by the ratios of the trait values under Low N to those under Normal N.

CONCLUSION

It is important for both economic and environmental reasons to improve N use efficiency in plants. Improving N uptake under their limiting supply would be a viable approach to utilize these nutrient elements more efficiently. The strategies for such improvement could include optimizing agricultural practices, molecular marker assisted breeding, and genetic engineering of genes involved in N uptake and metabolism. The present day rice breeding programs are concentrating more on improving nitrogen deficiency tolerance (NDT) and nitrogen use efficiency (NUE). Nitrogen deficiency due to insufficient input or inefficient acquisition is conceivably being experienced by all plants and particularly crops, and which constitutes a regularly recurring abiotic stress. The physiological effects of N deficiency have been intensively studied in many crops and the underlying molecular basis also under investigation.Several QTLs for both NDT and NUE have been identified which can provide explanation and genetic mechanism underlying the correlations between NDT and NUE traits, and could be a potential target for improving NDT and NUE traits in future rice breeding.

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Natural plant defense processes and genes involved in resistance against phytonematodes

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Eco-safety and biodiversity issues are pushing scientific societies to develop durable and environmentally friendly methods to manage pests of economically valuable a crops. Many resistant genes have been identified earlier which impart resistant against nematodes or to a group of nematodes. By using genetic engineering processes these resistant gene or gene involved in coding phytoalexins or plantibodies can be transferred to famous crop cultivars. Thus the investments made in plant protection measures can be reduced to a limited level.

INTRODUCTION:

Plant-parasitic nematodes are a major threat to sustainable crop productions. The plant responds to the attack of nematodes by employing multiple mechanism to suppress them. The defense mechanisms exhibited by plants are inherited genetic resistance, development of plantibodies, secretion of protease inhibitors and lethal hypersensitive responses. The identification of these mechanisms involved in pest-plant interactions and decoding the regulatory pathways involved in the aforementioned processes can lead to develop novel cultivar resistant against nematodes infestations.

Genetic resistance in plant against nematodes:

The plants naturally have capabilities to respond against pest or pathogen attack. Upon infestation of the host plant by these pests or pathogen including nematodes, the genes involved in defense is being expressed and try to suppress them. The Genic expression may occur at the site of infestation or systemic. The mechanism to suppress these biotic stress factors is broad which include tissue necrosis, enhanced peroxidase activity and deposition of pectate-lignin around the infested site. The damage to the plant or development of the disease is dependent on the extent of plant nematode interactions. In the field of nematology, the resistance can be stated as the ability of the host plant to suppress or reduce the nematode multiplication. These resistant genes are transferred into famous crop cultivars from their wild sources.

Source of resistant genes against nematodes

Gene	Host plant	Nematode
Hs1pro-1	*Beta procumbens*	*Heterodera schachtii*
Gpa2	*Solanum tuberosum*	*Globodera pallida*
Gro1-4	*Solanum tuberosum*	*Globodera rostochiensis*
Hero A	*Solanum pimpinellifolium*	*Globodera pallida, Globodera rostochiensis*
Mi-1.2	*Solanum peruvianum*	*Meloidogyne incognita, Meloidogyne arenaria, Meloidogyne javanica*

Hypersensitive reaction upon infestation by nematodes:

These HR responses occur rapidly against a range of pest attacks. The sudden death of tissue or localized cell occurs upon infestation by nematodes. The dead cell or accumulation of toxic accumulates cease the further movement of

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the nematode in host tissue which ultimately leads to the death of the nematode.

Development of phytoalexins:

Phytoalexins are crop-specific and are the primary products which accumulate in host cells upon infestation by nematodes. These phytoalexins cause physical or systematic injury to the nematodes. The phytoalexins include toxic compounds, antifeedants, and anti-eclosion factors etc.

Examples: Glycinieclepin A, Tomatine, Gossypol, Azadarachtin, Citral and Menthol etc.

Secretion of protease inhibitors:

These inhibitors hinder the proteolysis processes in nematodes and prevent the metabolic digestion of proteins. These protease inhibitors are the plant origin products which disrupt the enzymatic mechanism of protein digestion in nematodes. Ultimately these contradictory processes hinder the growth and development of nematodes. The four classes namely Serine PIs, Cysteine PIs, Aspartyl PIs, Metallo-proteinases PIs are found to exhibit against nematodes.

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Xeriscaping - An Approach of Landscaping for Dry Areas

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Xeriscaping:

Denver Water coined the term xeriscape in 1981 by combining "landscape" with the Greek prefix *xero-*, from *xeros*. Xeriscape is a word derived from the Greek word "Xeros" meaning dry and "Scape" means view. It is used to describe landscaping with water conservation as a major objective. An example of Xeriscaping outside the United States Capitol in Washington, DC.

Fig. 01 Xeriscaping in dry areas

Landscaping

Landscaping is an art of beautifying a piece of land or a landscape with planting material, non-living material in order to create a picturesque effect or to imitate nature. Landscaping makes a place more peaceful, beautiful, appealing or pleasing, where people can rest and enjoy with their family and friends. Xeriscaping is special type of Garden or Landscape. This is a technique used to practice water conservation in creative landscapes.

Need of Xeriscaping

- Xeriscaping is the process of landscaping or gardening that reduces or eliminates the need for supplemental water from irrigation.
- To live green with greater sensitivity to water consumption, dry landscaping strategies are in demand everywhere.
- It reduces water use by 60% or more, a properly xeriscaped lawn can increase the property value up to 15 percent.

Principles of Xeriscape

The seven principles of xeriscaping have since expanded into simple and applicable concepts to which creating landscapes that uses less water. The principles are appropriate for multiple regions and can serve as a guide for creating water conserving landscape-

- Plan and design comprehensively.
- Evaluate Soil and improve if necessary.
- Create practical turf areas.
- Use appropriate plants.
- Water efficiently.
- Use organic mulch.
- Maintain appropriately.

Xeriscape top ten evergreens-

Acacia spp., *Agonis flexuosa* (Peppermint), *Callistemon viminalis* (Weeping bottlebrush), *Calocedrus decurrens* (Lncense cedar), Juniperus spp. , Pinus spp., *Schinus molle* (California Pepprs), *Olea europea* (Olive), Cupressus spp. (Cypress)

Xeriscape top ten shrubs-

Fremontadendron californicum (Flannelbush), *Encelia californica* (Brittlebush), Ceanothus spp. (California Lilac), *Artemisia arborescens* (Shrubby wormwood) ,

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Arctostaphylos spp. (Bearberry), *Heteromeles arbutifolia* (Christmasberry), *Lavatera assurgentiflora* (Calif. Tree Mallow), *Leucophyllum frutescen* (Purple Sage), Mahonia aquifolium (Oregon Grape), *Tecoma stans* (Yellow Bells)

Elements to Use in Xeriscaping

Organic Mulches- Spread two to three inches of fresh mulch around plants, shrubs, and trees. Use organic mulch products, such as shredded hardwood or wood chips. The advantages of organic mulch include increasing moisture and nutrients in the soil, reducing the frequency of watering, retaining oxygen in the soil, and protecting the soil from compaction caused by heavy rains or harsh sun.

Hardy Grass Species - Three types to consider are: Bermuda grasses, St. Augustine grasses, and Ryegrass. Tifway 419 Bermuda grass is the traditional standard for golf and sport lawns because it performs best in full sun.

Low Water Use Plant - The desert offers a variety of low-water-use landscape plants.

Incorporating Hardscaping-

- Hardscape are man-made features such as walkways, curbing around planting areas, built-in benches or fireplaces, patios or decking, and raised garden beds or walls.
- Hardscaping materials include flagstone, pavers, concrete, travertine, and block.

SUMMARY:

Xeriscape programs are used to conserve the amount of water applied to urban landscapes. These programs are necessary because of limited water supplies, increasing water prices, and limitations on the use of existing water supplies. Xeriscaping is based on seven principles, and its goal is to conserve water. Some of the benefits of xeriscaping include reduced expenditures on water, less time spent on landscape maintenance, and increased use and appreciation of native plant material. Xeriscape is synonymous with the terms drought-resistant landscape and “dry garden.” All three terms refer to a landscape style that conserves water through using a combination of native plants, non-organic material, hardscaping, common-sense garden design and efficient irrigation. There are numerous reasons why this type of arrangement should be taken into consideration: lowered consumption of water, reduce maintenance and less cost to maintain, reduced waste and pollution, reduce fertilizer use (NPK). A well-planned xeriscape landscape, involves conserving water, it can be attractive, colorful and it utilizes a variety of styles (even formal style), shapes and textures. Contrary to the impression that "xeriscaping" shall include only cacti and succulents, many ornamental herbaceous and woody plants can be used for this type of arrangement

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Climate Smart Agriculture: Challenges, implications, innovations for achieving food and nutrition security

Article id: 21878

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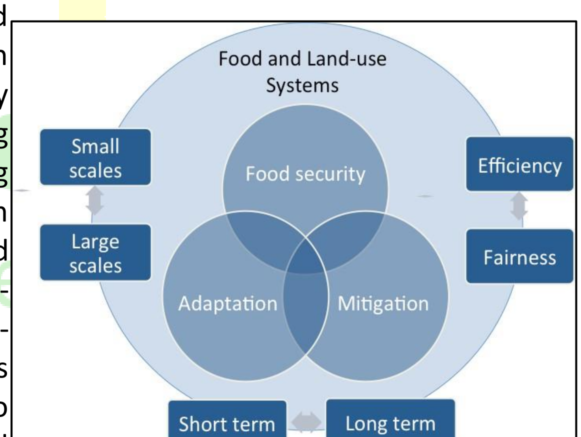
INTRODUCTION

Although global food production has increased in the past few decades, almost 800 million people still have insufficient food, especially in South and Southeast Asia, the Caribbean, and SubSaharan Africa (*FAO,* 2015). Moreover, global food production must double by 2050 to match population and income growth (Alexandratos *et al.,* 2012), and much of this must happen in Asia and Africa. Climate change is emerging as a major threat on agriculture, food security and livelihood of millions of people in many places of the world (IPCC, 2014). The estimated impacts of both historical and future climate change on cereal crop yields in different regions indicate that the yield loss can be up to 35% for rice, 20% for wheat, 50% for sorghum, 13% for barley, and 60% for maize depending on the location, future climate scenarios and projected year (Porter *et al.,* 2014). Threats can be reduced by increasing the adaptive capacity of farmers as well as increasing resilience and resource use efficiency in agricultural production systems (Lipper *et al.,* 2014). The impacts of climate change on crop yields indicate that yield losses may be up to 60%, depending on crop, location, and future climate scenario (Challinor *et al.,* 2014). In response, the concept of Climate Smart Agriculture (CSA), has been developed to address three pillars: food security, adaptation and mitigation (FAO, 2013). Climate-smart agriculture (CSA) is an approach to help agricultural systems worldwide, concurrently addressing three challenge areas: increased adaptation to climate change, mitigation of climate change, and ensuring global food security through innovative policies, practices, and financing (Torquebiau *et al.,* 2018).

Climate smart Agriculture: concept



CSA, an integrated approach to addressing the interlinked challenges of food security and climate change, focuses on three objectives: sustainably increasing food security by increasing agricultural productivity and incomes; building resilience and adapting to climate change; and developing opportunities to reduce greenhouse gas emissions from agriculture(Sala *et al.,*2016).Many technologies and practices can increase crop yields, farm income, and input-use efficiency, and may reduce GHG emissions (Khatri-Chhetri *et al.,* 2017). Climate-smart agriculture (CSA) aims to increase sustainable agricultural production by adapting to and building resilience to climate change. It focuses on food security and national development goals and, where possible, it also aims to reduce or remove GHG emissions (Lipper *et al.,* 2014, Steenwerth *et al*., 2014). Therefore, there is demand for the development

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and application of simple and reliable tools that can provide comprehensive information to identify and prioritize locally appropriate CSA practices across different scales (e.g., farm, community, watershed, districts, national, etc.) and the enabling environment required to sustain the uptake.

Climate Smart Village (CSV) design

The CSA approach encourages coordinated actions by farmers, researchers, the private sector, civil society and policymakers towards climate-resilient pathways through four main action areas:
– building evidence;
– increasing local institutional effectiveness;
– fostering coherence between climate and agricultural policies;
– linking climate and agricultural financing (Lipper *et al.*, 2014)

S.No.	Technology	Adaptation/mitigation potential
1.	**Water-smart**	Interventions that improve water use efficiency
a)	Rainwater Harvesting (RH)	Collection of rainwater not allowing to run-off and use for agricultural in rainfed/dry areas and other purposes on-site
b)	Drip Irrigation (DI)	Application of water directly to the root zone of crops and minimize water loss
c)	Laser Land Levelling (LL)	Levelling the field ensures uniform distribution of water in the field and reduces water loss (also improves nutrient use efficiency
d)	Furrow Irrigated Bed Planting (FIBP)	This method offers more effective control over irrigation and drainage as well as rainwater management during the monsoon(also improves nutrient use efficiency)
e)	Drainage Management (DM)	Removal of excess water (flood) through water control structure
f)	Cover Crops Method (CCM)	Reduces evaporation loss of soil water (also adds nutrients into the soil)
2.	**Energy-smart**	Interventions that improve energy use efficiency
a)	Zero Tillage/Minimum Tillage (ZT/MT)	Reduces amount of energy use in land preparation. In long-run, it also improves water infiltration and organic matter retention into the soil
3.	Nutrient-smart	Interventions that improve nutrient use efficiency
a)	Site Specific Integrated Nutrient Management (SINM)	Optimum supply of soil nutrients over time and space matching to the requirements of crops with right product, rate, time and place
b)	Green Manuring (GM)	Cultivation of legumes in a cropping system. This practice improves nitrogen supply and soil quality
c)	Leaf Color Chart (LCC)	Quantify the required amount of nitrogen use based on greenness of crops. Mostly used for split dose application in rice but also applicable for maize and wheat crops to detect nitrogen deficiency

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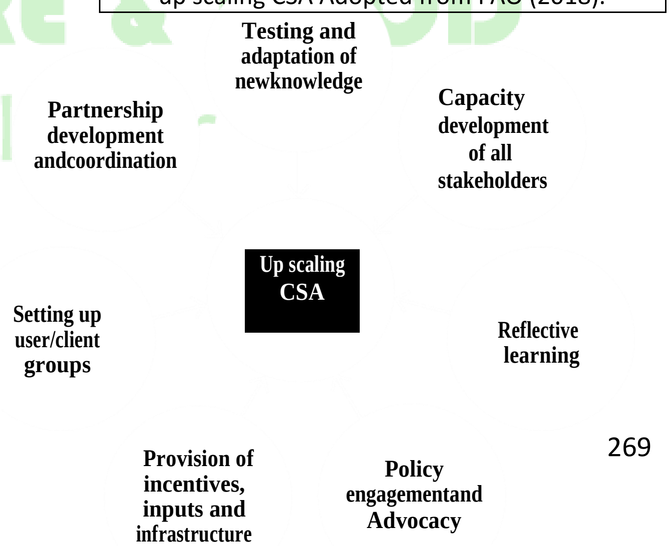
d)	Intercropping with Legumes (ICL)	Cultivation of legumes with other main crops in alternate rows or mixed. This practice improves nitrogen supply and soil quality
4.	**Carbon-smart**	Interventions that reduce GHG emissions
a)	Agro Forestry (AF)	Promote carbon sequestration including sustainable land use management
b)	Concentrate Feeding for Livestock (CF)	Reduces nutrient losses and livestock requires low amount of feed
c)	Fodder Management (FM)	Promote carbon sequestration including sustainable land use management
d)	Integrated Pest Management (IPM)	Reduces use of chemicals
5.	**Weather-smart**	Interventions that provide services related to income security and weather advisories to farmers.
a)	limate Smart Housing for Livestock (CSH)	Protection of livestock from extreme climatic events (e.g. heat/cold stresses)
b)	Weather based Crop Agro-advisory (CA)	Climate information based value added agro-advisories to the farmer
c)	Crop Insurance (CI)	Crop-specific insurance to compensate income loss due vagaries of weather
6.	**Knowledge-smart**	Use of combination of science and local knowledge
a)	Contingent Crop Planning (CC)	Climatic risk management plan to cope with major weather related contingencies like drought, flood, heat/cold stresses during the crop season
b)	Improved Crop Varieties (ICV)	Crop varieties that are tolerant to drought, flood and heat/cold stresses
c)	Seed and Fodder Banks (SFB)	Conservation of seeds of crops and fodders to manage climatic risks
Adopted from Khatri-Chhetri, *et al.*,2017		

Scaling up of Climate Smart Agriculture

Extension and advisory services (EAS) can play a very important role in scaling up Climate Smart Agriculture (CSA) which need to be more actively deployed (Figure 1) both to help rural communities adapt to climate change and to contribute to climate change mitigation (Sulaiman*et al.*, 2017).It is important to check whether the farmers are mentally, physically and electronically prepared foradopting these modern ICT tools and technologies (Kumar *et al.,* 2018).

Scaling up CSA is complex because it involves more than scaling up technological innovations in

Figure 1: Innovation management functions in up scaling CSA Adopted from FAO (2018).



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agriculture. Envisioning, implementing and monitoring CSA requires integrating biophysical, socioeconomic and institutional dimensions, at different scales for Successful scaling up CSA requires identifying and promoting appropriate practices, technologies or models (new, improved, adapted) within favourable enabling environments comprising supportive institutional arrangements, policies and financial investments at local to international levels (Neufeldt, *et al.,* 2015).There is need to develop ICT-based agricultural information management and delivery system and effective and relevant modification and redesigning in available technologies and setting up of awareness and capacity building programmes for farmers (Kumar *et al.,* 2018).

CONCLUSION:

Climate change is more complex and threatening than any other ecological problem. farming practices are exposed to several, interconnected ecological, economic and social pressures motivated by climate change. There is need to enhance investment flows based on private sector activity and public–private partnerships to strengthened and establish well-networked with local organizations. Similarly scaling out climate-informed advisories and early warning should be taken on priority for reaching to last mile of village. Realizing the digital era in food systems, Scaled out climate-resilient technologies and low-emission practices should be adopted.

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Conservation agriculture and its promise for climate change mitigation

Article id: 21879

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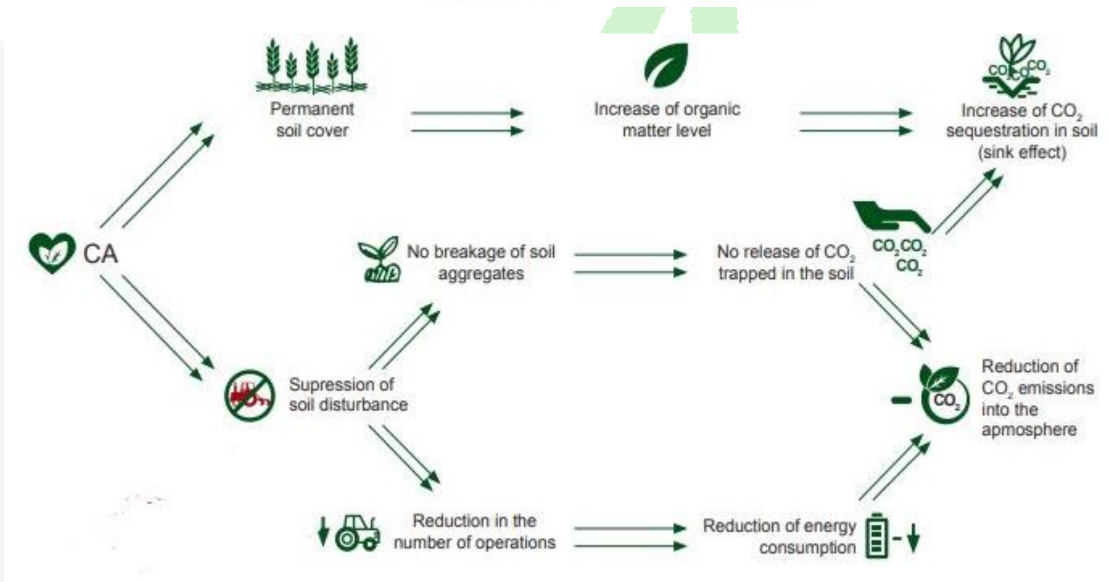
INTRODUCTION

Agriculture – on which we all depend for our food – is under threat from climate change. There is no doubt that systems worldwide will have to adapt, but while consumers may barely notice in developed countries, millions of people in developing countries face a very real and direct threat to their food security and livelihoods. Feeding a rapidly rising global population is taking a heavy toll on farmlands, rangelands, fisheries and forests. Water is becoming scarce in many regions. Climate change could be the additional stress that pushes systems over the edge. We know that climate change will mean higher average temperatures, changing rainfall patterns and rising sea levels. There will be more and more intense, extreme events such as droughts, floods and hurricanes. Although there is a lot of uncertainty about the location and magnitude of these changes, there is no doubt that they pose a major threat to agricultural systems. Developing countries are particularly vulnerable because their economies are closely linked to agriculture, and a large proportion of their populations depend directly on agriculture and natural ecosystems for their livelihoods. Thus, climate change has the potential to act as a 'risk multiplier' in some of the poorest parts of the world, where agricultural and other natural resource-based systems are already failing to keep pace with the demands on them.

Conservation agriculture is as an approach to farming that seeks to increase food security, alleviate poverty, conserve biodiversity and safeguard ecosystem services. Conservation agriculture practices can also contribute to making agricultural systems more resilient to climate change. In many cases, conservation agriculture has been proven to reduce farming systems' greenhouse gas emissions and enhance their role as carbon sinks. Principle of conservation agriculture as shown in following figures.

- No or minimum soil mechanical disturbance in practice, this means no-till seeding and weeding
- Permanent soil cover, in other words, it means to maintain crop residues and stubble in arable crops and to seed or preserve groundcovers between rows of tree in permanent crops. In this way, soil organic matter and water infiltration into the soil are increasing, weeds are inhibited, and water evaporation from the soil is limited. At least 30per cent of the soil must be covered after seeding to effectively protect it against erosion. However, it is recommendable to leave more than 60per cent of the soil covered to have almost complete control over soil degradation processes.
- Cropping system diversification through rotations, sequences and associations involving annuals and perennials. In this way, pests and diseases are better controlled by breaking cycles that are maintained in monocultures, in addition to including crops that can improve the natural fertility of the soil and biodiversity



Other mitigation opportunities:

Reducing methane emissions from rice systems:- Irrigated systems provide much of the world's food, but also produce greenhouse gases from chemical reactions between the water, fertilizers, soil bacteria and the plants themselves. Rice fields are often extensively flooded and produce significant amounts of methane. However, some simple changes in water regime can reduce emissions without yield losses. With alternative wetting and drying replaced continuous flooding of rice fields and farmers were able to see that yield was not reduced, and that water was used much more efficiently.

Reducing nitrous oxide emissions from soils: - Nitrous oxide is produced by microbial action on nitrogen compounds which are usually added as fertilizer. Fertilizers are important for improving yields, but additions are generally highly inefficient, leading to emissions. The key is to increase nitrogen use efficiency by the plants, and there are various ways to do that. Fertilizer best management practices are based on the principle of 'right source, at the right rate, at the right time, and with the right placement'.

Reducing deforestation: - Deforestation is a hugely complex issue, and reducing and reversing it requires action at many different levels, from global policy to local empowerment and diverse technologies that promote sustainable forest management.

Lowering greenhouse gas emissions from livestock systems: - There are many ways to reduce emissions from livestock systems. Feeding better quality diets to ruminants reduces methane emissions and can be facilitated with improved fodder technologies such as improved pasture species and use of legumes. Manipulation of rumen micro flora and use of feed additives are also effective. Switching livestock species or breeds allows replacement of many low-producing animals with fewer but better fed animals, thus reducing total emissions while maintaining the supply of livestock products.

Managing soils for carbon sequestration: - Soil carbon sequestration involves adding as much carbon as possible to the soil, and offers the biggest win–win mitigation–adaptation opportunity from farming systems. Management involves no burning and zero tillage.

Pro-poor biofuels: - ICRISAT is assembling the elements of a biofuels initiative designed specifically to benefit the poor in regions facing the threat of desertification. One of the initiative's components consists of new varieties of high-sugar sorghum, which can be grown for ethanol production. Since sorghum produces grain and fodder as well, the new varieties should help address the food–feed–fuel dilemma. In addition, sweet sorghum is well adapted to drought-prone environments, requiring only a seventh of the amount of water required for sugarcane, another biofuel crop.

CONCLUSION

Climate change promises serious negative impacts on agricultural systems. These same systems and the natural resources that support them are already under severe strain from overexploitation, the current climate and multiple other stresses. Many of the world's most vulnerable people depend directly on these systems for their food and livelihoods; and many countries' economies are also highly dependent on them. Agriculture is also adding to the climate change problem. This is the story so far.

We are at a crossroads in the development of our planet. The decisions we make now, for agriculture and natural resources as well as for other sectors, may prove to be the most important decisions humankind ever collectively makes. We know what to do to raise our chances of a better future. We know how to make agricultural and other natural resource-based systems more productive and more sustainable. Even without climate change, we have a moral imperative to turn this knowledge into action. Climate change adds urgency to the situation, but it also provides an opportunity. The products of agricultural research are ready to be implemented in adaptation and mitigation strategies that will help people build successful livelihoods despite changing conditions.

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Future of agriculture in India: A way forward to attracting and retaining youth in agriculture

Article id: 21880

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Today the major issue in developing countries is that the future of agriculture is not secure. Because young generation leaving agriculture and moving toward non-farm enterprise for employment generation. Even a farmer don't want that his son become farmer. They want white collar job. The major reason behind leaving agricultural profession by young generation are low profitability in agriculture, poor security of land tenure, shrinking land holding, high risks enterprise, high cost and low turnover, time consuming for money making, weather based enterprise, irrigation problem and lack of availability of smart technology for agricultural practices. Due to all these reason youth are leaving agriculture and migrate from rural areas to seek jobs in the cities. Another major issue among youth as well as farmer itself is negative perceptions about farming. Youth think that farming a not viable business. As we are in the modern technology world, no parent wants his or her child to become an agriculturist rather to be in a white collar job.They think happiness comes only through other business, not by farming. But this is dangerous scenario of country like India because Indian economy is largely depended on agriculture and if youth leaving agriculture then what will be the future of agriculture. To realize this thing government of India taken many initiative to attract youth generation toward agriculture as agricultural businessmen not as traditional farmers. There is many opportunity for youth generation to start agricultural as a business enterprise with modern technology. This is very good news that youngster who are IIT, MBA and other degree holders are leaving their corporate sector job and started their own business enterprise with modern and smart technology in agricultural sector. But still there is need that government should promote and protect these entrepreneurs and provide all necessary input and facilities to them. It is necessary to engage youth in agriculture and make agricultural scoter more popular and viable which help to change the negative perception of youngster toward agriculture sector. There is several means of promotion of agriculture and attracting youth in agriculture in which some of them are following:

1. Link social media to agriculture: The rise of social media and its attraction among young people with access to the appropriate technologies could be a route into agriculture if the two could be linked in some way. Mobile phone use is growing rapidly and people are now much more connected to sources of information and each other. Utilising these channels to promote agriculture and educate young people could go a long way in engaging new groups of people into the sector.

2. Improve agriculture image: Farming is rarely portrayed in the media as a young person's game and can be seen as outdated, unprofitable and hard work. Greater awareness of the benefits of agriculture as a career needs to be built amongst young people, in particular opportunities for greater market engagement, innovation and farming as a business. The media, ICT and social media can all be used to help better agriculture's image across a broad audience and allow for sharing of information and experiences between young people and young farmers.

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3. Strengthen higher education in agriculture: Relatively few students choose to study agriculture, perhaps in part because the quality of agricultural training is mixed. Taught materials need to be linked to advances in technology, facilitate innovation and have greater relevance to a diverse and evolving agricultural sector, with a focus on agribusiness and entrepreneurship. Beyond technical skills, building capacity for management, decision making, communication and leadership should also be central to higher education. Reforms to agricultural tertiary education should be designed for young people and as such the process requires their direct engagement.

4. Greater use of information and communication technologies (ICT): Not only can ICT be used to educate and train those unable to attend higher education institutions but it can be used as a tool to help young people spread knowledge, build networks, and find employment. Catering to a technologically savvy generation will require technological solutions. Such technologies can also reduce the costs of business transactions, increasing agriculture's profitability.

5. Facilitate access to land and credit: Land is often scarce and difficult to access for young people, and without collateral getting credit to buy land is nigh on impossible. Innovative financing for agriculture and small businesses is needed. For example soft loans provided to youth who come up with innovative proposals in agriculture or micro franchising.

6. Put agriculture on the school curricula: Primary and high school education could include modules on farming, from growing to marketing crops. This could help young people see agriculture as a potential career. For example a project Farm Africa is running in Africa aiming to help school children discover more about agriculture as a profession.

7. Greater public investment in agriculture: Young people may see agriculture as a sector much neglected by the government, giving farming the image of being old fashioned. Investment in agriculture is more effective at reducing poverty than investment in any other sector but public expenditure on agriculture remains low. Regional and continent-wide programmes should be develop in transforming the prominence and reputation of agriculture national wide and enhances the public private partnership investments in agricultural development.

8. Make agriculture more profitable: This is an easy statement to make but a difficult one to realise. Low yields and market failures reduce the potential of agriculture to be profitable and to provide people with a chance of escaping poverty and improving their quality of life. Making agriculture profitable requires that the costs of farmingand doing business are reduced while at the same time productivity increases. Although large-scale commercial farming springs to mind, this is not necessarily the case, and small farms can be highly productive with low labour costs. Of course all of these solutions come with their own hurdles like access to education and technologies, rural development, land rights etc. Foregoing engaging youth in agriculture and the potential for transformation this could bring because of the complexities of modernising agriculture would be a huge opportunity lost.

Recently some of the innovative approach taken by government of India for attracting youth in agriculture and develop some programme for this purpose which are following-

1. Attracting and Retaining Youth in Agriculture (ARYA): Youth plays a vital role in transforming Agriculture in India. There are emerging challenges of empowering the youth to improve their skills and to enable them to stay in the agricultural enterprise in rural situation. To address these issues, certain economic models are to be created in the villages for developing certain youth entrepreneurs in rural areas who can be a guide to others in the villages. Realizing the importance of rural youth in agricultural development especially from the point of view of food security of the country, ICAR had initiated a program on "Attracting and Retaining Youth in Agriculture (ARYA) during 2015-16. Under this scheme, special efforts are being taken up to attract the rural youth under the age of 35 years in agriculture so that the increase in the migration of rural youth towards cities is controlled. In order to meet the challenge of providing sustainable livelihoods for a rapidly growing population and to motivate and attract youth in agriculture (MAYA), ICAR creat create a "Mission for Youth in Agriculture" and "Regional Platform for Youth in Agriculture" with neighbouring countries as partners and said that we need to attract youth in agriculture by providing them lucrative alternatives.ICAR emphasized that youth should to be trained as employer rather than employment seeker. The farmers in India need one stop solution for all their problems like a multi-speciality hospital. Today youth want to get involved in glamorous jobs. If such jobs are created in agriculture sector, it will bring revolution.Agri-business centres and agri-clinics are needed on a big scale. Farm schools will have to be established in the fields of young farmers, in order to promote farmer to farmer learning. Value addition will have to be done to primary products in order to increase income.

2. Student READY: The Student READY (Rural Entrepreneurship Awareness Development Yojana) programme aims to provide rural entrepreneurship awareness, practical experience in real-life situation in rural agriculture and creating awareness to undergraduate students about practical agriculture and allied sciences. The programme will help in building confidence, skill and acquire Indigenous Technical Knowledge (ITK) of the locality and thereby, preparing the pass-out for self-employment. It also aims to provide opportunities to acquire hands-on-experience and entrepreneurial skills. To reorient graduates of agriculture and allied subjects for ensuring and assuring employability and develop entrepreneurs for emerging knowledge intensive agriculture, it was felt necessary to introduce this program in all the AU's as an essential prerequisite for the award of degree to ensure hands on experience and practical training. Major component of this programme are following:

- Experiential Learning on Business Model / Hands on Training
- Experiential Learning on Skill Development
- Rural Awareness Works Experience (RAWE)
- Internship / In-Plant Training / Industrial attachment
- Students Projects

The students will be required to have any three of the five components listed above depending on the requirement of their graduate education but it should be implemented for one complete year, so that their education up to level of III year may get right information and in the IV year and finally they should attain right stage of entrepreneurship. In some disciplines where some components, for example experiential learning is not possible at graduate level, the students will be given Hands on Training and/or Skill Development Training, but it should be (out of these 5 components) implemented for the complete year. All the above mentioned components are interactive and are conceptualized for building skills in project development and execution, decision-making, individual and team coordination, approach to

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problem solving, accounting, quality control, marketing and resolving conflicts, etc. with end to end approach.

3. Digital India: Digital India is a scheme that includes connecting all Indian villages with broadband. This will empower rural Indians, without spelling out all the details. India can be learn from China's Taobao villages, which have been bring a great revaluation through e-commerce and transformed whole marketing system including agriculture sector of China. China's e-commerce giant, Alibaba, has pioneered rural e-commerce through its rural arm, Taobao, claiming this has created 280,000 rural jobs in 2014 alone. The Chinese government has picked 55 poor counties for grants to develop industries using e-commerce. Taobao villages have risen from 20 in 2013 to 211 in 2014, and the trend continues. These villages now cover 70,000 rural producers including agriculture sector. India's rural market is booming, but e-commerce India is associated almost exclusively with urban distribution. We need same model of rural e-commerce in China for India and need to establish Indian Taobaos. Alibaba defines a Taobao village as a cluster of rural e-tailers where at least 10% of village households engage in e-commerce or at least 100 online shops have been opened by villagers, and transaction volume is at least RMB 10 million ($1.6 million). Indian Taobao equivalents will have to start with more modest targets, they have limited purchasing power and limited production capacity. But, as in China, they have access to the cheapest rural labour, giving them the potential to compete, provided they overcome logistical disadvantages. The curse of every rural area is the huge gulf between what the farmer or rural artisan gets, and the much higher price paid by urban consumers. To some extent this is justified that the cost of quality control, grading, transport, wholesaling and retailing is substantial. Nevertheless, e-commerce holds the promise of slashing the logistical costs and linking the producer directly to consumers, helping the rural producer get a better price even as the consumer gets a lower price. E-commerce has the potential to beat e-choupals and retail chains. It can go far beyond agriculture to rural manufacturing. But it will require supporting investment in rural roads, electrification and broadband. So the future of India agriculture is bright if governments give proper attention to development of precision agricultural technology both for production and marketing of product. There is also need to development of public and private sector investment in agricultural sector for developing agriculture as a business enterprise. Farmer producer organization is a good innovation but still it face several issue. Some of issue which need immediate action for attracting youth toward agriculture are availability easy repaying loan, easy access to credit, capacity development for business enterprise, market reform, land availability, identification and conservation of local product, licencing and certification for agricultural product etc. The government and policy maker should give attention on these issues and develop suitable policy for attracting youth in agriculture sector as a businessman so they should become job provider not job seekers.

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The secret of digital marketing strategy

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INTRODUCTION

With the growth of the technology, there is an enormous evolution in every field which means the occasion and blossom of the world of technology have finally come of age. It is an ever changing world with the advancement of technology in almost every aspects of our life and we have already witnessed the changes that technology brings to us in recent years. It is regularly evolving technologies, and the way of people using them is transforming. For instance, the way people choose and purchase the products and services.

Nowadays, the demand and needs of electronic devices are expectably quickly-growing. Most of the people cannot live without electronic devices such as smart phone, which is much more popular in this decade, tablet, laptop, iPod, camera and so on. Since the demand of electronic devices is expanding, it gives us all a significant clue as to the trend for future electronic products and what is to be expected in the world of digital marketing.

Latest Trends of Digital Marketing

In the digital age, digital marketers must change their aim from grabbing attention to holding attention to meet the new challenges. Many marketers realized the potentials and benefits of using the electronic devices and digital marketing was born. Marketers are getting smarter, technology is improving and marketers should figure out how to use data for how we interact and communicate with customers. There are even bigger growths on email marketing with the increase of social media, content marketing and mobile usage as more companies adopt digital marketing.

Digital marketing will catch-all term that includes all types of marketing done through the use of the Internet. It covered from the "push" marketing techniques such as email and instant messaging to the "pull" marketing techniques such as pay-per-click advertisements and content marketing. Users have to navigate to the website to view the content, for example websites, blogs and streaming media such as audio and video are pull digital marketing. Search Engine Optimization (SEO) is one tactic used to increase activity found that consumers prefer special sales and new product information, whereas those fascinating content was not useful. However, marketers send a message without the consent of the receivers, such as display advertising on websites and news blogs in push digital marketing. For instance, email, text messaging and web feeds can be classified as push digital marketing when the receivers have not given permission to receive the marketing information. Digital marketing is swiftly turning into a key pathway for every business looking to thrive today and tomorrow, as the Internet becomes an indispensable part of our life now. It is no secret that marketing has encountering more changes during the past few years than perhaps the preceding 100 years.

Strengths and Weaknesses of Digital Marketing

The results of digital marketing campaigns are easier to measure and it can reach an limitless audience. A web marketing campaign can be tailor made to fulfill the demand reaching

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a local audience or the World Wide Web. Because of the Web 2.0 and the social media outlets it contains, digital marketing is an interactive way to reach an audience. It allows directly contact between the organization and the audience which allows for valuable and precious feedback. However, weakness of digital marketing campaign which is, it does take some time to see the result and its success.

CONCLUSION

Digital marketing is ever-changing and required speedy innovation to keep up to date with it. Things are changing in a lot of ways, but not changing as fast people think. Innovations play significant role, they needs have future or longterm orientation, if organization wants to thrive and survive. In the digital age, marketers must change their focus from grabbing attention to holding attention by focusing on digital marketing.

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Horticulture in India: Importance, constraints and innovative techniques to overcome them

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Indian agriculture was mainly subsistence and based on traditional agricultural practices before 1960s. A marked increase in population of the nation coupled with difficulty in getting agricultural loans at economical rate and low agricultural production led to importing of food grains from foreign countries thereby draining the meagre foreign reserves that the country had. The high cost of imported food grains as wheat and rice made them essentially unreachable to the common folks of the country. Therefore the country's cereals demand was mainly fulfilled by coarse grains as millets which made up around 40% of all the cultivated grains, contributing more than wheat and rice. It was however in 1960s that green revolution commenced in India. It converted the Indian agriculture into an industrial system whereby modern methods and technology such as high yielding varieties, irrigation, pesticides and chemical fertilisers were used to remarkably increase the production per unit area of staple crops of the country as wheat and rice to the extent that the yield of rice and wheat doubled in Asia by 1990s and India achieved self-sufficiency in food production. On account of increasing income and health awareness amongst people, a shift in food pattern was observed which transformed Indian horticulture as a vibrant commercial venture with 5-6% annual growth rate in last decade. This lead to development of planned and organised horticultural policies which ultimately lead to the Golden revolution in the country.

Horticulture sector in India includes fruits, vegetables, floriculture, coconut, spices etc. The country is blessed with varied soil and agroclimatic conditions hence making it suitable for the cultivation of a large number of horticultural crops from tropical to temperate throughout the year. In fruit cultivation the country is among first ten in production of pineapple, citrus and apple while it holds the top most position in global production of mangoes, banana and cashew. As far as vegetable production is concerned India stands at a respectable position and is first in global production of cauliflower, second in onion and third in production of cabbage. It occupies top ten position in global production of tomato, potato and green peas. The production of fruits and vegetables in India was 307 Mt in 2017-18 which was 27 Mt higher than the production of food grains in the preceding year and it marks the consecutive sixth year when the production of horticulture crops surpassed the production of food grains. The compound annual growth rate of horticultural production in 2017-18 was 2.6%, double the annual growth in food grain output.

The data suggests that there is a growing preference for horticultural crops amongst Indian farmers. The small and fragmented land holdings in India makes the cultivation of short duration horticultural crops as vegetables more feasible for marginal farmers and promises quick returns. Better incomes, urbanisation and higher consumption of fruits and vegetable seem to be driving demand. Therefore the importance of horticulture in improving the productivity of land and economic condition of the farmers and entrepreneurs, generating employment, enhancing exports and above all providing

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nutritional security to the people is widely acknowledged.

In spite of widespread advantages of horticultural crops there are several gaps that limits the popularity and adoption of cultivation of horticultural crops by farmers. The higher production of horticultural produce is also accompanied with higher post-harvest losses of around Rs 32,000 crore, annually. In much of the developing world, rates of postharvest loss exceed 50 %, and cold storage is virtually non-existent owing to the high cost of equipment and limited electricity. Also the bumper production of horticultural crops during harvest season coupled with low processing potential leads to the tragic crash in price of the horticultural produce and hence India's record horticultural output has failed to translate into prosperity of farmers. One of the recent example of price crash was of tomato where the bumper tomato harvest during last three years have caused the tomato price to fall to as low as a rupee in some parts of Uttar Pradesh forcing farmers to dump there produce on fields. Peaking of the price during lean months is yet another problem associated with horticulture produce.

In order to address these problems a number of innovative techniques have been developed the adoption of which can solve most of the problems associated with horticulture production. Precision farming is one such innovative approach which can effectively increase horticulture production by many folds. Horticulture can be made more profitable for farmers by developing systems for productive and efficient use of water, nutrients and minimising the impact of pest and diseases by efficient forecasting technologies i.e., by adoption of precision farming. Precision farming relies on utilisation of specialised equipment, software and IT services to access real time data on crop, soil and air conditions. Sensors are present in the field which record data related to moisture content, temperature of soil and air. Information from sensors and satellites are integrated based on which decision regarding irrigation, fertiliser and pesticides application are taken. This helps farmers to avoid the wastage of input and ensures that soil has the right amount of nutrients and water that are required for optimum plant growth. A number of mobile applications have made precision farming possible for farming cooperatives and small family farms for e.g., a mobile application called SNAP have been recently invented by students of IIT, Roorkee. The application works on the principle of hyperspectral imaging of plant leaves. This techniques helps to quantify the amount of different nutrients as nitrogen, phosphorous, potassium, calcium, zinc etc. and the amount of water in plant leaves. A normal mobile phone camera can be used to capture the image of plant leaves and predict the level of nutrients in plant. Based on these prediction future line of action regarding application of fertiliser and irrigation in the field can be decided. The use of widely available mobile phone camera as an imaging device makes this mobile application to be profusely used in field by farmers.

Another hindrance in achieving high horticultural production is the insect infestation which is responsible for both pre and post-harvest losses. Many insects including fruit fly causes post-harvest rotting of a variety of fruits as mango, guava, pears, citrus, grapes and even vegetables as tomatoes, capsicum and bringal are affected. In Indian context *Bactocera dorsalis* is the major species which mainly damages mango and guava production in the country. The insect causes 5-70% crop loss in guava throughout India while the damage ranges from 2.5-59% in mango cultivation in Bangalore alone. The control method usually involves the use of methyl eugenol traps or pre harvest spray of insecticides

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as dimethoate, carbaryl and deltamethrin. The use of chemical pesticide for insect control however have serious limitations as they cause pollution, affect biological equilibrium, lead to resistance development among target pests, causes pesticide poisoning in humans and are a strict no as far as production of organic food is concerned. However recently Barrix catch fruit fly lure have been invented by Barrix Agro Sciences Pvt. Ltd. It uses an advanced isomer pheromone called 4 Allyl Veratrol to attract *Bactocera dorsalis* and 83 sub species. It involves the utilisation of a capillary impregnation technology so that more pheromone is trapped in a single trap providing prolonged utility for as much as 90 days. The trap have two step release i.e., flash release in which superficially adsorbed pheromone is released followed by slow and sustained release in which deeply trapped pheromone is released. Therefore this trap provides protection from fruit fly for relatively longer periods of time compared to methyl eugenol trap which needs to be rebaited after about 6 weeks in order to retain their seizing capacity. Hence Barrix Agro Sciences Pvt. Ltd, a Bangalore based startup have provided an eco-friendly crop protection method with minimal expenditure.

Keeping in view the requirement of cold storage for horticultural produce and limited resources of marginal farmers, the CoolBot technique was first developed by Ron Khosla, a farmer in upstate New York. This technique requires an air conditioner to convert an insulated room into cold storage. The normal window air conditioner cannot go below 16-18^{o} Celsius but the device CoolBot uses multiple sensors and a programmed microcontroller to overrides the temperature gauge of an air conditioner thereby maximising its cooling power. A CoolBot can reduce the temperature of a room to as low as 4-8^{o} Celsius when outside temperature shows great fluctuation. Therefore CoolBot is a cheap technology that puts cold storage within the financial reach of marginal farmers and extends the shelf life of the produce preventing distress sale by farmers.

It is estimated that at present rate of growth the population of world would increase tremendously to about 9 billion by the year 2030 and the major growth is expected in the developing countries where food shortages and malnutrition is the biggest threat to mankind. Horticultural produce including fruits, vegetables, mushrooms etc. can play a very vital role in feeding the world and overcoming the problem of malnutrition. It is therefore required that the problem of instable selling price of horticulture produce needs to be addressed by spending more on processing units located close to the farms, thereby converting bumper produce into processed food which fetches more prices and have increased storability compared to perishable raw material. A better cold chain network with pack houses and access to refrigerated transport can also help prolong the shelf life of fresh produce and earn better value for farmers. It is therefore the need of time to adopt different innovations so that horticultural production is increased and at the same time the post-harvest losses are minimised and availability of horticultural produce to each and every citizen irrespective of the economic strata of society is ensured, thereby ensuring nutritional security and a healthy world.

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Role of horticulture in nutritional security and economic development

Article id: 21883

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INTRODUCTION

A famous proverb says "Excess of anything is bad". This implies to each and every thing including population. More the population more are the mouths to be fed, the human count is increasing at an alarming rate leaving the only habitable planet so far, Earth in tatters. By 2025, the world's population is projected to reach 8.5 billion. The largest increase in populace is believed to be confined to the developing nations, where food shortage and malnutrition is already a major issue. According to David Rockefeller "The negative impact of Population Growth on all of our Planetary Ecosystems is becoming appallingly evident". Overpopulation leads to overexploitation of resources which will hinder the equilibrium and sustainability of agricultural systems. Population explosion is the root cause of several problems such as poverty, starvation, unemployment etc. food security has gained a major concern in today's scenario. Food and Agriculture Organization states "Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food for a healthy and active life". Food security does not completely refer to the physical availability of a single commodity but it has three pillars involving food accessibility, availability and nutrition. Horticulture an important branch of agriculture comes to the rescue of this problem. It may be defined as the cultivation, processing, pre and post-harvest management and marketing of fruits, nuts, spices, vegetables, flowers, aromatic plants, ornamental plants, plantation crops and many additional services. Horticultural sector encompasses the wide range of crops. For instance, the yield of horticultural crops on basis is comparatively higher than the per hectare yield recorded for cereals. Therefore, in the present context of high population density in the country, scarcity of cultivable land and shortage of nutritious food the cultivation of horticultural crops deserve preferential consideration.

Role of horticulture

In the agriculture sector, horticulture has become one of the major drivers of the growth. Horticulture sector is one of the most dynamic segments of agriculture. This sector has assumed a prominent position and an increment has been observed in its contribution to the agriculture and allied sectors. In the total agriculture output the percentage share of horticulture crops is around thirty percent. Among all the existing agricultural enterprise horticulture offers the best alternative for increasing food security in the developing nations. It ensures the increased self-sufficiency in food, better nutrition, improving the productivity of land and the economic condition of farmers as well as entrepreneurs and also ensures the enhanced generation of income and employment.

India is the second largest producer of fruits and vegetables in the world. India is endowed with diversity of soils which enables the availability of plethora of fruits and vegetables in the country throughout the year. The horticultural crops particularly the fruit crops are resilient to the climatic changes. Vegetables

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crops mostly grown by marginal and small famers augment the farmer's income. In addition, this sector provides a diverse and balanced diet for healthy living. Fruits, vegetables (including leafy vegetables) and nuts are a rich source of micronutrients (vitamins and minerals), fibers, bioactive compounds and proteins thereby assuming a prominent place in our daily diet. They are considered as protective foods. Leafy vegetables like Indian spinach, red and green amaranth have high amount of beta carotene (precursor of vitamin A) and folic acid. Ripe mango, papaya, carrot, pumpkin and orange fleshed sweet potato contain high quantities of pro vitamin A whereas local citrus fruits, carambola, aonla, jujube and guava provide vitamin C which is good for enhancing absorption of iron from the diet.

In the recent years the area under the cultivation of fruits and vegetable crops has received a great encouragement. In addition the horticulture crops when compared with the cereals are superior in terms of cultivation costs and income generation. The initial investment in the fruits crops such as banana, papaya and mango may be higher but in about 3 to 5 years the initial investment along with the recurring expenditure can be recovered resulting in higher profits in the subsequent years. Owing to the enormous increase in area and the shift in food pattern as a result of increasing income and the health awareness of the population horticultural research has received much importance.

Innovations in horticulture

In horticulture high tech precision farming which includes both temporal and spatial resource management is required. The precision farming aims efficient utilization of resources per unit of time and area. It basically means adding right amount of treatment at a right time and at correct location within the field. Due to the erratic climatic changes and pressure from rising population more attention is required towards the development of technology driven horticulture precision farming.

Many initiatives have been taken by different companies and firms to develop novel products and equipment that are beneficial to the agriculturists. Anulek Agrotech is set up by Mumbai-based entrepreneurs. Anulek focuses on increasing soil fertility with the purpose to attain higher agricultural productivity and crop yield with resource use. It produces a soil additive BIOSAT (Biochar based organic Soil Amendment Technology) which is made of biochar mixed with different organic nutrients. This product preserves soil fertility, maintains the topsoil strength, traps carbon emissions and increases crop production, thus reducing dependency on chemical fertilizers. Mitra (Machines, Information, Technology, Resources for Agriculture) is another Nashik based startup that aims to improve mechanization at horticulture farms with the use of research, development and high quality farm equipment. It produces air blast sprayers for fruits and vegetables particularly grapes and pomegranate. This is used to add a hormone that helps in the growth of crops, reduce the expenditure on manual labour and are also less time-consuming.

The horticultural commodities are produced seasonally and are highly perishable. So, cold chain storage is a prominent part of manufacturer's supply chain to minimize microbial activity, especially when there is a demand to transport fresh fruits, vegetables. A cost reducing innovation has been made in cold storage chain that involves the use of country's natural resource: solar power. A unique solar-powered micro cold storage system uses the methodology of thermal energy that controls compartment cooling in tandem with regular cooling. The solar panel instead of using the

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generators they generate the power that is directly sent to the compressor, which can regulate its own speed to adjust to the cooling demand. It does not involve the use of batteries as the thermal storage unit can store the power for more than 36 hours when there is no sun or when the weather is cloudy or rainy. Moreover, it works at zero running cost and also offers a clean and sustainable solution to growers all-round the year. An innovative way to maintain the ideal temperature of the products storage involves the use of wools which acts as a very efficient insulation material for chilled goods. It also involves zero cost as wool is biodegradable, compostable and makes use of by-products from the sheep rearing industry.

There is a huge spoilage in the horticultural produce at the time of harvesting, handling, storage, processing and marketing which results in the huge wastage. Efficient management of the waste products helps in bringing down the production cost of processed product, besides minimizing the environmental pollution. The horticultural waste is a rich source of vital constituent like carbohydrates, minerals, proteins, fats, fiber etc. For example, orange and melon seeds can provide fat and mineral matters. In the current situation some of the fruit waste are used for biogas generation and manure making. Similarly, mango seeds are rich in essential oils and are used in the manufacture of soaps and additional cosmetic products.

CONCLUSION

The horticulture sector is the most sustainable segment of agriculture throughout the world. The projected increase in the populace has certainly reduced per capita availability of natural resources and has given rise to poverty, malnutrition, high food prices and has also hindered the sustainability of agricultural systems. Over the past decade the earth's surface temperature has increased and it has a significant impact on agriculture. The horticultural crops are more resilient to the atrocities of the climate. The horticultural crops such as fruits and vegetables are rich in micronutrients, proteins and carbohydrates. They are the ready source of mineral salts, the lack of which causes metabolic disturbances. Many of them such as cabbage also have anticancerous compounds. Moreover, they give significantly higher yield, generate employment and also fetch higher prices in the market thereby improving the economic status of the farmers. Therefore, horticulture can considered as one of the best options for improving land productivity, safeguarding nutritional security for mankind and sustaining the livelihood of farming community.

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Hi-Tech nursery In Vegetable cultivation

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INTRODUCTION:

Success of any production system depends on the kind of seed we are sowing. Healthy seedlings grown in a well managed nursery will decide the yield and consequently the profit.

Nursery:

A vegetable nursery is a place or an establishment for raising or handling of young vegetable seedlings until they are ready for more permanent planting.Nursery is pre requisite for meeting the quality seedlings demand and nursery management is a potential tool to execute the activity in successful way (Krishnan et al., 2014).

HI-TECH nursery:

If there is sudden increase in the demand for certain commercial plants. It is not possible to fulfill this requirement by ordinary or common nursery practices. There is necessity to have special techniques and methods to meet the demand and only Hi-tech nurseries can satisfy this type of demand. These nurseries grow plants in greenhouse, building of glass or a plastic tunnel, designed to protect young plants from harsh weather, while allowing access to light and ventilation. Modern greenhouses allow automated control of temperature, ventilation, light, watering and feeding.

Hi-tech nursery is deployment of any technology which is modern, less environment dependent, capital intensive and has the capacity to improve the growth and quality of plants, or seedlings. Hi-tech nursery includes micro propagation, micro irrigation, fertigation, protected cultivation (green house/ poly house/ net house) and mechanization.

Need of HI-TECH nursery?

- High cost of hybrid seeds of different vegetables and increasing susceptibility of vegetable seedlings to a number of abiotic and biotic stresses, mainly to the viruses has warranted the attention of vegetable growers to produce seedlings of different vegetables under protected conditions.
- Field conditions during rainy and post rainy seasons are not at all favourable for raising virus free healthy seedlings of tomato, chilli, sweet pepper and brinjal due to the presence of high population of white fly in the atmosphere and soil borne fungus in soil. Therefore nursery raising technology under protected conditions has been standardized for different vegetables for raising virus free healthy seedlings.
- Protected nursery raising is also highly suitable and profitable venture for unemployed graduate youths of the country.

Importance of hi-tech nursery:

- High tech nursery is the only place, where people can get genuine quality planting material of their choice.
- The young plants, young and tender seedlings can be easily maintained in the high tech nursery.
- Vegetatively propagation of plants which required special skill and care can be easily

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done in the nursery but not at consumer's level.

- Seasoning of the seedlings against natural calamities is only possible in the high tech nursery.
- Many plants do not respond to direct sowing e.g. **cabbage, tomato, chilli** and papaya in the field as compared to transplanting of seedling raised in the nursery.
- For hardening of seedlings/grafts/layers, high tech nursery is a pre- treatment place, off season production of fruit, flower and vegetable plants high tech nursery is useful.

Advantages of hi-tech nursery:

- Better control over factors affecting plant growth (substrate, irrigation, fertilization)
- More marketing options (ways, sizes and times of the year)
- Higher plant densities
- Ability to use sites unsuited to field production
- Planting time is not weather dependent
- Some plants easier to grow in light weight containers for handling and shipping.

Different structures used for hi-tech nursery

- Multicelled plastic plug or pro trays
- Green house
- Net house
- Mist chamber
- Cold frames
- Hot beds
- Lath house
- Use of advanced containers

Optimum temperature ranges for germination of seeds

Crop	Germination (°C)	Dates to germinate (Approximate)	Growing temperature during day (°C)	Growing temperature during night (°C)
Tomato, Brinjal	21-24	3-4	18-21	12-18
Capsicum, chilli	26-28	4-6	18-21	12-18
Cole crops	18-24	2-3	10-18	8-14
cucurbits	24-30	2-3	21-24	12-18
onion	18-24	3-4	16-18	8-15

Protected structures required for raising nursery:

- Green houses
- Open vent green house
- Net house
- Mist chamber
- Cold frames
- Hot beds
- Lath house

Use of advanced containers in high tech nursery:

- Standard pots: Pots should be deep as well as broad and commonly used.
- Clay pots: It is excellent for large plants and alpines.
- Plastic pots: it is easy to handle and useful for outdoor plants.
- Seed pans: One third of the depth of a standard pot of the same diameter and used for germinating of the seeds.
- Half pots: It is ideal for plants having small root balls like azalea.
- Long tom pots: It is suited for deep rooted plants.

- Whale hide ring pots: It is bottomless and used for ring culture that holds the compost over the growing aggregate.
- Sweet pea tubs: It is ideal for seedlings which quickly develop long root system.
- Hydroculture pots: It has two portions. The outer pot holds the water supply and the inner one contains the growing medium.
- Bio degradable pots: It is good for propagating plants that face root disturbance when transplanted.
- Lattice pots: It is especially designed for qualities lets in water, but should be lined with hessian to retain soil.
- Peat pellets: It is expanded with water before use and good for seeds and rooting cuttings.
- Pot saucers: It is excellent for watering plants from beneath and to hold surplus water.
- Trays and modular systems: It is beneficial for sowing seeds, putting cuttings and growing of young plants, single use modules containing plastic cells, are useful for pricking out seedling and sowing seeds singly.
- Containers: Pots are used for culturing and displaying plants both indoors and outside. The small sized pots, pans and half pots are suitable for propagating and growing of young plants.
- Basically, pots are of two types, round and square. Pots may be made of clay, metals, plastic, wood and cement.

Vegetable transplants should be hardened-off by:

- Reducing temperature in the greenhouse through ventilation. Do not reduce temperature below 10°C on crops that are sensitive to chilling injury. Air movement also helps the hardening process.
- Reducing watering to let the plants wilt slightly. Do not let plants wilt excessively. Do not harden-off transplants by withholding fertilizer as this can result nutrient deficiencies and can delay field establishment.
- Holding plants outside for several days. This allows plants to become acclimated to the field conditions while they are still in the trays. Plants should be held in an area that is exposed to full sunlight, but is protected from drying winds.

Techniques of hardening:

- Depressing the available moisture to 20 percent by withholding the watering to the plant by 1-5 days before transplanting.
- Lowering the temperature also retards the growth and adds to the hardening processes.
- By application of 4000 ppm Nacl with irrigation water or by spraying of 2000 ppm of cycocoel.
- By spraying murate of potash@ 0.2 percent.

Duration and degrees of hardening:

- It is necessary that plants should be hardened according to their kind so that there is an assurance of high percentage of survival and slow growth under the condition to be expected at the time of transplanting.
- Hardening should be gradual to prevent or check the growth of the plant
- Warm season crops like tomato, brinjal and chillies do not favour severe hardening.
- In Indian conditions allowing the soil to become dry for 5-6 days does the hardening.

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Health and Environmental Impacts of Chemicals used in Agriculture

Article id: 21885

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INTRODUCTION

Agriculture remains the principal source of livelihood for majority of the population in India. The increased use of synthetic fertilizers and chemical pesticides in agriculture started in India since 1960s as part of the Green Revolution. Over the past five decades synthetic fertilizers' consumption has drastically increased several folds and India is now one of the leading producers of agrochemicals in the world. Many of the chemical pesticides can have harmful effects on human beings either as acute or chronic toxicity. Even Prime Minister Narendra Modi gave a clarion call to farmers to gradually reduce use of chemical fertilizers or eventually stop their usage to protect soil health.

Acute exposure to pesticides can lead to death or serious illnesses. About 355,000 people die globally each year due to unintentional acute poisonings. Two-thirds of these deaths occur in developing countries where such poisonings are associated with excessive exposure and or inappropriate use of toxic chemicals and pesticides present in occupational and domestic environments. The cumulative health impacts of human exposures to various agrochemicals can be a factor in a range of chronic health conditions and diseases like cancer, reproductive, endocrine, immunological, congenital and developmental disorders. Some of the other harm chemical fertilizers may cause include waterway pollution, chemical burn to crops, increased air pollution, acidification of the soil and mineral depletion of the soil.

Groundwater is the major source of drinking water in India. Besides, it is an important source of water for the agricultural and the industrial sector. The continued use of chemicals in agriculture has revealed its potential to percolate and reach the groundwater. There are four major routes through which pesticides reach the ground water. They may drift outside the intended area when sprayed, may percolate, leach or seep through the soil, may be carried to surface water as runoff. Factors that affect a pesticide's ability to contaminate water include its water solubility and half life, the distance from an application site to a body of water, weather, type of soil, presence of a growing crop and the method used to apply the chemical. Once in ground water, pesticides and their degradation products can persist for years, depending upon the chemical structure of the compounds and environmental conditions.

Good management, use, and disposal of agrochemicals are an important health and environment issue in developing countries. Safe pesticide management is essential to the well being of all those involved with using pesticides. The total exposure of a person to pesticide is the sum of all exposures resulting during different working situations like mixing, applying, storing or disposing the chemicals. Exposure to pesticides and there by its health impacts can be minimized at community level by appropriate and judicious use of agrochemicals, adopting recommended methods of mixing, applying, storing, disposing and practicing use of proper personal protective equipments (PPE).

Several studies revealed poor awareness regarding the harmful effects of agrochemicals among the farmers. The practice of storing,

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mixing and applying agrochemicals without personal protection and unsafe disposal of pesticide containers appears to be widely prevalent in the study villages. The farmers mainly depend on the information from the shop owner regarding the type and amount of agrochemicals to be used. The use of PPE while handling pesticides was low in the study villages. Only one in four farmers used to practice PPE adequately. Comprehensive program for creating awareness for safe management, handling and disposal of pesticides/containers among both users and shop keepers is required to address this important health and environmental problem. Education activities should focus on increasing awareness regarding need for using proper personal protective measures among farmers while handling agrochemicals and these activities need to be continuous and ongoing. Block agriculture office should take an active responsibility to monitor the use of PPE among farmers.

Many countries around the world like Brazil, Germany, Mexico and Benin have demonstrated that crops with good yield can be grown without the use of chemicals and have demonstrated that after the Chemical use in farming and its health and environmental implications in a rural setting in Chemical ban, yield has not dropped and there has been a large reduction in fatal poisonings.

CONCLUSION

The practice of storing, mixing and applying agrochemicals without personal protection and unsafe disposal of pesticide containers appears to be widely prevalent in rural. A comprehensive program for creating awareness for safe management, handling and disposal of pesticides among both users and shop keepers is required to address this important health and environmental problem.

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Global Warming is Global Warning

Article id: 21886

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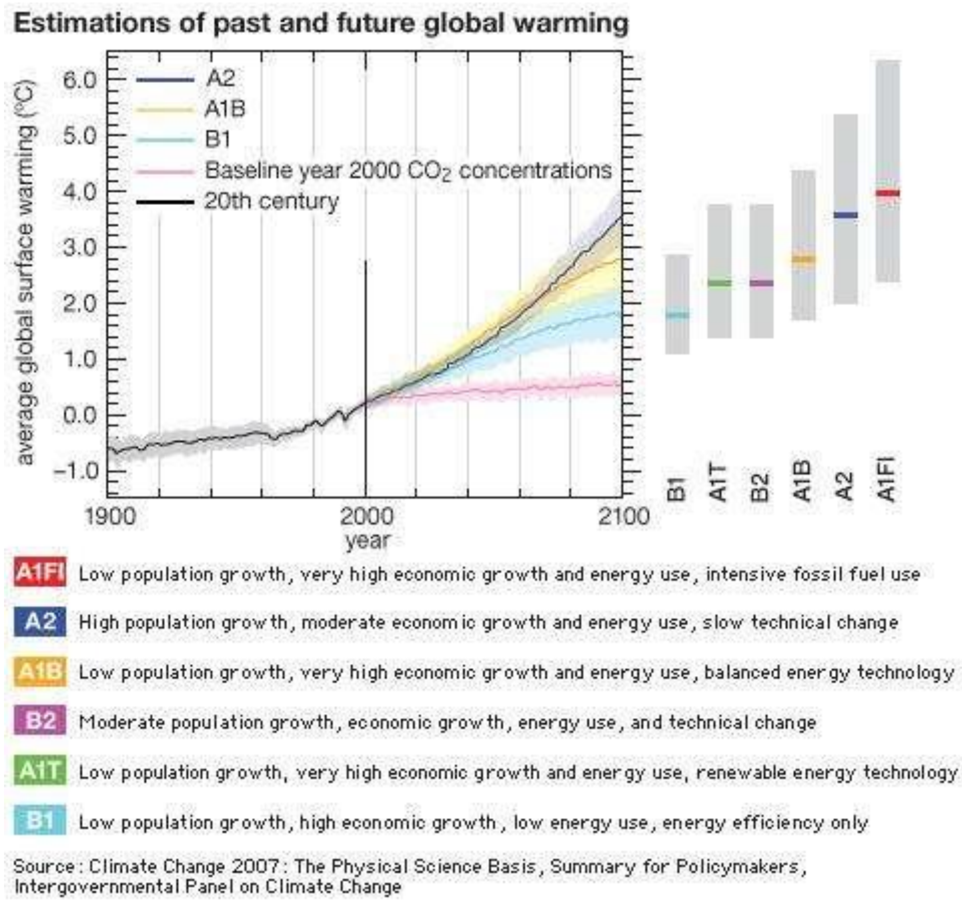
INTRODUCTION: Global warming is not a prediction. It is happening right now. It is a current increase in temperature of the Earth`s atmosphere, water, and surface. Human activities produce greenhouse gases that accumulate in the atmosphere and cause problems our planet faces today. Global warming can do more than just melt polar ice and change weather patterns throughout the world. It can change our maps, displace people from tropical islands and cities, and cause famine. There is no debate within the scientific community. The scientific evidence of the global warming is clear. The consequences of this global problem will only intensify if we do not confront the realities of climate change. Mankind should achieve some meaningful solutions in order to address the threat of global warming. We should stop deforestations, reduce carbon emissions, and fight misinformation. People should be prepared for the inevitable consequences of the global warming. It is our today`s reality and we should be responsible for doing so much harm to our planet Earth.

Many of the observed warming changes since the 1950s are unprecedented in the instrumental temperature record, and in historical and pale climate proxy records of climate change over thousands to millions of years.

In 2013, the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report concluded, "It is *extremely likely* that human influence has been the dominant cause of the observed warming since the mid-20th century." The largest human influence has been the emission of greenhouse gases such as carbon dioxide, methane, and nitrous oxide. In view of the dominant role of human activity in causing it, the phenomenon is sometimes called "anthropogenic global warming" or "*anthropogenic* climate change". A special report produced by the IPCC in 2018 honed this estimate further, noting that human beings and human activities have been responsible for a worldwide average temperature increase of between 0.8 and 1.2 °C (1.4 and 2.2 °F) of global warming since preindustrial times, and most of the warming observed over the second half of the 20th century could be attributed to human activities. It predicted that the global mean surface temperature would increase between 3 and 4 °C (5.4 and 7.2 °F) by 2100 relative to the 1986–2005 average should carbon emissions continue at their current rate. The predicted rise in temperature was based on a range of possible scenarios that accounted for future greenhouse gas emissions and mitigation (severity reduction) measures and on uncertainties in the model projections. Some of the main uncertainties include the precise role of feedback processes and the impacts of industrial pollutants known as aerosols, which may offset some warming.



Effects of global warming:

- One of the most obvious effects of global warming is extreme weather. The weather patterns are rapidly changing in all parts of the world. The increased rainfall in certain regions affects the balance that animals and plants need to survive. Climate changes cause health problems, animal migration, and the lack of food resources. Extreme heat and droughts in diverse regions of our planet have become disastrous to human health. The frequency of the heavy precipitation has lead to the greater prevalence of floods. Global warming creates more natural disasters. Extreme weather events will continue to occur with greater intensity. So, we will experience significant changes in seasonal temperatures variations, wind patterns, and annual precipitation.
- The effects of global warming on plants and animals are expected to be widespread and profound. Many organisms are migrating from the equator toward poles in order to find more comfortable conditions for their existence. However, a lot of animals go extinct as they are not able to compete in new climate regime. Global warming can cause the disappearance of up to one-third of Earth`s animals and one-half of plants by 2080.
- The effects of climate change due to the global warming can be devastating to the human society. People can face severe crop failures and livestock shortages that will cause civic unrest, food riots, famines, and political instability in the whole world. Global warming threatens our future health conditions. Humanity will experience an increase in tick-borne and

mosquito-borne diseases. What is more, people have become more vulnerable to extreme weather and climate changes that lead to serious mental health issues.

- The sea-level rise accelerates 0.12 inches per year in overage worldwide. This trend will continue if gas emissions remain unchecked. People are to blame for rapidly melting ice, warming oceans, and rising sea levels. Coral reefs are in danger as the ocean warms. Two-thirds of the Great Barrier Reef has been damaged as a result of climate change. Global warming increases the acidity of seawater because of the increase of the levels of CO2. The ocean is 26 percent more acidic than before the Industrial revolution. Melting glaciers endanger human life on the coastal areas. It can cause landslides and other land collapses.
- Increase in average temperatures is the major problem caused by global warming. The average global temperature has increased by about 1.4 degrees Fahrenheit over the past 100 years. 2016 was the hottest year on record worldwide. Such temperatures turn our environment into a breeding ground for infections and diseases. The worst thing is that increased dryness and greenhouse gases serve as natural fuels for wildfires.
- Scientists have predicted the effects for the future based on the climate changes due to the global warming problem. Snow cover is projected to contract. Sea ice is projected to shrink in both Antarctic and Arctic. Future tropical cyclones will become more intense. Heavy precipitation events, heat waves, and hot extremes will become more frequent. Arctic late-summer sea ice can disappear by the end of the 21st century. Sea level rise and anthropogenic warming will continue for centuries.
- People should cut power consumption in order to reduce the effects of global warming. We should buy less polluting cars, get more efficient refrigeration, and reduce water heating requirements. We should also fly less or not at all. Such measures will definitely influence modern society a lot. However, it is important for every person to do something to prolong life on earth. Just think, there is more carbon dioxide in the atmosphere today than at any point in the last 800,000 years.
- Air quality is affected greatly by the global warming. The air pollution caused by overabundance of carbon dioxide, vehicular emissions, and power plants influences the human respiratory system. A lot of people all over the world suffer from respiratory diseases.
- The Earth`s temperature will continue to rise so long as mankind continues to producegreenhouse gases. The surface of our planet can warm by 6 degrees this century.

According to NASA (National Aeronautics and Space Administrative)

- The Arctic is one of the worst places affected by global warming.
- More than 1 million species have become extinct due to the effects of global warming.
- Carbon dioxide levels in the atmosphere are at 406.5 ppm (parts per million) as of 2017, their highest levels in 650,000 years.
- Average global temperature is up 1.7 degrees F (0.94 degrees C) since 1880.
- The minimum expanse of Arctic summer sea ice has declined 13.3 percent per decade since the 1980s.
- Land ice has declined at the poles by 286 gigatons a year since 2002.
- Global sea level has risen 7 inches (176 millimeters) in the past century.

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CONCLUSION: Humankind activities are the main contributor to the increase in the green house gases in the atmosphere and so the major contributor to global warming. The earth is being damaged by unaccountable sources of the pollution and unsustainable human industrial activities, the most urgent strategy to restore the green earth should be that objective and truthful information on the global warming is to be shared among the global citizens.

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Role Dalal Mixture in Whitefly Management

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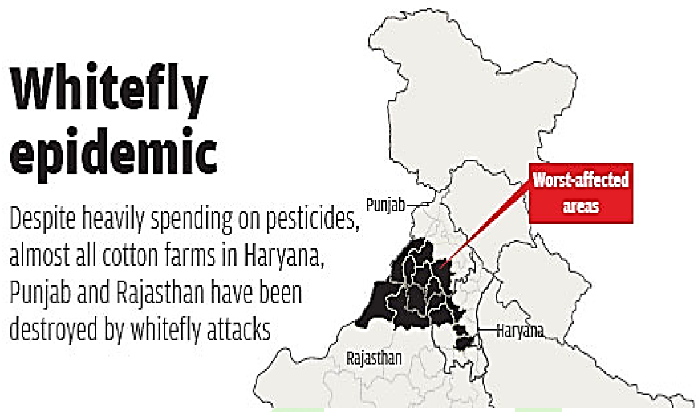

INTRODUCTION:

White Fly is a herbivorous sucking insect. White Fly nymphs are of the shape of tip of a pen. Due to small size it's not easy to see it with naked eye. This can be seen through microscope only. It survives on leaves by sucking sap. It helps in propagation of Leaf Curl Virus. It can spread virus through its saliva from one plant to the other. If a single leaf is having virus on it, even 10 White Flies are sufficient to spread it throughout the field. This insect is harmful for the crop but carnivorous insects present in the field controls these naturally.

Secretion of white fly contains sugars. Wherever this secretion drops, it creates a fungus like situation on that leaf surface and that leaf stops making food.

In 2015, entire cotton growing area of Punjab, Haryana and part of Rajasthan devasted by whitefly outbreak. Not a single insecticide is able to control this pest. At that time Dr. Surinder Dalal developed a solution for this and control this pest. The mixture which he developed named as Dr. Dalal Ghol or Dalal mixture.

Life Cycle of White Fly:

White fly lays its eggs on lower surface of the leaves. One white fly lays 100 to 125 eggs in its life and it takes one week for the eggs to hatch. Nymphs turn into pupa after 6-7 days and then it turns into the moth. Life period in moth stage is around 20-25 days. Wingless nymphs suck sap from leaves sticking to one place only. Whereas the adults suck sap from here and there.

Dr. Dalal Mixture (Dr. Dalal Ghol): Take 2.5 kg urea, 2.5 kg DAP, 500gm zinc (21%). Soak DAP in a plastic or earthen pot one day before spray and stirs it 2-3 times. This will help in dissolution of nutrients in water, perfectly. Before spray, urea and zinc shall be dissolved in water in separate pots. Then spray it with 100 ltrs of water in an acre. Care must be taken that no metallic containers shall be used for dissolution and 100 ltrs of water shall be used neither less nor more, otherwise it may damage the leaves. This will

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provide all the nutrition required by the plants and there is no need to provide fertilizers in the soil.

Schedule of Dr. Dalal Mixture:

First spray of the mixture can be started after first irrigation. In the cotton crop, sprays can be done at 10 days interval. Total 6-7 sprays are sufficient for cotton. In case average count of white flies cross ETL, spray of the mixture may be done at 2-3 days' interval. 10 sprays in sugarcane, 4-5 in wheat and not more than 2 in case of fodder.

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Cultivation of Dragon fruit: an ideal fruit for health and wealth

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Dragon fruit (Hylocereus polyrhizus F.A.C. Weber.) commonly known as pitaya is a member of the family Catacaeae and perennial climbing cactus with triangular green stem Cultivated in sub-tropical and tropical regions. It was first recognized worldwide as an ornamental plant and afterwards as a fruit crop dragon fruit plant take fruit 16 to 18 month after planting.Dragon fruits can tolerate poor soil conditions and Cultivated in sub-tropical and tropical regions. Tropical climate is good for dragon fruit cultivation. The optimum temperature range is about 20 - 30^{o}C. Highly organic, composted and well drained soils (pH5.5 to 7) Good drainage system is important to dragon fruit cultivation and planting space is about 2 x 2m. Pit size is about 60 x 60 x 60cm. fertilizer requirement Urea - 80g, Super phosphate - 80 g, Muriate of potash - 45 g per plant. Dragon fruit plant light pruning requirement give the proper shape and size and disease infected braches are removed Dragon fruit needs support to up right growth. Because of that, wooden or cement poles can be used. Immature stem must be tied to that column. Yield of 60-80 kg per pole have been reported in India. Dragon fruit market rate is Rs.300-400 kg per kg

INTRODUCTION

Dragon fruit (***Hylocereus spp.***) commonly known as strawberry pear,*pitaya* and Night-blooming cereusis a member of the family Cactacaeae and perennial climbing cactus with triangular green stem Cultivated in sub-tropical and tropical regions. It originated in North, Central and South America. The most advantage of this crop is that once planted, it will grow for about 20 years and one hectare could accommodate 1000 to 2000 dragon fruit plants. It produces fruit in the second year after planting and attain in full production within five years. Its interest has emerged due to their agronomy, industrial and medicinal importance and economic potential and currently being marketed worldwide. The dragon fruit plant come into flowering in May to June month and fruits from August to December month. After 16 to 18 months of planting dragon fruit plant start bearing the fruits. After one month of flowering dragon fruits are ready for harvest. The immature dragon fruit has a bright green color skin. After some day fruit skin turns in red color from dark green. The better harvesting time for dragon fruit is 3 to 4 days after fruit change its skin color. These fruit is non climacteric in nature hence it should be harvested at proper maturity stage. The cactus families are mostly highly adaptable to a new environment. The plants are able to tolerate drought, heat, poor soil and easily adapted in desert envirment. The modification of the stem for water storage, the reduction or absence of leaves, the waxy surfaces, and night-time opening of the tissues for carbon dioxide uptake (by the CAM process), enable the plants to tolerate harsh conditions. These are typical xerophytic characteristic of dragon fruit.

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Uses of the fruits nutritional value of dragon fruit

Dragon fruit is highly appreciated when served chilled and cut in half to reveal the attractive colors. The flesh and seeds are scooped out with a spoon, much like a kiwi fruit. The flesh is firm and crisp, with a delicately sweet and lingering flavour. The juicy flesh can also be mixed with milk or sugar, used in marmalades, jellies, ices, ready to Serve (RTS) Beverages and soft drinks.The red fleshed varieties of Dragon fruit are rich in antioxidants It is rich with beta carotene, lycopene, vitamin E, vitamin C, phosphorus and calcium, bones, teeth and skin and contain essential fatty acids, linoleic acid and linolenic acid. The various nutrients in a dragon fruit per 100 g, are Carbohydrate 82.14 g, Proteins 3.27g, Vitamin c 9.2mg, Calcium 107mg, sodium (Na) 39 mg, Fiber 1.8 g, Energy 264 k.cal.

Health Benefits from Dragon fruit.

Dragon fruit promotes the immune system and being rich source of vitamin C and fibres help provide an overall healthy body. The fruit helps indigestion. Because of the richness in fibres. Dragon fruit prevent formation of cancer causing free radicals. Dragon fruit cleans toxic ingredients thus prevents the occurrence of colon cancer. Dragon fruit as anti-oxidant its fruit helps to control cholesterol level. It is also rich in flavonoids that are known to have favourable effect against cardiac related disease.

Climate

Dragon fruits can tolerate poor soil conditions and cultivated in sub-tropical and tropical regions. Tropical climate is good for dragon fruit cultivation. The optimum temperature range is about 20 - 30^{o}C but it grows successful temperature range from 20 to 40^{o}C. Also it needs about 500-1200mm annual rainfall with alternate dry and wet climatic condition.

Soil

Highly organic, composted and well drained soils (pH 5.5 to 7) with good drainage system is important for dragon fruit cultivation. Soil use 10-30% sandy soils with organic matters provide good condition for plant growth. Sandy and sandy loam soils also suitable for dragon fruit cultivation. Heavy soil is not suitable for dragon fruit cultivation.

Propagation method of dragon fruit:

Dragon fruit is propagated by seed or cuttings. Seedlings are slow growing, and unreliable for fruit production making them unfavorable for propagation. Healthy, green cuttings are preferred for rapid propagation

By cutting

The dragon fruit is best propagated by cuttings. The cuttings are made from 8 to 12 month old triangular climbing shoots from mother plant. The cutting should be taken from healthy vigorous shoots and free from disease and insect infection. The cuttings are prepared at during December and January or August to first week of September. The length of cuttings is taken as 20 to 25 cm.Before cultivation, keep this cutting piece in a pot with the mixture of Dry cow dung, Topsoil, and Sand in the ratio of 1:1:2. Avoid sunlight from these cut piece. After planting 60 to 90 days sprouting is done than propagated cuttings are shifted in field.

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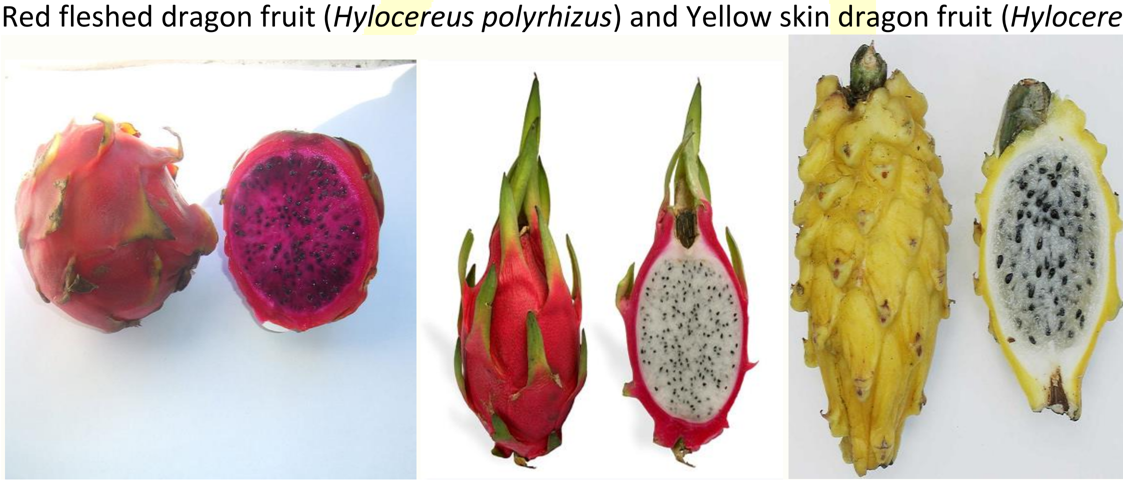
Fig - Propagation through cutting

Varieties

There are three types of varieties of dragon fruit namely, White fleshed dragon fruit (*Hylocereus undatus*), Red fleshed dragon fruit (*Hylocereus polyrhizus*) and Yellow skin dragon fruit (*Hylocereus megalanthus*).



(a) **Red fleshed** **(B) White fleshed** **(C) Yellow skin**

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Planting

The best time for planting is either July to September or February to march. After through preparation of land 2 x 2 meter spacing between plants and planting in a pit which is 60 cm x 60 cm x 60 cm in a size is maintained one hectare area accommodate about 2500 dragon fruit plants. For plant proper development and growth the support of cement concrete or wooden pole.

Fertilizers of dragon fruit farming

Dragon fruit requires nitrogen, phosphorus and potash for better yield and quality. Each requires 10 to 15 kg organic compost for well vegetative growth. Each plant also requires 40 grams muriate of potash, 90 grams Single Super Phosphate and 70 grams Urea per plant in the vegetative phase.

At flowering to harvesting stage apply 100 g muriate of potash, 50 g Urea and 50 g Single Super phosphate on a plant at fruit bearing phase for obtaining a high yield of dragon fruit.

Fertilizers apply stage.

- Before flower stage in April
- Fruit developing stage in July to Aug
- Harvesting of fruit stage In December

INTERCUTURAL OPERATION

Staking

Dragon fruit needs stakes to support its growth because of slender plant growth. Normally the support is made of concrete and its top framework is made of wood, used tyres. Farmers can also use old bicycle tyres to make the top framework in order to save cost.

Pruning

Pruning is most useful practices in dragon fruit cultivation. The purpose of pruning is to remove the unwanted, disease infected branches as well as to give balance to the whole plant. Maintain at least 40 to 50 main branches of the plants to get a healthy canopy is requred.


Irrigation

Dragon fruit belongs to cactus family so it requires low irrigation. Water management is a critical aspect for the successful cultivation of dragon fruit. In tropical, sub-tropical arid and semi-arid regions of India, water is a scarce resource and its efficient use has to be prioritized. There are so many irrigation systems including drip irrigation, basin irrigation and sprinkler irrigation but dragon fruit plant requires less water compared to other fruit farming. Regular water supply through drip irrigation system is essential for sustainable production of dragon fruit. The irrigation is required frequently at different stage flowering and fruit development stage of dragon fruit farming like planting.

Flowering and fruiting

In India the main fruiting season falls between May to October. Buds are contained in aerioles along the three ribbed stem and emerge in the summer months. Flowering will commence after 18 to 22 month of planting. Once emerged, the buds then form into branches or flowers. The scented, white, night-blooming flowers attract bats and moths. Bees and other insects visit the flowers before dusk as the petals open and after dawn as the flowers begin to close. Flowers only open for two to three days, after which, fruit set and development is rapid growth. Fruit setting will take place after 4-6 weeks after floral emergence. Pollination occurs at night since the flower bloom only during night time. Assisted pollination can be carried out. The pollens has to be collected, kept and stored. Assisted pollination is done at night time when the flower blooms. Hand pollination is done during 8 to 10 pm. assisted pollination produces bigger fruits almost 800g per fruit.

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Fruit can be harvested approximately 30 days after the flower closes. The fruit must be fully expanded and have 80 to 85% pink colour in the skin depending on verity. The average fruit weight is 350 to 450 g. The fruit is non-climacteric, having the best flavour, soluble sugar level and acidity when harvested at the full colour stage. Fruit will colour at the green-pink stage, but full flavour does not develop. Dragon fruit can be stored for two to three months at 7-10ºC with a relative humidity of 90-95%.

Yield: Yield of 60-80 kg per pole have been reported in India. Market rate is Rs.300-400 kg per kg meanwhile the farm rate is between Rs.125 to 200 per kg.

Pests and diseases: Common pest that attack the plant is birds, squirrels, bats, snailsants, and fruit flies and beetles. They damage both the young and adult fruit. To protect the fruits from birds, provide proper netting to the plants is requred.

Fruit flies

Observation in the field no visual sighting of flies at any stage of fruit development even when ripen. fruit fly on pitaya and regarded as quarantine pest for US and Canada. Thus strict quarantine requirement will be imposed on imported consignments.

Managing pest - Current views and trends

Organically grown pitaya. Agronomic and crop hygiene. Chemical control – usage of Cu sulphate or any cu compounds, mancozebs, Fruit bagging, soil amendments – organic fertilizer, soil microbes, effective microbes, antagonist, mychorrhiza and calcium infusion. • Soil improvement and crop health and quarantine measures.

Anthracnose

Anthracnose is acommon diseases of *pitaya.* It is due to agent *Colletotrichum gloesperoides*. Most common character disease red brown concentric lesions with ascervuli developed near ribs of vine, in particular where the spines emerged from the rib edge and disease also attack on fruits. Diseases see prominent during wet seasons.

Control

Fungicidal sprays like mancozeb, maneb would be able to control the disease.

Brown stem spot disease

Caused by *Botryoshaeria dothidea*

CONCLUSION

Dragon fruit is a perennial crop that gives fruit for many years after planting. It is one of the crops which is blessed with little pest problems and less requirement of water as compared to other major economic crops. Dragon fruit having high nutritional value and anti-oxidant properties. New ways and strategy in providing less cost and higher returns are sought so as to make the crop a viable investment.

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Mung bean (*Vigna radiata*) - A medicinal food

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Now days, there is an increase in the intake of plant-derived foods to improve health status for preventing chronic diseases. The mung bean,*Vigna radiata* (L.) is one of the most important short-season, summer growing legumes and is grown widely throughout tropic and subtropic regions. Mung beans have wide applications in agriculture, health food, pharmaceutical, and cosmetics industries. Bean seeds and sprouts are excellent examples of functional foods that lower the risk of various diseases. Moreover, the seeds and sprouts have health-promoting effects in addition to their nutritive value. During the germination process of the mung bean, its chemical constituents undergo a series of biochemical reactions. One such reaction is the synthesis of small active compounds from macromolecular substances, promoting absorption and utilization. Another change observed during germination is the formation and accumulation of many types of active substances, such as polyphenols, saponins, vitamin C, etc. Therefore, the changes in the chemical composition of mung beans during germination will lead to substantial and important changes in the pharmacological activities of mung beans as well. In the present review, the nutritional value, chemical constituents and metabolite changes during the sprouting process, as well as pharmacological activities and clinical applications of mung beans, which will provide a better understanding of the potential applications of this common food are summarized.

Phyto constituents:

Chemical constituents those are isolated from mung bean are flavonoids, phenolic acids, organic acids, amino acids, carbohydrates, and lipids. Dynamic changes in metabolites during the sprouting process and related biological activities, including antioxidant, antimicrobial, anti-inflammatory, antidiabetic, antihypertensive, lipid metabolism accommodation, antihypertensive, and antitumor effects, etc., with the goal of providing scientific evidence for better application of this commonly used food as a medicine. Flavone, isoflavone, flavonoids, and isoflavonoids (compounds 1–44) are the important metabolites found in the mung bean. Most flavonoids have polyhydroxy substitutions and can be classified as polyphenols with obvious antioxidant activity. Vitexin(apigenin-8-C-*β*-glucopyranoside) and isovitexin (apigenin-6-C-*β*-glucopyranoside) have been reported to be present in mung bean seeds at about 51.1 and 51.7 mg g^{-1}, respectively.

The mung bean (*Vigna radiata*) has been consumed as a nutrient food in India for more than a decade. It is well known for its detoxification activities and is used to refresh mentality, alleviate heat stroke, and reduce swelling in the summer. The mung bean was recorded to be beneficial in the regulation of gastrointestinal upset. The seeds and sprouts of mung beans are also widely used as a fresh salad vegetable or common food in India, Bangladesh, South East Asia, and western countries. As a food, mung beans contain balanced nutrients, including protein and dietary fiber and significant amounts of bioactive phytochemicals. High levels of proteins, amino acids, oligosaccharides and polyphenols in mung beans are thought to be the main contributors to the antioxidant, antimicrobial, anti-inflammatory and antitumor activities of this food and are involved in the regulation of lipid metabolism.

Nutritive value:

In recent years, studies have shown that the sprouts of mung beans after germination have more obvious biological activities and more plentiful secondary metabolites since relevant biosynthetic enzymes are activated during the initial stages of germination. Thus, germination is thought to improve the nutritional and medicinal qualities of mung beans. Importantly, mung beans are composed of about 20%–24% protein. Globulin and albumin are the main storage proteins found in mung bean seeds and make up over 60% and 25% of the total mung bean protein, respectively. Therefore, due to its high protein content and digestibility, consumption of mung beans in combination with cereals can significantly increase the quality of protein in a meal. Mung bean protein is rich in essential amino acids, such as total aromatic amino acids, leucine, isoleucine, and valine. However, compared with the reference pattern, mung bean protein is slightly deficient in threonine, total sulfur amino acids, lysine, and tryptophan. Moreover, the proteolytic cleavage of proteins during sprouting leads to a significant increase in the levels of amino acids.

Phenolic acids are secondary metabolites primarily synthesized through the pentose phosphate pathway (PPP) and shikimate and phenylpropanoid pathways. Phenolic acids are major bioactive phytochemicals, and their presence in wild plants has facilitated the trend toward the increasing use of wild plants as foods . Twelve phenolic acids have been identified from mung bean seeds and sprouts. Based on high levels of total phenolics and total flavonoids, mung beans show the benefits of 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activities, tyrosinase inhibition, and antiproliferative and alcohol dehydrogenase activities, which allow it to be used as a substitution for proper prescription drugs and as a preventative or therapeutic agent for the treatment of human diseases. Organic acids and lipids have also been found in mung beans and sprouts. Twenty-one organic acids, including phosphoric and citric acid, and 16 lipids, including γ-tocopherol, were reported to be the major components of mung beans.

Biological values:

In ancient books, mung beans were well known for their detoxification activities. Mung bean protein, tannin and other polyphenols are thought to combine with organophosphorus pesticides, mercury, arsenic, and other heavy metals, promoting the excretion of sediments from the body. Mung beans have been shown to possess antioxidant, antimicrobial and anti-inflammatory activities. Moreover mung beans have antidiabetic, antihypertensive, lipid metabolism accommodation, antihypertensive and antitumor effects. These various properties of this functional legume are discussed below.

Biological activities and compounds in mung beans

Biological activities	Biological compounds
Antioxidant effects	Proteins, polypeptides, polysaccharides, polyphenols
Antimicrobial activity	Enzymes, peptides,

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Biological activities	Biological compounds
	polyphenols
Anti-inflammatory activity	Polyphenols
Antidiabetic effects	Polyphenols
Lipid metabolism accommodation	Phytosterol
Antihypertensive effects	Proteins, amino acids
Antitumor effects	Polyphenols, mung bean trypsin inhibitor fragments
Antisepsis effects	Polyphenols, aqueous
	extracts from mung bean coat

CONCLUSION

The beneficial effects of mung bean are due to chemical constituents and it may be provided a solid base for the development and utilization of mung beans as medicinal food. Thus, future studies may focus on the extraction and purification of new active substances from mung beans for agriculture, health food and pharmaceutical applications.

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HYDROPONICS: a possible option for augmenting food production in nonarable and shrinking arable region

Article id: 21890

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INTRODUCTION

The unremitting trends of increasing population, urbanization, diminishing water supply, and continued climate change have contributed to declining stocks of arable land per person and is projected to decrease by 2050 to one-third of the amount available in 1970 (FAO 2016). Therefore, our planet is running short of farmland to feed the growing population resulting in an increasing need for alternative methods of food production. To maintain the sustainability of earth and effective utilization of resources like soil, water, nutrients, and sunlight; soilless cultivation remains as one of the options. Growing plants with their roots immersed in a nutrient solution without soil are known as hydroponics or soilless culture. Water, nutrients, and light are important determinants for hydroponics, and plants can be grown anywhere as long as their growth requirements are met.The pursuit of urban agriculture as part of a city's green infrastructure is often a challenge, particularly within compact cities, where there is a limited amount of space between buildings for urban farming and gardening. Soilless farming, though it has been around for over two millennia, is becoming more prevalent in modern food production as it not only saves water and space but also provides an effective option for indoor urban farming.

Importance of hydroponic farming

Greenhouse farming using the hydroponic system is more advantageous compared to conventional production systems with soil, including a greater density of plants and a decreased area requirement. Furthermore, the yield could in some cases be larger than when plants are grown in soil. When plants are grown in a closed, dense system, evaporation is kept at a minimum thus reducing the amount of water use and the plants are protected from the weather, insects and pests and fewer outbreaks of diseases when no soil is used. Recently, the application of hydroponic techniques in Vertical Farming (VF) has gained importance in the cities which combines the design of building and farms all together in a high rise building to effectively utilize the underutilized space. This technology needs to be manifested both in agriculture and architecture together. Improved growing space and water conserving methods, efficient nutrient management for food production under hydroponic have shown some promising results all over the world. Therefore, food production can be augmented in the non-arable region, space shrinking condition with this technology. In addition, underutilized space can be utilized efficiently for soilless culture in the future.

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Figure: Hydroponic-vertical farming

Conclusion and future prospective

Especially in a country like India, where urbanization is increasing, there is no option but adopting soilless culture to help improve the yield and providing quality produce to the people, therefore hydroponics is better option to achieve this. However, Government intervention and Research Institute interest can propel the use of this technology sooner and faster.

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Integrated Farming System: Dynamic approach towards sustainability

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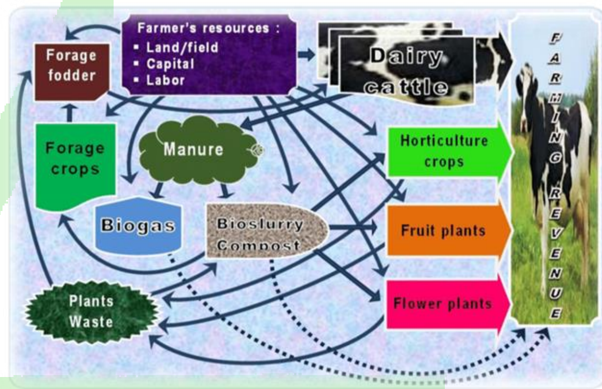
Integrated Farming System is a whole farm management system and a dynamic approach which can be applied to any of the farming system around the world, generally aims to deliver more sustainable agriculture for achieving ecological balances. Integrated Farming systems combines the best of modern tools and technologies with traditional practices according to a given site and situation. In simple words, it means using many ways of cultivation in a small space or land. At present, the farmers concentrate mainly on crop production which is subjected to a high degree of uncertainty in income and employment to the farmers. In this contest, it is imperative to evolve suitable strategy for augmenting the income of a farm. Integration of various agricultural enterprises *viz*., crop production, animal husbandry, fishery, forestry etc. has great potentialities in the agricultural economy. These enterprises not only supplement the income of the farmers but also help in increasing the family labour employment.

1. The integrated farming system approach introduces a change in the farming techniques for maximum production in the cropping pattern and takes care of optimal utilization of resources.
2. The farm wastes are better recycled for productive purposes in the integrated system.
3. A judicious mix of agricultural enterprises like dairy, poultry, piggery, fishery, sericulture etc. suited to the given agro-climatic conditions and socio-economic status of the farmers would bring prosperity in the farming.



Advantages of Integrated Farming System

1. Higher food production to meet the demand of ever increasing population pressure of the country.
2. Increase farm financial gain through correct residue usage and allied elements.
3. Improve soil fertility and productivity through organic waste usage.
4. Integration of allied activities results in the production of alimental food enriched with macromolecule, macromolecule, fat, minerals and vitamins.
5. Integrated farming system helps in environmental protection through effective usage of waste from animal activities like farm, poultry and bird rearing.
6. Reduces cost of elements through input usage from the byproducts of allied enterprises.
7. Regular stable financial gain through the product like egg, milk, mushroom, vegetables, honey and silkworm cocoons from the coupled activities in integrated farming.

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8. Inclusions of biogas in integrated farming system solve the prognosticated energy crisis.
9. Cultivation of fodder crops as intercropping and as border cropping ensure provision of adequate nutritious and alimental fodder for animals like cows, goat / sheep, pig and rabbit.
10. Minimization of soil loss through erosion by agro-forestry and correct cultivation of every a part of land by integrated farming system.
11. Generation of normal employment for the farm members of the family of small and marginal farmers.

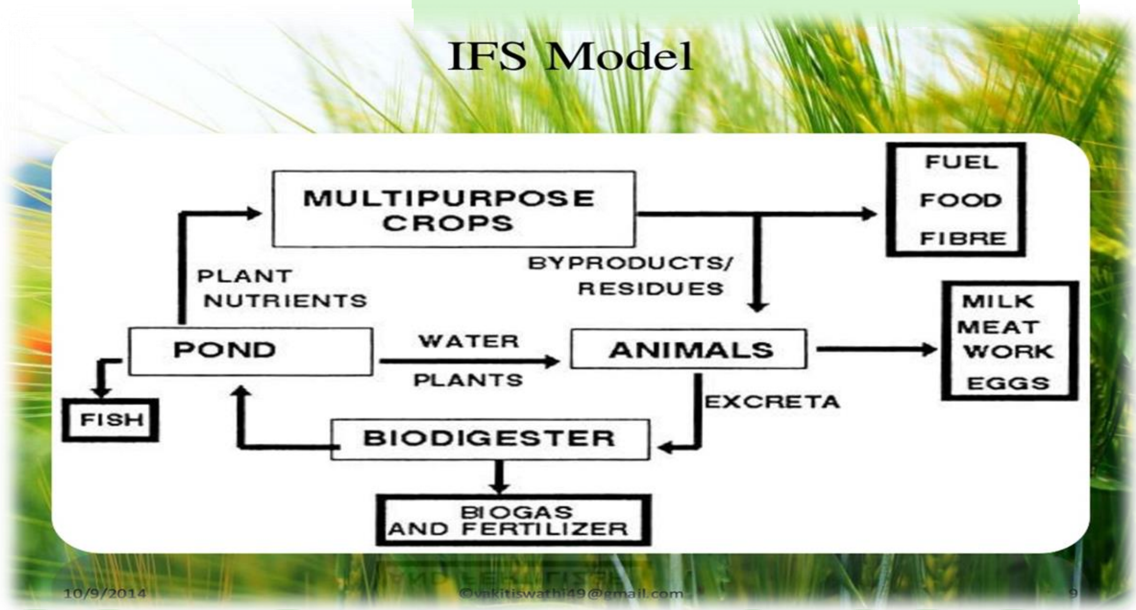
Components of integrated farming system

Crops, livestock including poultry and other birds and trees for fuel, food and fiber are the major components of integrated farming system.

There might have inclusion of certain systems like mono cropping, mixed/intercropping, multi-tier cropping of cereals, legumes (pulses), oilseeds and forage crops etc.

There might be use of milch cows, goats, sheep, poultry and bees under livestock integration system.

There might have agro forestry system like tree components which may include timber, fuel, fodder and fruit trees.



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Integrated Nutrient Management of Horticulture Crops

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Integrated Nutrient Management refers to the maintenance of soil fertility and of plant nutrient supply at an optimum level for sustaining the desired productivity through optimization of the benefits from all possible sources of organic, inorganic and biological components in an integrated manner. INM combines inorganic, organic and biological sources of nutrients in a judicious and efficient way into ecologically sound and economically viable farming systems. Inorganic fertilizers of interest for balanced nutrition today include – urea, DAP, MOP, gypsum, agribor/borax, zinc sulphate and others to meet equivalent amounts of nutrients . Organic fertilizers include prominently – vermicompost, FYM, poultry manure, green manuring, and bone-meal. Biological fertilizers include mainly – VAM, PSM and nitrogen-fixing bacteria. There are various components of plant nutrients for INM which can be applied in an integrated way: Inorganic fertilizers, Organic Fertilizers, Green manure crops, Crop residues, Crop rotation, Bio fertilizers. Advantages of INM: Enhances the availability of applied as well as native soil nutrients. Synchronizes the nutrient demand of the crop with nutrient supply from native and applied sources. Provides balanced nutrition to crops and minimizes the antagonistic effects resulting from hidden deficiencies and nutrient imbalance. Improves and sustains the physical, chemical and biological functioning of soil. Minimizes the deterioration of soil, water and ecosystem by promoting carbon sequestration, reducing nutrient losses to ground and surface water bodies and to atmosphere.

INTRODUCTION

Integrated Nutrient Management refers to the maintenance of soil fertility and of plant nutrient supply at an optimum level for sustaining the desired productivity through optimization of the benefits from all possible sources of organic, inorganic and biological components in an integrated manner.

INM combines inorganic, organic and biological sources of nutrients in a judicious and efficient way into ecologically sound and economically viable farming systems. Inorganic fertilizers of interest for balanced nutrition today include – urea, DAP, MOP, gypsum, agribor/borax, zinc sulphate and others to meet equivalent amounts of nutrients . Organic fertilizers include prominently – vermicompost, FYM, poultry manure, green manuring, and bone-meal. Biological fertilizers include mainly – VAM, PSM and nitrogen-fixing bacteria.

Principles Of INM

- Maximize the use of organic material
- Ensure access to inorganic fertilizer and improve the efficiency of its use
- Minimize losses of plant nutrients

Goals of INM

- ✓ To maintain soil productivity.
- ✓ To ensure productive and sustainable agriculture.
- ✓ To reduce expenditure on costs of purchased inputs by using farm manure and crop residue etc.
- ✓ To utilize the potential benefits of green manures, leguminous crops and biofertilizers.
- ✓ To prevent degradation of the environment.
- ✓ To meet the social and economic aspirations of the farmers without harming the natural resource base of the agricultural production
- ✓ To maintain or enhance soil productivity through balanced use of mineral fertilizers combined with organic and biological sources of plant nutrients

- ✓ To improve the efficiency of plant nutrients, thus limiting losses to the environment
- ✓ To improve physical conditions of soils

Advantages of INM

- Enhances the availability of applied as well as native soil nutrients
- Synchronizes the nutrient demand of the crop with nutrient supply from native and applied sources.
- Provides balanced nutrition to crops and minimizes the antagonistic effects resulting from hidden deficiencies and nutrient imbalance.
- Improves and sustains the physical, chemical and biological functioning of soil.
- Minimizes the deterioration of soil, water and ecosystem by promoting carbon sequestration, reducing nutrient losses to ground and surface water bodies and to atmosphere

Contraints of INM

- Non-availability of FYM
- Difficulties in growing green manure crops
- Non-availability of biofertilizers
- Non-availability of soil testing facilities
- High cost of chemical fertilizers
- Non-availability of water
- Lack of knowledge and poor advisory services
- Non-availability of improved seeds
- Soil conditions
- Non-availability of credit facilities

Basic components of Integrated Nutrient Management

There are various components of plant nutrients for INM which can be applied in an integrated way.

- Inorganic fertilizers
- Organic Fertilizers
- Green manure crops
- Crop residues
- crop rotation
- Bio fertilizers

Inorganic fertilizers

Inorganic fertilizers are rich in nutrients. They are required in less quantity to supply nutrients as compared to organic manures. But continuous use of chemical fertilizers deteriorates the soil conditions. Therefore, inorganic fertilizers should be accompanied by organic / biofertilizers. eg- Urea, DAP, MOP, Gypsum, Borax, Zinc sulphate, SSP etc.

Organic Fertilizers

FYM- FYM is prepared basically using cow dung, cow urine, waste straw and other dairy wastes. It is highly useful and is rich in nutrients.

Nutritional status of FYM (%)

N-0.5,
P-0.25,
K-0.40,
Ca-0.08,
S-0.02,
Zn-0.004,
Cu-0.0003
Mn-0.007,
Fe-0.45

Vermicompost

Vermicompost is the final product of composting organic material using different types of worms, such as red wigglers (*Eisenia Fetida*) or earthworms, to create a homogenized blend of decomposed vegetable and food waste, bedding materials and manure. Vermicompost , similarly known as worm castings or worm manure, enriches the soil and can be used as a high grade natural, organic fertilizer.

Composition

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Nutrient element	Vermicompost (%)	Garden compost (%
Organic carbon	9.8 - 13.4	12.2
Nitrogen	0.51 - 1.61	0.8
Phosphorus	0.19 - 1.02	0.35
Potassium	0.15 - 0.73	0.48
Calcium	1.18 - 7.61	2.27
Magnesium	0.093 - 0.568	0.57
Sodium	0.058 - 0.158	<0.01
Zinc	0.0042 - 0.110	0.0012
Copper	0.0026 - 0.0048	0.0017
Iron	0.2050 - 1.3313	1.1690
Manganese	0.0105 - 0.2038	0.0414

Other Organic Manures

Sheep and Goat Manure-The droppings of sheep and goats contain higher nutrients than farmyard manure and compost. On an average, the manure contains 3 % N, 1% P_2O_5 and 2% K_2O.
Poultry Manure-The excreta of birds ferment very quickly. If left exposed, 50 % of its nitrogen is lost within 30 days. The average nutrient content is 3.03% N; 2.63% P_2O_5 and 1.4% K_2O.

Biofertilizers

'Biofertilizer' is a substance which contains living microorganism which, when applied to seed, plant surfaces, or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant.

Green Manuring

Using Green Manure and the cover crops which are incorporated into the soil when they are still green are called as green manures. Green manure crops: Alfa-alfa, Cowpea, Fenugreek, mustard, Sesbania, Sunnhamp, Soybean.

Crop Rotation

Crop rotation is the practice of growing a series of dissimilar/different types of crops in the same area in sequential seasons.

Advantages

- Rotation of crops improves the fertility of the soil and hence, brings about an increase in the production of food grains.
- Rotation of crops helps in saving on nitrogenous fertilizers, because leguminous plants grown during the rotation of crops can fix atmospheric nitrogen in the soil with the help of nitrogen fixing bacteria.
- Rotation of crops help in weed control and pest control. This is because weeds and pests are very choosy about the host crop plant, which they attack. When the crop is changed the cycle is broken. Hence, pesticide cost is reduced.
- Crop rotation adds diversity to an operation.

Nutrients

- Nutrients absorbed by the plants from the soil are called mineral nutrients , they are derived from the minerals.
- The importance of mineral as nutrient for sustaining plant growth and development, and proper metabolic activities.

Criteria of essentiality:

- The function of element must not be replaceable by another mineral element
- The element must be directly involved in plant metabolism.
- A given plants must be enable to complete its life cycle in the absence of mineral element.

Classification of essential plant nutrients

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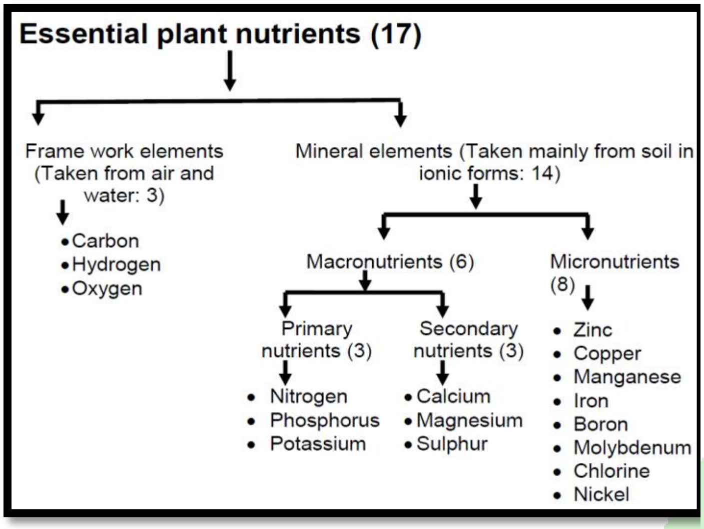

Diagnosing the mineral nutrition status of fruit crops-

Fruit growers have three main tools to use in evaluating the mineral nutrition status of their plantings.
These are:

- Examine visual symptoms exhibited by leaves, stems, and fruit.
- Analyzing leaf tissue and.
- Testing the soil.

Used together properly these are powerful tools that can be used to prevent nutrient deficiencies or toxicities as well as to assess current fertility management practices.

Modern Approaches in Mango

Singh and Rajput (1976) reported that the various levels of ZnSO4, increased the length of terminal shoot, number of leaves and leaf area per shoot of mango tree. An experiment on the foliar applications of Zn (0.1, 0.2 and 0.4%), Fe (0.1, 0.2 and 0.4%) and B (0.1, 0.2 and 0.4%) indicated that both Zinc and Boron promoted vegetative growth in terms of plant height, trunk girth and spread of young plants.
Singh et al. (2017) observed that the experiment was laid out in Randomized Block Design with factorial concept with three levels of soil application viz., S1 (control), S2 (200 g/tree multi micronutrient GradeV) and S3 (400 g/tree multi micronutrient Grade-V) and three level of foliar application viz., F1 (control), F2 (1% Spray of multi micronutrient Grade-IV) and F3 (2% Spray of multi micronutrient Grade-IV) and replicated thrice. Multi micronutrients were sprayed at three stages i.e.at flower bud initiation, at full bloom stage and at pea stage. In present investigation significantly maximum fruit weight (186.38 g), fruit volume (162.86 cc), numbers of fruits per tree (353.00), fruit yield of fruits per tree (62.99 kg), fruit yield per hectare (9.84 tonne) and fruit retention per panicle (4.00) were recorded under the treatment F2 (1% spray of multi micronutrient Grade-IV).

Results revealed that the treatment T5 (RDF + foliar spray of 0.4% zinc sulphate + copper sulphate (0.2%) + Borax (0.2%), spraying at just before flowering and marble stage of fruit growth recorded the highest number of fruits/tree (240.67) and fruit yield (6.41 t./ha). Further, the treatment T4 (RDF + foliar spray of 0.4% zinc sulphate + boric acid (0.2%) spraying at just before flowering and marble stage of fruit growth recorded the highest T.S.S (19.35 0B) and lowest acidity (0.13%) (Haldavnekar et al. 2018).

Citrus

Citrus is a nutrient -loving plant and about 15 elements have been known to have important role to play for proper growth and development of citrus in addition to the major nutrients like N, P, K, Ca, Mg, S citrus require micro nutrients Zinc, Cu, Mn, Fe, B, Mo, etc. Inadequate plant nutrition causes serious disorders in citrus and may eventually lead to decline of the orchards.
Extensive work has been done on citrus nutrition and the mineral nutrition of citrus has been throughly that reviewed about 18 tons of citrus fruit remove about 21 kg N,5kg P,41 kg K 19 kg Ca

,3.6 kg Mg , 2.3 kg S ,40g B ,9 g Cu ,50 g Iron , 13 g Mn and 13 g Zn.

The effect of foliar application of bio-regulators and nutrients on growth and yield of lemon (Citrus limon Burma.) cv. Pant Lemon-1. On the basis of overall performance of treatments on growth and yield characters of fruits, it can be concluded that the maximum values for fruit set (3.12%), days to maturity (148.23), yield of fruits (39.25kg) per plant have been obtained maximum with minimum fruit drop (33.58%) under GA3 (20 ppm), minimum fruit cracking was found under NAA 50 ppm, while minimum number of seeds (10.48) per fruit and minimum seed weight (0.580gm) per fruit under GA3 (10 ppm) treatment. However, the maximum number of fruits (403.27) per plant and maximum pulp:seed ratio (20.89) was recorded under NAA (10 ppm) foliar application (Bhatt *et al*. 2016).

Modern approaches in Grape

Kumar et al. (1988) reported that among the different concentrations of ZnSO4 (0.2, 0.3 and 0.4%), concentration of 0.2% gave the maximum juice, TSS and acidity percent. All concentrations of ZnSO4 were found better than control. The maximum TSS, total sugars as well as reducing and non-reducing sugars were found with the spray of 0.2% ZnSO4 followed by its higher concentration 0.4% (Kumar and Pathak, 1992). Prabu and Singaram (2001) reported that the application of ZnSO4 at 0.5% + borax at 0.2% through foliage increased the TSS, reducing sugars, many reducing sugars, total sugars and sugar acid ratio and reduced acidity.

Modern approaches in Litchi

Different doses of zinc sulphate (ZnSO4) @ 0.4%, 0.6%, and 0.8%; Borax @ 0.2%, 0.4% and 0.6% along with control were sprayed on new growth flushes before initiation of inflorescence, whereas 2, 4-D @ 10 ppm, 20 ppm and 30ppm; GA3 @25 ppm, 50 ppm and 75 ppm were sprayed after fruit setting in Dehradun litchi. Results shows that the maximum fruit set (78.15%), fruit retention (60.17%), fruit length (5.6cm), breadth (5.0cm), fruit weight (25.90gm), fruit yield(158.73kg/tree), pulp weight(22.19gm), pulp stone ratio(9.44), TSS(22.96°Brix) and sugars (18.52%) with minimum fruit cracking(2%), stone weight(2.35gm), peel weight(1.36gm) and acidity(0.4%) were recorded with 0.4% borax application followed by 50ppm GA3 (Kaur, 2017).

CONCLUSION

It is concluded that INM of horticulture crops is an important management practice .There is an urgent need to adopt an integrated nutrient supply and management system for promoting efficient and balanced use of plant nutrients. While the main emphasis was given on increasing the proper and balanced used of mineral fertilizers, the role of organic manure, biofertilizer, green manuring and recycling of organic wastes should be considered supplementary and not substitutable.

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Important indigenous and exotic breed of the cattle for Dairy business in India

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INTRODUCTION-: India is agriculture country more that 65 percent people working in the field of the agriculture. In agriculture field 4 percent GDP obtain from livestock farming. In India Dairy is important business for the rural as well as city people. From dairy business not only primary but also secondary and tertiary people get large amount of the employment. In present article best breed of desi and exotic cattle given which provided large amount of the milk and increase economical status of the people.

1. Gir

Synonyms-Surati, Kathiwarhi

Origin – Gir forest of the Gujrat

Character- Large body, reddish in colour, Ears are pendulous, heavy hump, Horn are curve shaped.
Female-386kg

Production- Cow are good milker producing 1746 liter milk per

Bullocks useful for draft power work.

2.Sahiwal

Synonyms-:This breed otherwise known as Lola (loose skin), Montgomery, Multani, Teli.

Origin-:Montgomery district in Pakisthan

Character- Large body, reddish in colour,
hump, Horn are curve shaped.
kg

Production- One of the best milk producing breed in India produce 2150 kg milk.
Now this breed maintain at NDRI,IARI farm.

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3. Red Sindhi

Synonyms-: Red karachi, Sindhi.

Origin-: Karachi in Pakisthan

Character-: Dark red in colour, male more as compared female.

Heavy hump and dewlap devlopment

Male-450 and Female-295kg

Production-: Lactational yield 1725 kg.

Bullock useful for road work.

---

4. Phule Triveni

Synonyms-: Phule triveni

Origin-: Proudes by MPKV,Rahuri

Character-: It is cross between Holstein frizen, Jersey and Gir, H.F useful for high milk production, Jersey for fat and gir for disease resistant power.

Production- Produce 4000 liter milk per annum and milk contain 4% fat

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5. Jersey

Synonyms-: Jersey

Origin - Jersey Island, U.K.

Character-: Smallest of the dairy types of per lactation.
Male-675 and Female-450 kg

Production-: Economical producers of milk with 5-5.5%

Average milk yield is 4500 kgs per lactation.

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6. Holstein Friesian

Synonyms-: H.F

Originated- Holland**.**

Character-: Largest of the dairy type's animal. Heavy body Female-675 kg

Production: Economical Largest producers of milk with 3.5% fat. Average milk yield is 6150kgs per lactation. 30 to 50 liter milk production per day

---

7. Sunandini

Origin and distribution-: The breed originated from Kerala by crossing the local non descript cattle with Jersey, Brown swiss and Holstein Friesian breeds. More than 2 million sunandini now distributed in India and that play important role not only Kerala but also in India. Breed exported to West Bengal, Orissa and Karnataka.

Distinguishing character-: The use of number of the breeds has resulted in the formation of mosaic type body colour and obviously appearance vary between individuals within limit. The body is compact with well developed udder.

Production and remarks-: The average milk production per lactation more than 2500 liter. The cow attains the average age of first calving 32.2 month and calving interval 14 to 15 months.

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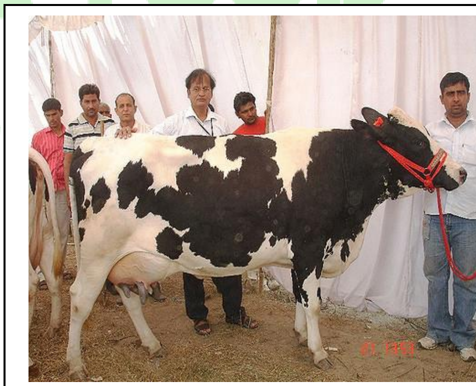
8. Karan Fries



Origin and distribution-: This breed is develop d by National Dairy research Institute, Karnal Hariyana. It is developed by crossing of Tharparkar cow with frozen semen of Holstein Friesian bull imported from unites state of the America. The breed now

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distributed many part of the Hariyana.

Distinguishing character-: The colour predominantly black patches and sometime is completely dark with white patches forehead and on the switch of the tail. The udder also dark with white patches on teat found. The animal extremely docile in nature.

Production and remarks-: The average age at first calving is 30 to 32 month and milk production is 3700 kg with 3.8 and 4.0 fat in the milk. The inter calving period is 400 to 430days.

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Integrated Nutrient Management in Paddy

Article id: 21894

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Basal application

1. Apply 25 % recommended dose of N and K as basal.
2. P may be applied fully as basal and incorporated**.**
3. Apply 25 kg of zinc sulphate mixed with 50 kg dry sand just before transplanting.
4. Apply 500 kg of gypsum/ha (as source of Ca and S nutrients) at last ploughing.

Top dressing

Apply 25 % recommended dose of N and K each as top dressing at active tillering, panicle initiation and heading stages.

1. In recent year's soluble fertilizers otherwise known as foliar fertilizers like Polyfeed and Multi 'K' were introduced in rice growing states.
2. Polyfeed contains 19: 19: 19 NPK with 6 micro-nutrients like iron, manganese, boron, zinc, copper and molybdenum, while multi K contains 13: 0: 46 NPK.
3. These fertilizers provide nutrients to the plant by foliar application as these fertilizers are completely soluble in water.
4. These fertilizers have no other impurities like sodium and chloride and they are 100 % nutrients and these nutrients are easily absorbed through the leaves.
5. In certain occasions like prolonged drought, there is no scope to apply fertilizers to the soil for want of moisture. Like wise in flooded conditions due to continuous rains fertilizers could not be applied to the soil. In such special circumstances these soluble fertilizers are must to protect the crop against hunger and this forms a compulsory act of crisis management.
6. And the foliar application of Speciality fertilizers plays an important role in supplying the nutrients at critical stages of flowering and grain formation.
7. Under special conditions of drought and waterlogging, apply N as foliar spray.
8. Urea may be applied as a low volume spray at 15% concentration using power sprayer or at 5% concentration using a high volume sprayer, the quantity applied in one application being limited to 15 kg/ha.
9. Foliar spray of Urea (10 g/lit) + DAP (20 g/lit) + KCl (10 g/lit) at PI and 10 days later for all varieties.
10. If deficiency symptom appears, foliar application of 0.5% Zinc sulphate + 1.0% urea can be given at 15 days interval until the Zn deficiency symptoms disappear.

Integrated Nutrient management

Integrated nutrient management (INM) aims at reducing the chemical fertilizer applied and improving its efficiency through combined use of different sources of plant nutrients such as Fertilizers,
1.Organic manures,
2. Green manures,
3. Crop residues,
4. Biofertilisers
5.Industrial wastes / soil conditioners in balanced proportions, depending on their availability and suitability in a specific rice ecosystem.

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Sources of nutrients:

1. Organic manures / compost – 12.5 t of FYM
2. Green manures / green leaf manures / crop residues - 6.25 t/ha
3. Fertilizers – Apply blanket recommendation as per the ecosystem.

Biofertilizers:

1. Azolla –as green rmanure @ 6t /ha, as dual crop (0.5 t/ha) in 7 DAT
2. Blue green algae - 10 kg/ha on 10 DAT.
3. Azotobacter /Azospirillium /Phosphobacteria - 10 packets (soil application)
4. Azophos – 20 packets (soil application)

Micronutrients:

1. Apply 25 kg of zinc sulphate mixed with 50 kg dry sand just before transplanting.
2. It is enough to apply 12.5 kg zinc sulphate /ha, if green manure (6.25 t/ha) or enriched FYM, is applied.
3. If deficiency symptom appears, foliar application of 0.5% Zinc sulphate + 1.0% urea can be given at 15 days interval until the Zn deficiency symptoms disappear.
4. Dip roots of the seedlings in 1% Zinc sulphate solution for one minute before transplanting.

Growth regulators

1. Foliar spray of Brassinosteriods 0.3 ppm at Panicle Initiation and Flowering stages increased the grain yield.
2. For increasing the rooting under broadcast method of planting, soaking roots in 25 ppm Induction of better rooting for early establishment in rice, root dipping for 16 hours in thiamin solution.

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Integrated water management in vegetables

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INTRODUCTION

Vegetables contain 80-95% water, and the product quality e.g. tenderness, succulence, crispiness and flavour is influenced by water supply at various crop growth stages. Plant-water relations consist of a group of interrelated and interdependent processes. The internal water balance of plant depends on the relative rate of water absorption and water loss.

Water deficit in plant causes: (i) decrease in stomatal opening (ii) reduction in transpiration and photosynthesis (iii) dehydration of protoplasm (iv) reduction in cell division and cell enlargement (v) increase in respiration rate at initial stage (vi) hastening in maturity and (viii) accumulation of sugar particularly during later part of growth. The total quantity of water required for essential physiological function of the plant is usually less than 5%. Most of the water is lost in transpiration.

The soil moisture level at 20-25 cm depth should not be allowed to drop below 70% of total available soil moisture. Most of vegetable crops require up to 4-5 cm of water each week during hot periods. This need decreases to about 2.5-3.0 cm per week during cooler periods. Irrigation rate depends on soil type but application rates through sprinkler should not exceed 1.0 cm per hour for sandy soils, 0.75 cm per hour for loamy soils or 0.5 cm per hour for clay soils. High application rates will result in irrigation water running off the field, contributing to erosion and fertilizer runoff.

Root depth of crop should also be considered in determining the depth of water to be applied. Shallow rooted crops can only extract water from a limited depth, and may require short and frequent irrigations. Deep-rooted plants, on the other hand, are able to extract water from deeper soil profile. Generally in loam soil, application of 1.0 cm of water will wet the soil to the depth of 4.5 cm. Beans, lettuce, onion and radish are considered as shallow rooted crops (30-50 cm root depth); whereas cole crops, cucurbits and eggplants are categorized as medium rooted vegetables (50-100 cm depth). Melons, tomato, okra and drumstick roots penetrate beyond 1.0 m depth and are classified as deep-rooted vegetables. Rooting depth decreases as soil becomes heavier.

The volumetric water content i.e. volume of water present in a definite volume of soil for sandy soils ranges between 14% and 18%, whereas it may reach 38% in clay soils. Gravimetric method may be used to determine water content of soil. The instruments available for routine monitoring of soil moisture are; tensiometers, granular matrix sensors (modified gypsum blocks), pressure plate apparatus, time domain reflectometry probes (TDR) and dielectric probes.

Drip irrigation

Drip irrigation has emerged as an appropriate water saving technique for row crops especially for wide spaced high value crops in water scarcity, undulated, sandy and hilly areas of India. Drip irrigation allows for much more uniform distribution as well as more precise control of the amount of water applied. Smaller amounts of water can be applied through dripper at more frequent intervals in order to maintain optimum soil water conditions resulting in maximum plant growth. In India drip technology at farmers' level was introduced around 1980. Area under drip irrigation in country has increased steadily from 1500 ha in 1985 to 3 lakh ha in 2000. At present more than 75% area under drip irrigation confines in the state of Maharashtra, Andhra Pradesh, Karnataka. The potentiality of drip irrigation in India is estimated to be 27 m ha. The major factors limiting its large scale adoption are high initial cost, lack of information on various aspects such as crop water requirement, scheduling of irrigation, fertigation and chemigation. Besides, in this method water is applied daily, which is practically difficult, particularly in states where electricity supply is deficit. In vegetables, drip irrigation is known to save 25-70% of water depending on soil, climate, crop and variety. The irrigation efficiency of drip system is very high (85-90%).

Sprinkler irrigation

Sprinkler irrigation is a method of applying irrigation water similar to natural rainfall. Water is distributed through a system of pipes usually by pumping. It is then sprayed into the air through sprinklers so that it breaks up into small water drops (0.54.0 mm) which fall to the ground. Sprinkler irrigation is suited for most row, field and tree crops. In vegetables, this system is commercially used for irrigation of peas and sometimes for leafy vegetables. However, large sprinklers are not recommended for irrigation of delicate crops such as lettuce because the large water drops produced by the sprinklers may damage the crop. Sprinkler irrigation may be adaptable to any slope, whether uniform or undulating. Sprinklers are best suited to sandy soils with high infiltration rates although they are adaptable to most soils. Sprinklers are not suitable for soils which easily form a crust. Sprinkler irrigation can also save water to the tune of 25-30% over flood irrigation.

The basic wetting pattern of a single-nozzle sprinkler is roughly conical in shape. Winds over 8 km/hour in velocity will distort this pattern, giving an uneven ellipse patterned distribution of water. High-pressure sprinklers with long trajectories are the worst affected by wind velocity. Allowance for wind distortion can be made by decreasing the spacing of sprinklers perpendicular to the wind direction, providing of course that the direction of the wind is reasonably constant. Drops greater than 4 mm in diameter have a tendency to damage delicate plants and contribute to water erosion problems, while drops less than 1 mm diameter are easily deflected by wind. Medium and low pressure sprinklers mainly produce drops within the 1-4 mm diameter size range while rain guns tend to produce a wide range of drop sizes, with a large proportion at or above 4 mm. The rate of evaporation in hot, dry climates can be excessive during the summer period. The best solution is to irrigate during the night. Frequent irrigations and the use of sprinklers which produce large drop sizes will also help; providing the soil and crop can withstand the treatment.

Furrow irrigated raised bed (FIRB) planting

The surface flood irrigation can result in a low potential irrigation water use efficiency and inefficient use of nitrogen. It can also cause crusting of the soil surface following irrigation and can contribute to the degradation of some soil properties. A raised bed-planting system where crop is planted on top of the bed (usually both sides of bed) with furrow irrigation has known to improve water use efficiency in vegetable crops. The benefits of FIRB compared with conventional flat planting with flood irrigation are as follows: first, there is a savings of applied irrigation water as much as 30% combined with enhanced water use efficiency, because water is supplied in furrows and around 50% area is always dry; second, the crust problem on the soil surface is eliminated and soil physical status is greatly improve; third, nitrogen use efficiency may improved by 10% or more due to improved nitrogen placement possibilities; fourth, the microclimate within the rhizosphere is very conducive for root proliferation and plant growth, resulting in enhanced yield by 15-25%; fifth, weed growth in FIRB system is less than flat bed because about 50% area is always dry, where weed growth is very less; sixth, raised bed planting is very convenient to walk over beds and perform intercultural operations, harvesting, etc, any time. Besides, the incidence of insects and diseases are less, and produce quality is comparatively better than the traditional planting system. The potential pitfalls of FIRB is the crop need to be irrigate more frequently because soil tends to dry out more quickly; however it is very efficient in water savings when combined with mulch. It is observed in tomato that when FIRB is combined with paddy straw mulch or black polythene mulch, water savings to tune of 36-49% can be achieved with increase in yield by 15-20%.

Mulching

The covering of the soil surface with a layer of organic or inorganic material to modify soil environment, prevent erosion and check weed growth is called mulching and the material used for covering is called mulch. The usual mulching materials are straw, compost, manure, dry grass, chipped bark and polyethylene sheet. It reduces the evapotranspiration from soil surface and weeds growth, and increased water-use efficiency and yield. Organic mulches consist of organic plant and/or animal residue or by-products. It includes; sawdust, bark, wood chips, leaves, grass clippings, rice husk, groundnut hulls, sugarcane bagasse, hays, straws and animal manures. They are generally spread over the ground surface around established plants or over the entire growing area to the depth of 5-7 cm (7-10 tones/ha). Organic mulches provide many of the benefits of most synthetic mulches, except soil warming potential and weed control. Plastic mulches have been used commercially on vegetables since the early 1960s. Presently plastic mulches are available in many different colours, textures and thickness that can be used as aid for growing of vegetable crops. The colour of mulch determines its energy, radiating behaviour and its influence on the microclimate around the plants. Mulch's colour affects the temperatures below and above the mulch through the absorption, transmission and reflection of solar energy. Depending upon the needs, black, transparent, yellow, IRT, biodegradable, etc are being used for vegetable production. All these materials work as barrier to evaporation of water from soil surface, thus conserve soil moisture save, considerable quantity of water and increased yield resulting higher WUE.

A. Earlier crop production (7 to 21 days earlier); Higher yields (two to three times higher);
B. More efficient use of water resources (25-50% water savings);
C. Cleaner and higher quality produce;
D. Less weed problems;
E. Reduced leaching of fertilizers, especially on light, sandy soils;
F. Reduced soil and wind erosion;
G. Potential decrease in the incidence of disease;
H. Better management of certain insect pests;

Impact of water imbalance in vegetables

Tomato:

Water stress at the time of flowering cause shedding of flowers, lack of fertilization and reduced fruit size, while higher amount of water during fruit ripening cause rotting of fruit and reduction in TSS. Fluctuation in soil moisture during fruit growth may cause splitting in fruit.

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Water stress during flowering is known to induce calcium deficiency and thereby blossom end rot may appear.

Brinjal:

Brinjal is very sensitive to soil moisture fluctuations. Low soil moisture drastically reduces yield and produces fruits of poor colour. Flooding causes root rot in plants.

Chilli and Capsicum:

Long dry spell particularly in summer crop may cause shedding of flowers and young fruits and plants make slow recovery upon re-watering. Moisture stress also reduces dry matter production and nutrient uptake and rate of fruit extension is slowed down. Maintenance of uniform soil moisture during growing season is essential to prevent blossom and fruit rot.

Radish and Carrot:

Being succulent and fleshy, moisture stress during growth and development adversely affects their productivity. Moisture stress during root enlargement causes poor growth of roots and they become distorted and rough. Nitrate content in roots is increased due to moisture stress. Low moisture grown carrots have very strong and pungent odour. Over watering results in excessive foliage growth, poor quality roots, delayed maturity and cause decaying of roots.

Onion:

Onion has very shallow roots and needs frequent irrigation. It is very sensitive to moisture stress particularly during bulb expansion. Moisture stress during bulb growth causes new growth, splitting and doubles, which greatly reduce market price. Bulb grown in moisture stress condition dry out earlier and considerable losses in weight occurs during storage. Irrigation in onion should stop 15 days before harvesting for proper curing of bulbs.

Cucumber:

Moisture stress during flowering results in deformed, non-viable pollen grains. A water stress during fruit growth causes bitterness and deformity in fruit. Water stagnation for any length of time cause chlorotic or yellow leaves and retarded growth.

Muskmelon:

Irrigation just before or during ripening period results in poor fruit quality due to decreases in TSS, reducing sugar and ascorbic acid (vitamin C) content of fruit.

Watermelon:

Watermelons need dry condition for ripening of fruit. Frequent irrigation at ripening of fruit causes cracking in fruit rind, and flesh becomes more fibrous and less juicy. Moisture deficit during fruit development increases NO3-N content in fruit juice.

Pea:

Vegetable peas require sufficient moisture for seed germination. Usually two light irrigations are given in peas; one at flower initiation (35-40 days after sowing) and other at pod development (between 65-70 days after sowing). Over irrigation generally reduces several quality aspects like uniformity of seed, maturity and colour intensity indices. High soil moisture at any growth period causes wilting in plants.

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Integrated Weed Management in Maize

Article id: 21896

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INTRODUCTION

Maize (*Zea mays* L.), also known as corn, is one of the most important cereal crops. Corn belongs to the grass family Poaceae and tribe Maydeae. In case of other cereals, corn has the highest genetic yield potential; that's why, it is known as "queen of cereals." The various type of cron like Flint, dent, floury, sweet or sugary, popcorn, multi-coloured, and other types of corn are grown throughout the world, with differ in color, size of kernel, kernel shape, and other attributes commute significantly. Harshberger reported that corn originated in Mexico and had once been a wild plant in central Mexico. In our country, maize is the third most important food crop after rice and wheat. It is grown in nearly 9.26 m ha with production of 23.67 Mt and average productivity of about 2.57 t/ha compared to the world average productivity of 4.94 t/ha. The maize is cultivated for grain, fodder, green cobs, sweet corn, baby corn and pop corn in peri-urban areas and also grown in rural areas and export in city areas. . The main corn producing states in India contribute more than 80% of the total maize production are Andhra Pradesh (30 %), Karnataka (16.5 %), Rajasthan (10 %), Maharashtra (9 %), Bihar (9 %), Uttar Pradesh (6%), Madhya Pradesh (8 %), Himachal Pradesh (4.4 %) . Being a rainy season crop, maize is highly infested crop with weeds from time of sowing to till harvesting. This is because of frequent rains encourages several flushes of weed, hot and humid climate favourable for the growth of weeds especially grasses, wider row spacing and higher rate use offertilizers. Maize crop is very sensitive to weed competition at the time of early growth period due to slow growth in the first 3-4 weeks. Critical period of weed competition is up to 40-45 DAS. Threrefore, management of weeds during the critical period is most critical for higher yields production of maize. Maize yield was reduced at least 25- 60% due to weed infestation. Crop losses due to weed competition all over the world as a whole, are more than combined effect of insect-pests and diseases.

Table 1: Major weeds of corn in the India listed by botanical name, English name, common name.

Botanical name	English name	Common name
Echinochloa colonum	Barnyard grass	sanwa
Eleusine indica	Goose grass	Wild finger millet
Setaria glauca	Yellow foxtail	Banara / banari
Amaranthus viridis	Splemder amaramthus	chaulai
Digitaria sanguinalis	Crab grass	Ghood doob
Cynodon dactylon	Bermuda grass	Doob ghas
Euphorbia geniculata	spurge	Badi doodhi
Digera arvensis	digera	tandla
Amaranthus viridis	Pig weed	Jungle chauli / dhimdo
Euphorbia hirta	spurge	doodhi

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Phyllanthus niruri	niruri	Hajar dana
Celosia argentea	White cockscomb	silyari
Ageratum conyzoides	Bill goat weed	mahkua
Commelina benghalensis	Tropical spiderwort	kenna
Cyperus rotundus	Purple nutsedge	motha
Cyperus esculentus	Yellow nutsedge	motha
Rabi season		
Phalaris minor	Little seed canary grass	Gehunsa
Avena ludoviciana	Wild oat	Jungle jayi
Chenopodium album	Common lambsquarter	Bathua
Melilotus indica	Wild senji	Senji / khandi
Coronopus didymus	Swine grass	chatpata
Convolvulus arvensis	Field bind weed	hirankhuri
Anagallis arvensis	pimpernel	Krishna nil

Integrated Weed Management in Corn

Integrated weed management has been defined as a multidisciplinary approachto weed control, utilizing the application of various alternative controlmeasures (Swanton 1991). The IWM involves a combination of cultural, mechanical, biological,genetic, and chemical methods for an effective and economical weed controlthat reduces weed interference with the crop while maintaining acceptable cropyields (Knezevic 2002, Swanton 1996). None of the individual control measures can provide complete weedcontrol. However, if various components of IWM are implemented in a systematicmanner, significant advances in weed control technology can be achieved (Swanton 1991).The IWM approach support the use of all available weed control options thatinclude.

Cultural Control

Cultural practices perform a crucial role in weed management program in maize crop. Corn is a very competitive crop so if managed properly therefore, the farmers should adopt a good crop husbandry. Every culture practices required to be adopted with care and aim at increasing up of initial growth rate. Than the crop itself would be able with able with against weed and do not affect by weed compition. In cultural control consist of crop species, crop variety/ cultivar, time of sowing, method of sowing, rate of sowing, row spacing, crop rotation, cropping practices,

Mechanical Weed Control

Mechanical, weed control techniques is a control weed density and population by a physical methods that eradicate, remove, injure, kill, or make the growing conditions unsuitable. Some of these practices causing direct damage to the weeds through complete removal or causing a lethal injury. Including mechanical weed control hand weeding/ hand pulling, hand hoeing, tillage, mowing and slashing, flooding, burning, flaming, and heating, cheeling and digging, chaining and dredging, mulching, soil solarisation, radiation application to soil.

Biological Control

The biological control method makes use of the weed's naturally occurring enemies to help reduce the weed's impact on agriculture and the environment. It consist of parasite, predators:

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insect, mites, pathogen: fungi, bacteria, and viruses, snail, fish, ducks and geese, deleterious rhizo-bacteria, botanical agents.

Chemical Weed Control Application of herbicides is the most important and easier, cheapest method of weed control in corn. The method of weed control through chemical is very effective and economical. Herbicides can be applied at different time and stages, such as before the crop is planted (preplant), after the crop is planted but before emergence (preemergence), and after crop emergence (postemergence).

Pre plant Herbicides – For control of winter annuals and early-spring annual weeds, herbicides applied on emerged weeds are known as burndown herbicide treatment.pre plant incorporation 10 – 15 days prior to seedling.

- Trifluralin @ 1.0 kg / ha.
- Glyphosate – 1.0 kg / ha 600 litres water
- Paraquat @ 0.5 kg / ha 600 litres water

Pre emergence- This herbicides applied after corn planting, but before emergence and having soil residual activity, are known as preemergence herbicides. the some pre emergence herbicides are

Acetochlor - 2.60–3.61 for sandy loam, 3.61–4.52 silt loam, 3.61–4.52 silt clay loam soil, Commercial product kg per hectare.

Alachlor @ 2.0 kg / ha.

Simazine and atrazine: The selective rates are 1.0 to 1.5 kg a.i /ha in 500 to 600 litres of water. Pendimethalin – (stamp 500 g /lit. EC,) 1.0 to 1.5 kg/ ha.

Post emergence- Herbicides applied after corn and weed emergence are known as postemergence herbicides. This is generally available as a foliar spray.

A. **2, 4-D-** It is applied @ 1 to 1.5 kg a.e /ha in 500 to 600 litres as post emergence spray.
B. **2,4,5-t :** Both the herbicides are similar to 2,4-D in properties and mode of action and useful for controlling bushes and woody weeds.
C. **Atrazine** - 1.60–2.5 kg / ha. Corn less than 30 cm; broadleaves 5–15 cm; grass weeds 2 cm or less
D. **Nicosulfuron** 0.05 Corn 10–91 cm (V10); if greater than 50 cm, use drop nozzle
E. **Primisulfuron** 75 % 0.03–0.05 Corn 10–50 cm; shattercane 10–30 cm;broadleaves 2–10 cm; grasses 2–8 cm
F. **Dicamba:** It is selective translocated herbicides and available by trade name Banvel (50 EC). Useful to control broad leaf weeds and used @ 0.5 to 3 kg a.i/ha as post emergence spray.

CONCLUSION:

So many kinds of weeds with highly differing life cycles and habitats, they definitely can't be managed by a using single control method. However, if they are implemented in a systematic manner, significant weed management can be achieved. There are a number of ways to start developing an IWM program. The use of various weed control methods keeps weeds "off balance" and prevents them from adapting to a particular IWM strategy and it's not promoting a any particular method.

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Agriculture Contribution to Climate Change and its Impact on Food Production

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INTRODUCTION

Impact of climate change on agriculture will be one of the major deciding factors influencing the future food security of mankind on the earth. Agriculture is not only sensitive to climate change but also one of the major drivers for climate change. Understanding the weather changes over a period of time and adjusting the management practices towards achieving better harvest are challenges to the growth of agricultural sector as a whole.Modern agriculture, food production and distribution are major contributors of greenhouse gases. Agriculture is directly responsible for 14 per cent of total greenhouse gas emissions, and broader rural land use decisions have an even larger impact. Agriculture contributes to global climate change by releasing carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), the three gases presently causing the most greenhouse warming. Agriculture emitted 5.1–6.1 billion tons of CO_2 equivalents in 2005, that is, 10-12 per cent of all human-caused (anthropogenic) releases of greenhouse gases in that year.

Its share of CH_4 and N_2O emissions was much greater: agriculture contributes about 47 per cent of global CH_4 and 58 per cent of N_2O. These figures do not count greenhouse emissions from electricity and fuel used in agriculture for machinery, buildings, processing, and transport. Also, emissions vary widely among countries, with more industrialized countries deriving much less of their greenhouse emissions from agriculture

Agriculture's GHG emissions do not come from cattle alone. Various methods of irrigation, tillage and soil management lead to the production of N_2O, and the use of manure contributes to both CH_4 and N_2O emissions.

In this context, a historical perspective needs to be considered: Dr. Rattan Lal, Professor of Soil Science at Ohio State University, has calculated that over the last 150 years, more carbon has been emitted from farmland soils due to inappropriate farming and grazing practices, compared with burning of fossil fuels. Whatever the correct figure, these reductions of 'living carbon potential' have resulted from.

- Deforestation
- Biodiversity loss
- Accelerated soil erosion
- Loss of soil organic matter
- Salinization of soils
- Costal water pollution and
- Acidification of the oceans

Agriculture both releases and absorbs greenhouse gases. Plants absorb CO_2 from the atmosphere, extracting its carbon to build their tissues. Dead roots and other plant parts remaining in the soil after harvest increase the soil's carbon content, though depending on environmental conditions this carbon may be re-released to the atmosphere by bacterial decay. Not counting CO_2 releases from fuel and electricity usage associated with plowing, spraying, harvesting, transport, processing, and storage, agriculture's CO_2 release and uptake are about balanced. Almost all of agriculture's direct

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impact on climate comes from its releases of CH_4 and N_2O.

CH_4 and N_2O have a greater greenhouse impact, ton for ton, than does carbon dioxide. Methane is over 20 times as effective, by weight, at causing climate change than is CO_2, and nitrous oxide is about 296 times as effective. However, because much greater quantities of CO_2 are being released into the atmosphere, CO_2 accounts for most of the greenhouse warming now occurring.

Emissions of CH_4 and N_2O from agriculture are increasing with human population growth, which is mostly occurring in developing countries and entails corresponding growth in agriculture and with rising per capita demand for meat in some developing countries. From 1990 to 2005, world agricultural emissions of CH_4 and N_2O increased by almost 17per cent. Direct agricultural emissions in developing countries increased by 32 per cent during this time period, while emissions from developed countries fell by 12 per cent overall. By 2005, developing countries were accounting for about 75 per cent of all agricultural direct emissions. Indirect agricultural emissions were higher in developed countries, where agriculture is more mechanized and therefore energy-intensive, and where food is far more intensively processed, packaged, marketed, and refrigerated. CO_2 emissions from on-farm fossil fuel use alone were equal to 12.7 per cent of direct greenhouse emissions in the United States in 2006.

Deforestation in the tropics is one of the main non-fossil-fuel contributors to global climate change, producing almost a third of global CO_2 emissions. Expansion of agricultural land area is one of the main drivers of such deforestation. In Brazil, where a third of the world's rain-forest is found, the rainforest was being cleared in the early 2000s at a rate of about 4,000 mi^2 (10,000 km^2) per year, almost entirely for cattle ranching, soy farming, and small-scale subsistence farming.

Such deforestation is often referred to as slash-and-burn agriculture, because land is cleared by the simple expedient of cutting down all the trees, piling them up, and burning them. This immediately releases their stored carbon into the air—750 tons of CO_2 per acre (0.4 hectare) for an old-growth Indonesian rain forest. As of 2005, slash-and-burn deforestation to clear land for agriculture made Indonesia the world's third largest greenhouse-gas emitter and Brazil the world's fourth largest.

Deforestation currently accounts for an additional 18 per cent of emissions. Agriculture is the growing of plants (crops) and animals (livestock) for food and other purposes. In 2007, lands used for crop growing and animal grazing took up 40–50 per cent of Earth's land surface, a 10 per cent increase since 1961.

As the World Future Council points out, soil erosion caused by agriculture and natural processes is also a significant cause for ecological concern. Though not directly related to global warming, its impact will be felt more acutely as the climate changes and the amount of top soil is reduced worldwide.

Impacts on Agriculture and Food Production

Food production in India is sensitive to climate changes such as variability in monsoon rainfall and temperature changes within a season. Studies by Indian Agricultural Research Institute (IARI) and others indicate greater expected loss in the Rabi crop. Every 1°C rise in temperature reduces wheat production by 4-5 Million tonnes. Small changes in temperature and rainfall have significant effects on the quality of fruits, vegetables, tea, coffee, aromatic and medicinal plants, and basmati rice. Pathogens and insect populations are strongly dependent upon temperature and humidity, and changes in these parameters may change their population

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dynamics. Other impacts on agricultural and related sectors include lower yields from dairy cattle and decline in fish breeding, migration, and harvests. Global reports indicate a loss of 10-40 per cent in crop production by 2100

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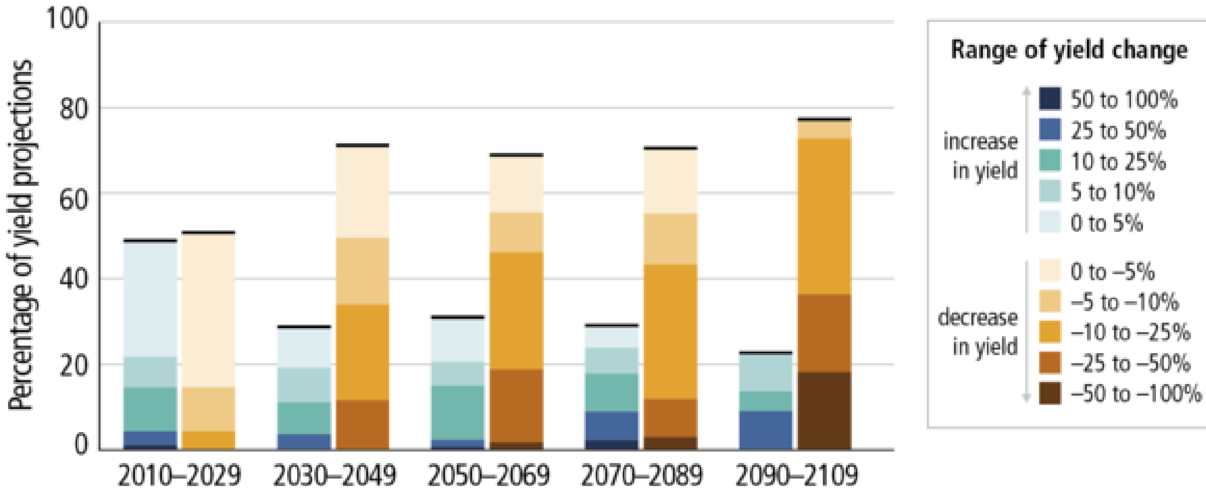

Summary of projected changes in crop yields, due to climate change over the 21st century. The figure includes projections for different emission scenarios, for tropical and temperate regions, and for adaptation and no-adaptation cases combined. Relatively few studies have considered impacts on cropping systems for scenarios where global mean temperatures increase by 4°C or more. For five timeframes in the near term and long term, data (n=1090) are plotted in the 20-year period on the horizontal axis that includes the midpoint of each future projection period. Changes in crop yields are relative to late-20th-century levels. Data for each timeframe sum to 100 per cent. *© IPCC, 2014, 5th assessment.*

Indian climate is dominated by the southwest monsoon, which brings most of the region's precipitation. It is critical for the availability of drinking water and irrigation for agriculture. Agricultural productivity is sensitive to two broad classes of climate-induced effects (1) direct effects from changes in temperature, precipitation or carbon dioxide concentrations, and (2) indirect effects through changes in soil moisture and the distribution and frequency of infestation by pests and diseases. Rice and wheat yields could decline considerably with climatic changes (IPCC 1996; 2001). However, the vulnerability of agricultural production to climate change depends not only on the physiological response of the affected plant, but also on the ability of the affected socio-economic systems of production to cope with changes in yield, as well as with changes in the frequency of droughts or floods.

The adaptability of farmers in India is severely restricted by the heavy reliance on natural factors and the lack of complementary inputs and institutional support systems. The loss in net revenue at the farm level is estimated to range between 9 per cent and 25 per cent for a temperature rise of 2°C to 3.5°C. Scientists also estimated that a 2°C rise in mean temperature and a 7 per cent increase in mean precipitation would reduce net revenues by 12.3 per cent for the country as a whole. Agriculture in the coastal

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regions of Gujarat, Maharashtra, and Karnataka is found to be the most negatively affected. Small losses are also indicated for the major food-grain producing regions of Punjab, Haryana, and western Uttar Pradesh. On the other hand, West Bengal, Orissa, and Andhra Pradesh are predicted to benefit to a small extent from warming.

The landmark Paris climate agreement has opened the door to new solutions by allowing countries to decide how to reduce greenhouse gas emissions and over the past year, many countries, particularly in the developing world, decided that an especially effective way to reach those targets is through their farms. Nearly 80 per cent of the countries said they would use agricultural practices to curb climate change and more than 90 per cent said they would use those practices in addition to changes in forestry and land use linked to farming.

CONCLUSION

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Renewable energy: Potential and benefits for developing countries

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It might come as an astonishment to discover that before the revelation of coal stores around the season of the Industrial Revolution, a large portion of the vitality we utilized for lighting and warming was from inexhaustible sources - with a couple of exemptions. At that point we found coal, which filled the mechanical upset in the western world, later still figured out how to tap oil in more prominent amounts prompting an increasing speed of innovations that would bring us into the twentieth century. All through a large portion of mankind's history and pre-history, we consumed what might today be known as "bio mass": plant material, for example, wood, grass, greeneries, etc., to fuel our hearths and later, residences. It turned into a significant fuel source, thus why the hearth and the chimney was integral to homes until generally as of late.

Sustainable power source:

As per a report by the International Energy Agency, the expansion of measure of power created from inexhaustible sources expanded from simply over 13% in 2012 to 22% the next year. They likewise foresee that that figure should hit 26% by 2020. As far as complete age, renewables represents 19% of our present utilization. All the more obviously should be done however for the reasons expressed underneath, yet these figures are empowering from the viewpoint of the utilization of renewables all alone. Most long haul conjecture models foresee that utilization will significantly increase somewhere in the range of 2012 and 2040, with a more noteworthy sum should the planet hit 2^{o} of warming. here is still a lot to do however; somewhere in the range of 2000 and 2012, the biggest development region regarding assets was coal - effectively the dirtiest type of petroleum derivative. The most utilized asset in the midst of fluctuating cost combined with what we presently comprehend to have been over-generation for quite a long while, was oil.

Petroleum derivatives are limited

The first and principle purpose behind why governments and organizations are quick to move to sustainable power sources at the earliest opportunity is that petroleum products are a limited asset. We could conceivably have achieved pinnacle oil - the time when request overwhelms supply - and by current figures, numerous specialists appear to concur we did as such around 2008 with just outer variables making changes popular making it hard to anticipate decisively when it will run out. That is another discussion altogether that our government officials and financial experts have contended for a considerable length of time, and will keep on argueing for a long time to come. However, we take a gander at it, petroleum products will run out in the long run and it will take somewhere in the range of 10,000,000 years to recharge what we have utilized in around 150 years.

As the human populace builds, our rate of utilization of these petroleum derivatives likewise increments. Geologists and others whose activity it is to find and access these pockets of raw petroleum are discovering it progressively hard to find and concentrate new sources. Regardless of whether we have 1 year or 100 years left of oil, many contend that what is left ought to stay in the ground since it isn't feasible - it will run out in the end thus we ought to get ready for a post-non-renewable energy source world at this point.

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Carbon Emissions and Climate Change

The most prompt issue, especially in light of the COP21 understanding of 2016, and the progressions we have seen to the atmosphere over the most recent 150 years, is environmental change and the carbon emanations that are compelling it. Over the most recent couple of years particularly, no piece of the world has been immaculate by monstrosity climate conditions. Most landmasses have recorded record high temperatures in summer, record lows in winter and expanded recurrence of tropical storms and typhoons, record droughts, dry season and flooding. There is no uncertainty that these oddity climate conditions are influencing each nation. Most sustainable power sources, and the innovation used to outfit them, are low carbon emanation. Much of the time, once introduced they have negligible or no carbon yield can in any case give our vitality needs. We can never go completely carbon unbiased as it takes assets to make a sun based board, construct a dam, etc., however it is a basic and noteworthy decrease of our carbon yield. What we do need to do, is to make the strides we can to lessen our carbon impression for global guidelines, to help those in the creating scene, and to secure ourselves against the oddity climate. We additionally realize that the ice tops are liquefying and the ocean levels are rising which makes nourishment deficiencies and national precariousness just as being a costly circumstance for our protection.

Vitality Security

Vitality security is a relative newcomer to open recognition when we think about the more prominent requirement for sustainable power source. The start of this decade has seen flimsiness in the Middle East. The Arab Spring cleared crosswise over Algeria, Tunisia, Libya, Egypt and Syria prompting professional majority rules system shows. There are continuous issues in Syria with the ascent and spread of ISIS.

The Middle East is one of the greatest providers of oil to the world. South America likewise delivered oil, North America and South America supplies coal and the UK, Russia and other European Atlantic powers dig for gas. New strain among Russia and the west, right off the bat over Ukraine and besides over Syria, has prompted expanded doubt between world forces. Being reliant on different nations for our vitality supply is risky in itself, yet when universal relations among provider and provided sharp, expanded discount costs taking steps to destabilize the economy is the least that could occur. On the off chance that a supply is cut off, at that point debacle could strike. Consequently, alone, we need save limit and various roads of vitality procurement.

Vitality security will turn into a lot more noteworthy factor as non-renewable energy sources start to decrease. Like never before previously, requests on vitality supply frequently exceed supply of customary generation driving costs up. It is normal that expanded pressure over procurement and security of assets could prompt worldwide clash. Some are now contending that the emergency in Syria is less about battle for vote based system change in a noteworthy Middle Eastern power, and more a consequence of progressing provincial atmosphere emergency. Previous ranchers who have fled to Europe and past have referred to dry spell as the real impetus for the common war in the nation. The cost of oil has vacillated incredibly in the last 10-15 years - from an unsurpassed high in 2012 to 2013 to record lows in 2015 to 2016. Oil costs have a thump on impact for the economy when they are at the extraordinary and lead to dissents. We should recall that oil is a product and when costs are

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sporadic, it influences occupations everywhere throughout the world.

Monetary Stability

Identified with a portion of the issues referenced above, where sustainable power source offers a consistent and supported supply, (for example, hydroelectric, wave control, sun based and biofuels), vitality costs are probably going to stay stable and thusly, keep the economy stable. As a rule, vitality created from inexhaustible sources is more of now less expensive than that delivered by non-sustainable methods. Referenced above, Idaho delivers a lot of vitality from geothermal sources. Another model is Texas where vitality created from wind power is detectably less expensive for the state's residents.

Ecological Damage

As non-renewable energy source supply gets more earnestly to procure, and miners look for new pockets of oil and need to penetrate longer and more profound to secure it, there has been struggle between ecological gatherings and industry and among governments and the two gatherings when neighborhood natural life and earth delicate regions are undermined. Here in the US, open awareness and the need to secure our untamed life and normal scenes implies that numerous new advancements are dissented with worries of ecological harm. Continuous dissents against fracking and new penetrating in Europe and North America and late models. In spite of the fact that some renewables will have a natural effect, many don't and when assembled, have no further effect - in contrast to continuous penetrating.

General Health

Oil, gas and coal boring and mining have abnormal amounts of contamination that are siphoned into neighborhood situations and the more extensive environment, so while protestors endeavor to forestall the structure of pipelines or new prospecting in virgin regions and wild, it is as much about general wellbeing all things considered about protection. We have known for a considerable length of time about the thump on impact of mechanical procedures for general wellbeing. Maybe a couple renewables are altogether emanation free, yet their yield is much lower than traditional petroleum derivative securing and handling.

The greatest financial favorable position to limiting our vitality supply is that the vast majority of the cash spent goes to those individuals creating the crude parts instead of to bringing in items at incredible cost that furnishes less individuals with occupations and isn't useful for the economy or the earth. This implies supporting occupations locally and broadly. As the US is a world head of innovation to supply sustainable power source, we as of now have the advantage of trading American industry - another extraordinary financial advantage of the inexhaustible business.

Financial advantages are not just about occupation creation however; there is a second significant angle and that is the average cost for basic items. On numerous occasions, we have seen that vitality from renewables is less expensive to deliver than that created by customary non-renewable energy sources with sunlight based driving the path in getting less expensive and less expensive consistently. A lower typical cost for basic items implies more cash in the pocket for the normal resident, which means more cash to put into different zones of the economy - reserve funds and consumption. These costs are additionally prone to stay stable contrasted with the fluctuating (and now and then sporadic) nature of petroleum products. Since the monetary downturn of 2008, oil gas and coal have all spiked and dropped. This isn't useful for any nation's economy, and surely not for the worldwide market.

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Aseptic Packaging of Food Products

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Aseptic packaging is a state-of-the-art technology for production of high-quality liquid food products with extended shelf life, ensuring the standards of food safety. It does not only include the packaging itself, but is a complete process, ranging from the product sterilization to the package sealing and is very complex to control. An array of sterilization techniques, packaging materials and systems have emerged to offer flexibility in processing different food products with this innovative processing technology. This article summarizes the aseptic processing, packaging principles, sterilization methods and technologies applicable to food industry. Additionally it highlights the difficulties, potential risks and solutions.

INTRODUCTION

The term "aseptic" implies the absence or exclusion of any unwanted organisms from the product, package or other specified areas, while the term "hermetic"(strictly "air tight") is used to indicate suitable mechanical properties to exclude the entrance of microorganisms into a package and gas or water vapour into or from the package. Aseptic packaging thus can be defined as filling of commercially sterile product into sterile containers under aseptic conditions and sealing of the containers so that the re-infection is prevented, i.e. so that they are hermetically sealed. There are two specific fields of application of aseptic packaging:

- Packaging of pre-sterilized and sterile products: e.g.: Milk and Dairy products, puddings, desserts, fruit and vegetable juices, soups, sauces.
- Packaging of non sterile product to avoid infection by microorganisms: e.g.: Fresh products such as fermented dairy products like yoghurt

Different food packed in aseptic packaging

Reasons for Use of Aseptic Packaging

- Aseptic packaging enables containers to be used that are unsuitable for in-package sterilization;

- The advantage of high-temperature-short-time sterilization processes which are thermally efficient generally give rise to product of superior quality compared to those processed at lower temperatures longer times
- It extends the shelf life of products at normal temperatures by packaging them aseptically.
  In comparison to classical canning, aseptic packaging is preferred for heat sensitive and nutritional foods & beverages for obtaining a finished product with better sensory qualities and higher nutrient retention.

Aseptic Filling System

An aseptic filling system must meet a series of requirements, each of which must be satisfied individually before the whole system can be considered satisfactory.
The container and method of closure must be suitable for aseptic filling, and must not allow the passage of organisms in the sealed container during storage and distribution. It is also desirable for the container to have certain physical properties that will help in minimizing chemical changes in the product during storage.

- The container or part of it exposed to the product must be sterilized, after it is formed and before being filled.
- The level of sterilizing effect is related to the probable initial contamination of the container surface. The container sterilization process may be single stage, either within the aseptic filler as apart of its operation or as a preliminary process or it may be two-stage with the second stage forming part of the filler operation.
- The container must be filled without contamination by organisms either from the equipment surfaces or from the atmosphere that surrounds the filler. Filling is done in an enclosed area that is supplied with a sterile atmosphere (air sterilized by heating or filtration).
- If any closure is needed, it must be sterilized immediately before it is applied.
- The closure must be applied and sealed in place to prevent the passage of contaminating organisms, while the container is still within a sterile zone.

Aseptic filling system of fruit juice

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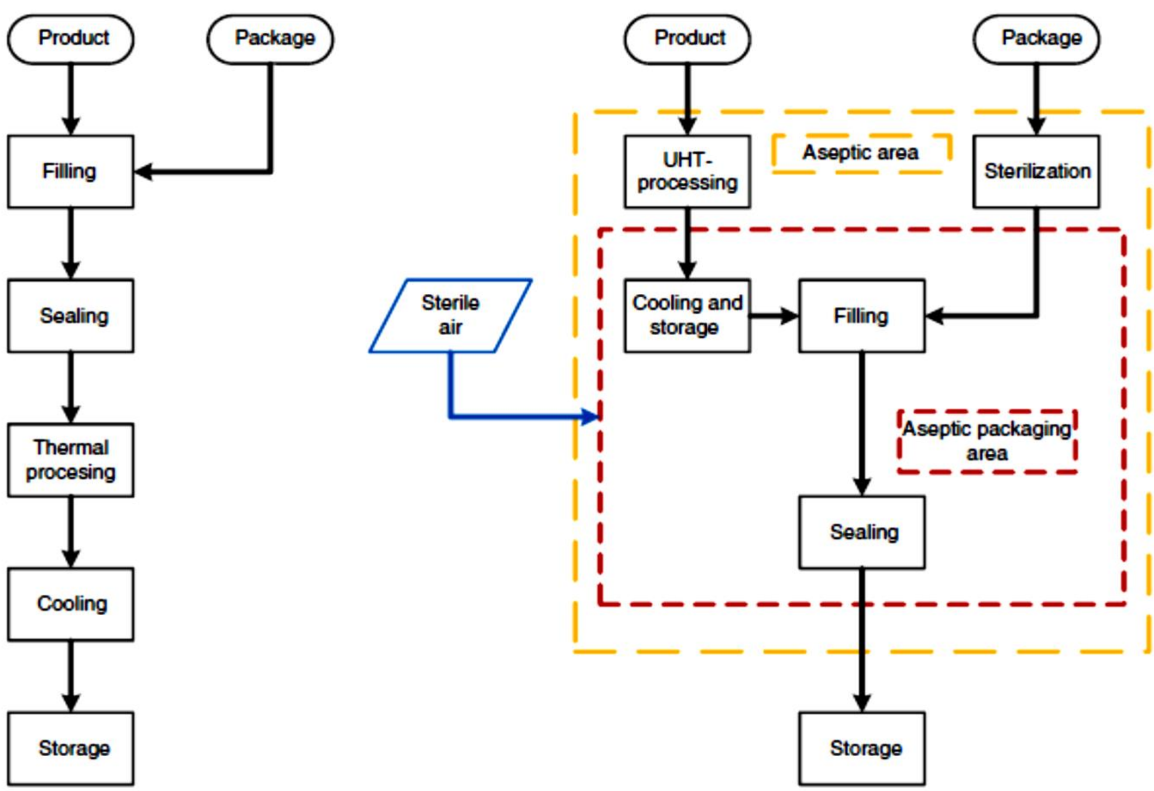
Aseptic Packaging Systems

The aseptic packaging system must be capable of filling the product produced by the HTST or UHT system in an aseptic manner and sealing the container hermetically so that sterility is maintained throughout the handling and distribution processes. Any aseptic packaging system should be however capable of meeting following four criteria.

- It should be able to be connected to the processing system in a manner that enables aseptic transfer of product to take place
- It could be able to effectively sterilize before use.
- It could be able to carry out the filling, sealing and critical transfer operations in a sterile environment.
- It must have ability to be cleaned properly after use.
- The type of packaging material used is influenced by the nature of the product, the cost of both the product and the package and the preferences of the consumer.
- The most widespread consumer package for aseptic products is the paper-based carton, which is used for many dairy products, fruit juices and other beverages.
- In addition to retail or consumer aseptic products, bulk-packaging systems are in use for products, which are then further processed and/or repacked into consumer-sized packs.



General comparison of common packaging technology for sterilized products and modern aseptic packaging technology. UHT, ultra- high temperature.

Criteria for Aseptic Packaging of Foods

Canned and aseptically packed foods come under this category, and a package of an aseptic food will certainly need to fulfill the following criteria; It should contain the product. It should prevent physical damage to packaged product. It should run smoothly on filling lines. It should withstand packaging processes. It should be easy to handle throughout distribution process. It should prevent dirt and other contamination. It should be able to protect the product from odours and taints. It should be resistant to rodent attack. It should be able to stop insect infestation. It should be biologically safe i.e. non toxic. It should be compatible to foodstuff. It should provide sterility to product. It should prevent ingress of microorganisms. It should show evidence of tampering. It should control moisture loss or gain. It should offer a barrier to oxygen. It should be protective against the light. It should maintain gas atmospheres, i.e.CO_2/N_2. It should communicate all the information regarding product and manufacturer. It should have good sales appeal. It should be easy to open. It should be cost effective. The above given pack criteria are separated into seven areas, mainly as follow;

- ***Product containment***: The need to contain the product in the sense that liquids or powders do not leak out is obvious.
- ***Physical protection***: This is again obvious when dealing with fragile foods like eggs or snack foods, but minor impacts on fresh fruits, for example, will release enzymes and lead to browning and softening. Equally important is the adverse effects on sales of damaged packages themselves-even though the product is in good condition.
- ***Food safety***: The need to ensure that the aseptically packed food retains its sterility, through a package that prevents adventitious contamination by microorganisms is very important. Tamper evidence is also now unfortunately a desirable requirement, in the face of malicious contamination situations. The other aspect of food safety is the avoidance of long-term chronic effects from the food packaging materials themselves.
- ***Shelf-life***: For dried foods moisture gain is a major factor in determining shelf-life, atmospheric oxidation, often catalyzed by light, is more critical for aseptically packed foods such as milk, fruit juices, or cream soups. Hence a good oxygen and light barrier, as provided by tinplate or aluminium foil, is needed to ensure maximum shelf life for these products. However shelf life can be determined by marketing considerations as less than the technically available maximum. This could occur in situations where, for example a plastic container preferred for sales purposes could not give the shelf life of glass or metal packaging.
- ***Communication of information***: The package should need to tell the purchaser what food is inside it and whose product it is. Apart from this, more information should be passed on to the customer, such as net weight, list of ingredients, batch number, use-by date, nutritional information, and so on.
- ***Sale-appeal***: The package must look attractive and 'catch the eye' of prospective purchasers, and it should also be easy to open and dispense the product.
- ***Cost-effectiveness***: Value for money in packaging is more important than looking for the lowest price. A cheap but dimensionally variable container could cause more down time during production or an increase of 'leakers' in the market place, thereby negating the apparent cost saving. Conversely, spending more to make a pack look more attractive could be justified in increased sales.

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Major categories of aseptic packaging systems

- *Can system*: It includes hermetically sealed cans
- *Bottle systems*: Glass containers and plastics bottles fall into this category. The bottles can further be divided into; a) Non-sterile bottles; b) Sterile blown bottles; c) Single station blowing, filling & sealing.
- *Sachet and pouch systems*: This system classified into Form-fill-seal systems and Lay flat tubing
- *Cup systems*: The aseptic packaging of food into cups can be into; Pre-formed plastic cups; and Form-fill and seal cups
- *Carton systems*: This type of aseptic packaging system includes Form-fill-seal cartons; and Prefabricated cartons
- *Bulk packaging systems*: This type of system classified into; Metal drum; and Bag-in-box Packaging Lines for Aseptic Processing There are five basic types of aseptic packaging lines as given below;
- *Film & Seal*: Pre-formed containers made up of thermoformed plastic, glass or metal are sterilized, filled in aseptic environment and sealed.
- *Form, Fill & Seal*: Roll of material is sterilized, formed in sterile environment, filled and sealed. e.g. Ex tetra packsn *Erect, Fill & seal*: Using knocked, down blanks, erected, sterilized, filled sealed. e.g. Ex. Gable-top cartons, Cambri-block.

Conclusion and Scope of Aseptic Packaging

There are number of limitations and disadvantages during actual application of this technology. However, we can't ignore the advantages over various lacunas of the process. Thus, it can be concluded that aseptic packaging of sterile/non sterile food and food products is the most significant innovation in the field of food science and technology and there is a big scope in this area.

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Roof Top Gardening: An urban Exigency

Article id:
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INTRODUCTION

A roof garden is a garden on the roof of a building. Besides the decorative benefit, roof plantings may provide food, temperature control, hydrological benefits, architectural enhancement, recreational opportunities, and in large scale it may even have ecological benefits. The practice of cultivating food on the rooftop of buildings is sometimes referred to as rooftop farming. Rooftop farming is usually done using green roof, hydroponics or container gardens. While talking about urban scenario a roof top garden is beneficial in reducing the environmental heat reaching inside the home as well as to produce sufficient vegetables and herbs for self-consumption. Roof top gardens in the sense of patio or rooftop gardens can be ornamental or functional, and they are usually designed with container plants to make the terrace easier to manage. Gardeners can also build raised beds on their terraces for gardening. Sun exposure and access to water are two important things to consider when establishing the garden, as is the goal of the garden. Loss of agricultural land for because of urbanization is the main problem in many countries. Increasing population requires shelters, buildings, industries etc. so agricultural land is being used to meet their needs. Garden roof systems can be divided into three categories: extensive, semi- intensive and intensive, which are defined as follows:

Extensive (shallow) roof garden system: Roof system with garden that has medium plants with approximately 50 mm to 150 mm deep roots
Semi-intensive (moderate) roof garden system: Roof system with garden that has medium plants with approximately 150 mm to 250 mm deep roots
Intensive (deep) roof garden system / roof garden: Roof system with a garden that has plants with roots that are more than 250 mm deep

Planning is an essential process before setting up a roof top garden, the main planning considerations are about selection of medium for growing plants, selection and arrangement of pots, selection of crops tom be grown, irrigation design for the roof top garden, waste utilisation and if needed rain water harvesting system design. A small roof top of a house constructed on a plot of 30 ×40 ft. is more than sufficient for growing the daily requirement of vegetables and flowers, apart from some from some fruits. It is advisable grow taller plants towards northern/southern side of the roof top, so that the shade does not fall on other pots. Smaller plants can be located in middle of roof top garden with sufficient space between the rows for movement and watering of plants. A roof top room can also be provided for recreational activities and a place to take rest. The entire roof top is placed with rows of convenient number of pots, by leaving sufficient space for walking between each row of pots, this walking space is utilised for watering and weeding plants

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whenever necessary. The perennial plants such as lime, banana, fig, sapota and drum stick etc. should be grown in big cement pots or old plastic barrels with drainage hole. These perennial plants should be place on the northern/southern side of the roof top, so that the shade does not fall on other pots.The wall of roof top will prevent the plants from strong winds and the barbed fencing can serve the dual purpose of support for the creepers as well as protection from monkey attacks. Selection and planning the layout of an irrigation system mainly depend on the schedule and ability of an individual to maintain the roof top garden. As discussed earlier if schedule is hectic automatic irrigation can be practiced. In a quarter portions or half portion a greenhouse arrangement can be provided so that rain water can be collected efficiently.One should plan a roof top garden if possible well before construction of a house so that excellent results can be obtained. The roof top garden can be a boon for the family environment and holistically speaking a certain blessing to mankind. Since, while designing the roof, we are going to take the consideration of factor of safety (3 to 4 times). Hence there is no need to worry about the weight on the roof.Planning for a roof top garden also includes selection of suitable pots for growing plants in the roof top garden. Generally it is recommended to go for locally available pots and half cut drum to make the entire process cost effective.Planning for water management of the rain water as well as the waste water from hand wash and kitchen should be done before setting up the roof top garden. Estimation of the capacity of the tank for the rain water harvesting system and selection of filters are main steps for planning the rain water harvesting system.One can go for a 20% penetration shade net or a small poly house in a part of roof top. This can facilitate water collection and crops can be grown disease free in them.The waste produced in the domestic household can be used in form of compost to enhance yield of the plant. Before setting up a roof top garden a compost pit should also be planned on the roof.Maintenance of a roof top garden includes proper management of irrigation, removal of dry leaves from the roof top as well ensuring moisture proofing of the roof top. A well maintained roof top garden is a positive sign of a healthy household. A terrace garden offers many benefits such as the reduction in ambient temperature especially in urban areas implementing a soothing environment. Terrace garden also acts as a filter for suspended impurities in the air purifying the air. The room temperature is also decreased and thus air conditioning cost reduces apprehensively. Vegetables, herbs and flowers can be grown at low maintenance for self-consumption with ease. It also adds to aesthetic value of home.

Irrigation Management in roof top garden

Application of right quantity of water at right time is important for growth of a crop in a roof top garden. Generally small kettles are preferred for application of water because application is easy and uniform using them and convenient carriage is also possible. If shortage of time is there we can go for drip irrigation which is one of the most efficient irrigation methods.

Dripler is an automatic drip irrigation system with a timer which controls the frequency and run-time of water for the plants. It comprises of an automatic timer which controls the frequency and run-time of water for the plants. This battery operated timer, once set, can take care of plant-watering automatically, regularly & efficiently, without any user intervention. This system is also called as Automatic plant watering care. In this system, a sensor is placed which automatically senses the moisture deficiency in the soil. According to pre-set timings, the irrigation will automatically start and used no manual cut off and starting. This method has two versions tap version and tank version, the tank version has more applicability. Tank Version is an automatic drip irrigation system with a battery operated timer, 25 Litre capacity water tank and drip irrigation accessories for 12 plants. The system controls the frequency and run-time of water for the plants according to the settings you set in the timer. Tank Version dripler has 1 Timer, a 12 mm pipe adaptor, 2 AAA batteries, 12mm Main line pipe 8 m, 4mm feeder line pipe 5 m., 2 litre/hour emitter 6 Nos (for smaller pots), 4 l/h emitter 6 Nos (for bigger pots), 12 No's feeder joint, 2 end caps, 1 T connector, 2 L connector , 1 straight connector, 2 end caps, 3 Dummy pins, teflon tape, 25 litre tank, tank attachment brackets, screws, bolts. The Tank version dripler as a kit serve for only 12 plants.

Waste Utilisation and Composting

Rotating Drum Compost Units: These units are off the ground on stands or bases. They are turned either with a handle or by pushing the drum. Most drums are batch compost units in which you add feed stocks as they are generated, but with each green addition, the process is interrupted, lengthening the composting time. For best results, the drum should be full to create a batch; compost activity occurs while you are filling but conditions are not optimal until it is full. To improve processing, 2 drums can be used consecutively, or a holding bin and drum can complement each other. Some are designed with side-by-side drums for this purpose. Once the drum is full, turn it as directed to mix the feed stocks until you have a finished product.

Terrace garden needs to be an emerging area if the ever increasing demand has to be satisfied. The growing interest in growing organic food in owns farm has gained importance and thus terrace gardens numbers are on a rapid increase. Various advantages clubbed together make terrace garden an achievement more than an occupation. But at the same time the demerit is there regarding our social obligation. The people capable of buying the produce of a farmer, if start growing their own food the poor farmers suffer and that situation is certainly not suitable for India.

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Present scenario of vertical farming in Agriculture

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INTRODUCTION

In 1915, Gilbert Ellis Bailey coined the term "vertical agriculture" and wrote a book called "Vertical Agriculture". In the early 1930s, William Frederick Gerick pioneered hydroponics at the University of California. in Berkley. In the 1980s, Åke Olsson, a Swedish organic farmer, invented the railway system for plant cultivation and vertical agriculture suggested as a means of vegetables production in the cities. Vertical agriculture could be the future of sustainable agriculture and replace traditional agriculture as the main source of food for society. Vertical agriculture cultivates and produces crops in layers and vertically stacked surfaces. The whole world is on the verge of population explosion and there is the most serious challenge of feeding the population. The population explosion has led to a decrease land per capita. Previously in order to provide more and more food the agricultural scientists of the population have expanded their innovative approaches to develop improved hybrid techniques and improved tools and implements integrated practices in water, nutrient and insect management and greenhouse technology, and even genetically modified crops(Wartman *et al* 2016). By replacing traditional farms with vertical farms, society would protect the environment while obtaining social and economic benefits. The main idea of vertical farms is to reduce the total amount of resources used and reduce the carbon footprint of agriculture. Vertical agriculture has been defined as "a type of internal agriculture that seeks to maximize production and efficiency per square foot by cultivating crops at multiple levels on a vertical axis" (Thomaier *et al* 2015). The vertical farm is considered to promote sustainable agricultural practices more than that by conventional farming, which refers to large scale, outdoor agriculture that embraces systems that engage heavy irrigation, intensive tillage and excessive use of fertilizers, pesticides and herbicides

World scenario

Vertical agriculture involves growing crops vertically in a controlled atmosphere using technology such as LED lighting, heating, ventilation and air conditioning (HVAC) systems, sensors and smart software, drones, mobile applications to maintain full control over environment. Food crops can be easily grown in urban areas by planting them vertically layers to save space and use a minimum of energy and water for irrigation (Shomefun *et al* 2018). Sparks & Stwalley (2018) tested the hydroponic nutrient film technique by cultivate lettuce plants and control the use of energy during the growing season. The examination of alternative energy scenarios revealed the energy consumption reductions of up to 53 percent and an improvement in the total production of systemic crops. Efficiency up to 55 percent of the reference level. Several experiments are underway in vertical agriculture worldwide. It has already been introduced in the United States and Europe, Spain, Japan and Singapore. Several vertical farms activated by technology, such as Aero farms and Green Sense in the United States, Delicious in the Netherlands, Sharp's Strawberry Farm in Dubai, Spread, Toshiba and more than 100 verticals in Japan, Packet Greens Singapore, the EU-funded project "INFORM" in Berlin are proven examples of successful vertical agriculture. National Aeronautics and Space Administration (NASA), the researchers considered that hydroponics was an appropriate method for growing food in space. They managed to produce vegetables such as onion, lettuce and radishes. In Colombia, the Association for Vertical Agriculture is working to ensure sustainability.

Need of vertical farming

1 **Food security**- Food security has become an increasingly important issue. Demographers predict that the population in Indian cities will increase dramatically in the coming decades. At the same time, ground specialists (for example agronomists, ecologists and geologists) warn of the growing shortage of agricultural land. For these reasons, demand for food could exceed supply exponentially, leading to a global famine. United Nations (UN) estimates that the world population will increase by 40%, exceeding 9 billion people per year 2050. It is important to keep in mind that vertical operations could help solve the problem of agricultural land scarcity (Corvalan *et al* 2005).

2 **Climate change**- Climate change has contributed to a decrease in arable land. Through the floods, the hurricane, storms and droughts, valuable farmland has been significantly reduced, damaging the world economy (Kalantari *et al* 2017). Scientists predict that climate change and adverse weather will continue to occur at an increasing rate. These events will lead to the theft of vast tracts of arable land, rendering them unsuitable for agriculture. Governments often strongly subsidize traditional agriculture through mechanisms such as crop insurance for natural causes. We must understand that "miles of food" refers to the distance traveled by crops to reach centralized urban populations. On average, the food travels 1,500 km from the farm field for dinner table (Astee *et al* 2010).In special circumstances, cold weather, for example, food miles can dramatically increase stores, restaurants and hospitals import products from abroad to meet the demand. This is particularly important given the increasing distance between farms and cities for global urbanization. Unfortunately, the greenhouse gas emissions resulting from the transport of food and agricultural activities have contributed to climate change.

3 **Health**- Conventional agricultural practices often focus on profits and profits while poorly paid attention to damage to human health and the natural environment. These practices regularly erode, contaminate the soil and cause excessive waste of water. As far as concerned human well-being, the World Health Organization has determined that more than half of the world's farms continue to use raw animal waste as fertilizer, which can attract flies and may contain weed seeds or diseases that can be transmitted to plants. As a result, the health of people is affected when consume such products. In addition, vertical agriculture indoors uses high-tech cultivation methods that use little water (approximately one tenth of that used in traditional agriculture) by providing accurate and efficient irrigation programming. This can have a significant improvement effect since the water requirements are increase as the urban population increases. Agricultural activities use more than two thirds of the world's resources and farmers are losing pulp for crops because urban areas are expanding and consume more water. It is likely that the water crisis will worsen as climate change causes warming.

4 **Economics**- Vertical agriculture offers an opportunity to support the local economy. Abandoned urban buildings can transform into vertical farms to provide healthy food in neighborhoods where there are fresh produce

weird. In addition, the high-tech environment of indoor farming can make agriculture enjoyable. In consecuense, a young generation practice was seduced by the practice, preparing a new generation of the farmers. In addition, vertical agriculture is driving the development of innovative agricultural technologies. Finally, it could allow the inhabitants of the city to reconnect with nature through agriculture.

Vertical cultivation systems

1. Hydroponics

It is a method to grow food in water using solutions of mineral nutrients without soil. The fundamental advantage of this method is that it reduces crop problems related to biotic factors.

2. Aeroponics

In aeroponics, there is no culture medium and, therefore, there are no culture containers. In aeroponic, fog or nutrient solutions are used instead of water. As the plants are attached to a the medium and the roots are sprayed with a nutritious solution, it requires much less space and much less water and not soil.

3. Aquaponics

It is a biosystem that integrates closed circuit aquaculture (fish farming) with hydroponics. Production of vegetables, flowers and herbs to create symbiotic relationships between plants and fish. Achieves this symbiosis through the use of nutrient-rich waste from fish. Reservoirs to "fertilize" hydroponic production beds. In turn, hydroponic beds also work such as biofilters that remove gases, acids and chemicals, such as ammonia, nitrates and phosphates. At the same time, gravel beds provide habitats for nitrification bacteria, which increase the nutrient cycle and filter the water. Therefore, the newly clean water can be recycled in aquariums.

Benefits of vertical farming

1. The first and main advantage of vertical agriculture is that it produces extremely high yields by land or available area.
2. Produce food throughout the year without risk of natural hazards such as floods, heavy rains, irregular rains, hail and snow, drought, periods of drought, extremely high temperatures, cold periods, epidemics of pests and diseases, etc.
3. Reduce the cost of transporting food grain shipments from rural areas to urban areas reduce the deterioration that occurs there. The consumption of fossil fuels during the transport of the agricultural products to the towns of the villages are also reduced even more.
4. Vertical agriculture uses 70 to 95% less water than traditional agriculture.
5. 90% less soil or no soil is needed for vertical agriculture and, therefore, there are no pests or diseases infestations.
6. Organic or pesticide-free foods are produced because they are not used.

Limitation in vertical farming

1. Limited plant crops have been identified for this purpose. However, the growing veggie crops are growing without any scientific validation.
2. No variety / hybrid were bred exclusively for the objective of vertical agriculture. As a result, the performance and quality of the product cannot be guaranteed.
3. Production technologies and good agricultural practices have not been standardized.
4. Currently, high-rise buildings are not built to suitable for vertical agriculture. It is necessary to reorganize the existing system and buildings

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providing additional structures to meet the goal of vertical farming. The above limitations are for research and intelligent development. Green cities / towns, high-rise buildings must be planned and built in such a way that it could be more suitable for vertical agriculture purposes

CONCLUSION

Vertical agriculture is certainly a solution to the critical problems of Indian agriculture, such as the lack of supply or overproduction of agricultural products, excessive use of pesticides, excessive use of fertilizers, deterioration of the soil and even unemployment. But there are challenges, such as the acceptance of vertical agriculture by the world agricultural community. Farmers face several problems, such as the lack of electricity supply in the day, guarantee of minimum support price, without control of market over-abundance, water shortage, etc. The considerable initial cost of infrastructure on a large farm is a major obstacle to implementation of vertical agriculture in world. Vertical agriculture faces other challenges, such as raising public awareness, including the agricultural community, technical knowledge the costs of administration and alignment of vertical production systems, as well as their economic cost viability.

Future research

It is important to note that future research must consider the issue of affordability of advanced vertical agriculture equipment to developing countries. Researchers must invent, refine and further develop local agricultural techniques to make vertical agricultural projects feasible in these countries. For example, they can invent recycling methods that reduce water dependence, design local systems by capturing rainwater, and take advantage of local solar energy to provide natural light and energy.

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SHIFTING AGRICULTURE - An indigeneous farming practice of north-east INDIA

Article id: 21902

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INTRODUCTION

The term 'shifting cultivation' refers to 'slash and burn' agriculture and nomenclature as 'Jhum' or 'Jhuming' cultivation in North-East India (NEI). It is variably termed as rotational bush fallow agriculture or slash and burn cultivation, and is an ancient form of agriculture still common in many parts of the humid tropics (Raman, 2001a). It is highly diverse land use system. It has been evolving since 10,000 BC in a wide range of distinct socio-economic and ecological conditions. Shifting cultivation spreads from mountains to lowland ecosystems and from tropical forests to grasslands (Spencer, 1966a). There is no universally accepted definition of shifting cultivation. The most complex and multifaceted form of agriculture, shifting cultivation is a practice, consists of cyclic nature, under which selection of fields, clearing them, drying and burning debris for the cultivation is carried out. Generally, shifting cultivation include cereals, vegetables and oil seeds. The main characteristics of shifting cultivation is rotation of fields rather than rotation of crops.

Currently, this practice is predominant in the seven states of North-Eastern India, especially in the humid forest of the hill tracts. About 14 percent of the geographical area of North-Eastern India is under Jhum cultivation. It is locally known as 'Jhuming' and is widely prevalent in all the states of the region.

Shifting cultivation, though a rudimentary technique of land and forest resource utilization, represents a complex relationship between ecology, economy and society of a region. The jhum fields and their surroundings forests provide two alternative sources of subsistence to the dependent population. In case of jhum fields are not good, surrounding forest area could provide food. Moreover, the shifting cultivators keep pigs and swines which feed on the vegetables and inferior grains.

Stages in shifting cultivation

1. Selection of plot

At first chooses a plot of land in the forest. Trees in the area are cut and the undergrowth is cleared at the beginning of the dry season. Selecting forest patches and clearing vegetation from it, takes place generally in the months of December and January.

2. Burning the cut trees

The trees are left to dry before they are burnt. The trees, herbs, shrubs, twigs and branches are burnt in February and March. The ashes of the burnt trees act as fertilizers for the soil.

3. Planting

Planting is carried out after the ground has cooled. In the months of April and May, seeds are shown. Holes are made with a dibble stick, into which seeds could be dropped.

4. Harvesting

Harvesting usually takes place during the dry season.

5. Fallowing

After a few years of cultivation, the soil loses the fertility. Farmers then move on to look for a new plot of land, leaving the first field to fallow or rest. They may return to the same plot after a period of time.

Problems of shifting cultivation

Shifting cultivation in general has proved fatal for forest cover. It has caused the destruction of forest and species habitat, which accounts for the most profound loss in biodiversity. The decline in the forest cover has resulted in the removal of the top soil, resulting in the loss of soil fertility. The shifting cultivation has caused extensive climate changes and destroyed rare flora and fauna. Burning contributes to increased CO_2 emission and air pollution. With large scale deforestation due to shifting cultivation there occur undesirable ecological changes. Due to shifting cultivation, there are major adverse effects on soil erosion, crop production and elimination of important free species as well as genetic resources of the region.

Prospects of shifting cultivation

During the agricultural operation for shifting cultivation no ploughing, hoeing and pulverization of soil is done, the soil remains compact. Moreover, the areas where shifting cultivation is practiced generally steep slopes on which sedentary cultivation cannot be developed easily.

Some of the techniques to manage shifting cultivation

- Salt models (Sloping agriculture land technology)
- ICAR 3-tier model
- NEPED (Nagaland environment protect and economic development)
- Intensive watershed based livestock production system
- SWEET (sloping watershed and environmental engineering technology)

CONCLUSION

The majority of the population of the North-Eastern hill states depends on shifting cultivation for their livelihoods because of low cost, labour and energy input involved in shifting cultivation compared to terrace cultivation. Due to limited arable land and increasing population growth people of hilly areas of North-Eastern region still continuing shifting cultivation. If the shifting cultivation in its present form is allowed to continue land degradation will be increased. Considering the adverse impacts of the shifting cultivation such as loss of fertile top soil, nutrients and forest biodiversity, low productivity, sustainable farming alternatives need to be developed and implemented immediately.

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Role of Mobile Technology is Improving Agriculture in India

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INTRODUCTION:

Mobile phone usage in third world countries is playing a vital role for the enhancement of farmers business towards agriculture. Recently, communication through mobile phones is considered very important in enhancing farmers' access to better understand agricultural market situation. Farming communities appreciate mobile phone as easy, fast and convenient way to communicate and get prompt answers of respective problems. Nowadays, the mobile phone has generated an opportunity for the farmers especially to get the information about marketing and weather. Through this important technology, they directly keep in touch with market personals and offer their produce with reasonable prices. The use of mobile phone also keep them aware for weather forecast for agriculture input application like fertilizer and pesticides which might be affected by unforeseen seen disasters as communicated by meteorological department. This device has given new direction and approach to farmers to communicate directly and share about recent advances with each other. The studies showed that mobile phones have saved energy and time of farmers and ultimately improved their income. Mobile phones have provided an opportunity to the farmers to communicate directly with market brokers and customers for sell their product in good price.

The agriculture sector is increasingly impacted by climate change. Variable weather patterns, soil erosion, and industrial agricultural practices have caused considerable damage to the farming Community, particularly in developing countries. However, mobile and other technological developments provide an opportunity to improve agricultural practices in developing countries and facilitate better adaptation to climate change.

Challenges in emerging economies

Agricultural practices are significantly different in developed markets, such as the United States, than in emerging markets, such as India. Challenges in developed economies include lower water tables, soil degradation, greenhouse gas emissions and increased nutrification of soil and water bodies. Emerging economies also face some of these challenges, but must deal with a lack of infrastructure and scarcity of technical expertise in advanced farming techniques. The predominant cultivation of certain cash crops has resulted in soil degradation and a loss of bio-diversity. Overuse of fertilizers and pesticides is also a major concern with industrial scale farming in developing countries. Further, the agriculture industry in most emerging market countries includes a large number of farms managed by families with limited technical and mechanical support, and poor access to finances. A lack of storage and transportation facilities causes a significant loss of harvested crop material, before it reaches the end consumer. There is need to address these and several other challenges in emerging economies.

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MOBILE TECHNOLOGY TO DRIVE SUSTAINABILITY IN AGRICULTURE IN EMERGING MARKETS

Rapid advancements in technology provide an opportunity to connect and serve a large number of farmers in emerging market countries. With the rapid adoption of smart phones, it's possible to serve smallholder farmers and connect them to governments, large corporations and other resources. Through smart phones and social media applications, farmers can access education and information about a range of agricultural topics. In addition, farming communities can exchange information with each other, and with agricultural experts, on best farming practices. Translation services on web browsers can also help them access information in the language of their choice.

CONCLUSION

Collaborative content management systems allow businesses to manage geographic information. Farmers create and share web-based maps with information about soil conditions, weather patterns and other data. Also, this information allows farmers to respond to significant risks, and minimize potentially negative impacts. Mobile and other technology provides opportunities for businesses to leverage the use of inexpensive sources of information. This information can help level the playing field for poor communities and small businesses. It can also inform a number of decisions. Food buyers, exporters, farmers and other stakeholders are already benefitting from using a mobile network. Emerging markets using mobile technology are well positioned to deliver a significant portion of the world's agriculture, improve efficiencies, and reduce the environmental impact of farming. One of the major benefits of connectivity to information technology is the availability and access to weather information, and geographical data. Soil conditions can be monitored in combination with weather information to determine what to grow, and when to plant, fertilize and harvest crops. Farmers also access information about the length of the growing seasons for crops, and the risks (e.g., droughts, floods, and extreme storms) they might encounter during the season. Geographic data provides valuable information on pests and animal diseases, allowing farmers to assess their level of risk. Among the financial benefits of mobile technology, information about real-time pricing allows farmers to decide whether to buy or hold, and identify the best crops to grow. Agricultural price information may help farmers sell their products at better prices, and provide reliable food price information to policy makers, preventing price volatility and speculation. Also, there is a preference to buy Goods locally, reducing transportation costs. Mobile technology can also help increase product traceability, with information about disease, pest tracking, and storage. Product traceability can improve public health by pinpointing the origin of produce, allowing officials to communicate risk information to consumers and others in the supply chain. A connected system allows for more efficient and effective farming methods and provides information about problems to reduce risks to farmers and consumers.

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Advanced Molecular Breeding Techniques for Improvement of Horticultural Crops in Terms of Nutritional Security and Health Care

Article id: 21904

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INTRODUCTION

According to an estimate the global population would reach a mark of about 9 billion by the end of year 2030. The major portion of this rise in population was contributed by developing countries especially India and it results in shortage of food supply, malnutrition, reduce per capita availability of resources and higher food prices. In such threatening conditions horticulture sector can play a crucial role not only in providing food security but also in maintaining nutritional security, reducing malnutrition and increasing the net income. Government is very serious about the nutrition deficiency in mothers & children's and to solve this problem of nutrient deficiency government has launched National Nutrition Mission (NNM) with a major target to reduce the level of stunting, under nutrition and anemia. On 8 March 2018 Prime Minister launched Poshan Abhiyan, an overarching scheme for holistic nourishment. Due to painstacking effort of horticulturist, India had achieved lot of milestones in horticulture like globally, India is the second largest producer of fruits and vegetables, largest producer of mango, banana, coconut, cashew, papaya and pomegranate, largest producer and exporter of spices, ranks first in productivity of grapes, banana, cassava, peas, papaya and export growth of fresh fruits and vegetables in term of value is 14% and of processed fruits and vegetables is 16.27%.

Despites these achievements still there are lot of challenges that need to be addressed by the scientists like reduction in yield due to global climate change, emergence of new pathotype, degradation of soil fertility, rise in global population, reduction in food quality, malnutrition, and reduction in per capita income of farmers. But among all these problems, hidden hunger and malnutrition are of utmost importance. To address these challenges several new innovations are required in horticulture sector so that farmers can increase farm yield, improve nutraceutical properties and get higher returns.

Molecular Breeding Tools for Nutritional security and Health care

Food and nutrition security exists when all people at all times have physical, social and economic access to food, which is consumed in sufficient quantity and quality to meet their dietary needs and food preferences, and is supported by an environment of adequate sanitation, health services and care, allowing for a healthy and active life (FAO/AGN 2011). Hidden hunger can be defined as the acute deficiency of micronutrients in human diets that are adequate in terms of energy; however lack vitamins and/or mineral elements (Pfeiffer and McClafferty 2007).Fruits and vegetable contains various useful compounds that helps human immune system to fight several diseases like carrot, tomato & sweet potato contains beta carotene (Vitamin A) which reduces the chances of cancer disease similarly onion provides quercetin which is highly effective for coronary diseases, beets provides folic acids which prevent birth defects. There are several new and advanced techniques that increase the nutraceutical properties of horticulture crops

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Techniques for crop biofortification: Biofortification means increasing thenutritional value of crop by using conventional or modern breeding approaches. For the populations that have limited access to diverse diets and other micronutrient interventions, biofortification is a feasible and cost-effective means of delivering micronutrients (Bouis and Saltzman 2017).Biofortified fruits and vegetables can help to fight against malnutrition in developing countries. Biofortified vegetables such as sweet potato, cassava have highly available micronutrients such as iron, zinc and vitamin A for preventing global deficiency of these nutrients. Several other breeding strategies for biofortification are mentioned below:

CRISPR/Cas9-Mediated Genome Editing: Genome editing involves techniques to change an organism's DNA. i.e. genetic material can be added, removed, or altered at particular locations in the genome. Among all the approaches of genome editing a recent one known as CRISPR-Cas9 (Clustered Regularly Interspaced Short Palindromic Repeats and CRISPR-associated protein 9) is most popular as it is faster, cheaper, more accurate, and more efficient than other existing genome editing methods. CRISPR-Cas9 is used to improve lycopene (provides cure for chronic diseases, cancer and cardiovascular diseases) content in tomato, domestication of strawberry groundcherry (*Physalis pruinose) and in tomatoes to* maintain long shelf life of fruits

Transgenic fruits and vegetables: With the availability of genetic engineering tools it is now becomes possible to incorporate desired transgenes into elite cultivars, thereby improving their value considerably. Many horticulture crops have been modified genetically to improve their nutritional status like transgenic carrot has high calcium content (to reduce the incidence of osteoporosis) and transgenic tomato (delayed ripening).

Edible Vaccines: Many fruit and vegetables are under trail to be released as edible vaccines. Edible vaccines are produced by introduction of a particular gene of interest into the plant cells, which produces the desirable encoded protein. In the year 1997 the first successful human trial for an edible vaccine was conducted and transgenic potatoes were given to volunteers to provide them immunity against diarrhoea. Fruits such as transgenic bananas (against diabetes) and vegetables like potatoes & tomato (against diarrhoea) are being used as edible vaccines.

Cisgenics & Intragenics: Cisgenesis is a technique of genetic manipulation in which both donor and recipient are from the same species (crossable and sexually compatible) and a gene (including its introns, promoter and terminator) is transferred. Intragenesis refers to GMOs where the introduced intragene also originates from the same species or a crossable species. The first intragenic potato was developed to produce high amylopectin content.

Metabolomics Techniques for Breeding Nutraceutical Vegetables: Metabolomics can be defined as genomics based approach which aims is to identify and quantify the metabolomes within a cell/tissue/organism produced during cellular metabolic pathways (Weckwerth 2003). Metabolomics Assisted Breeding along with genomics and proteomics, offers tools for nutraceutical breeding. It involves techniques like mass spectrometry, nuclear magnetic resonance spectroscopy and chromatography are being utilized to analyze hundreds ofmetabolites simultaneously. In case of onions sulphur containing nutraceutical had been developed by altering the γ-glutamyl peptide pathway.

CONCLUSION

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Out of our total agricultural area of about 140 million hectares, 17% of area is under horticultural crop that contributes to 30% of total agricultural GDP.Horticultural sector possess a tremendous potential not only in providing the nutritious food to our people but also increasing the farmers income. But there is a need to adopt advanced breeding techniques so that we can fight hidden hunger and increase nutritional properties of fruits and vegetables.

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Swertia specios. Wall. EX D.DON, can be substitute for *Swertia chiraiyta* from the Higher Himalayan Region?

Article id: 21905

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Swertia speciosa medicinal herb is an erect perennial robust herbs. Stems simple, hollow, pale green, Radical leaves long stalked, cauline opposite, sessile, stem clasping, ovate, acuminate, Pale green glabrous, 15-20x5, 5-6.5 cm; margins entire. Flowers lurid- green, 2.5-3 cm diameter. Calyx- lobe fringed, apiculate, membranous. Corolla lobes streaked with purples; glands purplish, fringed, 2 in each lobe. Capsules oblong- ovoid. Seeds compressed, olive green.


Distribution

Belongs to family Gentianaceae and in Himachal Pradesh it is locally known as Bambiri. These plants grow in grass land , Slopes or alpine bugyal and marshy localities of timber zone in Himalayan region from Western to North Eastern (Pakistan , Kashmir, Himanchal Pardesh, Uttarakhand, Nepal, Bhutan , Arunachal Pardesh between 2800 to 4000 m asl. Flowering and minute seeds inside ovoid capsule are formed by this herb in the month of August and September.

Medicinal & Traditional Uses

Root of ***S. speciosa*** contains bioactive principles like mangiferin, amaroswerin and amarogentin. Bitter secoiridiod glucosides (amaroswerin) and Xanthone –C-Glucoside (mangiferin). The major bioactive compound of ***S.speciosa*** play significant role as hepatoprotective, anti-hepatotoxic, anti-microbial, anti-inflammatory, anti-carcinogenic, anti-leprosy, hypoglycemic, antimalarial and anti-tumour . Root ground in Water are put into eyes like surma dyes to relieve snow burnt eye had been reported by gaddi tribe of

Bharmour areas in Himachal Pardesh. Monpa tribals in Arunachal Pardesh belive that its (***S.speciosa***) root part can cure fever, Cough, dysentery and Cold **.** Tribal of Nepal is used as in febrifuge, antipyretic, appetizer and effect against anorexia **.**

CONCLUSION

Biologically active amaroswerin and mangiferin increase usefulness of *S.speciosa* and open new avenues for investigation on pharmacological and domestication. *S.speciosa* has already been used as an adulterant medical herb of *S.chirayita* and it was critically endangered medicinal plant and is now on the verge of extinction and original populations of many them have been vanishing due to high demand of Pharmaceutical industries, traditional use and the development human activities. As *S. chirayita* had been banned for collection due to rarity in nature, *S.speciosa* will be useful for theraputic application and as a substitute drug formulation.

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Air pollution – Its impact on Environment and Human Health

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"Pollutants in the air aren't always visible and come from many different sources."

Ahead of the World Environment Day, an independent United Nations expert on June 4, 2019, said air pollution is responsible for seven million premature deaths each year. David Boyd, UN special rapporteur on human rights and environment, also urged member states to beat air pollution to fulfill their human rights obligations. "Air pollution is a silent, invisible and prolific killer that is responsible for premature death of seven million people each year, disproportionately affecting women, children and poor communities," said Boyd.

He added that the right to a healthy environment is fundamental to human well being and is legally recognized by more than 150 countries at national and regional levels. "Failing to ensure clean air constitutes a violation of rights to life, health and well being, as well as the right to live in a healthy environment. States must take urgent action to improve air quality to fulfill their human rights obligations," he added.

Pollution – What is it?

The term pollution is derived from a Latin word Polluter which means "to soil" or "to defile".Pollution may be defined as "an undesirable change in the physical, chemical and biological characteristics of air, water and soil which affects human life, lives of his related other useful living plants and animals, industrial progress, living conditions and cultural assets."

Pollution is a change in the characteristics of the air, water, soil and food that can adversely affect the health, survival or activities of human or other organisms. In other words, pollution alters the environmental conditions unfavorably for the ecosystem and its living organismsPollution occurs when a product added to our natural environment adversely affects nature's ability to dispose of it. This product could be a naturally occurring material or anthropogenicals produced materials.

Air Pollution

A Complete definition of air pollution given by Alan Gilpin, 1976 is "Substance present in the atmosphere in concentrations great enough to interfere directly or indirectly with man's comfort, safety or health. According to Indian Air (Prevention and Control of Pollution) Act, 1981, air pollution means any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentrations that may or tend to be injurious to human beings or other living creatures or plants or property.

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Air pollution means the presence in the outdoor atmosphere of one or more contaminants, such as dust, fumes, gas, miscellaneous. Odor, smoke or vapor in quantities of characteristics and of duration, such to be injurious to human, plant or animal life or property or which unreasonably interferes with the comfortable enjoyment of life and property.

Recently one news article said that Gujarat ranks number second in pollution in India. Around 7 million people died due to air pollution in the World. In Gujarat, only two lakh peoples were died due to pollution in 2018. In 2015 around 5.2 lakh peoples were died due to air pollution, 12 lakhs died in 2016, 17 lakhs died in 2017. Because of air pollution, 52,000 of peoples were died due to lung disease only in Gujarat.

What is polluting the environment?

As more and more people move to cities seeking better opportunities, the problem is expected to escalate. Globally, more than 1 in 2 people livein cities. By 2050, it is expected to grow to 2 in 3 people. Heavy traffic, limited green spaces, air pollution, noise and violence all affect our health. Rural areas, known for environmental tranquility, are also being subsumed in this expansion. Indoor cooking, especially in rural and peri-urban households, is a major health hazard.

In India, rapid urbanization and economic growth have resulted in increased need for energy. For its energy needs, the country is over- dependent on coal, a potent source of air pollution. Untreated pollutants from industry, unclean domestic sources and agricultural practices extensively pollute our air, land and water bodies. Unsafe disposal of biomedical and e-waste too contribute to environmental pollution.

Causes of air pollution:-

Air pollution results from gaseous emissions from mainly industry, thermal power stations, automobiles and domestic combustions, etc.

1. Industrial wastes – There are a number of industries which are a source of air pollution. Petroleum refineries are the major source of gaseous pollutants. The chief gases are SO_2 and NO_x. Mathura based petroleum refinery is posing threat to Taj Mahal in Agra and other monuments at Fatehpur Sikri complex.

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2. Thermal Power Stations – The coal consumption of thermal plants is several million tones. The chief pollutants are fly ash, SO_2 and other gases and hydrocarbons. There are a number of thermal power stations and super thermal power stations in the country. The National Thermal Power Corporation (NTPC) is setting up four mammoth coal-powered power stations to augment the energy generation. These are at Singrauli in U.P., Kobra in M.P., Ramagundam in Andhra Pradesh and Farakka in W. Bengal.

3. Automobiles – The two-wheelers and three-wheelers contribute 60% of the total CO and 83% of total hydrocarbon, whereas heavy traffic vehicles 55 to 80% of the oxides of nitrogen. It is estimated that a car (without cleaning device) on burning 1000 litre of fuel emits 350 Kg CO, 0.6 Kg SO_2, 0.1 Kg lead and 1.5 Kg SPM (Suspended particulate matter).About 1000 gallons of petrol after combustion produces 3200 lb. of CO, 200 – 400 lb. organic vapours, 20 – 75 lb. of NOx, 18 lb of aldehydes, 17 lb of sulphur compounds, 2 lb of organic acids and NH_3 each and 0.3 lb of solid carbons.

4. Natural sources – Air is produced by natural climatic activities like a cyclone, high velocity winds, etc. which make the atmosphere full of dust and makes the visibility almost nil and it becomes difficult to inhale this dusty air. Air pollution is also caused, due to flying ashes from volcanos, forest fires, pollen grains and microbes.

5. Solvents – Solvents used in the polish of floor, furniture, etc. are low boiling point hydrocarbons. These chemical mixes into the air when used and pollute the air.

6. Smoking – The people who smoke cigarettes, bidi, cigar, etc. pollute the air with smoke, this harms the non-smokers also as they inhale the smoke.

7. Nuclear explosion – The nuclear explosion in the area, pollute the air of a large area at once, including many hazardous chemicals, dust particles, in excess.

8. Agricultural activities – To increase the yield, excess of harmful chemicals are sprayed on the crops, in the form of liquids and powders. These chemicals travel a large distance with air, polluting it.

9. The Crackers – It is very common practice to burn crackers for entertainment. Many shows are organized on weddings, diwali festival and a large amount of sulphur and nitrogen gases are introduced in the air.

10. Combustion for disposal of garbage – It is very common practice to burn all types of garbage, expelled from houses, hotels, hospitals, gardens, farms, etc. However, all type of biodegradable or non-biodegradable material produces smoke and soot polluting the air.

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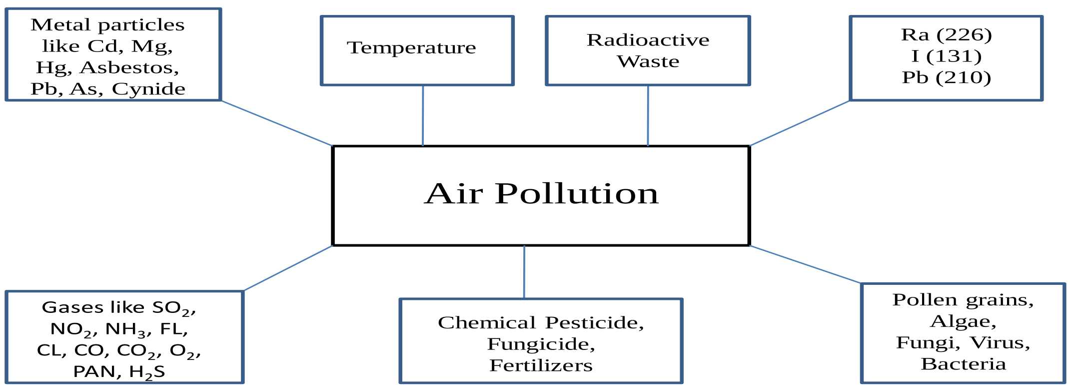
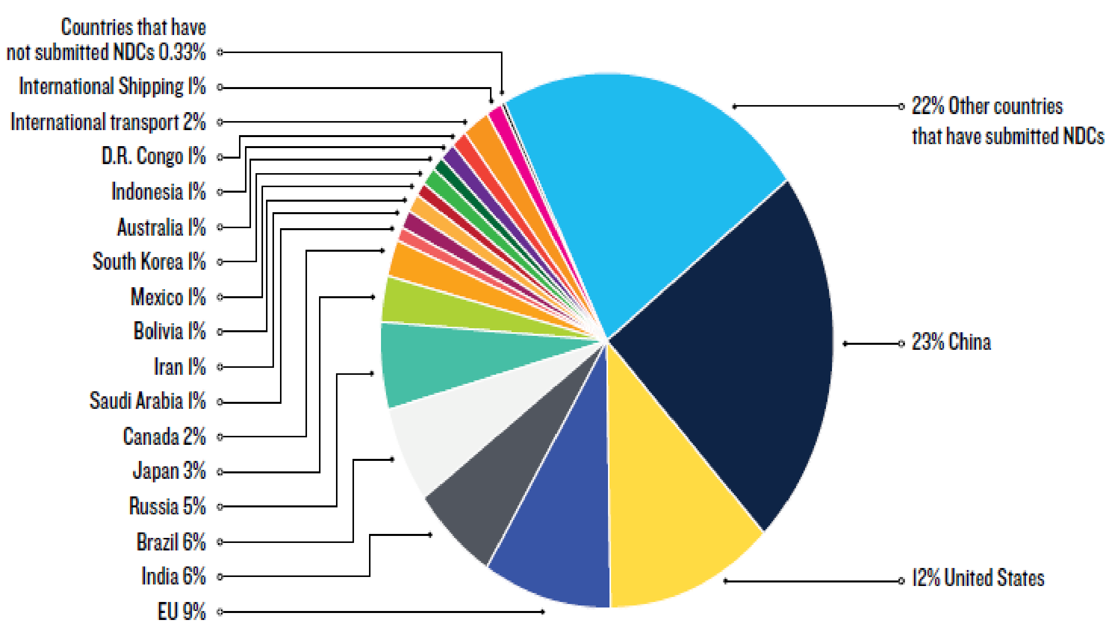


Fig. 1. Air Pollutants

FIGURE I: SHARE OF GREENHOUSE GAS EMISSIONS BY COUNTRIES WITH CLIMATE TARGETS



Source: Natural Resources Defense Council. Countries' share of emissions was calculated as a share of the world total GHG emissions for 2012, as reported by EDGAR. Countries that have not submitted targets are: Libya, Syria, Nicaragua. (Syria has not joined the Paris Agreement.) Emissions Database for Global Atmospheric Research, "GHG (CO_2, CH_4, N_2O, F-gases) emission time series 1990-2012 per region/country," European Commission Joint Research Centre, http://edgar.jrc.ec.europa.eu/overview.php?v=GHGts1990-2012.

Effects of Air Pollution

Polluted air affects human and animal health, vegetation, small insects, organisms and environment in general. Some of the harmful effects of air pollution are

Effect on human health – Effects of air pollution on human health are summarized in Table 1.

Table 1. Effects of Air Pollution on Human Health

Sr. No.	Pollutant	Effect	Main Source
1.	Carbon monoxide (CO)	Reduces oxygen bearing muscles. Especially harms asthamatic people	Partial combustion of fuel (e.g. Vehicles)
2.	Sulphur dioxide (SO_2)	More harmful when mixes with smoke. Increases respiratory problems, chocking, burning of eyes, cause acid rain when mixed with water vapours, acidifies soil and water bodies, corrosion of monuments	Burning of coal, oil, etc. with pungent smell
3.	Suspended particulate matter (SPM)	Poisonous according to the combination. Increases effect of SO_2, reduces light, form smog, rusting increases	Smoke from houses, industries and vehicles, Dust storms, earthquakes and volcanos.
4.	Nitrogen oxide (NO_2)	Respiratory infections in kids, copper colored fog in the atmosphere of the town. Rust producing	Burning of fuel in vehicles and forest fires.
5.	Volatile hydrocarbons	Causes burning in eyes when mixes with other pollutants (acrolein, aldehyele). Ethylene is bad for plants, aerosols reduce visibility	Burning of organic fuels, industrial process and disposal of solid wastes.
6.	Carbon dioxide (CO_2)	Not any direct effect on human beings but can cause global warming	Vehicles, burning of fuels for energy productions
7.	Oxides and ozone	Burning in eyes, damage lungs, corrode buildings and other things, reduce visibility and ozone is hazardous for plants	Emitted from vehicles, photochenmical reaction between nitrogen oxides and hydrocarbon

Table 2: Mechanisms by which some key pollutants in smoke from domestic sources may increase the risk of respiratory and other health problems

Pollutant	Mechanism	Potential health effects
Particulate matter: small particles less than 10 microns, and particularly those less than 2.5 microns aerodynamic	• Acute: bronchial irritation, inflammation and increased reactivity • Reduced muco-ciliary clearance • Reduced	• Wheezing, exacerbation of asthma • Respiratory infections • Chronic bronchitis and COPD • Exacerbation of

diameter	macrophage response and reduced local immunity • Fibrotic reaction • Autonomic imbalance, pro-coagulant activity, oxidative stress	COPD • Excess mortality, including cardiovascular disease
Carbon Monoxide	Binding with Haemoglobin (Hb) to produce COHb which reduced O2 delivery to key organs and the developing fetus.	Low birth weight (fetal COHb 210%, or higher) • Increase in perinatal deaths
Benzo[a]pyrene	Carcinogenic (one of a number of carcinogenic substances in coal and biomass smoke)	Lung cancer Cancer of mouth, nasopharynx, and larynx
Formaldehyde	Nasopharyngeal and airways irritation • Increased allergic sensitization	increased susceptibility to infections • May lead to asthma
Nitrogen dioxide	Acute exposure increases bronchial reactivity • Longer term exposure increases susceptibility to bacterial and viral lung infections	Wheezing and exacerbation of asthma Respiratory infections • Reduced lung function (children)
Sulphur dioxide	Acute exposure increases bronchial reactivity • Longer term: difficult to dissociate from particulate effects	Wheezing and exacerbation of asthma Exacerbation of COPD, CVD

*The health effects of indoor air pollution exposure in developing countries pp 11

Halons and chlorofluor carbons are most dangerous and braking ozone layer inviting ultraviolet rays, which are damaging the genetic material DNA responsible for skin cancer.

I. Effects on the Environment

A. Global Warming: CO_2 is confined exclusively to the troposphere, it's higher concentration acts as a serious pollutant. Most heat is absorbed by the CO_2 layer and water vapours in the atmosphere, which adds to the heat which is already present. The net result is the heating up of the earth's atmosphere. Thus increasing CO_2 levels tend to warm the air in the lower layers of atmosphere on a global scale. Nearly 100 years ago the CO_2 level was 275 ppm. Today it is 350 ppm and by the year 2035 and 2040 it is expected to reach 450 ppm. Imagine the earth's temperature. CO_2 increases the earth temperature by 50% while CFCs are responsible for another 20% increase. There are enough CFCs up there to last 120 years.

The Heat trap provided by atmospheric CO_2 probably helped to create the conditions necessary for the evolution of life and the greening of the earth. Compared to moderately warm planets, Mars with too little CO_2 in its atmosphere is frozen cold and Venus with too much is a dry furnace. The excess CO_2 is absorbed by the oceans. But with industrialization of West and increased consumption of energy CO_2

was released into atmosphere at a faster rate. Thus its concentration increased. According to some estimates CO_2 in air may have risen by 25% since the middle of 19th century. It may even be doubled by 2030 A.D.According to computerized models doubling the CO_2 level will increase the global mean temperature (15 °C) by 2 °C. But some others say that this will be less than one quarter of a degree.

Some scientists believe that changes in earth's mean temperature will be apparent by 2050 when the temperature would be increased by 1.5 to 4.5°C. According to projection changes will be the least in the tropics and the most at the poles. Siberia, Greenland, Iceland, Norway, Sweden, Finland and Alaska will be among the most affected. The polar ice caps would melt. A rise of 5°C would raise the sea level by five meters within a few decades threatening all the densely populated coastal cities from Shangai to San Fransisco. It is suggested that North America would be warmer and drier. The U.S. would produce less grain. On the other hand North and East Africa, India and West Australia would be warmer and wetter enabling them to produce more grain. However, this may not happen as higher surface temperature will increase the evaporation of water thus reducing grain yield. According to George Woodwell India's annual Monsoon rains may even cease altogether.

Fig: An iceberg melts in the waters off Antarctica. Climate change has accelerated the rate of ice loss across the continent.

According to an estimate if all the ice on the earth should melt 200 feet of water would be added to the surface of all oceans and low lying coastal cities as Bangkok and Venice would be inundated. A rise in sea level of 50 – 100 cm caused by ocean warming would flood low lying lands in Bangladesh and West Bengal. Due to Global warming there may occur more hurricanes and cyclones and early snow melts in mountains causing more floods during Monsoon. According to some within next 25 years there will be a rise in sea level by 1.5 to 3.5 meters and in Bangladesh alone 15 million people will have to move or drown. Low lying cities of Kolkata may be inundated.

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After months of record temperatures, scientists say Greenland's ice sheet experienced its biggest melt of the summer on 3 August 2019, losing 11 billion tons of surface ice to the ocean – equivalent to 4.4 million Olympic swimming pools. Greenland's ice sheet usually melts during the summer, but the melt season typically begins around the end of May; this year it began at the start. This July alone, Greenland's ice sheet lost 197 billion tons of ice, according to Ruth Mottram, a climate scientist with Danish Meteorological Institute. She told CNN the expected average would be between 60 – 70 billion tons at this time of year.

B. Green House Effect – During normal conditions (with normal CO_2 concentration) the temperature at the surface of the earth is maintained by energy balance of the sun rays that strike the planet and heat that is radiated back into space. However, when there is an increase in CO_2 concentration, the thick layer of this gas prevents the heat from being re-radiant out. This thick CO_2 layer thus functions like the glass panels of a greenhouse (or the glass windows of a motor car), allowing the sunlight to filter through but preventing the heat from being re-radiated in outer space. This is the so called greenhouse effect.

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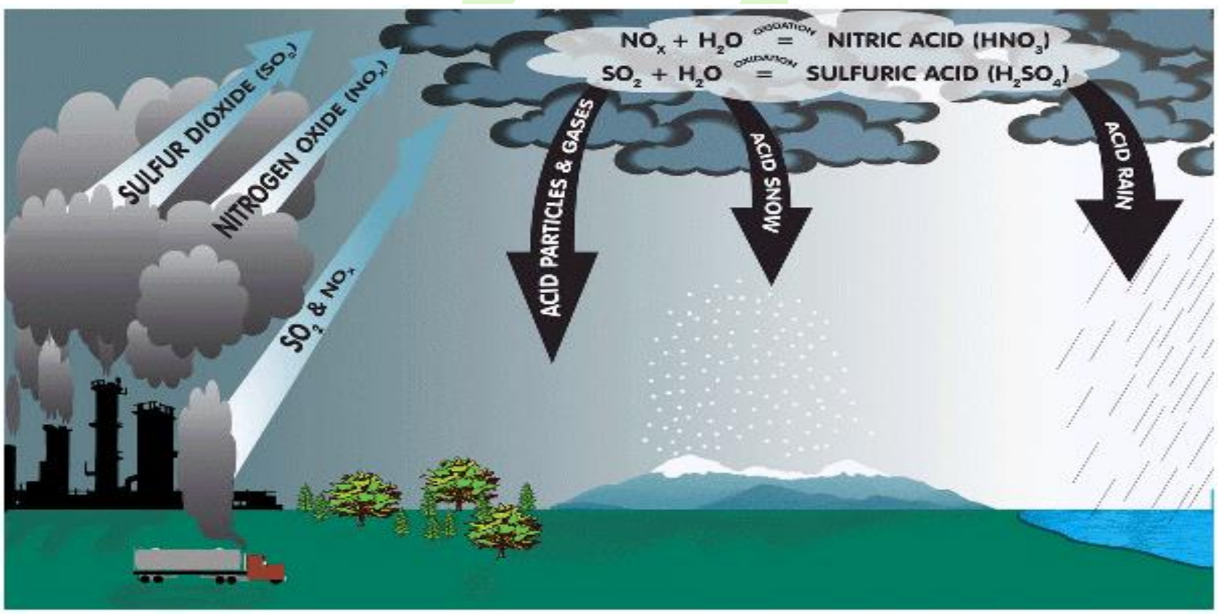
Greenhouse gases are a key factor in the Earth's changing climate.

(B) Acid Rain – The acid rain is infact a cocktail of H_2SO_4 and HNO_3 and the ratio of the two may vary depending on the relative quantities of oxides of sulphur and nitrogen emitted. On an average 60 – 70% of the acidity is ascribed to H_2SO_4 and 30 – 40% to HNO_3. The acid rain problem has dramatically increased due to industrialization.



We have seen that the oxides of sulphur and nitrogen are important gaseous pollutants of air. These oxides are produced mainly by combustion of fossil fuels, smelters, power plants, automobile exhausts, domestic fires, etc. These oxides are swept up into the atmosphere and can travel thousands of kilometers. The longer they stay in the atmosphere, the more likely they are to be oxidised into acids. Sulphuric acids and nitric acid are the two main acids, which then dissolve in the water in the atmosphere and fall to the ground as acid rain or may remain in atmosphere in clouds and fogs.

The acid rain is infact a cocktail of H_2SO_4 and HNO_3 and the ratio of the two may vary depending on the relative quantities of oxides of sulphur and nitrogen emitted. On an average 60-70% of the acidity is ascribed to H_2SO_4 and 30-40% to HNO_3. The acid rain problem has dramatically increased due to industrialisation. Burning of fosil fuels for power generation contributes to almost 60-70% of total SO_2 emitted globally. Emission of NO_3^{--} from anthropogenic sources ranges between 20-90 million tons annually over the globe. Acid rains have assumed global ecological problem because oxides travel a long distance and during their journey in atmosphere, they may undergo physical and chemical transformations to produce more hazardous products.

Acid rains create complex problems and their impacts are far reaching. They increase soil acidity, thus affecting land flora and fauna; cause acidification of lakes and streams thus affecting aquatic life, affects crop productivity and human health. Besides these, they also corrode buildings, monuments, statues, bridges, fences, railings, etc. Due to acidity, levels of heavy metals as aluminium, manganese, zinc, cadmium, lead and copper in soil and water increases beyond the safe limits. Many bacteria and blue green algae are killed due to acidification, thus disrupting the ecological balance.Thousands of lakes in U.S.A., Canada, Norway have become unproductive due to acidity. Over 10,000 lakes in Sweden have become acidified. The fish population has decreased tremendously and there are deaths of salman trout etc. Many bacteria and blue green algae are killed due to acidification. In West Germany nearly 8% of the forests died and nearly 18 million acres of forests are critically afflicted by acid rains. Nutrients as calcium, magnesium and potassium have been leached away from soil by acids.

Acid rains are carried away by prevailing winds to elsewhere where precipitation takes place. Thus, oxides may produce at one place and these affect elsewhere by turning into acids. The two such victims are Canada and Sweden. Canada gets acid rains from petrochemical units in North America. Heavy winds pick up acid rain from factories in Britain and France to Sweden. It is said that 90% of the acid rain of Norway and 75% of Sweden are due to drifted oxides of Sulphur and Nitrogen.

In India, industrial areas with the pH value of rain water below or close to the critical value have been recorded in Delhi, Nagpur, Pune, Mumbai and Kolkata. This is due to sulphur dioxide from coal-based power plants and petroleum refinery. According to a study made by B.A.R.C. Air Monitoring Section, the average pH value of acid rain at Kolkata is 5.80, Hyderabad 5.73, Chennai 5.85, Delhi 6.21 and Mumbai 4.80. The situation may even worsen in the future due to increased installation of thermal power plants by NTPC and consequent increase in coal consumption. According to one estimate total emission of SO_2 in India from fossil fuel burning has increased from 1.38, million tons in 1966 to 3.20 million tons in 1979, a 21% increase as compared to corresponding. There is urgent need for proper regular monitoring to provide timely warnings about acidification of our environment.

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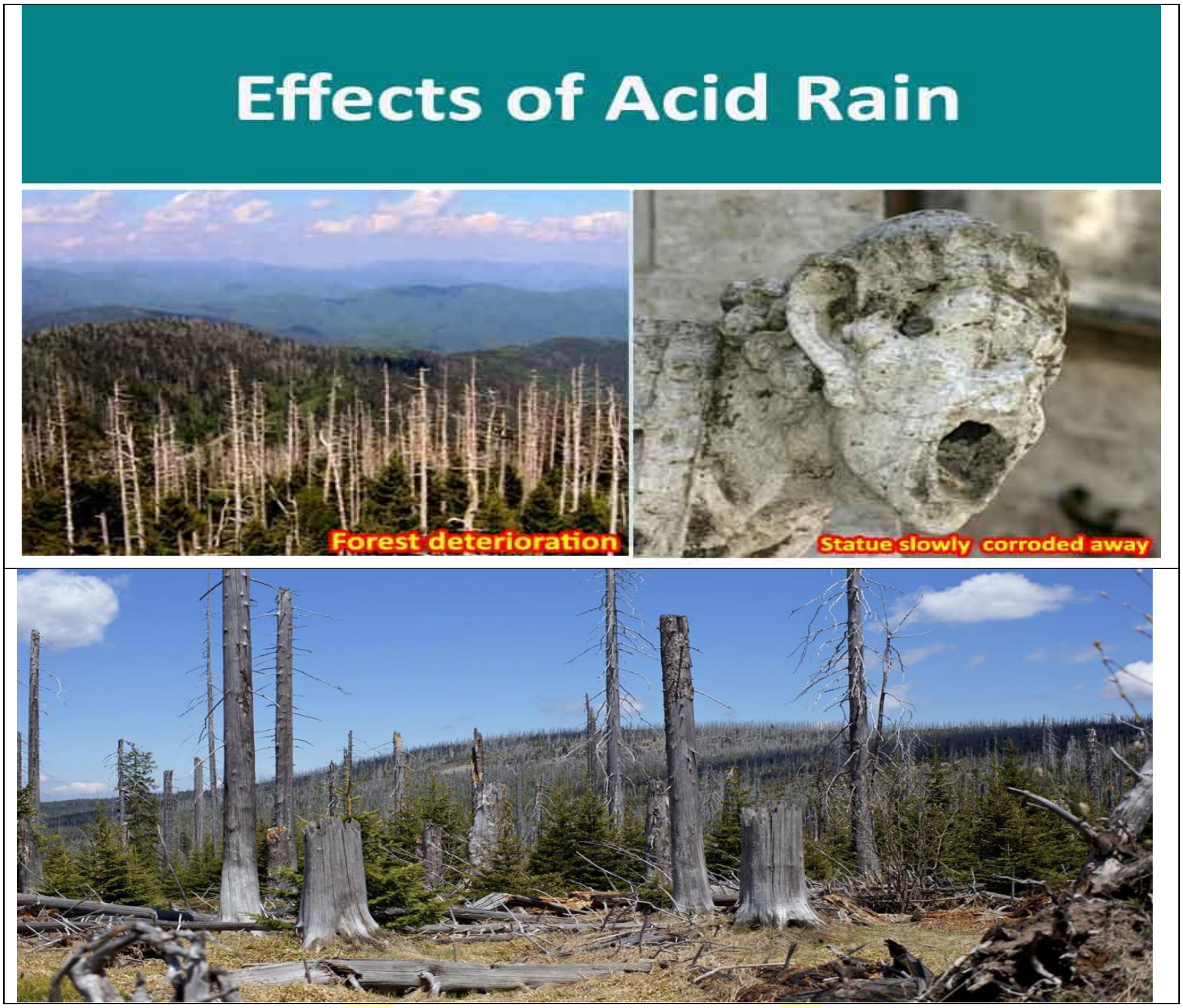

(**C**) **The threat to Ozone –** Some of the pollutants (CFCs) enter the stratosphere and remain there for years until they are converted to other products or are transported back to the stratosphere. The stratosphere could be regarded as a sink, but unfortunately these pollutants (CFCs) react with ozone and deplete it. Ozone protects us from the harmful UV-radiations from the sun. It filters out all radiations below 3000 Å. Thus, it is intimately connected with the life sustaining process. Any depletion of ozone would have catastrophic effects on life systems of the earth. Over the last few years, the O_3 concentration of earth's atmosphere is thinning out.

Causes of depletion: Ozone layer by absorption of U.V. radiation heats the stratosphere. Causing the temperature inversion. This temperature inversion limits the vertical mixing of pollutants. However, some pollutants also enter the stratosphere and remain there for years until they react with ozone and converted to other products. Major pollutants responsible for this depletion are chlorofluorocarbons (CFCs), nitrogen oxides (coming from fertilizers) and hydrocarbons. CFCs are widely used in air conditioners and refrigerators, cleaning solvents, aerosol propellants, in foam insulation and in fire extinguishing

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equipment's. They escape as an aerosol in the stratosphere. Jet engines, motor vehicles, nitrogen fertilizers and other industrial activities are responsible for emission of CFCs, NOx, etc. The supersonic aircrafts flying at stratosphere heights cause major disturbances in O_3 levels. The threat to O_3 is mainly from CFCs which are known to deplete O_3 by 14% at the current emission rate. On the other hand, NOx would reduce O_3 by 3.5%. The nitrogen fertilizers release nitrous oxide during denitrification. Depletion of O_3 would lead to serious temperature changes on the earth and consequent damage to life support systems.

Since the temperature rise in the stratosphere is due to heat absorption by ozone, the reduction in ozone would lead to temperature changes and rainfall failures on earth. Moreover, one percent reduction in O_3 increases UV radiation on earth by 2%. A series of harmful effects are caused by an increase in UV radiation. When the O_3 layer becomes thinner or has holes it causes cancers especially relating to skin like melanoma. A 10% decrease in stratospheric ozone appears likely to lead a 20 – 30% increase in skin cancer. The other disorders are cataracts, destruction of aquatic life and vegetation and loss of immunity. Under greenhouse effect conditions plants exposed to UV, radiation showed a 20 -50% reduction in growth, reduction in chlorophyll content and increase in harmful mutations.

In India, no such effort has been made to monitor O_3 concentration in major cities but the scene is not quite satisfying. Emissions from automobiles are about 1.6 million tons, which are likely to increase in coming years due to increased dependence on coal and oil for several uses. Burning of these fuels causes emissions of NOx and hydrocarbons necessary for oxidant formation. On the other hand, the same pollutants are instrumental in ozone depletion. Ozone pollution is likely to become a major global problem during the coming decades.

(D) Photochemical Smog – Ozone and other oxidants such as peroxyacetyl nitrate (PAN) and hydrogen peroxide are formed by light dependent reactions between NO_2 and hydrocarbons. Ozone may also be formed by NO_2 under UV- radiations effects. These pollutants cause Photochemical smog.

Photochemical smog adversely affects plants, human health and materials. These oxidants enter as part of inhaled air and alter, impair or interfere with the respiratory process and other processes.

Control measures – Control measures of air pollution are mentioned as below

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1. The industrial gaseous waste is passed through scrubbers where the high pressure water stream is lashed on the gases and they are dissolved in water from where some useful substances can be recovered.
2. It can also be checked by converting hazardous chemicals into less harmful substances like carbon dioxide, water, etc.
3. Instead of throwing industrial soot and smoke directly into the air it should be first passed through electrostatic precipitators where the suspended particulate matter (SPM) and other fine particles of hydrocarbons can be adsorbed and precipitated down and the smoke becomes clean.
4. By absorption on the surface of activated charcoal. The solid particles present in the industrial, gaseous waste are adsorbed when allowed to pass through a bed of activated charcoal. These are used in the chimneys of industries.
5. The air quality can be improved and maintained by growing and developing green belts and forests.
6. By passing the industrial smoke through a simple centrifuging apparatus so that the heavy polluting particles are dropped down and the smoke released becomes clean.
7. Instead of using low grade and conventional fuels, non-conventional fuels like gober gas, bio gas compressed natural gas and LPG must be prepared and used.
8. The vehicular pollution can be controlled by using good quality fuel by keeping the engine fully effective so that the fuel is totally burnt by using unleaded petrol and by minimizing the use of motored vehicles.

Role of individual in prevention of pollution

One can contribute to the prevention of pollution in many ways even without giving any extra time or money such as-

- By following the pollution control lows.
- By participating and endorsing the environmental protection awareness programmes.
- By avoiding the equipment's containing the chlorofluorocarbons (CFCs).
- Increasing the use of organic fertilizers, which are good for the crop as well as the environment.
- By growing and saving trees.
- By keeping city and monuments clean.
- By protecting the natural resources.
- By reducing the use of insecticide and pesticides and chemical fertilizers.

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Some nature loving groups were doing such type of activities to save trees.

Paris Agreement

In Paris on December 12, 2015, countries adopted an international agreement to address climate change that requires deeper emissions reduction commitments from all countries developed and developing. Countries responsible for 97 percent of global emissions submitted their climate commitments prior to the conference. These commitments have been enshrined in over 160 countries with domestic ratification, acceptance, or approval. The agreement contains provisions to hold countries accountable for their commitments and mobilize greater investments to assist developing countries in building low-carbon, climate resilient economies. Encouragingly, businesses, investors, states, provinces, cities, financial institutions, and others have also pledged actions to help governments implement the agreement and even exceed their commitments. While the Paris Agreement does not "solve" climate change, it is a critical inflection point. It brings us much closer to a safer climate trajectory and creates an ambitious path forward for decades to come. Countries have put forth an agreement that helps strengthen national action by ensuring that the current commitments are the floor—not the ceiling—of ambition. The agreement will also help spur greater action by cities, states, provinces, companies, and financial institutions. The Paris Agreement has created a virtuous cycle of increased ambition over time.

"**A great tide has turned. Finally, the world stands united against the central environmental challenge of our time, committed to cutting the carbon pollution that's driving climate change. This agreement sets us on a course of verifiable gains we can build on over time. It provides real protection for people on the front lines of climate chaos. It speeds the global shift away from dirty fossil fuels and toward cleaner, smarter energy options to power our future without imperiling our world. And it sends a clear message to our children: we will not abandon you to pay the price for reckless habits that wreak havoc and ruin on our planet and lives. A crisis that took centuries to get here won't go away overnight. But climate change has met its match in the collective will of a united world. Our challenge now, in our country and all others, is to make good on the promise of Paris, by turning the action we've pledged into the progress we need.**"

Rhea Suh, President, Natural Resources Defense Council

What are countries' post-2020 climate targets?

Prior to the 2015 Paris Climate Conference, countries submitted their proposed climate commitments, including specific targets for emissions reductions. So far, 192 countries accounting for 97 percent of global greenhouse gas emissions have submitted their climate pledges. These proposed commitments turned in to NDCs as soon as each country formally joined the Paris Agreement.

United States: Cut economy-wide emissions of greenhouse gas emissions by 26 to 28 percent below its 2005 level by 2025 and make best efforts to reduce its emissions by 28 percent.

China: Peak carbon emissions no later than 2030, increase non-fossil fuels to 20 percent of the energy mix, and reduce carbon emissions per unit of gross domestic product (GDP) by 60 to 65 percent from 2005 levels by 2030.

India: Reduce emissions intensity by 33 to 35 percent from 2005 levels by 2030, increase cumulative electric power installed capacity from non-fossil fuel energy resources to 40 percent by 2030, and create additional carbon sequestration of 2.5 to 3 billion tons of carbon dioxide equivalent by 2030.

Mexico: Cut greenhouse gas and short-lived climate pollutants 25 percent below business-as-usual (BAU) by 2030, implying a reduction of 22 percent for greenhouse gas emissions and 51 percent for black carbon.

European Union: Reduce emissions to at least 40 percent below 1990 levels by 2030 through only domestic measures.

Brazil: Reduce economy-wide greenhouse gas emissions by 37 percent below 2005 levels by 2025, increasing renewable resources to 45 percent of the energy mix by 2030, and increasing the share of non-hydropower renewables in the electricity mix to 23 percent by 2030.

South Korea: Reduce greenhouse gas emissions by 37 percent from BAU levels by 2030 across all economic sectors.

Indonesia: Cut emissions by 29 percent from BAU levels by 2030.

Japan: Reduce greenhouse gas emissions by 26 percent from 2013 levels by 2030.

Australia: Reduce economy-wide greenhouse gas emissions by 26 to 28 percent below 2005 levels by 2030.

Initiatives by the Indian government

In India, the government is looking at innovative solutions. The Swachh Bharat Abhiyan encourages citizens to adopt cleanliness in all spheres of life and is particularly relevant and timely.

The 'Smart Cities' initiative assures urban planning, building energy efficient housing and a good network of public transport, all of which are environment friendly. Citizens' participation is in-built, thus ensuring sustainability.

Promoting more equitable access to clean fuels by removing blanket subsidy on cooking gas to high income group and including more households from the low-income group in the LPG distribution list are appreciable steps to address household air pollution. The government has also constituted a multi sectoral Steering Committee to address air pollution, both household and ambient; WHO India is a member of this forum.

Smoke-free legislation to reduce exposure to second-hand smoke is already in place in India viz. Cigarette and other Tobacco Products Act, 2003. India is also a signatory to the WHO Framework Convention on Tobacco Control, 2004.

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Mission Clean Air Mission – INDIA(CAM - INDIA)

It is a cross-sectoral initiative for air pollution mitigation launched by GoI involving Ministries of Transport, Power, Construction, Agriculture, Rural Development, Environment and the states. Along with a five-year action plan to curb air pollution, the Mission hopes to build a pan-India air quality-monitoring network and heighten citizen awareness.

Air quality can be significantly improved by cutting the use of solid fuel in households; using sustainable fuels can reduce air pollution levels by almost 40 percent. According to the 2011 cencus, 16.6 crore households out of a total of 24.7 crores continued to rely on solid fuels (firewood, crop residue, dung and coal) for cooking. Hopefully, GoI's Ujjwala scheme, which provides cooking gas to millions of poor households, will substantially reduce solid fuel usage. Additionally, reducing emissions from thermal power plants, instituting strong emission standards for industries and introducing stronger vehicular emission standards also need to be effectively implemented.

In this regard, state pollution control boards (PCBs) are adopting the Star Rating Programme. The programme rates industries on their fine particulate pollution emissions and enables the monitoring of industries pollution levels. Furthermore, in partnership with GoI, states are promoting an electric vehicle policy. Use of electrically powered buses, cars and two-wheelers are bound to have a positive qualitative effect on air quality in cities.

In conclusion, environmental health interventions can make a valuable and sustainable contribution to reducing the global disease burden and improving the well being of people everywhere. We, therefore, owe it to ourselves and succeeding generations to do all we can to keep the environment healthy. And thereby stay healthy ourselves.

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DRONE - Flying eye in the sky

Article id:
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Subsistence farming the use of bullocks was generally replaced with massive tracts of land ploughed by tractors and mechanized harvesters and the use of GMO's to enhance crop immunity and they have an impact on of technology in agriculture is a tremendous trend, as it is the solution to feed the teeming population. Food safety is a query that wishes to be addressed, in the heritage of environmental degradation, pollution, and water scarcity, and an advantageous solution is a high priority. By 2050, the world populace will be around 10 billion, and to keep away from food shortage, agricultural production will have to be doubled. In the new agricultural era, farmers are in a position to use a variety of high-tech sensing units based totally on GPS, variable rate application, guidance systems, and remote sensing, as properly as farm management software for the better solution to these problems. This is where usage of new technological know-how like drone cans assurance a sustainable answer and they have a massive function to play in precision agriculture.

Unmanned aerial motors (UAV), regularly named drones, are small aerial structures weighing up to 20 kg (50 lbs). Drones the small and light aerial vehicles or robot range is ushering in a new agricultural revolution which might also fly at extraordinarily high altitudes and carry a number of navigation systems or recording gadgets such as RGB cameras, infrared cameras, and other sensors. Drones can be operated in two methods first one direction, in which a human has complete control of the vehicle with the aid of wireless remote; and autonomously, in which the vehicle is in a position to control itself and follow a route based totally on the information from GPS or different sensors. There are many specific sorts of drones like fixed winged very simple car to control, Rotary wing the most frequent drone type, Tethered vehicle type, and Lighter-than-air (LTA) type.

Drone have costs varied from $1,500 to over $20,000 for a commercial grade spraying drone. General India legal guidelines for the usage of drone-like do not fly your drone over densely populated areas, within 5km of airports, in sensitive areas along with government or navy facilities, inside 50km of a border, greater than 500 meters into the sea from coastal line, within 5km of Vijay Chowk in Delhi, over national parks or wildlife sanctuaries. Must be at least 18 years old and have done a training course, All drones must have legal responsibility insurance, fly inside visible line of sight and during daytime hours and only fly in appropriate weather conditions. Durable experience flying drone technology adds value in the course of the growing season of agriculture or horticulture. the use of drones in the agriculture industry can

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essentially be boiled down to four segments: Crop area scanning with compact multispectral imaging sensors, GPS map creation via onboard cameras, heavy payload transportation, and farm animals monitoring with thermal-imaging by camera-equipped drones.

Analyses of fields and soil scanning has historically required massive sensors and manned aircraft. Drones ought to be used for soil and area analysis. They can be used to produce correct three-D maps that can be used to conduct soil evaluation on soil property, moisture content, and soil erosion. This is very necessary for planning seed planting patterns. Even after planting such records is beneficial for both irrigation and the management of the nitrogen level in the soil.

From centuries, crop spraying applications has been an arduous and burdensome endeavor for whole farmers and agricultural production companies.In addition to being a laborious duty, crop spraying utilizes many harsh chemical compounds that pose risks to human health with continued exposure. Drone technological know-how is a plenty safer alternative, incorporating ultrasonic, light detection and grounding lasers that provide huge comfort to farmers by precision crop spraying that is five times quicker than traditional crop spraying.

Crop irrigation is fundamental to stopping the dry prerequisites that inevitably result in lifeless crops. Highly refined drone science makes use of a plethora of sensors which includes thermal, multispectral, and hyperspectral sorts to analyze and pinpoint the unique vegetation that are dehydrated, in addition to measuring the density, heat signature, and regular overall health of the field as an whole to grant a comprehensive overview for farmers and producers.

The monitoring or observation of crops is a highly efficient, low-risk by the using of drone technology. For farmers and producers, the observing of crops has been a problematic endeavor due to the navigating of extensive swaths of land on foot. Further exacerbating difficulties in monitoring crops and fields are inclement climate stipulations that can end result in an lack of ability to check the crop.

Assessing the overall health of vegetation and fields is a critical component of agricultural endeavors. Health assessments will now not solely make notice of parched, lifeless crops but will additionally make vital fungal and bacterial analyses on trees, crops, fields and more. Agricultural drones employ light sources consisting of visible and infrared lighting to become aware of plants that reflect the kinds of light that point out disease or any decline in health. As a result, producers are the use of drones in agriculture to attain real-time pictures of their fields to prevent costly losses and make certain the typical growth and success of their crops.

Planting crops is an expensive and cumbersome exercise that has historically relied on manpower. Today's high-end drone farming science provides drone-powered planting techniques that limit planting expenses by means of up to 85%. The notable reduction in planting expenses is a result of the drone’s capability to operate a litany of obligations including, but no longer confined to, planting within the soil, injecting pods with seeds, and developing flora

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and crops that are geared up to develop, Grow and be used.

One time investment is to reduce the lifetime labor charges and save time. Using advanced technology like drones improving the monitoring and save the farmers time and energy to monitoring the whole fields. The reduced hazardous effect of chemicals while spraying, reduce the lose, increase the yield and quality of the crops.

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A Herbal sugar substitute – Stevia

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Stevia is an intensely sweet-tasting plant that has been accustomed sweetens beverages and builds tea since the sixteenth century. The plant is originally native to South American country and Brazil however is currently conjointly growing in Japan and China. It's used as a non-nutritive sweetener and flavoring supplement. A non-nutritive sweetener is one that contains very little to no calories. Stevia is employed as an additional sugar in several meals and beverages. The U.S Food and Drug Administration (FDA) prohibited the selling of stevia as an additive in 1987. However, stevia regained its standing as a sweet, property dietary ingredient in 1995. Since then sweetener has soared in quality, with a fifty eight % boost in new product that contains stevia.

Rapid facts on stevia

- Stevia is primarily full-grown in Brazil, Paraguay, Japan, and China.
- The natural sweetener tastes two hundred to three hundred times sweeter than table sugar.
- Stevia will be classified as "zero-calorie," as a result of the calories per serving are therefore low.
- It has shown potential health edges as a healthful sugar different for individuals with polygenic disorder.
- Stevia and erythritol that are approved to be used in U.S. and don't seem to cause any health risks.

About stevia-

Stevia known as natural sweetener conjointly referred to as *Stevia rebaudiana*, belongs to Asteraceaefamily. There are hundred and fifty species of stevia, all are native to North and South America. China is current leading bourgeois of stevia product. However, stevia is currently growing in several countries. Stevia is two to three hundred times sweeter than table sugar. It hardly requires twenty % of the land and much less water to produce an equivalent quantity of sweetness as an alternative sweetener. Steviol is the basic building block of stevia's sweet glycosides. These are the sweet elements isolated and purify from the leaves of stevia. These glycosides include:

- Stevioside
- Rebaudiosides A, C, D, E, and F
- Steviolbioside
- Dulcoside A

Stevioside and rebaudioside a (reb A) are the foremost of those elements.

In "stevia" the active compounds are made up of steviol glycosides. These are extracted by gathering of the leaves, then drying, water extraction, and purification. Crude stevia, the processed product before its sublimate, usually carries a bitter taste and foul smell till bleached or discolored. It takes roughly forty steps to extract stevia. Stevia leaves contain stevioside their concentration varies up to around eighteen %.

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Some of the common trade names for stevia sweeteners are:

- Enliten
- PureVia
- Rebiana
- Stevia
- Steviacane
- Stevia Extract within the Raw
- SweetLeaf

Possible health edges:

As an alternate to disaccharide, or table sugar, stevia as a sweetener carries the potential for appreciable health edges. Stevia is taken into account "no-calorie," which means that it contains 5 grams of sugar. They will be combined with alternative ingredients; therefore a couple of calories from those extra ingredients could also be gift reckoning on the merchandise. Stevia doesn't strictly contain zero calories; however it's considerably less than disaccharide and low enough to be classified intrinsically. The sweet-tasting elements in stevia sweeteners occur naturally. This characteristic could profit those that like naturally-sourced foods and beverages. The low calorie count qualifies stevia to be a healthful different for polygenic disorder management or weight loss. Here are a number of the potential health edges of stevia.

1) Polygenic disorder

Research has shown that stevia sweeteners don't contribute calories or carbohydrates to the diet. They need conjointly incontestable no impact on glucose or hormone response. This enables individuals with polygenic disorder to eat a wider type of foods and fits a healthful hotel plan. In one of the study, two polygenic disorders triggered by stevia showed vital reduction in glucose and hormone response when taking once a meal. Hormone may be a secretion that regulates aldohexose levels within the blood, and also the mechanism that secretes hormone is commonly faulty in individuals with polygenic disorder. Glucagon drops once glucose climbs. This regulates the aldohexose level.

2) Weight management

Stevia will replace sugar in a very diet to manage weight. There are several causes of overweight and fatness, like physical inactivity and enhanced intake of energy-dense foods that are high in fat and additional sugars. The intake of additional sugars has been shown to contribute a mean of sixteen % of the full calories within the yankee diet. This has been joined to weight gain and reduced management of glucose levels. Stevia contains no sugar and extremely few calories. It will be a part of a well-balanced diet to assist scale back energy intake while not sacrificing lifestyle.

3) Carcinoma

Stevia contains several sterols and inhibitor compounds, as well as kaempferol (polyphenol antioxidant). Studies have found that kaempferol will scale back the danger of carcinoma by twenty three %.

4) Force per unit area

Certain glycosides in stevia extract are found to dilate blood vessels. They will conjointly increase Na excretion and excretory product output. In, 2003 study showed that stevia may doubtless facilitate lower force per unit area that prompts stevia plant might need cardiotonic actions. Cardiotonic actions normalize and regulate the heartbeat. Additional analysis is needed to verify this good thing about stevia.

5) Children's diets

Foods and beverages containing stevia will play a crucial role in decreasing calories from unwanted sweeteners within the diets of youngsters. There are currently thousands of products on the market containing naturally-

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sourced stevia, starting from dish dressings to snack bars. This convenience permits youngsters to consume sweet foods and drinks while avoiding additional calories whereas transitioning to a lower sugar diet. Excessive sugars and calories are joined to fatness and obesity.

Side effects of stevia

High-purity stevia extract is approved for consumption by the agency and variety of alternative restrictive bodies. Safety studies have marked stevia extract as freed from facet effects. While sublimate steviol glycosides will be additional to foods and are usually recognized as safe (GRAS) by the Food and Drug Administration.

It was originally thought that stevia poses a danger to excretory organ health. A study on rats dispensed since then suggests that stevia leaves in supplement type could instead possess qualities that defend the kidneys and scale back the impact of polygenic disorder. Current analysis conjointly suggests that it's safe to consume the suggested quantity of sugar substitute or less during pregnancy.

Some stevia product conjointly contains sugar alcohol. Individuals with sensitivity to sugar alcohol could expertise bloating, abdominal cramps, nausea, and diarrhea, although one form of sugar alcohol, erythritol, poses less risk of symptoms than others. As long as stevia is highly-purified and employed in moderation, it will not cause facet effects and might be consumed freely.

How to use stevia?

In the U.S., stevia sweeteners are primarily found in table sugar product and reduced calorie beverages as sugar substitutes. Extracts from the stevia leaf are offered as dietary supplements within the U.S. since the mid-1990s, and contains, a mix of each sweet and non-sweet elements of the stevia leaf. This might additional profit that customers preferring foods and beverages made up of stevia they understand as natural product. Worldwide, around five thousand food associated drink products presently use stevia as an ingredient. Stevia sweeteners are used as associated ingredient product throughout Asia and South America such as:

- Ice cream
- Desserts
- Sauces
- Yogurts
- Pickled foods
- Bread
- Soft drinks
- Chewing gum
- Candy
- Seafood
- Prepared vegetables

Environmental impact of stevia

Earthwatch is looking at the environmental impacts of stevia and will put a figure on key aspects of the production system, including impacts on soil, water, waste as well as energy use. While Earthwatch, an NGO that conducts held research to promote environmentally sustainable action, is not new to the food and beverage industry, the study marks its rest exploration of the impacts of stevia.

Stevia plant

Stevia flower

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Precision farming in fruit crops: A game changer in Indian agriculture

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Precision Farming or Precision Agriculture is generally defined as information and technology-based farm management system to identify, analyse and manage spatial and temporal variability within fields for optimum productivity and profitability, sustainability and protection of the land resource by minimizing the production costs.

Precision farming is an approach where inputs are utilised in precise amounts to get increased average yields compared to traditional cultivation techniques. Hence it is a comprehensive system designed to optimize production by using a key element of information, technology and management, so as to increase production efficiency, improve product quality, improve the efficiency of crop chemical use, conserve energy and protect environment. Thus, precision farming is an appealing concept and its principles quite naturally lead to the expectation that farming inputs can be used more effectively, with subsequent improvements in profits and environmentally less burdensome production.

Precision farming is a basically three approaches *i.e.* Site specific crop management (SSCM), Spatially variable crop production (SVCP) and Smart farming (SF).

Objectives of precision farming:

- ✓ Increased Production Efficiency
- ✓ More Efficient Input Usages
- ✓ Improved Product Quality
- ✓ Energy Conservation
- ✓ Soil and Ground Water Conservation

Need for precision farming in india:

- ➢ Increased Land degradation.
- ➢ Depletion of Water resources.
- ➢ Socio economic need for enhanced productivity / unit of land, water and time.
- ➢ Environment Pollution because of increased use of fertilizers and chemicals.
- ➢ PF is essential in order to address poverty alleviation, enhance quality of life and food security

Steps in precision farming: It is a cyclic process but farmer needs to perform annual planning, data collection and analysing various steps to complete the precision cycle.

1. **Assessing variability:** Inputs are to be applied in accordance with existing variability using GPS, GIS, RS, YM *etc*….
2. **Managing variability:** By applying and making farm inputs available only in require quantities at particular time and specific location known as Variable Rate Application (VRA).
3. **Evaluation of precision farming**:

i. Economic viability focuses on market return through sale of the produce

ii. Maintenance of environment focus on PF can improve soil, water and crop environment.

iii. Finally how far this technology can be transferred to other farmers.

Components of precision agriculture:

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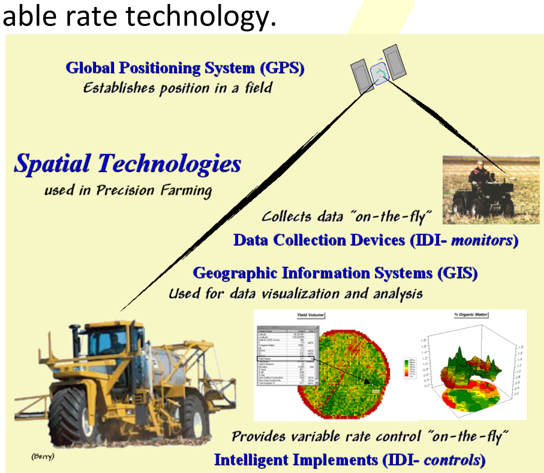
i. Global Positioning System (GPS)
ii. Variable rate applicator (VRA)
iii. Yield mapping
iv. Geographic Information System (GIS)
v. Remote sensors
vi. Proximate sensors
vii. Computer hardware & software
viii. Precision Farming Practices
ix. Technology Dissemination

Global Positioning System (GPS): Global positioning system ("GPS") is a location system based on a constellation of about 24 satellites orbiting the earth at altitudes of approximately 11,000 miles which provides accurate positioning system necessary for field implementation of variable rate technology.



- ✓ It is a network of satellites developed for and managed by the U.S. Défense Department.
- ✓ The GPS are important to find out the exact location in the field to assess the spatial variability and site-specific application of inputs.
- ✓ The most common use of GPS in agriculture is for yield mapping and variable rate fertilizer/pesticide application.

Application of GPS in Precision farming:

- ➢ Controlled application of inputs by equipment's.
- ➢ Identification the precise location of farm equipment's within inches (or 5 cm).
- ➢ One can monitor and record the yield data of the field.
- ➢ Fertilizers and pesticides can be prescribed according to the soil properties, soil condition. Tillage adjustment can be made as one finds various condition.

Geographic Information System (GIS):- Geographic Information System (GIS) is a computer based management system used for computation, storage, retrieval, analysis and display of spatial data in the form of a map. GIS is rightly called as the brain of the precision farming.

Dr. John Snow is known as the 'father of modern epidemiology' and the 'father of GIS' because of the famous case of the 1854 Cholera outbreak in London's Broad Street region.

GIS contributes significantly to Precision farming:

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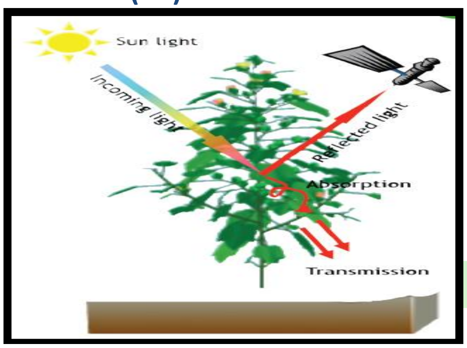
- It contains base maps like topography, soil type, nutrient level, soil moisture, pH, fertility, weed and pest intensity maps *etc.*.
- It can integrate all types of information and interface with other decision support tools.
- So these maps and information are used for application of recommended rates of nutrients or pesticides.

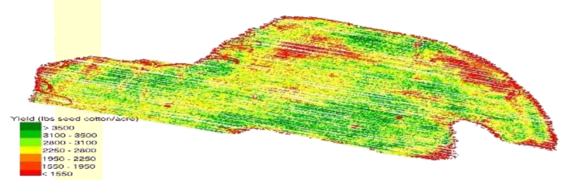
Remote Sensors (RS):



- Remote sensors are generally categorized as aerial or satellite sensors.
- They can indicate variations in field colour that corresponds to changes in soil type, crop development, field boundaries, roads, water etc.
- Aerial and satellite imagery can be processed to provide vegetative indices, which reflect plant health.
- Proximate sensors can be used to measure soil (N, P, K and pH) and crop properties as the tractor passes over the field.
- Our eyes are an excellent example of a remote sensing device
- Remote sensing actually deals with inventory, monitoring and assessment of natural resources through the analysis of data obtained by observation are synoptic, provide repetitive coverage of large areas and the data is quantifiable.
- This involves sensing and recording reflected or emitted energy and processing, analysing and applying that information.

Variable rate Technology (VRT): Variable Rate Technology (VRT) includes computer controllers that allow variation of inputs such as seed, fertilizer, herbicides and pesticides. Application rates are varied as areas of different problems warranting different rates are encountered

Yield maps: Yield maps are produced by processing data from adapted combine harvester that is equipped with a GPS *i.e.* integrated with a yield recording system. Yield mapping involves the recording of the grain flow through the combine harvester, while recording the actual location in the field at the same time.



Misconceptions about precision agriculture:

- ✓ Precision farming cannot be done without the aids of RS, GPS and GIS
- ✓ Precision farming is only for crop management
- ✓ Precision agriculture in cropping equals yield mapping
- ✓ Precision farming is nothing but sustainable farming

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Major challenges that are to be faced before realizing the real benefits from precision nutrient:

a) Making the interpretation process more automatic, generic and mechanistic as against empirical
b) Location-specific RS solutions for integrated crop management program
c) Developing simple and robust technologies and methodologies
d) Evaluation at multiple sites with standardized methodologies providing proof of economic and environment benefits
e) Customization of the precision farming technology to the actual Indian field conditions.

What is the site-specific nutrient management (SSNM) approach?

- ✓ It emphasizes 'feeding' crop with nutrients as and when needed.
- ✓ Fertilizer used to fill the deficit between the nutrient needs of a high-yielding crop and the nutrient supply from naturally occurring indigenous sources (soil, organic amendments, crop residues, manures and irrigation water).
- ✓ It aims to apply nutrients at optimal rates and times to achieve high yield and high efficiency of nutrient use by the crop.

Principles of SSNM: Principles of SSNM are generic and applicable to other crops

- ➢ SSNM provides an approach for feeding crops with nutrients as and when needed.
- ➢ Optimal use of existing indigenous nutrient sources, including crop residues and manures
- ➢ Timely application of fertilizers at optimal rates to meet the deficit between the nutrient needs of a high-yielding crop and the indigenous nutrient supply

Three criteria of SSNM:

i. Significant "within the field" spatial variability exists in factors that influence crop yield
ii. Causes of this variability can be identified and measured
iii. The information from these measurements can be used to modify crop-management practices to increase profit or decrease environmental impact.

Limitation of adopting PF under Indian conditions:

- ➢ Small farm size
- ➢ Heterogeneity of cropping systems
- ➢ High cost of obtaining site specific data
- ➢ Complexity of tools and techniques requiring new skills
- ➢ High initial investment
- ➢ Infrastructure and institutional constraints
- ➢ Lack of local technical expertise (India spends only 0.3% of its agricultural GDP in Research and Development)
- ➢ PF as new story to Indian farmers needs demonstrated impacts on yields.
- ➢ Knowledge and technical gaps

Stakeholders of precision farming:

- ✓ Government/Public Institutions/ Research Institutes/NGOs
- ✓ Identification of problematic areas and thematic map preparations
- ✓ Development of the technologies
- ✓ Cooperatives/Contract farming Systems
- ✓ Variable applicators/Sensors Manufacturing Companies
- ✓ Individual Farmers

Precision farming practices in fruit crops are

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- ✓ Micropropagation
- ✓ Micro irrigation-drip irrigation and sprinklers
- ✓ Fertigation
- ✓ Mulching
- ✓ Protected cultivation
- ✓ Pruning and training
- ✓ Direct seeding/transplanting
- ✓ Mechanization
- ✓ Use of modified crop varieties
- ✓ Hitech post-harvest technology

Future line of work:

- GPS/GIS/RS is required for each and every farm unit for adoption.
- Need to standardize SSNM for crops to be adopted in precision farming.
- Need to tailor location specific precision farming technologies for high value crops.

CONCLUSION: PF gives farmers the ability to use crop inputs more effectively including fertilizers, pesticides, tillage and irrigation water. More effective use of inputs means crop yield and or quality, without polluting the environment. PF is proven difficult to determine the cost benefits of precision agriculture management. Precision farming technology looks promising as a future farming tool, however its effective use in Indian agriculture especially in fruit crops is yet to be realized.

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Major application of remote sensing in agriculture

Article id:

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Remote sensing is the acquisition of information about an object or any phenomenon without making any physical contact with the object. It is a phenomenon that has numerous applications including photography, surveying, geology, forestry and many more. But it is in the field of agriculture that remote sensing has found significant use. There are very many applications of remote sensing in the agricultural sector. Below is a summary of these applications.

1. Crop production forecasting: Remote sensing is used to forecast the expected crop production and yield over a given area and determine how much of the crop will be harvested under specific conditions. Researchers can be able to predict the quantity of crop that will be produced in a given farmland over a given period of time.

2. Assessment of crop damage and crop progress: In the event of crop damage or crop progress, remote sensing technology can be used to penetrate the farmland and determine exactly how much of a given crop has been damaged and the progress of the remaining crop in the farm.

3. Horticulture, Cropping Systems Analysis: Remote sensing technology has also been instrumental in the analysis of various crop planting systems. This technology has mainly been in use in the horticulture industry where flower growth patterns can be analyzed and a prediction made out of the analysis.

4. Crop Identification: Remote sensing has also played an important role in crop identification especially in cases where the crop under observation is mysterious or shows some mysterious characteristics. The data from the crop is collected and taken to the labs where various aspects of the crop including the crop culture are studied.

5. Crop acreage estimation: Remote sensing has also played a very important role in the estimation of the farmland on which a crop has been planted. This is usually a cumbersome procedure if it is carried out manually because of the vast sizes of the lands being estimated.

6. Crop condition assessment and stress detection: Remote sensing technology plays an important role in the assessment of the health condition of each crop and the extent to which the crop has withstood stress. This data is then used to determine the quality of the crop.

7. Identification of planting and harvesting dates: Because of the predictive nature of the remote sensing technology, farmers can now use remote sensing to observe a variety of factors including the weather patterns and the soil types to predict the planting and harvesting seasons of each crop.

8. Crop yield modelling and estimation: Remote sensing also allows farmers and experts to predict the expected crop yield from a given farmland by estimating the quality of the crop and the extent of the farmland. This is then used to determine the overall expected yield of the crop.

9. Identification of pests and disease infestation: Remote sensing technology also plays a significant role in the identification of pests in farmland and gives data on the right pests control mechanism to be used to get rid of the pests and diseases on the farm.

10. Soil moisture estimation: Soil moisture can be difficult to measure without the help of remote sensing technology. Remote sensing gives

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the soil moisture data and helps in determining the quantity of moisture in the soil and hence the type of crop that can be grown in the soil.

11. Irrigation monitoring and management: Remote sensing gives information on the moisture quantity of soils. This information is used to determine whether a particular soil is moisture deficient or not and helps in planning the irrigation needs of the soil.

12. Soil mapping: Soil mapping is one of the most common yet most important uses of remote sensing. Through soil mapping, farmers are able to tell what soils are ideal for which crops and what soil require irrigation and which ones do not. This information helps in precision agriculture.

13. Monitoring of droughts: Remote sensing technology is used to monitor the weather patterns including the drought patterns over a given area. The information can be used to predict the rainfall patterns of an area and also tell the time difference between the current rainfall and the next rainfall which helps to keep track of the drought.

14. Land cover and land degradation mapping: Remote sensing has been used by experts to map out the land cover of a given area. Experts can now tell what areas of the land have been degraded and which areas are still intact. This also helps them in implementing measures to curb land degradation.

15. Identification of problematic soils: Remote sensing has also played a very important role in the identification of problematic soils that have a problem in sustaining optimum crop yield throughout a planting season.

16**. Crop nutrient deficiency detection:** Remote sensing technology has also helped farmers and other agricultural experts to determine the extent of crop nutrients deficiency and come up with remedies that would increase the nutrients level in crops hence increasing the overall crop yield.

17. Reflectance modeling: Remote sensing technology is just about the only technology that can provide data on crop reflectance. Crop reflectance will depend on the amount of moisture in the soil and the nutrients in the crop which may also have a significant impact on the overall crop yield.

18. Determination of water content of field crops: Apart from determining the soil moisture content, remote sensing also plays an important role in the estimation of the water content in the field crops.

19. Crop yield forecasting: Remote sensing technology can give accurate estimates of the expected crop yield in a planting season using various crop information such as the crop quality, the moisture level in the soil and in the crop and the crop cover of the land. When all of this data is combined it gives almost accurate estimates of the crop yield.

20. Flood mapping and monitoring: Using remote sensing technology, farmers and agricultural experts can be able to map out the areas that are likely to be hit by floods and the areas that lack proper drainage. This data can then be used to avert any flood disaster in future.

21. Collection of past and current weather data: Remote sensing technology is ideal for collection and storing of past and current weather data which can be used for future decision making and prediction.

22. Crop intensification: Remote sensing can be used for crop intensification that includes collection of important crop data such as the cropping pattern, crop rotation needs and crop diversity over a given soil.

23. Water resources mapping: Remote sensing is instrumental in the mapping of water resources that can be used for agriculture over a given farmland. Through remote sensing, farmers can

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tell what water resources are available for use over a given land and whether the resources are adequate.

24. Precision farming: Remote sensing has played a very vital role in precision agriculture. Precision agriculture has resulted in the cultivation of healthy crops that guarantees farmers optimum harvests over a given period of time.

25. Climate change monitoring: Remote sensing technology is important in monitoring of climate change and keeping track of the climatic conditions which play an important role in the determination of what crops can be grown where.

26. Compliance monitoring: For the agricultural experts and other farmers, remote sensing is important in keeping track of the farming practices by all farmers and ensuring compliance by all farmers. This helps in ensuring that all farmers follow the correct procedures when planting and when harvesting crops.

27. Soil management practices: Remote sensing technology is important in the determination of soil management practices based on the data collected from the farms.

28. Air moisture estimation: Remote sensing technology is used in the estimation of air moisture which determines the humidity of the area. The level of humidity determines the type of crops to be grown within the area.

29. Crop health analysis: Remote sensing technology plays an important role in the analysis of crop health which determines the overall crop yield.

30. Land mapping: Remote sensing helps in mapping land for use for various purposes such as crop growing and landscaping. The mapping technology used helps in precision agriculture where specific land soils are used for specific purposes.

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Orchard management in fruit crops

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Orchard management in refers to the management of the orchard soil in such a manner that the fruit trees give higher yield of quality fruits in successive years for sustainable economic returns. It should be executed in a timely manner during the lifetime of the orchard. Several systems of managing the orchard are available, each with advantages and disadvantages to consider before choosing a particular programme for an orchard. An efficient orchard management program always ensures higher return to the grower. However, no single management practice can be recommended for all orchards. A particular program is followed depending on factors like climate, location of orchard,
topography, tree spacing, planting system/ orchard design *etc*.

Objectives of orchard management:

1) To create favorable conditions for supply of moisture to plants adequately and provide proper drainage for excess moisture.
2) To maintain high fertility levels and regular replishment against losses.
3) To check or minimize or reduce soil erosion
4) To provide proper soil conditions for gaseous exchange and microbial activities through addition of organic matter(prevent buildup of pest and diseases)
5) To ensure supply of nutrients for growth and development of plants.
6) Proper utilization of land for generation of additional income.
7) To suppress weed population.
8) To reduce the cost of cultivation to get higher economical returns.

Appropriate orchard management practices is an important for the control of weeds, incorporation of organic and inorganic fertilizers and to facilitate absorption of water and nutrients from soil prevents soil erosion
Commonly practiced orchard management practices are:

a) No cultivation
b) Clean cultivation
c) Sod culture
d) Cover cropping
e) Mulching
f) Inter cropping
g) Crop rotation
h) High density planting
i) Use of herbicide

Choice of the method adopted is determined by management factors as mentioned below:

a) Crop(main crop)
b) Spread of the roots of the crop
c) Slope of the land/ soil
d) Rainfall of the area
e) Climatic condition of the place
f) Economic strength of the farmer

A. Clean cultivation:

Clean cultivation aims at keeping the orchard completely free from weeds. This removes competition of weeds for light, water and nutrients and avoidance of alternate host for pests and diseases. This is done by deep ploughing and harrowing preferably during the stage when trees are least active. Care should be taken to minimize the damage to feeding / active roots while cultivation practices are taken up.

Advantages:

a) It avoids availability of alternate hosts for pest and diseases.
b) Improves soil physical condition through better aeration by breaking clods.
c) Helps in breaking hard top (especially in hard soils) top which is involved in obstruction in the infiltration of water.
d) Improves soil biological activity through better aeration.

Disadvantages:

a) It my loss of organic matter
b) Loss of soil through erosion by water and wind forces as soil is directly exposed to erosive forces.
c) Loss of nutrients through excessive leaching
d) Injuring the roots during deep ploughing affects absorption and provides an entry for pathogens

B. **Sod culture:** (*Ex:* Rye grass, alfa alfa grass)

This practice of soil management in orchards involves covering the soil by grasses which may arise by themselves or by seeding and no other tillage operations is done.This system is well suited in places which receiving heavy rainfall where natural grasses grow abundantly.

Advantages:

a) Prevents washing of soil
b) It does not exposure the soil directly to rain, sunlight thereby prevents washing/ leaching of nutrients and depletion of organic matter
c) There will be less mechanical injury to the dropped fruits.
d) Reduces cost of cultivation.

Disadvantages:

a) The grasses will normally compete for water and nutrients
b) This system can be practiced only under heavy rainfall areas /water is not a scarcity

C. **Cover cropping:**

This system is compromise between clean cultivation and sod culture. Cover crop remains on the field for few months. This prevents soil erosion especially during monsoon season

Ex: Beans, Leafy vegetables, Green gram, Black gram, Cowpea, Cluster bean- Kharif season
Peas, Fenugreek, Broad beans and Lentil- Rabi season

Characters of cover crops:

a) It should be spreading and quick growing
b) It should grow under rainfed condition
c) It should be preferably legume
d) It should produce large quantity of leaves to cover the area and add huge bioass to soil.
e) It should easily decay when incorporated into soil.

Advantages:

a) Adds organic matter to the soil
b) Improves soil condition
c) Improves soil fertility
d) Increases water retention capacity of soil
e) Checks soil erosion
f) Checks nutrient losses through soil erosion
g) Increases biological complexes of the soil

D. Mulching : It is a practice of covering the soil with some material (usually non living things) like dried straw, coarse hay, cereal stalks, crops

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residues, saw dust, paper sheet, leaves, polysheet, etc.

Advantages:

a) It covers the soil without competing with the fruit trees for nutrients and water
b) It reduces loss of soil moisture by evaporation
c) It reduces surface runoff and thus checks soil erosion
d) Gives protection from sun and wind
e) It prevents compacting of soil
f) The decomposition of organic mulch adds organic matter to the soil
g) It makes soil more favorable for conserving the soil moisture
h) Mulches moderates the effect of fluctuation of soil temperature and greatly helps in activation of soil micro flora
i) It controls weeds
j) Improves soil infiltration rate,soil structure

Disadvantages:

a) High cost
b) Transportation cost
c) Pest and disease infestation through the dead plant material
d) Fire hazards
e) Roots grow shallow due to the effect through soil temperature and moisture.

The commonly used mulching materials are: Straw, hay grass, and crop residues these are effective, inexpensive and easily available to mankind. Paper is very expensive but is quite effective in a crop like pineapple which grows well on shaded ground. Polythene sheet is ideal and has been fund most effective, however it is costly (thickness of polythene mulch is 6-10µ).

E. Intercropping:

This system involves use of open space during pre-bearing period when the main fruit trees are still young and their canopy and root system do not occupy entire space. This space is therefore used to grow cover crop. The inter crop should be compatible with main crop in their water, nutrient and soil requirements. The intercrop should be discontinued after the main crop tree starts bearing.

Ideal inter crop should be

a) Short duration *Ex:* Papaya, Banana, Drumstick
b) Compact stature, should not compete with main crop
c) Should be shallow rooted
d) Should not act as a source of alternate host for pest and diseases.

Purpose of inter crop: To maximize land and space use efficiency to generate supplement income particularly during the initial unproductive phase.

F. Crop Rotation:

If the same crop is grown for several consecutive years onthe same land yields will normally decline (or more fertilizerwill be needed to reach the same yield) and health problemswill arise in the crop or field. Weeds that are well adapted tothe conditions offered by the crop (e.g. good light conditions,typical soil cultivation), may spread and require increasedefforts to be controlled.

G. Green manuring in fruit orchard:

To restore the fertility, productivity, some crops are turns into soil while still they are green.This practice is known as **green manuring.**This is an important soil management practicewhere in green manuring crop like sunhemp, cowpea, glyricidia, pongamia, diancha, etc. aregrown in the interspaces of the main crop and they are incorporated back into the soil oncethere is initiation of flowering. Green manuring is practiced during kharif season in rainfedfruit growing gardens.

Advantages:

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- Capable of nitrogen fixing, add nitrogen in the soil
- Improve physical properties of soil.
- Helps in controlling insect pest and diseases
- Helps in equalization of available nutrients
- Avoids bad effects of continuous monoculture through elimination of buildup of toxins, pests and diseases.

CONCLUSION: Orchard management is an one of essential operation for ensuring better cultivation of fruit crops by adopting different management practices like no cultivation, clean cultivation, sod culture, cover cropping, mulching, inter cropping, crop rotation and use of herbicide helps to improve the fruit quality and also improves the physical, chemical and biological properties of the soil. By adopting one or combination of these methods is helpful to improve sustainable production of fruit crops. Hence, there is wide scope for adopting soil management practices in fruit production.

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PRE-BREEDING: A new genetic resource for crop improvement

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INTRODUCTION

The exploitation of the existing genetic diversity and reinforcement of the plant breeding progression is a vital part of sustainable agriculture system to meet the global food security which is possible through some novel strategies. It is surprising to know that, in spite of large collection of germplasm, only a few germplasm accessions (<1%) were used in the breeding programme due to cross incompatibility, undesirable linkage drag existing in the wild germplasm. Plant genetic resources are reservoirs of natural genetic variation and provide raw material for crop improvement programmes. About 7.4 million germplasm accessions of different crops have been collected and/or assembled and conserved in over 1750 ex-situ gene banks worldwide (FAO, 2010).

PRE-BREEDING

Pre-breeding refers to all activities designed to identify desirable characteristics and/or genes from unadapted materials that cannot be used directly in breeding populations and to transfer these traits to an intermediate set of materials that breeders can use further in producing new varieties for the farmers GIPB/FAO, 2008). The plant breeders should ultimately, able to manipulate the intermediate materials further to develop new advance varieties by utilizing the wild relatives and other unimproved materials. The term 'enhancement for germplam' was first used by Jones (1983), whereas Rick (1984) used the term 'Pre-breeding'. Pre-breeding aims at introgression of desirable genes and base broadening of pre-breeding material.

The word 'domestication' was loosely defined by R.W. Allard, 1960 as "the bringing of a wild species under the management of man. It is a method of plant breeding in the sense that, when successful, it provides domestication types that are superior to ones previously available". Allard further intensified the definition by adding, "when a plant breeder transfers one of a few desirable genes from a wild relative to a cultivated type, he is, in a sense domesticating the wild species in pare". The current delineation of 'pre-breeding' also used as an equal sense as like Allard. So it defined as "any manipulation of germplasm leading to domestication". The pre-breeding activity helps in genetic base broadening and genetic enhancement of many cultivated crop plants like chickpea and lentil through collaborative research work. The developed materials not only shown the yield improvement but also shown the increasing genetic diversity along with the emerging concern of heat, drought, new pathogen races and other stresses in India.

Difference between genetic resources and pre-breeding:

The genetic resources well-defined as the sum total of all the genes present in a crop species which is also with equivalent meaning referred to as genetic resources or gene pool or genetic stock or germplasm. In other words, gene pool refers to the whole library of different alleles of a species. Germplasm or gene pool is

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the basic material with which a plant breeder has to initiate the breeding programme.

Sir Otto Frankel coined the term 'genetic resources' only in 1968 shows that the plant breeders though aware of the gradual loss of the germplasm, failed to recognize the urgency of protecting the genetic resources of crop plants prior to a point of no return. The sum total of all allelic sources influencing a wide range of characters constitutes the plant genetic resources of a crop. It is the genetic wealth that a crop has acquired over millions of years of its existence under natural conditions or human cultivation and thus provides the raw material for further improvements through the natural or human interference.

Pre-breeding is a special approach for the use of wild and unadapted germplasm and land races where the desirable gene complexes are transferred from wild species to good agronomic bases through specialized breeding programme. The desirable gene complexes from wild or primitive types are therefore, brought into these types before the start of actual breeding work.

Whys and Wherefores for low utilization of germplasm resources?

Even though a large size germplasm collection is there, but plant breeders' preference for working collections and the linkage drag associated with utilizing wild relatives in crop improvement programmes are the some of the reasons for whys for low utilization of germplasm resources. A large germplasm collection of most of the crop plants possesses lack of information about the trait of economic importance, which often show high genotype × environment interaction. This is a problematic situation for plant breeder to select the appropriate enetic diversity for use in their breeding programmes. So the alternative to avoid this problem is development of small sized subsets such as core (Frankel and Brown, 1984) and minicore (Upadhyaya and Ortiz, 2001).

About 7.2 million accessions are available in over 1300 gene banks, but these accessions are not used optimally in crop improvement because:

- Lack of documentation and adequate description of collections.
- Insufficient evaluation of the collection.
- Limited input by breeders during documentation to understand what information would be most valuable.
- Accessions with limited environmental adaptability.
- Accessible materials not always suited to agronomic needs.
- Adequately quantities of seeds are not available in a timely manner.

Pre-breeding scheme needs:

- Close collaboration between gene bank manager and breeders.
- Greater likelihood of more complex hybridization issues.
- End product of pre-breeding is a raw material for breeding.
- Breeding result should be a new variety.

Pre-breeding is not necessary if one of the following is available:

- Commercially available adapted and acceptable varieties.
- Advanced selection, well adapted to the target environment.
- Gene bank accessions that is well adapted to the target environment.

Pre-breeding probably needed if only one of the following is available:

- Gene bank accessions are not well adapted to the target environment.

- Closely related wild species easily crossed with the crop species.
- Wild species less closely related and more difficult to cross.

Pre-breeding as an alternative to genetic resources:

The limited usable genetic resource in the present situation is a specious threat to meet the growing food requirement to feed the billions. The global climate change also create alarming situation for better sustainable food security. The newly developed modern cultivars though increasing the food grain production, on the opposite side it also increases the genetic vulnerably by replacing the wild potential germplasms like local cultivars and land races. The genetic vulnerability helps in emerging new races of pathogens and insect pests. These emerging problems badly need the efficient utilization of genetic resources through pre breeding to develop not only the resistance cultivars but also quality products also.

Pre-breeding for assessing novel genes

The success of any crop improvement program depends on the availability of sufficient genetic variability, but this variability must be in conventionally usable form. The variability available in any crop germplasm conserved in genebanks for present and future use belongs broadly to the following three groups: (1) Cultivated type, (2) Cross-compatible wild type and (3) Cross-incompatible wild type.

The genetic variability in cultivated type germplasm is either in poor agronomic background or in genetic background not adapted to the breeding or target climate for its direct use in conventional breeding programmes. The exploitation of genetic variability in wild species for cultivar improvement is hindered mainly by linkage drag and different incompatibility barriers between cultivated and wild species. Under such situations, prebreeding offers a unique tool to enhance the use of genetic variability present both in cultivated and wild type germplasm. Pre-breeding involves all the activities associated with identification of desirable traits and/or genes from unadapted germplasm (donor) that cannot be used directly in breeding populations (exotic/wild species), and to transfer these traits into well-adapted

Improvement of Pre-breeding materials:

The following efforts may enhance the activity of pre-breeding materials:

- Information on gene pool origins, domestication syndrome traits, molecular diversity and mapping data of the wild forms.
- Indirect screening for the biotic and abiotic stresses.
- Marker-assisted selection.

Pre-breeding should aims at:

- Identify potentially useful genes in a well-organized and documented gene bank.
- Design strategy that leads to development of an improved germplasm ready to use in varietal development.
- Pre-breeding is a collaborative endeavor, that is buttressed by communication, between gene bank curators and breeders.

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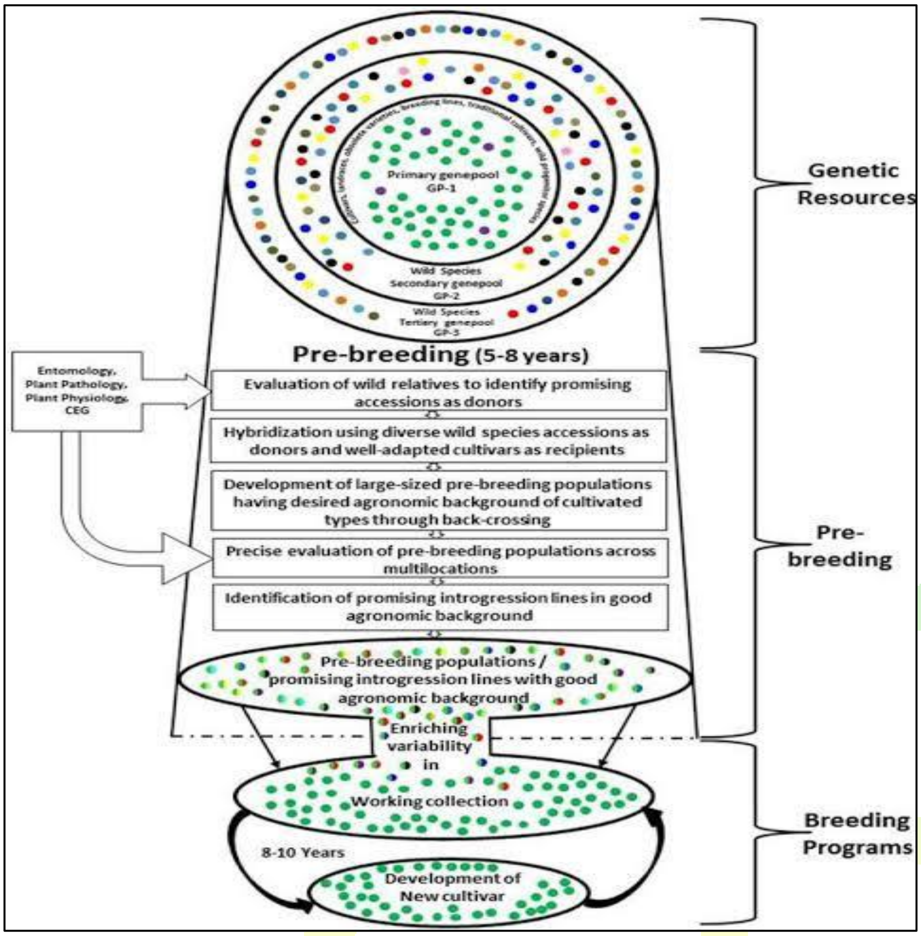

Fig:- Pre-breeding as a bridge between genetic resources and crop improvement (Sharma, 2017).

CONCLUSION

- Domestication and selections (plant breeding and farmers) have narrowed the base of our most gene pools.
- Concerns over long-term sustainability of crop improvement resulting in enhanced conservation and sustainable use of Plant Genetic Resources for Food and Agriculture (PGRFA).
- Direct use of gene bank accessions directly in breeding programmes is desperate with constraints.
- Pre-breeding is a bridge between gene banks and breeding programmes.

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Potential applications of stem cells

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INTRODUCTION:

A stem cell is basically any cell that can replicate and differentiate. This implies that the cells can not only multiply, but can also turn into different types of tissues. There are several kinds of stem cells. Most people have heard about the term “embryonic stem cells”. These are cells from the embryonic stage that have yet to differentiate as such; they can develop into any body part at all.

In recent times, much work has been done isolating bone-marrow derived stem cells. These are also known as “Mesenchymal stem cells” because they come from the mesodermal section of the body. They can modify into bone and cartilage, and probably all other mesodermal elements, such as fat, connective tissue, blood vessels, muscle and nerve tissues. Cell therapy around the globe is shifting its focus from bone marrow based cells to adipose (fat) derived cells since the cells are simple to obtain and usually very robust. Clinical success and favorable outcomes appear to be related directly to the number of stem cells deployed. Once these adipose derived stem cells are supplied back into the patient, they have the potential to repair human tissues by affecting healing and also producing new cells of mesenchymal origin, such as cartilage, bone, ligaments, tendons, nerve, fat, muscle, blood vessels, and certain internal organs.

Basic characteristics of stem cells:

There are many different types of stem cells, but in general they all share two basic characteristics that make them distinctive from other cell types. These are:

1. **Self-renewal property:** Stem cells grow and proliferate independently by mitosis to create populations of identical stem cells.
2. **Differentiation into specialized cell types:** Under control of key signals, stem cells can differentiate into specialized cell types such as skin, muscle, bone or blood cells.

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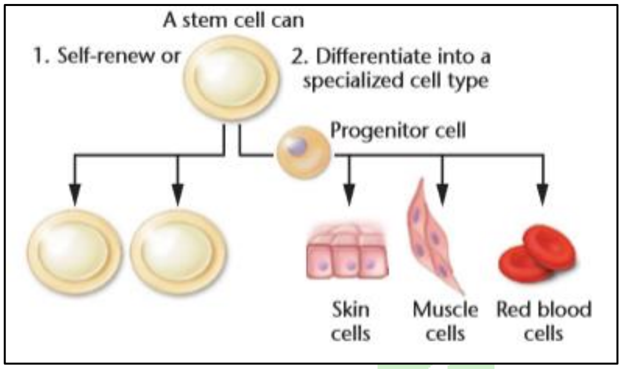

Fig:-1 Characteristics of a Stem Cell. Self-renewal and differentiation into different cell types are two key characteristics of stem cells (from Klug *et al.*, 2012).

Potency of stem cells:

Some stem cells possess greater differentiation ability than others, and researchers refers that ability as he potency of the cell type.

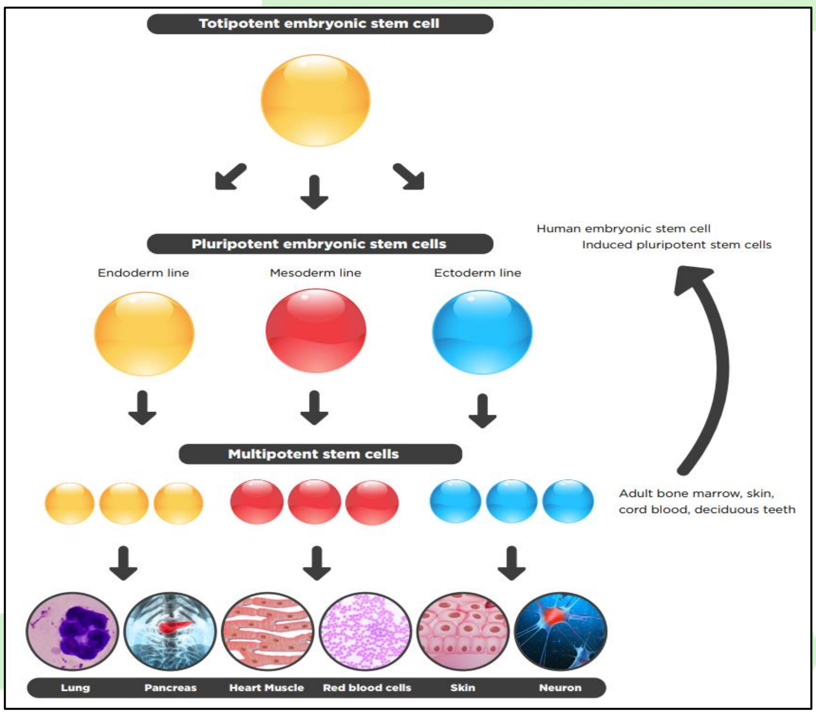

Fig:- 2 Hierarchy of cell potency of stem cells (MacDonald, 2018).

1. **Totipotency:** A totipotent cell, such as the zygote, can form not only all adult body cell types, but also the specialized tissues needed for development of the embryo, such as placenta.
2. **Pluripotency:** Many types of stem cells are called pluripotent because they have the potential to eventually differentiate into a variety of different cell types to form all the 220 cell types in the human body.

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3. **Multipotency:** Multipotent stem cells can develop into a limited number of cell types (e.g.- Haematopoietic stem cells, neural stem cells, mesenchymal stem cells) in a particular lineage.

Sources and types of stem cells:

Earlier t was thought that stem cells only present in embryos but now that there are several sources and different types of stem cells identified.

1. Human Embryonic Stem Cells (hESCs):

To understand what stem cells are, we need to briefly consider the development human embryo.

- The fertilized product of a sperm and an egg cell is called zygote. The zygote divides rapidly and after three to five days first forms a compact ball of 12 cells called a "morulla", meaning "little mulberry".
- Around five to seven days after fertilization, the dividing cells creates an embryo consisting of a small hollow cluster of approximately 100 cells called blastocyst. The balstcyst is approximately one-seventh of a millimeter in diameter and contains an outer row of single cell called the trophoblast; this layer develops to form the fetal portion of the placenta that nourishes the developing embryos.
- Within the blastocyst is a small cluster of around 30 cells that form a structure known as the inner cell mass. The inner cell mass is the source of human embryonic stem cell (hESCs).
- During embryonic development, cells of the inner cell mass develop to form the embryo itself, and hESCs can differentiate to form all cell types in the body they are hESCs are pleuripotent in nature.
- Successful isolation and culturing of the first hESCs from a human blastocyst was reported in 1998 by James Thomas of the University of Wisconsin at Madison who had clustered ESCs from rhesus monkey two years earlier.
- Also in 1998, John Gearhart and colleagues Johns Hopkins University isolated embryonic germ cells, primitive cells that form the gametes-sperm and egg cells from human faetal tissues and demonstrated that these cells can develop into different cell types.

1.1. How these stem cells isolated from embryos?

- Scientists use a holding pipette that applies a brief suction to "hold" the blastocyst in place and a glass micropipette is then inserted into the blastocyst to gently remove cells from the inner cell mass, which are then cultured in dishes and flask in the lab.
- Initially, the main source of hESCs was leftover embryos produced by assisted reproductive technology such as *in vitro* fertilization.

1.2. Process of in vitro fertilization:

- Multiple eggs are removed from a woman and fertilized in vitro.
- Resulting embryos are then implanted into a woman's uterus.
- But typically a few of the embryos produced by this way are implanted.
- Excess embryos are typically frozen at ultra-low temperature for use by the couple in future if desired.
- They may donate for research.

1.3. Aging of Human Embryonic Stem Cells

- Human Embryonic Stem Cells avoid senescence (cell aging).

- Because they express high level of telomerase.
- Several groups maintained stem cells for over three years and over 600 rounds of division without apparent problem.
- Cultured cells maintained and grown successively are called **cell lines**.
- Stem cells grow rapidly and stored for longer period without losing their properties.

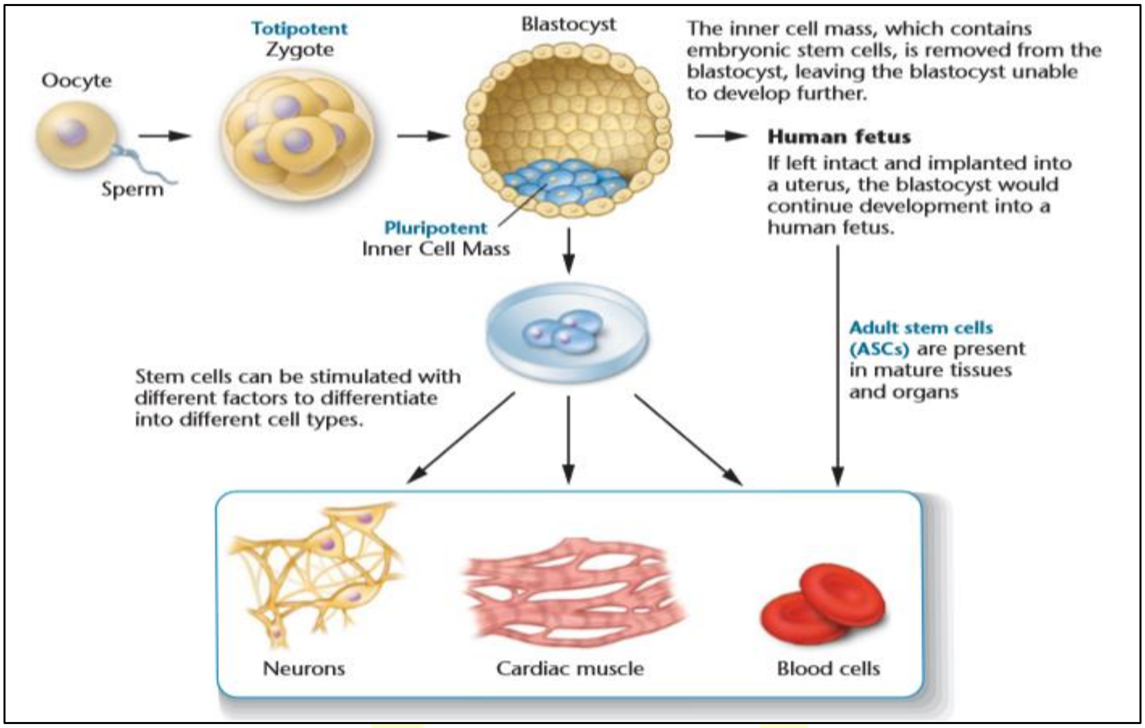

Fig:- Isolating and Culturing Human Embryonic Stem Cells. Cells isolated from the inner cell mass of human embryos can be grown in culture as a source of hESCs. Under the proper growth conditions, hESCs can be stimulated to differentiate into virtually all cell types in the body (from Klug *et al.*, 2012)

2. Adult derived Stem Cells (ASCs)

- Adult derived Stem Cells (ASCs) reside in differentiated tissues of the body.
- They are not such abundant as like Human Embryonic Stem Cells.
- They can be isolated from the brain, intestine, hairs, skin, pancreas, bone marrow, fat, mammary glands, teeth, muscle and blood and almost every adult tissues.

2.1. How ASCs are isolated?

- ASCs are more acceptable alternative than hESCs.
- Because, isolation of ASCs does not require the destruction of an embryo.
- ASCs can be harvested from people by fine needle biopsy, where a thin diameter needle is inserted into muscle, bone or tissues which are potential source of stem cell.
- But demerit of ASCs is they may not be as pluripotent as hESCs.

3. Amniotic Fluid-Derived Stem Cells

- Stem cells can be isolated from the human amniotic fluid *i.e.* the protective fluid that surrounds a developing fetus.
- In lab, these amniotic fluid-derived stem cells have been coaxed to become neurons, muscle cells, adipocytes, bone, blood vessels and liver cells.

4. Cancer stem cell (CSCs)

- Cancer stem cells (CSCs), also called tumor-initiating cells, have been identified and implicated in the development of cancer, tumor progression, tumor metastasis and the recurrence of cancer.
- CSCs have self-renewable capacity and they form the tissue from which they were derived.
- Some CSCs cells grow slowly in clusters or niches within a tissue.
- The CSCs cells are a focus of intense research and potential therapeutic treatments for the treatment of Cancer.

Potential application of stem cells:

- To studying stem cells to understand and treat birth defects and genetic diseases.
- To genetically manipulating stem cells for delivering genes in gene therapy approaches.
- To creating whole tissue in laboratory using tissue engineering.
- Research is going on for the treatment for diseases such as heart disease, stroke, Alzheimer's disease, Parkinson's disease, chronic spiral cord injuries and diabetes.

Modern applications of stem cell technology:

- **Bone marrow transplantation** is a form of stem cell therapy. Bone marrow contains ASCs. During a bone marrow transplant, stem cells are transferred from a healthy donor to a needy recipient, where in the cells regenerate various blood cell types as needed.
- A patient with **leukemia**, a cancer that causes white blood cells to divide abnormally, producing immature cells, frequently requires chemotherapy or radiation treatment which ultimately weakens the patient's immune system. Using stem cells to make white blood cells is becoming an effective way to treat Leukemia.
- Stem cells from umbilical cord blood have also been used to provide red blood cells for **Sickle-cell anemia** patients and individuals with other blood deficiencies.

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Nutrient management in wheat

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INTRODUCTION:

Wheat (*Triticum* spp.) occupies the prime position among the food crops in the world. In India, it is the second important food crop being next to rice and contributes to the total food grain production of the country to the extent of about 25%. Wheat has played a very vital role in stabilizing the food grain production in the country over the past few years.

The origin of the durum wheats was probably in the region of Abyssinia, whereas the whole group of soft wheat, which includes the bread wheats, probably originated in the region of Pakistan, South Western and the Southern parts of mountainous Bokhara.

Classification of Indian Wheats:

1. Emmer Wheat (*Triticum dicoccum* schub L.):

This type was reported to be grown in south i.e. Maharashtra, Tamil Nadu and Karnataka. This type is believed to be developed from T. diccoides koru., a wild form. It is also grown in Spain, Italy, Germany and Russia.

2. Macroni Wheat (*T. durum* Desf.):

The durum or macroni wheat, cultivation in India, is considered to be very old. It is a best wheat for drought conditions or under restricted irrigated conditions of Punjab, M.P., Karnataka, Tamil Nadu, Gujarat, West Bengal and H.P. It is used for semolina (suji) preparation.

3. Common Bread Wheat (*T. vulgare* Host):

It is a typical wheat of alluvial soils of Indo-Gangetic plains i.e. Punjab, Uttar Pradesh, Bihar and parts of Rajasthan. The bulk of the Indian crop, therefore, consists of this type.

4. Indian Dwarf Wheat (*T. spherococcum* Mihi.):

This belongs to the club wheat of western countries. This is found in limited areas of M.P., U.P., of India and in Pakistan. These are characterised by very short and compact heads having a shorter grains.

5. *Triticum aestivum*:

This is the type presently grown in India in almost all the wheat growing zones. It is used mainly for bread purpose.

Climate and Soil:

The ideal temperature requirement varies from plant type and stages of growth. The dwarf varieties require the following temperature for their growth and development:

Growth stages	Temperature requirement
Germination temperature	20 to 25 ^{0}C mean daily
Tillering temperature	16 to 20 ^{0}C mean daily
Accelerated growth temperature	20 to 23 ^{0}C mean daily
Proper grain filling temperature.	23 to 25 ^{0}C means daily

Wheat plants are sensitive to very cold or frost injury at any stage of growth particularly at reproductive growth if temperature is below 150

Land Preparation:

The wheat crop requires a well-pulverized but compact seed bed for good and uniform germination. Three or four ploughings in the summer, repeated harrowing in the rainy season, followed by three or four cultivations and

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planking immediately before sowing produce a good, firm seed bed for the dry crop on alluvial soils.

Sowing:

a) Sowing time:

Based on above temperature requirement it has been found that for indigenous wheat last week of October, for long duration dwarf varieties like Kalyansona, Arjun, etc. first fortnight of November and for short duration dwarf wheats like Sonalika, Raj 821 etc. second fortnight is the best sowing time.

b) Seed rate:

Generally, a seed rate of 100 kg/ha has been found to be sufficient for most of the varieties like Kalyan Sona, Arjun, Janak, etc. which have moderate tillering and medium sized grains.

c) Spacing:

For irrigated, timely sown wheat, a row spacing of 15 to 22.5 cm is followed, but 22.5 cm between the rows is considered to be the optimum spacing. Under irrigated late-sown conditions, a row spacing of 15-18 cm is the optimum.

d) Seed treatment:

The seed of loose smut-susceptible varieties should be given solar or hot-water treatment. If the wheat seed is used only for sowing, and not for human consumption or for feeding cattle, it can be treated with Vitavax.

Wheat Nutrition and Fertilizer Requirements:

Nitrogen:

Nitrogen play very important role for the primary growth of the plant. The most important role of N in the plant is its presences in the structure of protein, the most important building substances from which the living material or protoplasm of every cell is made. In addition, nitrogen is also found in chlorophyll, the green colouring matter of leaves. Chlorophyll enables the plant to transfer energy from sunlight by photosynthesis.

Potassium

Potassium is second important elements in wheat. Wheat plant need potassium for Proper growth and development. Adequate potassium results in superior quality of the whole plant due to improved efficiency of photosynthesis. Potassium increased resistancey to diseases, and also improved water use efficiency. It help in to make balance between carbohydrates and proteins.

Sulphur

Sulphur is ingredient in the formation of chlorophyll. Without adequate sulphur, crops can not possibly reach their full potential in terms of yield or protein content.

Calcium

Calcium regulates transport of other nutrients into the plant and is also involved in the activation of certain plant enzymes. Calcium deficiency results in stunting. This nutrient is involved in photosynthesis and plant structure.

Magnesium

The outstanding role of magnesium in plant nutrition is as a constituent of the chlorophyll molecule. As a carrier, it is also involved in numerous enzyme reactions as an effective activator, in which it is closely associated with energy- supplying phosphorus compounds. Magnesium is very mobile in plants.

Micronutrients

"The elements which are required in less amount for the growth and development of the plants that elements are known as Micronutrients"

Micronutrients are required for optimum crop production and the term micronutrient refers to the relative quantities required for plant growth and does not mean that they are any less important to plants than other nutrients. Wheat growth and development may be effected if any

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one of these elements is lacking in the soil or if a nutrient is not adequately balanced with other nutrients.

The amounts of nutrients required can be derived from soil testing and the nutrient removal by grains and straw. A crop of winter wheat producing 6.7 tonnes grain/ha absorbs an average of 200 kg N, 55 kg P_2O_5 and 252 kg K_2O/ha.

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Plant resistances mechanism under salinity stress

Article id: 21915

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INTRODUCTION

Soil salinity stresses plants in two ways. High concentrations of salts in the soil make it difficult for roots to uptake water, and high concentrations of salts within the plant can be toxic. Salts on the outside of roots system have quick effect on cell growth and associated cell metabolism; toxic concentrations of salts take time to accumulate inside plants before they affect plant function. The biochemical and molecular mechanisms of tolerance to osmotic and ionic components of salinity stress are reviewed at the cellular, organ, and whole-plant level. Plant adaptations to salinity are of three distinct types: Physiological stress tolerance, Na+ or Cl− exclusion, and the tolerance of tissue to accumulated Na+ or Cl−. Role of the HKT gene family in Na+ exclusion from leaves is increasing, the molecular bases for many other transport processes at the cellular level. Molecular genetics and functional genomics provide a new opportunity to synthesize molecular and physiological knowledge to improve the salinity tolerance of plants relevant to food production and environmental sustainability

Different Types of Plant Response or Tolerance

a. Response to osmotic stress: The osmotic stress initially reduces cell expansion in root tips and young leaves and causes stomata closer. A reduced response to the osmotic stress would result in expansion of leaf growth and stomatal conductance, but the resulting increased leaf area would benefit only plants that have sufficient soil water.

b. **Na+ exclusion from leaf blades**: . Na+ exclusion by roots system ensures that Na does not accumulate to toxic concentrations within leaves. A failure in Na+ exclusion manifests its toxic effect after days or weeks, depending on the species, and causes premature death of older leaves.

c. **Tissue tolerance**: Tolerance of tissue to accumulated Na+, or in some species, to Cl−. Tolerance requires compartmentalization of Na+ and Cl− at the cellular and intracellular level to avoid toxic concentrations within the cytoplasm, especially in mesophyll cells in the leaf.

Cellular Signaling in Salinity Stress

Long-distance signalling of salinity stress to the shoot from the roots, mediated at least in part by ABA. The first recorded response to an increase in Na+ around roots is an increase in cytosolic free Ca2+ ([Ca2+]cyt; the extracellular addition of Na+ is apparently able to activate the flux of Ca2+ into the cytosol across the plasma membrane and also, interestingly, the tonoplat. The changes in [Ca2+] cyt are complex, and are modulated by differences in extracellular composition, including Na+ concentration, providing opportunities for information to be encoded by the [Ca2+]cyt changes. An additional level of complexity in NaCl-induced [Ca2+]cyt increases has been demonstrated by root cell type–specific expression of aequorin in Arabidopsis. In response to 220 mM NaCl, the increase in [Ca2+] cyt is lower in the pericycle than in the other cell type.

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Genes Involved in Salinity Stress

A large number of genes and proteins, such as HKT and NHX, encoding K+ transporters and channels have been identified and cloned in various plant species. During salt stress expression of some low abundance transcripts is enhanced which are found to be involved in K+ uptake. Transporters located on the plasma membrane, belonging to the HKT (histidine kinase transporter) family, also play an essential role in salt tolerance by regulating transportation of Na+ and K+. Class 1 HKT transporters, in Arabidopsis, protect the plant from the adverse effects of salinity by preventing excess accumulation Na+ in leaves. Intracellular NHX proteins are Na+, K+/H+ antiporters involved in K+ homeostasis, endosomal pH regulation, and salt tolerance. the two major tonoplast-localized NHX isoforms are essential for active K+ uptake at the tonoplast, for turgor regulation, and for stomatal function.

Role of Compatible Solute Accumulation in Salinity Stress

Organic osmolytes are synthesised and accumulated in varying amounts amongst different plant species. The concentration of compatible solutes within the cell is maintained either by irreversible synthesis of the compounds or by a combination of synthesis and degradation. The biochemical pathways and genes involved in these processes have been thoroughly studied. As their accumulation is proportional to the external osmolarity, the major functions of these osmolytes are to protect the structure and to maintain osmotic balance within the cell via continuous water influx. Glycine betaine is an amphoteric quaternary ammonium compound ubiquitously found in microorganisms, higher plants and animals, and is electrically neutral over a wide range of pH. It is highly soluble in water but also contains nonpolar moiety constituting 3-methyl groups. Because of its unique structural features it interacts both with hydrophobic and hydrophilic domains of the macromolecules, such as enzymes and protein complexes. Glycine betaine is a nontoxic cellular osmolyte that raises the osmolarity of the cell during stress period; thus it plays an important function in stress mitigation. Glycine betaine also protects the cellby osmotic adjustment, stabilizes proteins, and protects the photosynthetic apparatus from stress damages and reduction of ROS.

Antioxidant regulation in salinity tolerance

Under Salinity conditions molecular oxygen (O2) acts as an electron acceptor, giving rise to the accumulation of ROS. Singlet oxygen (1 O2), the hydroxyl radical (OH−), the superoxide radical (O− 2), and hydrogen peroxide (H2O2) are all strongly oxidizing compounds and therefore potentially harmful for cell integrity. Antioxidant metabolism, including antioxidant enzymes and non-enzymatic compounds, play critical parts in detoxifying ROS induced by salinity stress. Salinity tolerance is positively correlated with the activity of antioxidant enzymes, such as superoxide dismutase (SOD), catalase (CAT), glutathione peroxidise (GPX), ascorbate peroxidase (APX), and glutathione reductase (GR) and with the accumulation of non-enzymatic antioxidant compounds.

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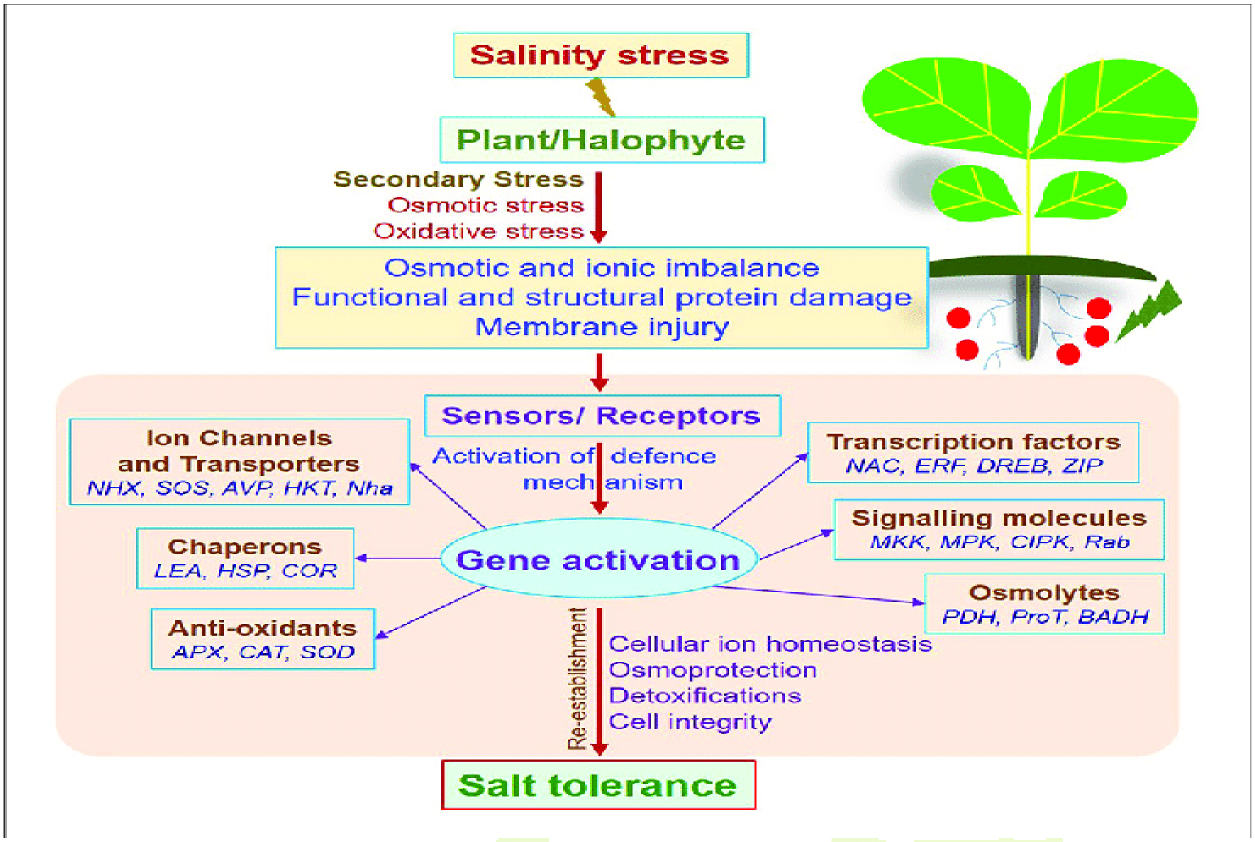

Fig no A. Salinity Stress mechanism in Plant

CONCLUSION

Salinity tolerance involves a complex of responses at molecular, cellular, metabolic, physiological, and whole-plant levels. Extensive research through cellular, metabolic, and physiological analysis has elucidated that among various salinity responses, mechanisms or strategies controlling ion uptake, transport and balance, osmotic regulation, hormone metabolism, antioxidant metabolism, and stress signalling play critical roles in plant adaptation to salinity stress. Taking advantage of the latest advancements in the field of genomic, transcriptomic, proteomic, and metabolomics techniques, plant biologists are focusing on the development of a complete profile of genes, proteins, and metabolites responsible for different mechanisms of salinity tolerance in different plant species.

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Think globally and act locally to improve your environment

Article id: 21916

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MEANING

- "Think globally, act locally" urges people to consider the health of the entire planet and to take action in their own communities and cities.
- It is not only corporations that are acknowledging the importance of environmental issues, but also the education system.

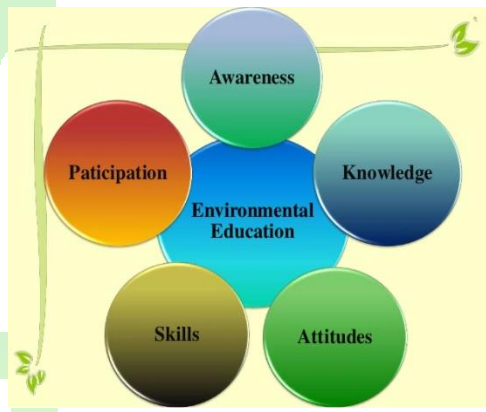
Environmental Education

- Man as a part and parcel of the environment, has to recognize the role and important of environment in order to protect it and to get protection from it for this, he needs environmental education

Importance of environmental education.

- To improve the quality of environment.
- To create an awareness among the people on environmental problems and conservation.
- To create an atmosphere so that people participate in decision making and develop the capabilities to evaluate the developmental programmes.

Objective of Environmental education



Aims of Environmental education

- To provide different group of people as well as graduates in a variety of professional fields with the knowledge needed to develop a sense of responsibility towards the environment and the rational utilization of its riches.
- To make use of these knowledge and skills to preserve, conserve and utilize the environment in a sustainable manner for the benefit of present and future generation.

Major Environmental issue

- Climate change

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- environmental degradation
- Intensive farming
- Land degradation
- Nuclear issues
- Overpopulation
- Ozone depletion
- Pollution
- Resource depletion

Environmental awareness is essential for

- Protection of the atmosphere
- Protection of land resources
- Conservation of biological diversity
- Environmentally sound management of biotechnology and hazardous wastes.
- Prevention of illegal traffic in products and waste.
- Improvement in living and working conditions of the poor by eradication poverty and stopping environmental degradation

Providing environment education at different levels of education

- Primary education- Awareness of environment (knowledge).
- Secondary education- Relevance for real life situation of environment(understanding)
- Higher secondary education- Conservation of natural resource of environment (skills)
- College & University Education- Sustainable development by solving problems of environment (Attitude and Evaluation)

Multidisciplinary approach

Role of teachers in Environmental education

- To use the children's interest in the environment and to raise challenging problems.
- To discuss the approach to problems or topics
- To arrange visits
- To provide materials needed for practical work.
- To arrange for visiting speakers.
- To initiate and develop discussion and debate
- To provide facilities for displays and exhibition of the work carried out.

Prevention of environmental pollution from agricultural movements:

Diffuse agricultural pollution:

For the diffusion of agricultural pollution is contamination of the soil, air and water environments resulting from farming activities. This pollution tends to arise over a wide geographical area and is dependent on what happens on the surface of the land. Even though separately minor, such pollution on a catchment scale can be significant, allowing for the cumulative affect which these separate discharges can have on the environment. Activities such as ploughing, seedbed preparation, crop spraying, fertilizer spreading and applying slurry may all contribute to diffuse pollution. Run-off from farm roads and yards, the

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surface of fields and dusty roofs after rainfall are all ability sources of pollution.Therefore, a wide range of potential diffuse pollution sources which are associated with farming practices and which can harm the environment.

CONCLUSION

"Chinese perception about education which says"

"If you plan for one year, plant rice, if you plan for ten years, plant trees, But, if you plan for one hundred years, educate the people". So this article promote individual to do better for environment, it is important to remember that steps towards improving our environment always begin at an individual level. 'You' can make a difference for our world. Hence, activities such as ploughing, seedbed preparation, crop spraying, fertilizer spreading and applying slurry may all contribute to diffuse pollution

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Surge irrigation: conceptualizing '*More crop per drop*' into a reality

Article id: 21917

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Water, the elixir of life, on one hand is becoming scarce day by day while India's population is outgrowing its water supply on the other. India is set to overtake China as the world's most populous country in less than a decade and demand for water will reach twice the available supply by 2030, placing hundreds of millions of lives in danger. It is a high time to give a rejuvenated impetus to conserve and utilize every drop of water in every sector-agriculture, industry or even the household utilization. Among the different methods of irrigation followed throughout the country, surface irrigation deserves special mention. However, due to poor efficiency, a huge wastage of water is incurred through excessive runoff and deep percolation. Surge irrigation is a better technology which results in less labor and costs besides saving water and indirectly increases the net income of the farmers. The article is thus primarily emphasized to uplift the concept of surge irrigation in the light of improving water use efficiency and crop productivity.

"A drop of water is worth more than a sack of gold to a thirsty man."

INTRODUCTION:

The world's second populous country is at present running out of water resources. About 100 million people across India are on the front lines of a nationwide water crisis. According to a 2018 report by government-run think tank NITI Aayog[1], a total of 21 major cities are poised to run out of groundwater. Although currently, India is not under severe stress; however, it is likely to become a moderate water scarce country by 2050[2]. Excessive use of groundwater for irrigation in agriculture has also caused a strain in the resource. As India is one among the top agriculture producers in the world, the consumption of water for land and crops is also one of the highest. The widespread use of ineffective techniques for irrigation aligned with mismanagement is an aggravator for the water deficit and crisis.

Assessing the current situation, there is a need for a paradigm shift. We urgently require a transition from 'supply-and-supply-more water' provision to measures which lead towards improving water use efficiency, reducing leakages, recharging/restoring local water bodies as well as applying for higher tariffs and ownership by various stakeholders[3].

A recovery-based closed loop system is the need of the hour. This emphasis should be initiated in the irrigation sector where judicious use and management of water resources can be successful in enhancing the efficiency of utilization and reducing the losses, which is an important concern for all agriculturists in near future.

Issues to ponder and reiterate:

Over exploitation of surface water resources and unscrupulous pumping of groundwater have led the farming community to a precarious situation where counting every drop of water towards sustaining maximum possible crop production has become a necessity. Even as micro irrigation systems embedded with fertigation components are gaining popularity and momentum, surface irrigation systems such as border strips or furrows or check basins are still in vogue and are quite inevitable from the point of view of farm management.

Excessive runoff and deep percolation in surface-irrigated fields result in wastage of water and can result in increased levels of dissolved salts and fertilizer residues to enter groundwater and surface water. Growers are increasingly concerned with how to stretch limited supplies of water, while maintaining yield. At the same time, growers face more stringent standards regarding water quality[4]. Irrigation management practices that reduce deep percolation and runoff will address both of these concerns. It is in this foreground, a much efficient proposition is use of surge irrigation to harmonize both.

What surge irrigation is?

Surge irrigation may be defined as the intermittent application of water to surface irrigated furrows or borders in a series of relatively short *on and off* time periods during the irrigation which may be between 20 minutes to two hours. In this technique, water is usually applied intermittently rather than with a continuous stream, as in conventional surface irrigation. The concept of "surge flow" was introduced at Utah State University by Stringham and Keller in 1979[5]. Intermittent water applications during the irrigation advance phase generally reduced infiltration by providing a short drainage period following wetting. Thus more rapid advance of the wetting front occurs than with continuous flows. The difference in intake opportunity time between the upper and lower ends of furrows reduces and more uniform distribution of water intake over the length of the furrows occurs [6].

Mode of operation:

In surge irrigation, a butterfly valve is placed in the center of the top of the field from where water enters through pipeline. Gated pipe leads out of the valve and goes in both directions along the top of the field. The valve oscillates water from one side to the other at predetermined intervals. As against conventional surface irrigation systems where the water flows continuously during the irrigation set, the alternating flow of water in surge irrigation on each side of the valve causes an intermittent wetting and soaking cycle in the irrigated furrows which is often corroborated as the ON and OFF system.

The alternating wetting and soaking cycle causes soil particles to settle to the bottom of the furrow and they partially seal the soil surface. The water intake rate is curtailed. As a result, less water is lost due to deep percolation at the beginning of the furrow and the water can advance down faster. Precise timing shuts off the water flow and by reducing deep percolation at the beginning of the row and tail-water runoff at the end, the result is more uniform water application, less total water applied and water runoff.

Fine textured soils are less responsive to surge irrigation than coarse textured soils having higher initial intake rate. If the land is steeper the water may move down rapidly rendering this method ineffective [7].

The surge effect depends upon a number of factors such as soil texture and consolidation, antecedent moisture content and number and duration of the ON- OFF cycles. Invariably in all the continuous flow long furrows, the water front advance could not reach the furrow tail end within the designed duration of irrigation and nearly 25 to 40% additional times are required. The continuous flow long furrow layout could have high water distribution uniformity around 55% only, but the surge irrigation will have 80 to 85% [8].

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Some important connotations in surge irrigation implementation:

A number of terms are used in the field of surge irrigation implementation, some of which are stated as follows:

- ***Advance time:***Time required for the wetting front to "advance" from the crown (top) to the end of the furrow.
- ***Continuous Flow:***Irrigation flow in a furrow that does not stop from crown to end, before the required depth is applied.
- ***Recession time:***Time for the wave front to recede from the furrow; essentially this occurs when majority of the tail water has stopped draining from the field.
- ***Opportunity time:***Time for water to infiltrate into the soil. The more the opportunity time for water to contact with the soil, the more volume will be infiltrated.
- ***Soak Time:***Time after advance has completed, when the remainder of the set time is used to meet the required application depth.
- ***Number of cycles:***The number of advance cycles (water on/water off) used to complete a surge advance program.
- ***Application depth:***The depth of irrigation applied during a surge irrigation. This depth should be between 2.5 and 3.0 ac-in.
- ***On-time:***The time when water is applied to one side
- ***Off-time:***The time when water is not applied to one side
- ***Cycle-time***: The time required to complete an on/off cycle (sum of on-time and off-time)
- ***Irrigation set time:***The total irrigation time involved, which includes advance and soak times.

Benefits of surge irrigation:

Studies done at the different research stations have shown significant benefits to surge irrigation:

- More uniform application of irrigation water
- Reduced water use through reductions in deep percolation and runoff
- Reduced costs through reductions in water use and labor.
- Reduced nitrogen leaching
- Reduced sediment loss
- Reduced surface water contamination

Limitations of surge irrigation:

There are few drawbacks associated with surge irrigation. Firstly, surge flow may not always reduce the advance time of water down the furrow; even in that case there may be the benefits of labor savings and runoff reductions.

Infiltration rates are often lower with surge flow; a second concern is associated with the net water application. Under lower rate of infiltration, less amount of water will be stored in the root-zone in a specific irrigation application. Thus it is to be compensated by irrigating the field more frequently or increasing the set time to avoid under watering. The importance of proper irrigation scheduling is even more perceived under surge flow.

Thirdly, another important consideration for surge irrigation is proper land leveling. The presence of low spots or reverse grades in the field results in water ponding and the advance time is increased owing to lower infiltration. This phenomenon is more observed in coarse textured soils rather than fine textured ones and proper grading up to level the land becomes necessity.

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CONCLUSION:

According to a UN human rights report, the world is fast approaching "climate apartheid" where only the wealthy can afford basic resources in the face of fatal droughts, famine and heat waves. In some places in India, disaster has already arrived; 600 million people are facing acute water shortages nationwide -- according to the NITI Aayog report. As water runs out, the country may have to confront a series of associated problems: food insecurity, vulnerability during heat waves, disease due to deteriorating sanitation and regional conflicts over water access. Under this situation where the availability of drinking water is becoming scarce; wastage of water through inefficient irrigation systems cannot be connived. The time has come to press into service every drop of water for augmenting crop production.Surge irrigation can be managed to achieve a more rapid advance of the wetting front and to control runoff. Infiltration rate reduction by surging is attributed primarily to soil consolidation caused by negative hydraulic gradients and surface sealing caused by soil particle migration, reorientation, and deposition and thereby emerge as an important armory for the agriculturists. This endeavor is a real time necessity since *"every drop you save now will save the children of tomorrow".*

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Application of Global Positioning System (GPS) in agriculture

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The development and implementation of precision agriculture or site-specific farming has been made possible by combining the Global Positioning System (GPS) and geographic information systems (GIS). In the past, it was difficult for farmers to correlate production techniques and crop yields with land variability.

Today, GPS technology has been transferred partly in civil sphere, finding use in many fields such as auto transportation, rail, ship and aircraft, construction equipment, equipment monitoring and surveillance, agriculture, cartography, medicine and so on (Mureşan, 2006). The first GPS was launched in 1978 and Current GPS system is composed of 2nd generation GPS satellites, known as Block II. In 1989, the First Block II satellite was launched. In 1995, the Defense Department declared Global Positioning System, fully operational in 1995. GPS enable the farmers to work during low visibility weather conditions such as during dust, rain, fog, and darkness. GPS based applications in precision farming are being used for farm planning, field mapping, soil sampling, tractor guidance, crop scouting, variable rate applications, and yield mapping.

The accuracy of GPS allows farmers to create farm maps with precise acreage for field areas, road locations and distances between points of interest. GPS allows farmers to accurately navigate to specific locations in the field, year after year, to collect soil samples or monitor crop conditions.

Uses of GPS in Agriculture

1. **Soil Sampling:** GPS provides the necessary data to accurately determine soil variability and to establish whether a given type of soil is ideal for the growth of a particular crop.
2. **Ploughing, Planting and Fertilization:** GPS also comes in handy when planning the planting of a given crop. Using GPS, it is easier to tell what spacing a given seed requires and to what depth the seed should be planted in order to return maximum yields. Ploughing is something that the GPS technology is making easier to do.
3. **Fertilization, Weed Infestation and Crop Protection:** Optimization Less fertilizer or protectant material and apply it only where it's needed. Through GPS, farmers can identify locations that are nutrient deficient and apply the right amounts. GPS can be used to single out weed patches in vast areas of lands. The data from GPS is used by researchers and crop advisors to efficiently identify pest, insects or weed infestations in the field. This minimizes chemical drift by reducing over spraying in areas that do not require spraying. Therefore, it benefits the environment and its habitat at large.
4. **Field Mapping:** GPS technology makes work more manageable, it really helps farmer overcome any challenges that they face while working in their fields. Accurately scout crops and navigate to weeds, pests and diseased areas.
5. **Efficiency:** GPS system offers quite a number of cost-effective alternatives to the previous out-dated methods of planting, harvesting or raising crops.
6. **Correlation of Production Techniques with Crop Yields:** GPS can be used to make a correlation of the production technique that was used over a given piece of land and the crop yields after a given period of time. This information can then be used to determine the viability of a given technique.

7. **Machinery Location:** It is easier to locate any farm machinery on a vast piece of land thanks to GPS. The farmer does not need to physically go out and locate farm equipment especially in cases where the number is high. GPS can pinpoint the exact location of these farm machineries.
8. **Machinery Direction:** Technology has necessitated the use of autonomous farm machinery for use in farming. GPS is used to direct these machineries into deciding what direction the seeds will be placed and the spaces in between each seed.
9. **Identification of Irrigated Crops:** GPS can also be used to identify areas where there are crops that have been irrigated and those that have not been irrigated. This helps in creating a profile between irrigated crops and non-irrigated crops to help in making comparisons.
10. **Identification of Swamps and Other Water Logged Areas**: GPS can be used to identify swampy areas and waterlogged areas that may not be ideal for certain types of crops. This helps in determining the suitability of these types of lands for certain crops and their non-suitability for other types of crops.
11. **Land Usage in The Locality:** GPS can also be used to monitor the land usage within a given locality. Through GPS, it is easier to tell what area of the land has been put under cultivation and what part of the land has been left bare.
12. **Meteorological Mapping Such as Climatic Patterns:** GPS plays an important role in mapping out some climatic conditions which may determine the type of crop that can grow in a given region.
13. **Classification of Areas for Cultivation Based on Various Characteristics:** GPS can be used to classify different areas for cultivation based on various characteristics such as soil types and the terrain maps. Areas that are not suitable for cultivation can be identified and alienated while those that are suitable can then be developed.
14. **Harvesting & Yield Monitoring:** GPS can also be used to locate a yield map by mounting a GPS receiver on a farm. Monitor the quality of harvesting operations Minimize fuel and other costs with more accurate driving, Maintain detailed records of harvest operations and Create yield mapsGPS can as well be used to monitor the yields in a given field. Yield monitoring systems utilize a mass flow sensor by measuring the harvested weight of the crop.

GPS technology as an integral part of precision agriculture. GPS plays a critical role in optimization the profits, sustainability with a reduced environmental impact. Farmers and agriculture service providers can expect even further improvements as GPS continues to modernize.The use of GPS in Agriculture is limited but it is fair to expect wide spread use of GPS in future. Recently a GPS based crop duster (precision GPS Helicopter), which can spray an area as small as 4 X 4 m is attracting great attention (Shanwad. *et . al*., 2002).

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Association Mapping: Novel approch for crop improvement

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INTRODUCTION

Association mapping is a fine resolution mapping method for quantitative trait loci based on principle of linkage disequilibrium for the dissection of complex genetic traits. It is a powerful tool for the finding of complex agronomic traits and for the identification of alleles that can contribute to the increase a target trait. The power of association mapping studies is determined by the size of the experimental population, the magnitude of the target allele effect, the density of markers used, and the rate of Linkage disequilibrium decay between marker and target allele as well as errors in phenotyping and genotyping data and the desired resultant statistical significance level (Gordon and Finch, 2005). AS is a optional to standard QTL mapping approaches which involves the linkage of DNA polymorphisms with morphological variation in a diverse assemblage of individuals. The comparatively fine-resolution provided by association mapping is dependent upon the structure of linkage disequilibrium across the genome.

Association mapping studies can be divided into two broad categories:

(i) Candidate gene association mapping.

(ii) Genome Wide Association mapping.

General strategy for Association Mapping

1. Association Mapping Population

Large random sample from a natural population, a collection of breeding lines including cultivars, or a population derived from multi parent crosses of related species use for association mapping. This sample contains the association mapping population and association panel.

2. Phenotyping

Phenotyping must be based on replicated trials conducted over various locations and years to reduced environmental effects. Phenotypic trials should conduct using a suitable experimental design like randomized block design (RBD), augmented design, nested design, etc

3. Genotyping for Population Structure Analysis

Sample run with a set of molecular markers that are abundantly located over the entire genome of the species. These markers should be unlinked, i.e., is located more than 40 cM apart in the genome.

4. Structure and Kinship Analysis

The marker data then, analyze to detect and estimate the population structure of the sample using the STRUCTURE program and the extent of kinship among the individuals of the sample using the TASSEL program.

5. Genotyping for LD Analysis

The sample also genotyped with a sufficiently large number of molecular markers that cover the entire genome as densely as is feasible so that LD between markers and the loci of interest can be detected. The pattern of LD in the concerned genomic regions of the species and the extent of LD observed among different populations of the species would determine the number of markers required for adequate coverage of the whole genome. SSR and SNP marker systems are the most widely used for this purpose.

6. Association Mapping and Linkage Disequilibrium Analysis

A model-based analysis of relatedness between the phenotype and the genotype data done to detect and quantify LD between the markers and the genes/QTLs governing the traits of interest. The estimates of population structure and kinship use as covariates in the model to minimize false associations between the markers and the genes/QTLs of interest. Since these analyses are computationally intensive, suitable computer programs use for their implementation.

7.Software Uses for Association Mapping

Nowadays several software uses to assess the association of marker loci with traits. The most commonly used statistics include logistic regression with the possibility of structured associations implemented in TASSEL General Linear (TASSEL: http://www.maizegenetics.net), a multiple regression model combined with the estimates for the false discovery rate suggested by Kraakman et al., (2006), and an unified mixed-model approach described by Yu et al., (2006) and implemented in TASSEL Mixed Linear Model or in SAS v9.1.2 (Ehrenreichet et al., 2007).

Advantages of Association Mapping

- Association mapping is a impotent tool for the detection of new genes or QTLs of important agronomic characteristics.
- The extensive application of this approach in crop plants is expected in the long term as a result of establishment of the novel high-throughput genotyping and sequencing technologies.
- Gene-based markers are more accurate than linked markers for the prediction of phenotype, since the marker–trait association do not lost during segregation in the course of recurrent breeding selection cycles.
- Results from association analysis can be used to predict the best haplotype across one or multiple genes for optimum expression of the target trait.
- Genome-wide association studies are currently exploited for mapping of disease genes in human genetics.
- This approach has a potential to identify a single polymorphism within a gene that is responsible for the difference in phenotype.
- The distance over which Linkage disequilibrium persists will determine the number and density of markers and experimental design needed to perform an association mapping analysis.

Application of Association Mapping

- Linkage disequilibrium can be used for a variety of purposes in crop plant genomics research., One of the major uses of LD in plants would be to study marker-trait association followed by marker-assisted selection (MAS).
- Linkage disequilibrium based association mapping, which can be used for germplasm bank collections, synthetic populations, and elite germplasm.
- Genetic association mapping or linkage disequilibrium mapping is a method that based on linkage disequilibrium to study the

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relationship between phenotypic differences and genetic polymorphisms.

Genetic association mapping is a new tool which takes into account thousands of polymorphisms to evaluate for QTL effect and is more efficient as compared to linkage analysis because it does not require generation of segregating populations/large numbers of progeny.

- Association mapping is only capable of identifying phenotypic effects of alleles with reasonably high frequency in the population under investigation.

CONCLUSION

Association mapping offers great potential to enhance crop genetic improvement. This is strengthened by the use of high throughput and cost effective next generation sequencing techniques that will enable GWA studies to become a popular and routine approach. However, association mapping remains complementary as replacement for linkage mapping and other gene identification and validation techniques.

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Issues in pm fasal bima yojana

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INTRODUCTION

In January, 2016 Prime Minister Narendra Modi introduced a new crop insurance scheme, "Prime Minister Fasal Bima Yojana" with the aim of bringing 50 per cent of the country's farmers under insurance cover within three years. There will be uniform premium rate of only 2% for all kharif crops, 1.5% for all Rabi crops and 5% for annual commercial and horticultural crops. Some modifications have been included in this insurance scheme than the previous insurance scheme which has made it unique in the history of crop insurance scheme in our country. There is no upper limit on government subsidy. The capping provision which was present in earlier insurance scheme has been removed. Normally the capping provision is introduced to limit the government outgo on premium subsidy. Hence, now farmers will get full claim against full sum insured without any reduction.

ISSUES

As several improvements have been included over the previous crop insurance schemes, it is obvious to expect increasing number of farmers under the crop insurance coverage. This will safeguard the farmers interest and avoid their vulnerability. Data shows that in kharif 2016- the first season after the scheme's launch — crop insurance coverage had risen. However, despite the Centre's claims, this growth is mainly due to the increase in insurance coverage of farmers who have taken crop loans (loanee farmers). This can be obvious from the data of the Agriculture Insurance Company (AIC), a State-owned insurer that has covered 40 per cent of all farmers under the new scheme. The data has revealed that in the 2016 kharif crop season, loanee farmers covered under crop insurance (Pradhan Mantri Fasal Bima Yojana and Weather-based Crop Insurance Scheme) stood at 2.69 crore (as of January 3, 2017) against the enrolment of 2.10 crore of loanee farmers in kharif 2015. This 28 per cent increase in number of loanee farmers under crop insurance can be due to the increase in targets for the bank to cover more number of farmers under credit.

On the other hand, the enrolment of non-loanee farmers (those who have not taken a crop loan) covered by insurance has increased only by 3 per cent, to 1.01 crore, in kharif 2016 from 98.4 lakh in the previous year. However, the non-loanee farmers need more insurance coverage. The cost of cultivation for non-loanee farmers is relatively higher because they also pay huge lease rent. In costal Andhra for instance, a tenant farmer pays 30,000 per acre, per year, in Punjab, this goes as high as 40,000-45,000 per acre. Hence, their farm economic activity needs to be protected and the vulnerability of farmers need to be minimised. Tamil Nadu has seen the worst drought along with irregular heavy flood in the recent North-east monsoon season, with farmers incuring large losses in paddy and other grains. But enrolment into the Pradhan Mantri Fasal Bima Yojana till Kharif 2016 in Tamil Nadu was among the lowest. Data from AIC shows that the total number of farmers covered under PMFBY and the Restructured WBCIS in the State in Kharif 2016 was 15,915. Other States in the South fare a little better. The like figure for Karnataka was 13.49 lakh and Telangana was 6.18 lakh.

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Since states to choose voluntarily implement the PMFBY, it is their obligation to notify crops. There are no strict rules regarding the selection of major crops for different districts by the state. Hence, this results in the elimination of farmers who grow non-notified crops from insurance coverage. The decision regarding how much land will be insured and the sum insured totally depends on the discretionary powers of the state governments and in this regard any government wants to lessen the burden of subsidy premium. Thus, farmers often find it worthless to buy the insurance if the sum insured is less than their cost of cultivation. An article in “Down to Earth” reported that in a village in Sonipat, farmers were forced to pay the premium amount with a condition that they would have to pay seven percent interest subsidy on a loan. This is unfair if the farmers have not received their claims, and it demotivates small farmers from taking new loans. Vulnerable farmers under debt and in need of new loans are incapable to avail this insurance unless all dues are paid, putting them in a vicious cycle of debt.

Farmers are anxious about the scheme because of trust issue, which is due to the mandatory credit-linked insurance. A farmer who takes loan from any banking institution, the premium for the insurance is deducted from his account along with the loan amount even without his knowledge or prior consent. Because, Loanee farmers do not have the choice to opt out of this scheme and find it unfair to pay the premium each season without being compensated for the losses in the previous year. In addition to this, the insured farmers do not receive no policy documents or receipts of premium charges from the banks or insurance companies. Thus, the insurance sector witnessed 20-percent reduction of loanee farmers in 2017-18 as compared to 2016-17. Very limited farmers now take loans or credit, thus ultimately harming future yield production. Leasing agricultural land is banned in Kerala and J&K, while states such as Bihar, MP, UP and Telangana have conditions on who can lease out land. Hence, tenant farmers are unable to buy insurance. A recent survey done in eight states (Uttar Pradesh, Gujarat, Odisha, Andhra Pradesh, Chhattisgarh, Nagaland, Bihar and Maharashtra) by BASIX, reported that only 28.7 per cent of the sampled farmers are aware about PMFBY. Hence, farmers are still unaware about the details of PMFBY. Many also find it difficult the process for enrolment for non-loanee farmers. As obtaining of sowing certificates and land records from the local revenue department is time consuming, but is mandatory to obtain loan. From those who were aware of the scheme only 12.9 per cent could get their crop insured, of which 77 per cent were linked to loan.

Many state governments have failed to pay the subsidy premiums on time, as the premium holds a significant proportion of their state agriculture budget. This leads to insurance companies delaying or not making claim payments. In 2016, the Bihar government had to pay INR 600 crore as premium subsidy, which was about one-fourth its agricultural budget of INR 2,718 crore in 2016. As this contribute to reduction of state government’s available fund, many governments may opt the path of minimum basic income or direct transfer or loan waiver as cheaper alternatives as well as it may serve vote bank strategy. In 2016–17, private insurance companies paid a compensation of INR 17,902.47 crore, and the difference between the premiums received and compensation paid was INR 6,459.64 crore. Insurance companies continue to profit, despite a decline in the number of farmers being benefitted. Moreover, approximately 80–85 percent of the premium is paid by the government, which puts a huge burden on the exchequer, leading to delays in paying premiums and, in turn, delays in the claims-benefit process.

CONCLUSION

Simply increasing the funds allocated to the scheme will not help the government achieve higher enrolments and lower premiums. What is needed is a robust system of trust and investment to provide credit and insurance. If modern insurance to reach the last farmer, the current issues have to be addressed. By riding on an insurance model backed by private and public partnership along with technological advancements, the PMFBY scheme can include and protect the vulnerable farming population.

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Button mushroom: cultivation, utilization and processing

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INTRODUCTION

Button mushroom is a rich source of good quality proteins having most of the essential amino acids, vitamins and minerals and is popular for its delicacy and exotic flavour. Its production has tremendous scope as an income generating activity. It requires little space or land, hence it is of great importance for landless and marginal farmers. Mushrooms can be treated as a healthy and nutritive food, supplying good amount of protein, minerals and vitamins. They are recommended as alternative source of proteins for bringing the protein malnutrition gap in the developing countries of the world.

- ## CULTIVATION / PRODUCTION

The method of cultivation of mushroom was recorded as early as 300 BC and their international cultivation was started as early as 600 AD in China. Large scale white button mushroom production is centred in Europe (mainly western part), North America (USA, Canada) and S.E. Asia (China, Korea, Indonesia, Taiwan and India). World's total production of mushroom is about 10378163 metric tonnes with China contributing the lions share (FAO, 2016).

In India, commercial production of white button mushroom was initiated in the hilly regions of the country (17- 18 °C) like Chail (Himachal Pradesh) Kashmir and Ooty (Tamil Nadu). Recently, Himachal Pradesh, Punjab, Haryana, Uttar Pradesh, Maharashtra, Tamil Nadu, Karnataka and Andhra Pradesh are a major mushroom producing state (seasonal cropping during winter). The total white button mushroom produced in India from both seasonal and high tech cultivation units is estimated at 94676 metric tons. Out of this, approximately 8500 metric tons of button mushrooms was produced from the seasonal growing units located in Haryana and Punjab which accounted for 9% of total button mushroom production (Sharma *et al.,* 2017).

- ## UTILIZATION

Mushrooms are the health food of the world. Analysis of fresh button mushrooms show that, they contain 90 to 93 per cent moisture, 28 to 42.5 per cent crude protein, 8.3 to 16.2 per cent crude fibre, 9.4 to 14.5 per cent ash, 59.4 per cent carbohydrates and 3.1 per cent fat. Among the minerals 71 mg calcium, 912 mg phosphorous, 106 mg sodium, 8.8 mg iron and 2850 mg potassium (per 100 g dry weight basis) are present. Among the vitamins 8.9 mg thiamine (B_1), 3.7 mg riboflavin (B_2), 26.5 mg ascorbic acid (C) and 42.5 mg niacin (B_3) are also available on 100 g dry w eight basis.

Mushrooms are good as nutritious food for all ages and under all conditions of health. They are rich in good quality proteins with lysine and tryptophan that are normally deficient in cereals. The carbohydrates in the mushrooms are at a level of 4.5 to 5.0 per cent but are in the form of glycogen, chitin and hemicelluloses instead of starch. The fat contain is as low as 0.3 % but is rich in linoleum acid, an essential fatty acid. Cholesterol is absent and in its place ergo-sterol is present which gets converted to vitamin D by the human body. Mushrooms are fairly good source of vitamin C and vitamin B complex, particularly thiamine, riboflavin, niacin, biotin and pantothenic acid. Folic acid and vitamin B_{12} which are

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absent in most vegetables are present in the mushrooms which also supply a range of valuable minerals especially potassium and iron (Mehta *et al.,* 2012).

Mushrooms have traditionally been used for medicinal and tonic properties and cosmetic products. Compounds extracted from button mushroom have been reported to have anti-fungal and anti-bacterial properties. The high proteins, sterols, macro-elements and low calorie content make mushroom ideal for prevention of cardiovascular diseases. Thus they are an ideal food ever for patients, old people, pregnant ladies and children. Therapeutic properties of mushroom include enhancement of macro phase function and host resistance to many bacterial, viral, fungal and parasitic infections, activation of non-specific immune stimulation and reduction of blood cholesterol and glucose levels.

- **PROCESSING**

In view of Mushroom's high perishable nature, the fresh mushrooms have to be processed to extend their shelf life for off season use. This can be achieved by adopting appropriate post-harvest technology to process surplus mushrooms into novel value added products. The value-added products are the need of the hour for the mushroom growers not only to reduce the losses but also to enhance the income by value-addition and boost the consumption of this important horticultural crop. The possible value-added products can be developed either by converting freshly harvested mushrooms into ketch-up, murabba, candy, chips and pickles or by dehydrating freshly harvesting mushrooms into dehydrated form and then making soup powder, biscuit, nuggets ant RTE.

1) Mushroom Ketch-up:

Freshly harvested button mushrooms are washed in 0.05 per cent KMS Solution, sliced and cooked in 50 per cent of water for 20 minutes. Mushroom paste is prepared using a mixer grinder with 0.2 per cent Arrarote, 1.5 per cent acetic acid and other ingredients and cooked to bring its TSS to 35 ^{0}Brix. Then the ketch-up is filled in the sterilized jars. Followings are the ingredients that are used for preparation of ketch-up are:

(i) Salt 10 per cent	(ii) Sugar 25 per cent
(iii) Acetic acid 1.5 per cent	(iv) Sodium benzoate 0.065 per cent
(v) Onion 10 per cent	(vi) Garlic 0.5 per cent
(vii) Ginger 3 per cent	(viii) Red chilli powder 1.0 per cent
(ix) Ajinomoto 0.2 per cent	(x) Arrarote 0.2 per cent
(xi) Cumin 1.0 per cent	(xii) Black pepper 0.1 per cent

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2) Mushroom Murabba:

A murabba is made by cooking it whole or in the form of pieces in heavy sugar syrup, till it becomes tender and transparent. In preparation of 1kg mushroom murabba 1.250 kg of sugar is required and cooking is continued till a concentration of at least 68 per cent of soluble solid is reached. Freshly button mushrooms are graded, washed, pricked and blanched in 0.05 per cent Potassium mete bisulphite (KMS) for 10 minutes. It is treated with 40 per cent of its weight of sugar daily for 3 days. Then, mushrooms are taken out from the syrup and 0.1 per cent citric acid and remaining 40 per cent of sugar is mixed in the syrup. After making its concentration to 65 ^{0}Brix, mushrooms are added in the syrup and the good quality murabba is prepared (Arumuganathan *et al.*, 2005).

3) Mushroom Candy:

A fruit or vegetable impregnated with sugar, subsequently drained and dried is called a candied fruit or vegetable. The total sugar content of the impregnated fruit or vegetable is kept at about 75 per cent to prevent fermentation. Fresh mushrooms after harvesting are subjected to washing and halved into two pieces. Halved pieces are blanched for 5 minutes in 0.05 per cent of KMS solution. After draining for half an hour they are treated with sugar. Sugar treatment is given at the rate of 1.5 kg sugar per kg of blanched mushroom. Initially sugar has to be divided into three equal parts. On the 1st day, blanched mushrooms are covered with one part of sugar and kept it for 24 hours. Next day, the same mushrooms are covered with 2nd part of sugar and again kept for overnight and on the third day mushrooms are removed from the sugar syrup. This sugar syrup is boiled with 3rd part of sugar and 0.1 per cent of citric acid to bring its concentration up to 70 ^{0}Brix. Blanched mushrooms are mixed with this syrup and again the contents are boiled for 5 minutes to bring its concentration up to 72 ^{0}Brix. After cooling, the mushrooms are removed from the syrup and drained for half an hour. The drained mushrooms are placed on the sorting tables to separate only defected and unwanted pieces are subjected to drying in a cabinet drier at about 60 ^{0}C for about 10 hours. As soon as they become crispy, all mushrooms are taken out and packed in polypropylene bags. The candy can be stored up to 8 months with excellent acceptability and good taste. Joshi *et al.* (1991) developed sweet chutney from button mushroom and the storage of the product was more than a year.

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4) Mushroom chips:

The freshly harvested button mushrooms are washed, sliced and blanched in 2% brine solution. The mushrooms are dipped overnight in a solution of 0.1 per cent of citric acid +1.5 per cent of NaCl + 0.3 per cent of chilli powder. After draining off the solution, the mushrooms are subjected to drying in cabinet dryer at 60 ^{0}C for 8 hours. Then it is fried using the refined oil and good quality chips are prepared. Garam masala and other spices can be spread over the chips to enhance the taste. After spice mixing, the chips are packed in polypropylene packets and sealed after proper labelling.

5) Mushroom soup powder:

Soups are commonly used as food appetizers. Mushroom powder is produced from dried mushroom slices with the help of mixer. Then mushroom soup powder is prepared by mixing this mushroom powder with the following ingredients:

(i) Mushroom powder 16 %	(ii) Milk powder 50%
(iii) Corn flour 5%	(iv) Refined oil 4%
(v) Salt 10%	(vi) Suar 10%
(vii) Cumin powder 2%	(viii) Black pepper 2%
(ix) Ajinomoto 2%	

The above soup powder when mixed with equal quantity of water gives a good quality mushroom soup.

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6) Mushroom biscuit:

Mushroom biscuit is prepared from mushroom powder by mixing it with following listed ingredients:

(i) Maida 100 g	(ii) Fat 45 g
(iii) Sugar 30 g	(iv) Milk powder 1.5 g
(v) Glucose 1.5 g	(vi) Backing powder 0.6 g
(vii) Salt 0.6 g	(viii) Ammonium bicarbonate 0.3 g
(ix) Vanilla essence 0.02 g	(x) water 12 to 22%

Above mentioned items are mixed in a mixer for 3 to 5 minutes. Then dough is kept at 30 °C in an oven for 90 minutes. The dough is then spread to a thickness of 2 to 4 mm over a cleaned platform and cut into desired shape (circular or triangular shapes) of 5 cm diameter and backed for 10 to 20 minutes at 210 °C in a laboratory backing oven.

7) Mushroom nuggets:

Nuggets are generally used for the preparation of vegetables curry along with suitable vegetable or alone in North India and are prepared from dhal powder such as black gram powder, soybean powder, urad dhal powder etc. It adds taste as well as nutrients to the meal. For preparation of mushroom nuggets, mushroom powder is mixed with the urad dhal powder and a paste is prepared by adding water. The

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ingredients are added to the prepared paste and round balls of 2 to 4 cm diameter are made out of the paste. The prepared balls will be spread over a tray and are sun dried. Thus the mushroom nuggets are prepared. Following are the ingredients that are used for preparation of mushroom nuggets:

(i) Urad dhal powder 80%
(ii) Mushroom powder 10%
(iii) Salt 2%
(iv) Red chilli powder 1%
(v) Sodium bicarbonate 0.01%
(vi) water 7%


8) Ready–to–eat mushroom curry (RTE):

It is generally prepared from freshly harvested mushrooms. But it can also be prepared from dried button mushroom slices after its rehydration by adding the following ingredients:

(i) Onion 510 g	(ii) Green chilli 250 g
(iii) Garlic 250 g	(iv) Ginger 200 g
(v) Salt 160 g	(vi) Red chilli powder 150 g
(vii) Curry powder 100 g	(viii) Oil 400 ml
(ix) Water 1000 ml	

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Sorghum bicolor: A potential source to enhance food security

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Food insecurity as a situation that exists when people do not have adequate physical, social or economic access to food. Sorghum is the more tolerance to drought and hot temperatures, diseases, pests various soil types and have higher water use efficiency, higher production capacity from unit area. The plant has for a long time been noted to be the most important cereal for human consumption surpassed only by maize, wheat, rice and barley. Sorghum is a globally cultivated cereal unique due to its tolerance to drought, water logging and saline-alkali infertile soils and high temperature. It has for a long time been considered as a crop of the resource-poor small-scale farmers. Despite the potential of sorghum to improve household food security and promote regional development, the sorghum sub-sector is faced with numerous challenges. Interventions are necessary to enhance enhance food security in semi-arid areas through increased sorghum production to accrue to the economy at large.

INTRODUCTION

Food security is defined as food systems when ‘all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs for an active and healthy life’ (FAO, 1996). Food systems encompass three components: (i) food availability (production, distribution and exchange) (ii) food access (affordability, allocation and preference) and (iii) food utilization (nutritional value, social value and food safety) (Gregory et al., 2005). Food insecurity has been noted to be the main cause of the rising poverty levels. Food security is diminished or a state of food insecurity occurs when any one of the three components of the food systems are diminished. Concurrently, the declines in agricultural production from about 3.6 % during 1985–1995 to less than 2% in the decade 1995–2005 have given rise to renewed concerns about future food security. Major areas of concern are production and availability of food grains. The globalization of agricultural trade in the 1990s led to changes in some of the macro policies that supported agriculture and also subjected the Indian farmer to significant market risks. All of these have led to a steady decline in farm incomes and rural distress in recent years, affecting both access to food and its utilization. With the limited availability of land and water resources emerging at this time, the national policy goal of 4% growth in agriculture to ensure food security can be achieved only by increasing productivity through use of natural resources.

In India, three components of food security, namely availability, access and utilization are governed by the vulnerability of the production base of agriculture, the scope for increasing rural incomes and the nutritional quality of food respectively. The primary determinants of agricultural production are the genetic productivity of the crops, and the quality of the natural resource base determined by the soil health and vulnerability of water resources. Together these determine the total quantity of food available for consumption, storage and distribution. If any of these are vulnerable, the food availability is affected.

Sorghum is the fifth most important cereal crop after maize. It is moderate drought tolerant, grown in arid and semi-arid tropics of Asia and Africa for centuries (Fetene et al., 2011). It is an important source of energy, protein, vitamins and minerals for millions of the poorest people in the world. It is grown in harsh environments where other crops grow or yield poorly. Therefore, and because it is mostly consumed by disadvantaged groups, regarded to as "coarse grain" or "poor people's crop". All of the sorghum cultivars taken into cultivation are belong to *Sorghum bicolor* (L.) Moench sp. which is commonly cultivated incorporated with animal husbandry. Sorghum is the more tolerance to drought and hot temperatures, diseases, pests various soil types and have higher water use efficiency, higher production capacity from unit area. Plants having the ability to increase root growth into regions with more available soil water have better chances of survival under drought situations, since increased root growth re-establishes the soil-root contact and facilitates water uptake.

Potential of Sorghum for Improving Food Security

The arid and semi-arid lands of the world make up to over 40 % of the earth's surface on which over one billion people depend for their livelihood. Communities in arid and semi-arid lands of the country were particularly vulnerable to food insecurity because of the recurring natural disasters of drought, livestock diseases, animal and crop pests and limited access to appropriate technologies, information, as well as credit and financial services (Kinyua, 2004). Grain sorghum is mainly used as a principal food in tropical areas and often used as raw material for alcoholic beverages, sweets and glucose. Broom sorghum on the other hand is for making brooms while sweet and grass sorghum is used to make sweetener syrup and green feed (U.S Grain Council, 2010). The plant has for a long time been noted to be the most important cereal for human consumption surpassed only by maize, wheat, rice and barley (Akram et al., 2007). It is reported to be one of the main staple food crops for the world's poorest and food insecure people (Timu et al., 2012). Sorghum is a globally cultivated cereal unique due to its tolerance to drought, water logging and saline-alkali infertile soils and high temperature. It has for a long time been considered as a crop of the resource-poor small-scale farmers.

The potential of sorghum to catalyze regional development and improve food security is considerably high. Sorghum is thinly traded due to low production volumes and poor marketing channels; only an estimated 30% of domestic production is marketed. Trade statistics from FAO indicate that in total Africa imports up to 1 million tonnes of sorghum per year (USAID). Of concern, however, is the fact that despite the growing population which mainly depends on cereal grains as their main diet, the sorghum sub-sector's economic contribution at the micro and macro level is well below its potential. The reasons for the low performance include: low processing capacity, lack of ready market, low processing efficiency levels, and the crop being labour intensive. Farmers in the semi-arid areas often prefer to grow maize since it is less labour intensive and there is often a ready market even in the rural areas. There is also inadequate government support in promoting the production of sorghum inspite of its potential to improve food security and enhance economic development.

Production of sorghum has been on the increase due to the introduction of improved sorghum varieties. Over the years, research institutions including KARI and ICRISAT have produced suitable dryland crops. This has resulted in the development of genetically superior cereal and legume crops in terms of yields, early maturity and drought tolerance or drought escaping and higher water use efficiency. Among the cereals, several varieties of sorghum have been developed and released. The low current production is due to the low adoption of these improved varieties, low use of fertilizers to boost soil fertility, dietary preferences, and low prices (Miano et al, 2010).

Constraints to Sorghum Production

Despite the potential of sorghum to improve household food security and promote regional development, the sorghum sub-sector is faced with numerous challenges. The problems are further compounded by inefficiencies in input and output marketing including poor market infrastructure, lack of marketing support services and limited market information. The other problem facing the sorghum sub-sector is an image problem where it is considered to be a food crop for the poor and vulnerable communities. Interventions are necessary to expand the market and increase acceptance of sorghum among the more financially endowed middle class residing in urban areas. Lessons on improving food

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security through increased sorghum production can be drawn from India where the government launched the vision 2030 for sorghum.

CONCLUSION

The foregoing shows that sorghum has the potential to enhance food security in semi-arid areas where maize performs poorly. It is demonstrated that not enough is being done to tap into the potential of this crop in terms of government support to research, dissemination of research findings and promoting sorghum markets. As a way forward, policies promoting sorghum production should be viewed beyond just enhancing household food security to also include other benefits that accrue to the economy at large.

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Prevalence of A1 and A2 Milk on Human Health

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INTRODUCTION

Casein is the principal protein of milk. It is also known as caseinogen. The casein content of milk has been reported from 2-3.5 per cent. The purified casein is usually a fine powder it is nearly insoluble in dilute acids or alkalies. Consequently it would be listed as glutelin in abbreviated classifications. In more elaborate classifications it is called a "phosphoprotein" because it is one of the few proteins containing phosphorus. The composition of casein showed that casein is a mixture of several proteins that are very nearly alike.The casein is the largest group of proteins in milk, making up about 80% of total protein content. There are several types of casein in milk. Beta-casein is the second most prevalent and exists in at least 13 different forms.Protein is an essential components for growing children, especially children between the ages of 1-5.

The two most common forms are:

- **A1 beta-casein:** Milk from breeds of exotic cows that originated in northern Europe is generally high in A1 beta-casein. These breeds include Holstein, Friesian, Ayrshire, and British Shorthorn belonging to species *Bos taurus* which humpless. In A1 milk beta casein is 2009 amino acid chain, in 67 no position histidine bond is present. At the time of digestion A1 protein releases the peptide BCM7 due to this which cause varies diseases related to cardio vascular type 1 diabetes.
- **A2 beta-casein:** Milk that is high in A2 beta-casein is mainly found in Asiatic cow which having well developed and prominent hump. Such breeds belongings to species *Bos indicus*. Regular milk contains both A1 and A2 beta-casein, but A2 milk contains only A2 beta-casein.

Some studies suggest that A1 beta-casein may be harmful and that A2 beta-casein is a safer choice.

Effect on human health

A. Diabetes

Type I diabetes, an auto immune disease in which the body destroys its own insulin producing cells. It occurs usually in childhood or early adulthood. Type 1 diabetes is typically diagnosed in children and characterized by a lack of insulin. The increasing incidence of Type 1 diabes oer time is like to be a function of issues affecting gut permeability or antigenic susceptibility (viruses, antibiotics, hygiene factor, Vitamin D etc.) rather than quantity of A1 beta casein. The drinking A1 milk during childhood increases risk of type 1 diabetes. However, these studies are observational.

B. Heart disease

A1 milk consumption to an increased risk of heart disease. A1 beta-casein promoted fat buildup in injured blood vessels. This buildup was much lower when the rabbits consumed A2 beta-casein.

Fat accumulation may potentially clot blood vessels and cause heart disease. Still, the human relevance of the results has been debated.

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C. Sudden infant death syndrome

Sudden infant death syndrome (SIDS) is the most common cause of death in infants under 12 months old. SIDS is the unexpected death of an infant without an apparent cause. It is found that BCM-7 may be involved in some cases of SIDS. The BCM-7 in the blood of infants who temporarily stopped breathing during sleep. This condition, known as sleep apnea, is linked to an increased risk of SIDS. Some children may be sensitive to the A1 beta-casein found in cow's milk.

D. Autism

Autism is a mental condition characterized by poor social interaction and repetitive behavior. In theory, peptides like BCM-7 might play a role in the development of autism. A1 beta-casein and the peptide BCM-7 may be linked to diabetes, heart disease, autism and SIDS.

E. Digestive health

Lactose intolerance is the inability to fully digest milk sugar (lactose). This is a common cause of bloating, gas, and diarrhea. The amount of lactose in A1 and A2 milk is the same. However, some people feel that A2 milk causes less bloating than A1 milk. In fact, the milk components other than lactose may cause digestive discomfort. The certain milk proteins may be responsible for some people's milk intolerance. The A1 milk causes softer stools than A2 milk in some individuals. Keith Woodford suggests that the slower passage of A1 milk through the digestive system (due to the release of BCM 7), increases problem of lactose intolerance but this unproven things. It is well known that opioid including BCM-7 can reduce the rate of passage through the gut which is susceptible to constipation and in extreme cases can suffer anal fissures.

CONCLUSION

- The mothers would be well advised to breast feed their babies for as long as possible, and to insist on breast milk substitutes made with A2 milk not A1 milk.
- It is also not known whether BCM 7 likely to be a problem in cheese, or in ice cream, yoghurt and various other milk products. The issue of A2 milk is real life decision issue of relavance to all dairy farmers throughout the word.
- The problem can be structured using concept of strategic management, risk management and decision theory. Research suggests that, A1beta-casein causes adverse digestive symptoms in certain individuals.
- But the evidence is still too weak for any solid conclusions to be made about the supposed links between A1 beta-casein and other conditions, such as type 1 diabetes and autism.
- That said, A2 milk could be worth a try if you struggle to digest regular milk. Future work will be promotion of indian breeds of cows, which are continue as A2 milk producer and rethinking of indian cross breeding strategies.

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Antifreeze Protein: Mitigate of Cold Stress

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INTRODUCTION

Chilling stress slows cellular function, alters protein-protein interactions and minimizes membrane fluidity, among other effects. Further, chilling injury induce ice crystal growth, which disrupts cellular processes, and is often lethal when formed intracellularly. Through the process of natural selection, some basic strategies have evolved for survival of cold temperatures, and fall into three main categories: migration, hibernation and resistance. The first two work well for seasonal climates. However, both come with risks – migration can involve high mortality rates, and hibernation requires the energetically expensive process of rewarming, especially for young and small sized animals. In cold regions that are consistently low temperature, a preferred approach is resistance. An effective strategy for cold resistance is the expression of antifreeze proteins (AFPs) (a type of ice structuring protein – ISP), a class of polypeptides that allow survival in cold environments. AFPs and AFGPs (antifreeze glycoproteins) are relatively high molecular mass molecules that have the ability to stabilize membranes during chilling and control ice crystal growth during freezing of cells and tissues.

Features of antifreeze protein

a. Antifreeze proteins are a diverse group of proteins that bind to ice crystals and arrest their growth. Detailed characterization of AFPs showed that they exhibit two complementary yet independent properties by virtue of which these are able to protect organisms during freezing stress.

b. A single ice crystal has two distinct planes – the basal plane and the prism plane. Ice grows due to addition of water molecules to these planes.

c. AFPs, it is crucial to understand the molecular structure of ice. Ice grows as a hexagonal lattice in which water molecules are held together by hydrogen bonds.

d. When ice grows, solute molecules are excluded from the ice lattice, except AFPs/AFGPs, which get irreversibly adsorbed in the growing ice crystals and modify the ice crystal growth. In the presence of antifreeze activity, ice crystals are hexagonal, flower shaped or needle shaped.structure of Antifreeze Protein

e. Antifreeze protein are rich in transform infrared spectroscopy of L. perenne AFP (LpAFP) showed that it had an unusual type of highly β-sheeted secondary structure. LpAFP was proposed to have a left-handed β-roll supported by a valine hydrophobic core and two internal asparagine ladders on both the sides of the roll. Two flat, opposite-facing ice binding sites, having conserved asparagine residues, were proposed to be complimentary to the prism plane of the ice crystals. The presence of the asparagine in ice binding sites was also confirmed in carrot AFP (DcAFP) by mutational studies. Replacement of asparagine residues of DcAFP with valine or glutamine resulted in a significant loss of TH activity, while an enhancement of TH activity was observed when phenylalanine or threonine was replaced with asparagine (Zhang et al. 2004). A 3-D model, proposed for DcAFP, had 10 β-helix loops containing the 24 amino acid tandem repeat (P———L–L-LS-N-L-G-I).

Regulation of Antifreeze Protein

Plant AFPs are considered to be dual functioning proteins as some of these are homologous to PR proteins and exhibit both antifreeze and hydrolytic activities. It was found that the chitinases purified from cold acclimated winter rye and seabuckthorn exhibit hydrolytic as well as antifreeze activities. Similarly, β-1,3-glucanase also retained their partial hydrolytic activities (14–35%) at sub-zero temperatures in addition to antifreeze activity, indicating involvement of some post-translational event in regulating the activities (Yaish et al., 2006). Mechanism of regulation of the antifreeze activity in plants. Some reports suggest involvement of hormones like jasmonic acid and ethylene in controlling the antifreeze activity. Winter rye plants, when exposed to ethephon (ethylene-releasing compound) or ACC (ethylene precursor), resulted in the accumulation of antifreeze activity even in non-acclimated conditions (at 20°C), and this effect was blocked by application of AgNO3 (an ethylene inhibitor), indicating involvement of ethylene in regulating the antifreeze activity. Interestingly, winter rye plants treated with salicylic acid, abscisic acid (ABA) or pathogen attack (Microdochium nivale) resulted in the accumulation of same set of proteins (chitinase, β-1,3-glucanase and thaumatin-like proteins).

CONCLUSION

Overall, it is clear that cold stress causes accumulation of AFPs in apoplast of some freezing-tolerant plants. Based on our current knowledge on plant antifreeze activity regulation, a hypothetical model is generated. Some reports suggest involvement of calcium in this conversion, while others suggest that the refolding of PR proteins makes these AFPs. However, involvement of any PTM also cannot be neglected. Release of ethylene and jasmonic acid during cold stress is quite evident, and these hormones in turn lead to accumulation of AFPs by changing in gene expression.

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- → **Singh *and Mishra,* 2015) found that ABCDEFG HIJK LMNO PQR**

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[1]. Dutta R.N., (1984). Comparative ecological study of makhana in Darbangha region. Ph.D. thesis. Ranchi University, Ranchi Bihar.

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Only annual members and life members are eligible for this award.

2. **Author of the Year**

Best author in a calendar year would be awarded with best author of the year award.
Only annual members and life members are eligible for this award.

3. **Article of the Year**

More than 3 best articles published in a year would be awarded with best article of the year award.
Only annual members and life members are eligible for this award.

4. **Innovative article award**

Only 1 article would be awarded with innovative article award.
All authors are eligible for this award.

5. **Honorary award**

It is given as a gesture of respect to any person who helped in the overall development of this e-newsletter (directly or indirectly).

6. **Best Editor Award**
7. **Best Reviewer Award**

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