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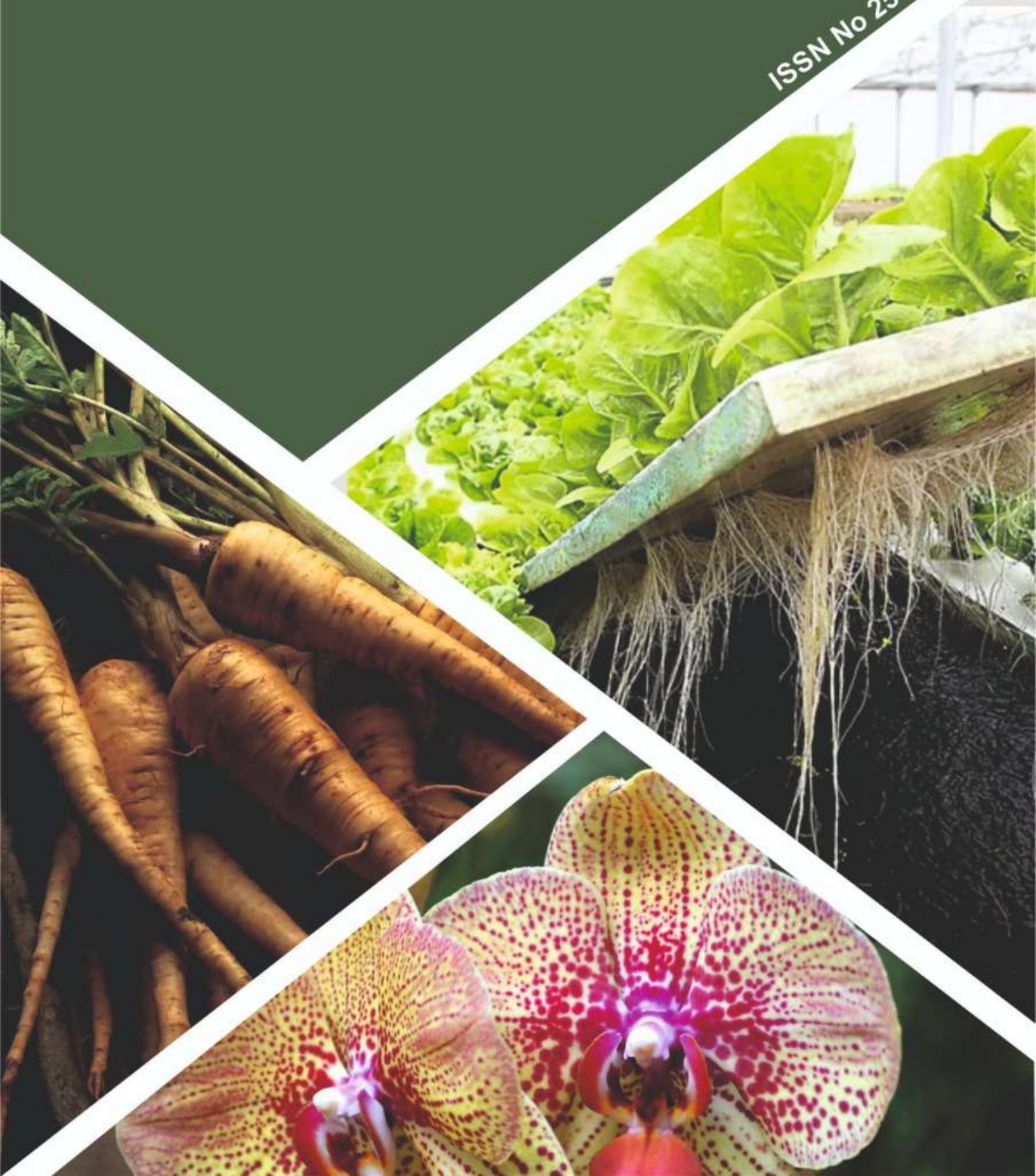

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Grafting of Brinjal: A Noble Approach to Improve and to Tackle Biotic and Abiotic Stresses

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Introduction

Brinjal, eggplant or aubergine (*Solanum melongena* L.) is one of the important vegetable crops belonging to the Solanaceous family, grown for its unripe, immature fruits. Brinjal is the fourth most important vegetable growing in India after potato, onion and tomato. It is a self-pollinated and day neutral crop grown in warm season. It shows enough resistance to heat, drought and it has wider adaptability to various soil and climate.

Now a days, the severity of biotic and abiotic stress is increasing at an alarming rate which hinders the production of brinjal and infestation of soil borne pathogens along with extreme climatic conditions reduces the productivity. Improvement of productivity by mitigating such adverse situation is very much challenging in the farmers' field. But, the sustainable grafting technique is gaining popularity for its multidirectional achievements. Grafting is the union of two different plant parts to form a single new plant where the root providing part is known as Stock and the added portion on or into the stock is known as Scion. Grafting of brinjal cultivars on perennial and wild *Solanaceous* species increased the yield and availability period of the fruits (Lee, 1994; Gisbert *et al*., 2011). To get positive effect of grafting on vegetable quality, rootstock/scion combinations should be chosen properly for specific climatic and geographic situations (Davis *et al*., 2008).

Brief History of Grafting

The grafting in herbaceous vegetable crops started first in Japan, Korea and some parts of European countries in the 19th century with the main objective of tackling fusarium wilt in watermelon on pumpkin rootstock (Leonardi, 2016; KAWAIDE, 1985). In the solanaceae family, brinjal was first grafted during 1950. First time, the brinjal (*Solanum melongena* L.) was grafted on scarlet aubergine (*Solanum integrifolium* L.). In India, grafting works on vegetables were first initiated in IIHR, Bengaluru by Dr. R. M. Bhatt and his team.

Why grafting is gaining popularity?

Grafting has the prime focus in imparting resistance against serious diseases and pests, soil borne pathogens, reduces the final load of chemicals on plant and plant parts, resistance against biotic and abiotic stresses, improves its qualitative and quantitative characters by using the desirable and compatible rootstock. Moreover, so many research works are going on to standardize the specific rootstock for particular concern.

Important factors for grafting

Appropriate rootstock/scion selection

Desirable rootstock and scion with same stem diameter should be used. Grafting should be done at two to three true leaf stage.

Graft compatibility

Compatibility becomes a huge factor as mortality depends on it and also the growth and yield of the plant.

Grafting equipments

Commonly used equipments for grafting are grafting clips, tubes, pins and grafting blade etc.

Screening house

Screening house is required to grow seedlings before grafting. 60-mesh nylon net constructed screening house should have proper facilities.

Healing of grafts

Healing is most critical to provide favourable conditions to promote callus formation of grafted seedlings. In healing chamber, temperature should be 28-29° C with 95% relative humidity for 5-7 days in partially shaded place (darkness for 1 2 days) to promote callus formation at union point. It helps in formation of better graft union by reducing transpiration, maintains high humidity, maintains optimum temperature and reduces light intensity.

Acclimatization of the grafted plants

After callus formation and healing of surface wounds, plants may be put under a mist system, greenhouse or placed under a clear plastic cover for acclimatization to prevent leaf burning and wilting.

Methods of grafting in Brinjal

There are so many grafting methods that are gaining acceptance but mainly two types of grafting methods are followed in brinjal.

Cleft grafting

It is also known as apical grafting or wedge grafting. In this method, the stock is split across the centre to a reasonable depth. Then the scion with 1-3 true leaves is given a slant cut at the bottom to make the scion shaped like a tapered wedge. After that, the scion is inserted into the stock and plastic clip is used to keep both the cambium layer properly connected.

Tube grafting

Tube grafting is also known as splice grafting or one cotyledon splice grafting. This method is followed basically when seedlings are grown in the plug trays. The stock is given a 30° cut just below the cotyledon and same cut is given in the scion also. Then, with the help of a graft tube both the stock and scion are jointed properly so that both the cambium layers connects each other properly. This method is much easy and it has higher survival rate and success. After that, the graft is placed in the healing chamber for 5-7 days.

Determination of grafting success

Translocation of water and nutrients from rootstock to scion and the transfer of photosynthates from scion to the stock is estimated as successful graft union. An experienced grafter can estimate its success but there are few modern ways to determine that-

a. Thermic camera

In successfully grafted plants, water is transferred smoothly from the root to the leaves of the scion where, due to transpirational loss, the temperature is 2- 3°C lower than that of the leaves of the unsuccessfully grafted seedling. Intermediate leaf temperatures are observed in the case of partially successful grafting (Bletsos and Olympios, 2008).

b. Measurement of the electric wave

Electric wave is transferred through graft union point from scion to stocks. This transfer is related to the histological changes that occur during the union of the rootstock and scion. Histological changes during union process is recorded from high to medium and finally zero at which point callus formation is completed and vascular bundle becomes fully functional.

Effect of grafting on biotic stress

Brinjal production is severely affected by various biotic stresses. Brinjals are traditionally grafted on wild species such as *Solanum integrifolium* or on tomato hybrid rootstocks.

King *et al*. (2010) reported that brinjal grafted on to wild Solanum species and other rootstocks is an efficient technique to control various pathogens. According to AVRDC recommendation, brinjal accessions EG195 and EG203 are resistant to the diseases caused by bacterial wilt, root-knot nematode and these can be used as root stock. When *Solanum torvum* is used as rootstock, it provides resistance to verticillium wilt, fusarium wilt and bacterial wilt (Curuk *et al*., 2005). The *Solanum integrifolium* also provides resistance against bacterial wilt and fusarium wilt. *S. xanthocarpun* and *S. khasianum* (as rootstock) is reported to be immune to the shoot and fruit borer (Kale *et al*., 1986). Another wild species, *Solanum sisymbriifolium* when used as root stock imparts resistance against verticillium wilt, root-knot nematode etc. But, *Solanum torvum* exhibits long germination period and often has irregular and erratic germination even if preferable weather is provided. This germination problem may be due to hard seed coat and embryo dormancy. There is also the problem of performing grafting on *Solanum sisymbriifolium* as it is very much spiny in nature. Lowman and Kelly (1946) suggested jimson weed (*Datura stramonium* L.) as a potential rootstock for grafting against root knot nematode infection. According to Sen *et al. (*2018) Beaufort as a rootstock shows resistance against nematode. Alternatives of wild rootstock is interspecific hybrids i.e., *S. melongena* × *S. incanum* L. and *S. melongena* × *S. aethiopicum* L. are having good compatibility and moderate resistance to root-knot nematode without negative effects on quality parameters.

Effect of grafting on abiotic stress

The ever changing climate is the major concern for brinjal as well as for vegetable production also. Now, to develop a variety or a planting material tolerant to environmental stresses is very much difficult. The method of grafting can be a great way to solve this partially in brinjal. Salinity is one of the major issue which causes reduction in productivity. The wild rootstock of *Solanum torvum* shows resistance against the salinity to some extent. Drought can be another problematic issue, which is very common now a days. Christodoulakis *et al*. (2009) reported that, *Solanum elaeagnifolium* when used as a root stock is capable of showing resistance against drought. Another rootstocks like *Solanum macrocarpum, Solanum gilo,* PKM-1 are potentially tolerant against drought (Sen *et al.,* 2018). Darré *et al*. (2022) stated that the hybrid rootstock *Solanum java* can be used in grafting as rootstock to improve cold tolerance in brinjal. Flooding has affected the yield of brinjal hugely in recent past years. To counter this problem, Bhatt *et al*. (2014) suggested *S. macrocarpon* as rootstock for grafting purpose which shows tolerance against flooding. The inter-specific rootstock *Solanum integrifolium* × *Solanum melongena* is tolerant against high temperature. These type of various biotic and abiotic stresses and the prohibition of using methyl bromide for soil disinfection has encouraged for further research and standardization of brinjal grafting rootstocks.

Effect of grafting on quality, yield and other characters

The fruit yield and its quality is influenced by the grafting. Compatible grafted plants produce higher amount of antioxidant enzymes, which enables better and strong root growth whereas in case of incompatible grafted plants low level of antioxidants are produced (Aloni *et al*., 2010). It is also reported that, vitamin C and tenderness of brinjal is improved when *S. torvum* and S. *sisymbriifolium* is used as rootstock. Rootstock *Solanum torvum* also improves fruit size and vigour when grafted. Interspecific hybrid rootstocks of *S. melongena* × *S. incanum* L. and *S. melongena* × *S. aethiopicum* L. have also shown good compatibility, high plant vigour and obtained yield was superior when grafted on it. But late flowering in grafted plants is seen various occasions may be due to the renewed growth of the scion. As a result, the harvesting period also delays a little.

Recent innovations

Countries like Japan and Korea have developed automated prototype grafting machine. These machines are capable of producing successful grafts. The main advantage is that these machines can produce a large number of grafts within small span of time. JT'S ROBOT, TGR'S ROBOT, BRAIN ROBOT are some examples that are being developed, eventually not used in commercial production till now, as it requires more development and advancement (Kurata, 1994).

Future scope of research

- Further study and experiments are required to standardize the beneficial rootstocks for resistance against various stresses.
- Study of graft compatibility is a major factor in grafting technology and appropriate methodology to be followed is yet to be confirmed.
- Extensive research work is required to understand various genetic and physiological factors for better execution of this technology.

Conclusion

Grafting of brinjal is gaining popularity day by day for its multi-purpose benefits. This modern day technique has the potentiality to improve productivity along with resistance against different types of diseases, pests and abiotic factors. Considering this positive outcomes from experiments around the globe, it is expected that share of grafted plant cultivation will increase in our country in near future which will cut down the farmers' expense of chemicals like fungicide, pesticide etc. and farming will become more eco-friendly.

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Drones in Indian Agriculture

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Introduction

Subject matter authorities agree, the anticipated total populace will be 9 billion by 2050. Horticultural utilization is additionally said to increment all the while by almost 70%. Drone innovation, outfitted with man-made reasoning (AI), AI (ML) and remote detecting highlights, are ascending sought after in view of its benefits. The focal government has recognized the significance of automated aeronautical vehicles (UAVs), AI and man-made consciousness with their 'Computerized Sky Platform' on the web. Drone new businesses in India have utilized this chance to achieve better innovative limits.

Not with standing Indian horticulture's commitment to the GDP, our nation is yet to upgrade usefulness and productivity in the area to arrive at the most elevated potential. A few aspects and concerns should be recognized, upheld, and outfitted with goals. Unacceptable techniques for checking crops, water system, utilizing pesticides and numerous other vital cultivating exercises are at present taken on. Assets are deficient not distributed by atmospheric conditions or have not been taken advantage of to their most extreme potential-a justification for why there is regularly a decrease in the Return On Investment (ROI).

These preventions have allowed numerous amazing open doors for development and advancement in the realm of innovation. The impact of innovation in the agrarian area has been perpetually sure since its beginning. As states and organizations the nation over perceived the meaning of food security and the outcomes of natural debasement, contamination and water shortage, the direness to beat specific impediments emerged.

Drones – A revolution in Agriculture economy

How might drones uphold Indian agribusiness? Drones don't simply upgrade by and large execution yet additionally urge ranchers to address other grouped hindrances and get a lot of advantages through accuracy farming. With the market for agrarian robots arriving at an incredible $1.3 billion, UAVs (automated flying vehicles) fill the hole of human mistake and shortcoming by customary cultivating techniques. The motivation behind embracing drone innovation is to reject any mystery or uncertainty and on second thought centre around precise and dependable data.

Outer variables like climate, soil conditions and temperature assume a basic part in cultivating. A gribusiness drone engages the rancher to adjust to explicit conditions and settle on careful decisions as needs be. The acquired information manages crop wellbeing, crop treatment, crop exploring, water system and complete field soil investigation and harvest harm evaluations. The robot study assists help with editing yields and limit time and costs.

The service area is announced to be the most significant supporter of India's GDP. Our nation rules the world as the most conspicuous maker of heartbeats, milk, rice, wheat, sugarcane, flavours and so on. These additionally increase the value of the economy with their exercises in the agrarian area. The Indian rural area contributes a huge 18% to India's GDP (Gross Domestic Product). It is viewed as the excellent wellspring of occupation for around 58% of the

nation's populace, essentially for rustic regions. Indian agribusiness area, alongside ranger service and fishing, brings about a Gross Added Value of around Rs. 18.55 lakh crore (US$265.51 billion) starting at 2019. The rural area extends with equal businesses at a development pace of 2.1% (2019-20).

How does the technology works?

Examining the region: This recognizes the domain being tried. Thusly, the initial step incorporates laying out a limit, investigations of the area and afterward at long last, transferring the specialized GPS data into the robot's route framework.

Utilizing Autonomous Drones: Since Unmanned elevated vehicles (UAVs) are free, they enter flight designs into their all-around laid out framework to gather required information.

Transferring the information: After catching every one of the expected information through sensors, for example, the multispectral sensor/RGB sensor, it is handled through various programming for additional examination and translation.

Yield: After gathering the information, they design it so ranchers can comprehend the information with no issue, presenting to them a bit nearer to accuracy cultivating. 3D planning or Photogrammetry is well known techniques to show broad information gathered.

What can drones offer to you?

Irrigation monitoring: Drone study develops water proficiency and reveals potential pooling/spills in water system by giving Irrigation checking yields estimations of the vegetation record to assist with understanding the soundness of harvests and discharged heat/energy.

Crop Health Monitoring and Surveillance : It is critical to follow the strength of the vegetation and spot bacterial/parasitic infections in the beginning phases. Farming robots can see which plants reflect various measures of green light and Near-Infrared Spectroscopy (NIRS) light. This information helps produce multispectral pictures to follow crop wellbeing. Fast observing and disclosures of any deformities can assist with saving yields. In conditions of yield disappointment, the rancher can likewise archive the harms for precise protection claims.

Crop Damage Assessment: Agrarian robots fitted alongside multispectral sensors and RGB sensors additionally identify field regions caused by weeds, diseases and vermin. As indicated by this information, the specific measures of synthetic compounds expected to battle these invasions are known and this reduces the expenses incurred by the rancher.

Field Soil Analysis: The robot review permits ranchers to acquire data about their territory's dirt circumstances. Multispectral sensors permit holding onto information valuable for seed establishing designs, careful field soil examination, water system and nitrogen-level administration. Exact Photogrammetry/3D planning grants ranchers to investigate their dirt circumstances completely.

Planting: Drone new companies in India have concocted drone-establishing frameworks that permit robots to shoot cases, their seeds and critical supplements into the dirt. This innovation doesn't just lessen costs by practically 85% yet additionally expands consistency and proficiency.

Farming showering: Through drone crop splashing, human contact with such unsafe synthetic substances is restricted. Agri-robots can complete this task much faster than vehicles/ planes. Drones with RGB sensors and multispectral sensors can exactly distinguish and treat risky regions. Experts say that ethereal showering is multiple times quicker with drones when contrasted with different strategies.

Animals following: The robot study permits the ranchers not to monitor their harvests just but rather additionally screen the developments of their dairy cattle. Warm sensor

innovation helps track down lost creatures and distinguish a physical issue or infection. Robots can complete this work well and this adds exhaustively to the development of vegetation.

A strategy towards Locust attacks

Beetle swarms are known to benefit from harvests, trees and different kinds of plants. This taking care of can obliterate yields planted, causing starvation and hardship in social orders that exclusively depend on these harvests for endurance. Lately, multitudes of insects have attacked a few regions in India, particularly Rajasthan. With almost 90,000 Hectares of land impacted across 20 areas, these developing multitudes are taking steps to intensify into an agrarian fiasco.

Most countries doing combating beetle swarms depend altogether on organophosphate synthetics. These are used in minimal focused parcels by vehicle-mounted and elevated sprayers. Rajasthan has positioned robots to do the showering productively. Robots can diffuse pesticides on around 2.5-sections of land in just 15 minutes. Utilizing robots to battle the beetle swarms is a prompt, secure and useful methodology.

Conclusion

Farmers should get the whole interaction. Assurance of objectives, making a balance in the robot and programming used and being comfortable with the standards of utilizing such innovation will remain as a test. The ranchers will unavoidably require complete preparation or associations with outsider specialists in the robot business for the procurement of dependable information. Drones have redirected getting information in pretty much every kind of industry, and will just consider to expand and better before long.

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Effect of Climate Change in Food Security

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Introduction

The momentum behind climate change is unstoppable, even if greenhouse gases are reduced substantially. Climate change directly and indirectly impacts many aspects of food security, particularly in the agricultural and livestock sectors. Agriculture is the main source of income and employment for 70% of the world's poor in rural areas. However, the livestock sector also makes a significant contribution to climate change, accounting for 18% of green house gasses, whilst also being a prime cause of soil and water pollution. Agriculture is therefore the sector most vulnerable to climate change, directly impacting the economic activity of countries and increasing the risk of hunger and malnutrition. This leads to a vicious cycle, as the poorest suffer the worst consequences of the adverse weather caused by climate change, whilst having the least capacity to deal with them, due to poor nutrition, the number of people affected, drinking water shortages and poor sanitation; this in turn leads to the rapid spread of infectious diseases and failings in social protection systems. Climate change has very specific local effects. Even so, regional impacts are expected to be most severe in developing areas. For example, the productivity of rain-fed agriculture is expected to fall by up to 50% in some countries, potentially undermining their food security. The area of arid and semi-arid land is also expected to increase by between 5% and 8% by 2080.

Effects of climate change on agriculture and livestock activities

The Effect of Higher Temperatures

Agriculture is perhaps the most sensitive of all food security activities to climate changes. Agricultural and livestock farming has adapted to the local climate throughout the world. This has influenced what is grown and how, the type of rural buildings and the lifestyles of farming communities. This is the result of experience, the way that people have adapted to their environment and the passing of agricultural knowledge from generation to generation. However, in semi-arid and tropical regions, where farming conditions are extreme, a temperature increase could result in reduced harvests, increasing the stress of high temperatures, with increased water loss through evaporation, further increasing water stress for plants. Soil fertility could also be affected by increased air temperatures.

Changes in Rainfall Patterns

Water is essential for plant life. Any change to rainfall patterns would impact directly on agriculture, 80% of which is dependent on rainwater. It is very difficult to predict the effects of global warming on rainfall in a particular region as a result of the changes this will cause to atmospheric circulation patterns. Nevertheless, most of the forecasts produced conclude that there will be an increase in rainfall at high latitudes in winter, with lower rainfall

in tropical and subtropical regions. In our country, it is more useful to establish the seasonal changes that might occur, rather than talking about annual precipitation. In this region, there is expected to be lower rainfall in the dry season, with higher rainfall throughout the rest of the year, including the monsoon season. Maize would be one of the crops most affected by increased temperatures and changing rainfall. Some studies have found that output might decrease by 10% by 2055.

Extreme Weather

Meteorological records show that heat waves have been more frequent since the end of the last century and this trend is expected to continue over coming decades. Together with lack of rainfall, this directly impacts the performance of some crops. The adaptation of crops to these occasional temperature increases varies depending on the geographic region. The impact in more temperate zones will be lower than in hotter zones, where agriculture is already at the limit of its ability to adapt and where it might be faced by conditions that have never been experienced before. If there is a heat wave during a key period in the plant's development, such as when it is flowering, this could have a serious impact on the harvest.

Drought

Drought is a regional phenomenon, with different characteristics depending on the climatic region, frequency and duration. Lack of rainfall causes water stress in plants and, as with heat waves, the area's most affected will be those already suffering extreme water shortages. Dryness of the soil stops root growth and decomposition of organic material, further decreasing soil fertility. However, droughts have further effects, as they increase soil erosion due to reduced plant cover; this is of particular concern on mountainsides. Forecasts suggest that by 2050, the proportion of the earth subject to constant drought will increase from 2% to 10%, with the area suffering from extreme droughts increasing from 1% to 30% by the end of the 21st century.

Torrential Rain, Flooding and Tropical Storms

Experts believe that there will be an increase in the amount of water falling as torrential rain over coming years. Excess water can damage crops, ruining harvests. And flooding can devastate large expanses of cultivated land. Tropical cyclones may become more intense over the coming decades, with stronger winds and higher rainfall. Cyclones can have serious social and economic impact, particularly in developing areas. This is critical in the Indian Ocean region, where the majority of the population lives in river deltas, for example in India, Bangladesh and Myanmar. Increasing populations in these areas make them extremely vulnerable to the risk of flooding, which will be aggravated by the loss of harvests.

Increased Infestations and Diseases

Higher temperatures resulting from climate change may spread insects and pathogens to a wider range of latitudes. It is very difficult to forecast the effect of this on future agriculture, as this depends not just on the presence of the pathogen, but also on the condition of the crops; these two factors cannot be considered separately as they influence one other. Climate change may cause -and is in fact already causing- changes to the geographic distribution of diseases, changing the dispersion of bacteria and fungi as wind patterns change, leading to the appearance of emerging and re-emerging illnesses and an increase in the severity of pathogens.

Rising Sea Levels

Rising sea levels are an inevitable consequence of climate change. There are two main reasons for this increase: thermal expansion of the oceans and an increase in the mass of water due to ice melting from warming. Although these effects should be taken into account at present, they are not expected to occur in the short term,

given the rate of ice melting in the major ice shelves at present. The fourth IPCC report estimates that sea levels could rise by between 0.1 m and 0.5 m.

Mass Migrations

Environmental degradation is one of the main causes of mass migrations at present, both intra and inter-state. This is increasing with climate change and has even led to coining of terms such as environmental migrations or environmental refugees and even original coining such as climigration. This is a complex relationship and very hard to predict, in which migrations can be considered either a consequence of the ineffectiveness of policies to cope with climate change in the source countries or as a means of adapting to climate change.

Adaptation of agricultural systems to climate change

Climate change is unstoppable, but the sooner this is accepted the sooner appropriate measures can be taken to adapt and to counter its negative effects and boost its positive effects, which we must also seek to do. Adapting is as or almost as, important as offsetting these effects. Therefore, adapting farming to this new scenario must be a priority. Those who can adapt best and most quickly will be the most sustainable and the most competitive. Adaptation capacity relates to the capacity to take on climate change to moderate its potential impact, benefit from new opportunities and handle its consequences.

The experts argue that the farming sector should focus on the following areas.

a. Analysis of hot spots.
b. Improvement and integration of weather forecasting systems.
c. Early warning systems for serious weather conditions.
d. Appropriate handling of risks resulting from natural disasters and the preparation of contingency and social aid plans.
e. Rural investment: harvest insurance, incentives and the adoption of best farming and land use practices.
f. Improvement of water storage and conservation systems.
g. Water reuse.
h. Desalination.
i. Increased efficiency of water use and irrigation.
j. Changes to planting cycles for different crops.
k. Improvements to land management to avoid soil erosion.
l. Implementation of disease monitoring systems to warn of possible outbreaks.

Climate-Smart Agriculture

Investment in the agricultural sector must aim to contribute to food security, considering sustainable development, adaptation to climate change and its contribution to mitigation. These factors are included in what the FAO has called «Climate-smart agriculture». The FAO defines this as being agriculture that sustainably increases productivity and resilience (adaptation) and productivity of agricultural production systems, whilst also reducing and removing emissions. The smart-agriculture concept includes aspects related to improving production systems, policy coordination locally, nationally and internationally and finance for the transformation needed by agriculture.

Improvements in Production Systems

The FAO has set out the key factors required for sustainable agricultural production. These include:

- Appropriate soil and nutrient management, based on practices that reduce needs for synthetic fertilizers.
- Improvements to the management of ecosystems and agricultural biodiversity.

- Use of genetic resources, both through preservation of natural genetic resources and the generation of new varieties that are more resistant to adverse climate conditions, pests and diseases and adapting production cycles.
- Improved post-harvest preservation, both in storage and distribution.
- Implementation of agricultural conservation
- Agro forestry.
- Developing urban and peripheral agriculture.

Local, National and International Policy Coordination

The FAO has highlighted the need to establish consistency amongst policies to fight climate change and for agricultural development and food security. This requires:

- Fostering institutional and political support to channel investment, social security networks and access to insurance and land.
- Spreading information amongst agricultural communities on sustainable agricultural practices, together with information from early-warning systems for bad weather.

The Need for Finance

The concept of «climate-smart agriculture» recognizes that finance, investment and political commitment is needed to implement the changes to agriculture needed to adapt to climate change and ensure food security. This very necessary transformation of the agricultural sector also includes its capacity to make a significant contribution to mitigation. There is a wide gap between the cost of adapting agricultural systems to climate change and the finance provided, mainly from development funds. Action is required to ensure that financing mechanisms and public and private funds for combating climate change consider the agricultural sector and food security.

The role of the agricultural sector in mitigation

Greenhouse Gas Emissions

Agricultural activity directly contributes 12% of greenhouse gas emissions, mainly nitrous oxide. Agriculture also contributes a further 12% from changes in land use. We also need to include the contribution of the industrial sector directly related to agriculture (pesticides, fertilizers and machinery). Livestock contributes 18% of greenhouse gas emissions. Livestock is responsible for a large share of human-induced climate change.

The FAO considers that the following practices could reduce greenhouse gas emissions:

- Reducing deforestation and degradation of forests.
- Fostering carbon retention.
- Improving control of forest fires.
- Stopping burning of farming waste.
- Adopting systems that do not use land clearance to reduce emissions from arable cultivation.
- More efficient energy use in agriculture and associated industries.
- More efficient management of nitrogen and manure fertilizers and cultivated land. More efficient irrigation of rice fields.

Carbon Retention in the Agricultural Sector

Soil is the second most important reservoir of organic material. However, changes to rainfall patterns, increasing temperatures due to climate change and agricultural practices focusing on productivity have reduced the amount of organic material in the soil, resulting in its degradation. In addition to helping to mitigate the effects of climate change, appropriate management of

organic matter in the soil is also a form of adaptation to stop desertification and the negative effects of prolonged droughts, as organic material in the soil can absorb up to twenty times its own weight in water.

The FAO proposes the following ways of increasing organic matter:

- Fostering forestation and reforestation.
- Introducing agro forestry systems, combining crops, pasture land and trees sustainably.
- Recovery of pasture lands. Land in arid and tropical regions has been seriously degraded by poor use.
- In agricultural land, the solution consists of conservation agriculture; this includes leaving land fallow and covering the soil with vegetable matter, whether living plants or waste from these, and crop rotation.
- Change of use of degraded land for fuel biomass production and creation of productive forests.

The rise of bio-fuels

The obligation to reduce the use of fossil fuels is encouraging the use of other energy sources, including bio-fuels. However, the purchase of extensive areas of land in developing countries to grow such crops conflicts with the fight against hunger and the need to ensure food security for the poorest communities.

Conclusion

Feeding a population of 9 billion people by 2050 without increasing greenhouse gas emissions is one of the world's great challenges. Climate change has, and will increasingly have in the near future, direct and indirect effects on food security in developing countries; and such countries are the most vulnerable to its consequences. To achieve food security at a time of climate change, the agricultural sector in developing countries needs to undergo a profound transformation. This process must consider the synergy between adaptation capacity and the mitigation opportunities offered by sustainable agriculture or climate-smart agriculture, which take into account traditional practices, biodiversity and the fundamental role of rural women in developing countries. This transformation of agricultural systems requires finance. This is not currently sufficient and there is a clear «financing gap». Apart from funds from development aid programmes , agriculture must also have access to funds for fighting climate change. However, the main problem is that there are no mechanisms to quantify the contribution of the agricultural sector as, to date; agriculture has not played a major part in international negotiations on the reduction of greenhouse gas emissions. Nevertheless, if such a contribution is established, both mitigation and adaptation strategies in developing countries must consider food security to avoid developing countries being monopolized by large areas taken over for bio-fuels or mono-cultivation as the agricultural sector enters carbon markets. Mitigation must not compromise food security.

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Scientific Way of Asiatic Lily

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Introduction

In the *Lilium* there are two important groups of Oriental and Asiatic but we discuss about only Asiatic. First commercially successful group of hybrid lilies is Asiatic lily having Chromosome no. 24 and it is commonly known as Asiatic Lily belongs to family liliaceae. China, Japan, Korea and Europe are the native of Asiatic lily. It derived from hybridization of 12 species *viz*., *Lilium amabile, L. bulbiferum, L. concolor, L. dauricum, L. davidii, L. hollandicum, L. maculatum, L. leichtlinii, L.pumilum and L.tigrinum.* The cultivars of genus Asiatic lily are highly appreciated by the floriculturist for their outstanding range of colours like yellow, orange, pink, red, white and bicoloured but lack in fragrance. Asiatic lily is commercially cultivated in different parts of India i.e., The Nilgiris (Cooner, Ooty, Kothagiri), Kalvarayan hills (Karumanthurai) Kodaikanal, Shevroyhills (Yercad), Himanchal Pradesh i.e., under Shimla and Kullu condition, North Eastern states, Arunanchal Pradesh, Manipur, Jammu and Kashmir etc. The popularity of Asiatic lily is rising in our country due to their large and attractive flowers having capacity to rehydrate after a long transportation.

Varieties

There are innumerable varieties available under Asiatic lily hybrid, a few of the important ones are mentioned below

Pollyana (yellow), Dreamland(yellow), Nove Canto (yellow) Connecticut King (yellow), Elite (orange), Vivaldi (pink), Novona (White), Yellow Giant (yellow), Litouwen (white), Brunello (Orange), Blackout (deep red), Apeldoorn, Prato, Solemio, Grand Paradise, Cordellia, Mercedes, Novcento, etc.

Climate

Lilies are grown in polyhouse or shade net houses. The maximum day and night temperature for obtaining good yield is 21 to 25ÚC and 12 to 15ÚC, respectively. Lilies grow well under low light intensity of 2,000 to 3,000 foot candle. Therefore, during summer months, shade net can be used to cut off 75 percent light and 50 percent during winter season. The optimum humidity inside the green house must be 80-85 %. Sandy loam soil with pH 6-7 is suitable.

Planting Time

For planting of Asiatic lily in N.I. plains is Oct.- Nov., whereas, in Hilly area the planting time of Asiatic lily is March and July-Sep.

Soil/Growing medium

Field should be dug out properly. Soil should be sandy loam with pH ranging between 7.0-8.0, organic matter may be supplied at 4-5kg/ m^2. If soil is heavy it needs to be amended with sand. Good drainage is essential factor as there is loss of lily bulbs if water stagnation occurs in field.

Planting Density

Asiatic lily bulbs should be planted 6-8 cm deep in moistened medium at a distance of 10 cm from bulb to bulb and 20 cm from row to row. The medium should be thoroughly watered

before planting and thereafter, kept moist and not wet till sprouting of the bulbs.

Propagation

Lilies can be multiplied through seeds, scales, bulblets and bulbils. Tissue culture method is used for large scale multiplication. Lilies are commonly multiplied by division of bulblets formed on the stem of most lilies just below the ground level. Detachment and planting of bulblets separately help to reproduce flowering size bulbs after a year's growth.

Intercultural Operation

Uniform moisture is important especially in initial three weeks. Watering must be carried out depending upon the crop need. Regular weeding is done with slight hoeing occasionally.

Staking

Staking is an important operation particularly when the stem length is above 80cm. staking can be done with nylon netting, hessian string or flexible bamboo sticks.

Weeding & hoeing

Weeds should not be allowed to grow and should be remove as soon as they appear otherwise they compete for nutrients and water with the main crop. Hoeing helps in aeration of soil and better development of bulbs. In early stages of growth frequent weeding & hoeing are required.

Harvesting

Asiatic lily is ready for harvesting between 90-120 days after planting. The stage of harvesting flowers depending upon the distance of travel.For local market stems are harvested when 1-2 florets are open. Whereas, for distant market stems are cut when the lower most buds are fully developed and show colour but is not open properly. When the bud open fully it will cause damage to flowers during transportation. Stems should be placed in cold water immediately after harvesting. Vase life of Asiatic lily is 7 to 14 days.

Grading: After harvesting the Asiatic lily are usually sorted by number of flower buds per stem and length of stem. The leaves from the bottom 10-15 cm of the stems should be removed this still improves the keeping quality of the flowers.

Bulb size (cm)	10-12	12-14	14-16	>16
Bulbs/m²	65-90	55-80	45-70	40-65

Packaging, Transportation and Storage

Wrapping of stems of Asiatic lily with butter paper for six days at 4ÚC improves longevity without loosen potential vase life and quality of flowers. 10 to 12 cut stems are firmly tied at the base with tape or rubber band and wrapped in newspaper. These bunches of flowers are packed in standard size carton and transported in refrigerated containers.

Yield

30-40 flower stems/m²/year

Disorder

Leaf scorch

Due to deficiency of Mn, Al which occur at over dose of nitrate level and add lime @ 10 ton/ha .

Bud blast

Due to storage of water at top of plant, competition for nutrients, fluctuating carbohydrate level, low light intensity and high nitrate level.

Puffy foliage

Due to frost injury and stunting of plants.

Diseases & Insect-pests

Gray Mould: The symptoms are the presence of circular or oval and yellowish to reddish brown spots on the leaves. In some spots central parts turns light gray in colour while outer region in dark purple. Due to spotting, other parts of the plant like leaves, buds, wither and die.

Control

Follow proper phytosanitory measures.

Bulb & Scale rot

This disease is commonly confined to the base of the scales which are detached from the basal part of the bulbs. Lower leaves that grow from infected bulbs become yellow and dry prematurely. In case of severe infection, whole plant dies.

Control

Remove infected plants from the field. Keep the soil temperature as low as possible during the entire period of cultivation by frequently irrigating the field. Follow proper phytosanitory measures.

Aphids

These insects suck the cell sap from growing terminal points, also from the foliage. Honey dew secretions by aphids furnish nutrient for development of black sooty mould fungus, resulting in discolouration.

Control

Spray Dichlorovous 76% EC @2ml/lit of water.

Conclusion

A scientific way of Asiatic lily can help to produce quality products, increase production and directly or indirectly, helps to enhance farmer's income.

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Advances in Exotic Vegetable Production and Their Future Scope in India

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Introduction

Anything of foreign origin, something not of native growth, as a plant is called exotic. Exotic Vegetable farming is a profitable venture and become source of livelihood to the farmers and contributing significantly to food security in country. Growing of exotic vegetables is a more profitable business than the cultivation of traditional Indian vegetables. Vegetables can be eaten either raw or cooked and play an important role in human nutrition, being mostly low in fat and carbohydrates, but high in vitamins, minerals and fibre. Many governments encourage their citizens to consume plenty of vegetables, five or more portions a day often being recommended. Exotic vegetables market is growing at the rate of 15 to 20% per annum and is increasing day by day. India is importing more than 85% exotic vegetables. Exotic vegetable has major two niche market hotel industry and export. Jammu and Kashmir is endowed with unique climatic superiority over many parts of India in growing high quality exotic vegetable because of cool weather since most vegetables exotic to India are temperate to subtropical in nature and respond well to cultivation in hilly areas as a result of which a huge number of temperate vegetables can be cultivated here. The recent advances in production and improvement of exotic vegetable crops includes, the development breeding of new varieties, use of protected structures, use of mulching, hydroponics, tissue culture, integrated farming, organic farming.

Importance

a. Exotic vegetables as economic source

Exotic vegetables are globally important, and a source of cash income for small holders. Public and private sector partners supply adequate seeds of adapted lines to small holder farmers at reasonable prices.

b. Nutritional and medicinal value

Vegetables not only provide essential micronutrients but also contain a range of health- promoting phyto-chemicals. These can prevent nutritional deficiencies and reduce the risk of obesity and chronic disease including diabetes, cardiovascular diseases and cancer.

c. Exotic Vegetable as home garden

Immense nutritional value as health food and neutraceutical. Growing exotic vegetable originally at home makes exotic vegetables excellent choices which are not easily available in market.

d. Exotic Vegetable for commercial purpose

Lend themselves well to small scale and part time farming operation. For plains serve as off-season vegetable. Commercial production and marketing requires knowledge about their time of planting and availability in various regions.

Important Exotic Vegetables Grown In India

Mostly exotic vegetables are cultivated in small pockets in India for consumptions, marketing as well as for export. Some important exotic grown in India especially in Jammu and Kashmir are as follows :

Lettuce

Lettuce (*Lactuca sativa L.)* is a member of compositae family. It is a popular salad crop grown in all parts of the world and is gaining popularity in Jammu and Kashmir also. It is nutrient packed with several vitamins, folic acid, magnesium and chromium.

Recent Advances in Lettuce: Hydroponics, Deep Water Culture, Nutrient Film Technique, Mulching, Micro sprinkler and Plastic Film Mulching.

Broccoli

Broccoli or sprouting broccoli (*Brassica oleraceavar. italica*), is gaining popularity throughout world because of its nutritive value.

The edible portion consists of immature, fully differentiated flower buds and tender portions of the upper stem. Broccoli is very rich in vitamin A, calcium, phosphorous, potassium and vitamin C. Broccoli is also rich in Sulphoraphane which is known to have anti-cancer properties.

Recent Advances in Brocolli: Fertigation and Protected Cultivation

Brussels sprouts

Brussels sprouts (*Brassica oleraceavar. gemmifera*), is a delicious cold-climate vegetable. The edible part is swollen axillary bud known as sprout. It lacks an apical head but bears a number of axillary heads or sprouts of 20 to 60 mm diameter along an elongated stem. Brussel sprouts contains vitamin A, vitamin C, potassium and protein.

Recent Advances in Brussels sprouts: Use of plastic mulch and low tunnels, Drip irrigation.

Chinese cabbage

There are two distinct species of Chinese cabbage, viz., heading types (Brassica pekinesis) also known as pet-sai, and non-heading types (B. chinensis) also known as pakchoi. It is very tender, crisp and highly perishable salad vegetable. Chinese cabbage is a low calorie vegetable containing about 95% water, 1.2 g protein, 0.6 g fibre, 43 mg phosphorous and 250 mg potassium per 100 g edible part.

Recent Advances in Chinese Cabbage : Hydroponics, Mulching.

Celery

Celery (Apiumgraveolens L.) is one of the important salad crops. It is a member of the Umbelliferae family. The seeds of celery are used as condiment. The stalks or petioles are eaten as salad, in soup, sauce, puree, fried and spiced curry. Celery is mainly consumed for its aroma and flavour which is due to Apiin a glycoside present in leaves and celeriac storage roots.

Recently developed varietiesinclude: Ford hookEmperor, Standard Bearer, Wright's Grove Giant, Celebrity, Jason.

Parsley

Parsley (Petroselinum crispum) is one of the most popular garden herbs belonging to Umbelliferae family. Fresh leaves of parsley have strong odour and are commonly used for garnishing and seasoning. It is eaten fresh, incorporated in salads and used as an ingredient of soups, stews and sauces. The herb is reported to possess diuretic, carminative, antipyretic and expectoran tproperties and has long been used for urinary troubles.

The recently developed varieties include: Mosscurled, Champion MossCurled, Extra TripleCurled, Paramount, Extra curled Dwarf, ItalianGiant

Red cabbage

The red cabbage (Brassica oleraceavar. capitata sub var. rubra) is grown for its reddish purple head. In a 100g edible portion red cabbages contain about 90% water, 6.9 g total carbohydrates, 42 mg calcium, 268 mg potassium, 61 mg vitamin A and other nutrients in minute quantitie

The recently developed Varieties include: Red rock, Red DrumHead, Kinner Red, Solan BandSarson

Asparagus

Asparagus (A. officinalis L.) is a perennial vegetable belonging to Liliaceae. It is grown for its edible, tender, unexpanded shoots commonly called "Spears". It has an underground network of fleshy storage roots and underground stems called crowns. It is a dioecious, perennial monocot cultivated for more than 2,000 years.

Recently developed Varieties include: Mary Washington, Marth-Washington, Perfection, New JerseyImproved.

Cherry tomato

Cherry tomato (Solanumly copersicum var., cerasiforme) is a one of the important high value exotic vegetable crop. According to the USDA nutritional information, one cup of cherry tomatoes (149 g) provides 26.8 calories, 1.3 g protein, 4.5 mg omega-3 fatty acids, 119 mg omega-6 fatty acids, 1241 IU of vitamin A, 18.9 mg vitamin C, 22.3 mcg folic acid, 11.8 mcg vitamin C, 353 mg potassium, 35.8 mg phosphorus and 14.9 mg calcium.

Recently developed Varieties include: Punjab Red Cherry, Punjab Kesar Cherry, Pusa Cherry Tomato-1, Punjab Sona Cherry.

Recent Advances in Cherry Tomato: Protected Cultivation, Hydroponics.

Colored Capsicum

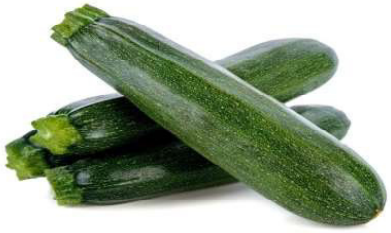
Coloured capsicum also known as sweet pepper or bell pepper (Capsicum annum) is one of the important high value vegetable crops cultivated in green houses and to the some extent under shade net house in milder climatic regions. It is rich in vitamin-A, C and minerals. It contains high amount of antioxidant i.e., ascorbic acid (140mg/100 gm edible portion).

The recently developed hybrids/varieties include: Indra, orobelle, Bombay

Recent Advances in Capsicum: Protected Cultivation, Mulching.

Zucchini

Zucchini (Cucurbita pepo) is a summer squash, a vining herbaceous plant whose fruit are harvested when their mature seeds and epicarp (rind) are still soft and edible. It can be green, yellow and light green. Zucchini contains zero fat and is high in water and fiber. It also contains significant amounts of vitamins B6, riboflavin, folate, C and K and minerals, like potassium and manganese.



Recently developed Zucchini Varieties: Ambassador, Costata Romanesco, French White, Gold Rush, Eight Ball, Spacemiser, Seneca.

Problems associated with exotic vegetable production.

- The method of farming and selling exotic vegetables differs from the typical farming.
- Skilled labour is required for cultivation of these vegetables.
- For growing exotic vegetables, the specific climatic as well as soil conditions required.
- Production and productivity of most of the exotic vegetables are low.
- Problem of biotic and a biotic factors. Most of the exotic vegetables need protected cultivation.
- Lack of proper market or market fluctuations.
- Cost of cultivation is high.
- Lack of improved production technologies.
- Lack of improved varieties.
- High cost of seed.
- Lack of active research on exotic vegetables in India

Status of Exotic Vegetables in India

- The new polyhouses build is undertaking exotic vegetable cultivation in total of their 75% area.
- Almost 50% of flower cultivating farmers have shifted to exotic vegetable cultivation.
- The open area for Exotic vegetable cultivation is 3 to 5% of the vegetables.
- Exotic vegetable market is growing at the rate of 15-20% per annum and is increasing day by day.
- India is importing more than 85% of exotic vegetables.
- Growing of exotic vegetables is more profitable business than cultivation of traditional Indian vegetables. There is an increasing demand in domestic market due to their nutritive value.
- Exotic vegetable has major two niches i.e., market hotel industry and export.

Scope of Exotic Vegetables In India

- In India, North-western Himalayas and Nilgiri hills provides excellent climate for production, especially during the summer months.
- In India, seed and planting material requirements presently are not very high and can be met by multinational seed companies easily.
- Seeds of many crops like lettuce, broccoli, Beek, Chinese cabbage, etc., are available in Himachal Pradesh at IARI Regional Research Station Katrain, Kullu and Dr. YSPUH&F, Nauni.

Conclusion

Exotic vegetables offer several advantages for growers in terms of novelty, high productivity and comparatively stable prices. Exotic Vegetable farming is a profitable venture and become source of livelihood to the farmers and contributing significantly to food security in country. The recent advances in production and improvement of exotic vegetable crops includes, the development breeding of new varieties, use of protected structures, use of mulching, hydroponics, tissue culture, integrated farming, organic farming.

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Important Diseases of Rice and their Control

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Introduction

The world's most important food crop is rice (*Oryza sativa*). More than 3.5 billion people worldwide eat rice as a primary diet. In Asia, rice was possibly the first crop that was cultivated and rice production may be traced back to antiquity. Since prehistoric times, rice has been grown in India. This is corroborated by archaeological findings and the multiple times rice is mentioned in ancient Hindu literature and scripture. At a site dating from between 1,000 and 750 B.C., The largest food crop in the world, rice is grown on 155 million hectares of land and produces 596 million tons annually (paddy). It comes in second to wheat in terms of acreage and production. Asia has the most rice-growing land. India (44.8 million hectares) has the greatest area among the nations that grow rice, followed by China and Indonesia. India comes well behind China in terms of production, with 131 million tons of paddy (200 million tonnes of paddy). Egypt tops the list for average yield per hectare, followed by the USA. Only 2929 kg of rice are produced on average per hectare in India. In almost every state in India, rice is grown. The leading states in the region are Andhra Pradesh, Bihar, Uttar Pradesh, Chhattisgarh, Madhya Pradesh and West Bengal. The states with the highest rice production are West Bengal and Uttar Pradesh. Punjab has the highest average production per hectare (3346 kg/ha).

The discussion of important rice diseases and their management strategies is the focus of this article. Some of the most prevalent diseases that impact rice crops include blast, brown spot of rice, Sheath Blight (ShB) and bacterial leaf blight (BLB) and false smut of rice, khaira disease and Rice Tungro Disease (RTD).

Rice Blast : *Magnaporthe oryzae* fungus, which causes rice blast, produces lesions on the leaves, stems, peduncles, panicles, seeds and even roots. This disease has been listed as one of the most significant plant diseases of all due to the potential hazard it poses for crop failure. All plant aerial parts and growth stages of paddy might be affected by disease (Leaf, neck and node). The neck infections are the worst of the three leaves. Small spots start out on the leaves and then grow into spindle-shaped spots with an ashy centre that are 0.5 to 1.5 cm long and 0.3 to 0.5 cm wide. Large, erratic patches are created when a number of spots coalesce. Leaf Blast (fig.1) infection results in the appearance of a burned or blasted crop, hence the word "BLAST." In severe circumstances, crops must be lodged (after ear emergence). Panicle breaks at the neck and hangs. Neck Blast (fig.2) the panicle's neck region turns black and shrivels fully or partially. Nodal blast (fig.3) nodes develop black lesions around them. The infected nodes may split apart and all of the plant sections above them may die. Diseased seed can be treated dry with carbendazim 50 WP at a rate of 3.0 g/kg seed or wet with carbendazim solution at a rate of 1.0 gm/Litre of water/kg of seed for 24 hours prior to sowing.

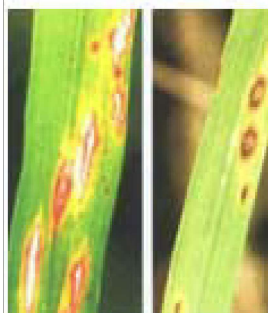


Fig.1. Leaf blast

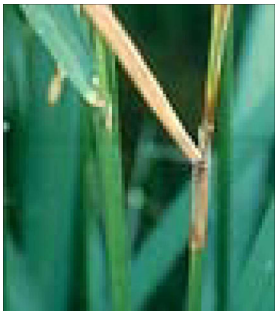
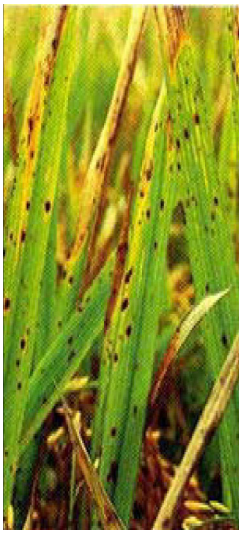


Fig.2. Node blast

Fig.3. Neck Blast

Brown Spot of rice: The cause of brown spot in rice is the fungus ***Helminthosporium oryzae***. On leaves, there will be rectangular to oval reddish brown dots with a grey centre. The spots will eventually extend to the ear head and leaf sheath as well. Brown lesions might be partially or completely seen on the surface of the grains. Treat the seeds with Thiram or Captan at 4g/kg and with Mancozeb@0.3%. Spray the crop in the main field twice with Mancozeb@0.2%, once after flowering and second spray at milky stage.



Leaf symptoms

Glumes infection

Bacterial leaf blight of Rice (BLB):

Xanthomonas oryzae pv. oryzae is caused by BLB. The disease can manifest before going but is typically discovered then. Nursery seedlings exhibit round, yellow spots in the margin that grow larger and merge, causing the leaves to dry out. 1-2 weeks after transplantation, seedlings exhibit the "Kresek" symptom. The bacteria enter through the puncture wounds in the leaf tips, spread throughout the seedling and eventually kill it. Near the leaf margin, mature plants develop water-soaked, transparent lesions. Within a few days, the lesions grow in length and width with a wavy edge, cover the entire leaf and turn straw yellow. Lesions spread throughout the lamina as the condition worsens, turning it white or straw-colored. Techniques to control the sickness burn the stubble, use the right amount of fertilizer, Avoid being in flooded areas, use the most splitting possible of nitrogen. Spray a tetracycline and streptomycin mixture of 300g plus 1.25 Kg of copper oxychloride per hectare.

Leaf blight symptom

Kresek symptom

Sheath blight (ShB): The fungal disease *caused by* ***Rhizoctonia solani***. ShB is one of the most economically significant rice diseases worldwide. This disease causes significant grain yield and quality losses. Near the water's edge, the leaf sheath develops uneven, elongated black lesions as a result of the infection. The entire plant dries out as a result of these patches coalescing. Numerous small, brown sclerotia that are spherical in shape are developed both inside the culm and on the leaf sheath. To control the disease an one of the following fungicides should be used hexaconazole 5 EC @ 2.0 ml/L, validamycin 3L@2.0 ml/L, propiconazole 25 EC@1.0 ml/L second spray should be given at 15 days after the first spray if needed by altering the chemical. Dry seed treatment with carbendazim 50 WP@3.0 g/ kg seed or wet seed treatment with Carbendazim @ 1.0 gm/L of water / kg of seed for 24 hours before sowing.

False Smut of Rice: The disease-causing fungus is ***Ustilaginoidea virens***. Typically, only a few grains in a panicle are contaminated, while the majority are healthy. Each every grain of rice

changed into a cluster of yellow fruiting structures. spores that are silky and encapsulate flower components are growing. Young spores are smooth, golden, somewhat flattened and membrane-sealed. Broken membrane is the outcome of spore growth. Spores mature to an orange colour before turning yellowish green or greenish black. Chemical control through the treatment of seeds with carendizm 2.0g/kg of seeds. Spray carbendazim (0.1 percent) or copper oxychloride (0.3 percent) at the panicle emerging stage.

Rice Tungro disease (Tungro virus): Plants affected by **Tungro virus**. Diseased plants get stunted and change colour from yellow to orange from the bottom to the top. The coloration begins at the tip and travels downward. Older leaves have rusty streaks on them. The grains are poorly packed and the ear heads are tiny. The green leaf hopper is the vector for the virus. Both

the nursery and the main field are infected. Plants have obvious stunting. Interveinal chlorosis and yellow to orange staining are visible on the leaves. Sometimes, young leaves have mottling, whereas older leaves get rusty patches. With a weak root system, tillering is decreased. If panicles do form, they are tiny with few, malformed and chaffy grains and do not form in the very early stages of infection. Control the vectors in the nursery by application of Carbofuran 170 g/cent 10 days after sowing to control hoppers.15 and 30 days after transplanting, spray the main field with Phosphomidan 500 ml, Monocrotophos 1lit/ha (2 ml/litre), Neem oil 3 percent or NSKE 5 percent to control the vector. Field cleaning, weed removal and eradication of virus hosts and vectors. Cultivars resistant to disease such as Pankhari 203, BM66, BM68, Latisail, Ambemohar102, Kamod 253, IR50 and CO-45 should be grown. To keep an eye on the vector population, install light traps.

Khaira Disease: Zinc deficiency is the major cause of the Khaira disease of rice. Dusty brown patches on the upper leaves of stunted plants are a symptom. Variable plant growth. Especially close to the leaf base of younger leaves, chlorotic midribs. As brown streaks and blotches form on lower leaves, they become larger and combine, losing their turgor and turning brown. On sometimes, a white line will run down the middle of a leaf. Reduced size of leaf blades. Manage the disease cultivate Zn-efficient strains. Apply organic manure to the nursery seedbed a few days prior to transplanting or before sowing or transplanting. $ZnSO_4$ should be sprayed on nursery seedlings. When sowing in soil that lacks zinc, apply zinc sulphate at a rate of 25 kg per hectare or spray $ZnSO_4$ at a rate of 5 kg per hectare.

Conclusion

Rice is the primary food crop grown worldwide (*Oryza sativa*). Multiple diseases have an impact on it, which is why the yield production is decreasing. As a result, when we manage the rice crop properly, both its nutritional value and output will grow.

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Phalaenopsis a "Moth Orchid": Production and Care

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Introduction

Moth Orchid, which is scientifically known as *Phalaenopsis,* is an orchid genus of nearly 60 species. The *Phalaenopsis* name comes from the ancient Greek word *phalaena* which means "a kind of moth". This particular orchid species are native to the Indo-China region, Southeast Asia, New Guinea, and Australia. However, the varieties and largest populations are found in the Philippines and Indonesia. The moth orchid is one of the most popular orchids in world trade. Many hybrids have also been developed. One of the prominent features of this particular genus is the unique shape of the flower, which looks like the wings of a flying moth. *Phalaenopsis* orchids are epiphytic, shade-loving orchids while some are found to be lithophytic. It possesses neither pseudobulbs nor rhizomes and shows a monopodial growth habit, meaning a single growing stem produces one or two alternate, thick, fleshy, elliptical leaves from the top while the older basal leaves drop off. The inflorescence of these orchids is either a raceme or panicle and they bloom for several weeks. Under cordial conditions, flowers may last for two to three months. This orchid is commonly used as pot plants and cut flowers. The clarity and glamour of the *Phalaenopsis* flower make it ideally special for interior adornment, bouquets, functions, birthdays, weddings, funerals, etc.

Hybrids

Bigeneric hybrids

Aeridopsis = Phalaenopsis x Aerides

Arachnopsis = Phalaenopsis x Arachnis

Doritaenopsis = Phal. x Doritis

Vandaenopsis = Phal. x Vanda

Trigeneric hybrids

Sappanara = Phal. x Arachnis x Renanthera

Trevorara = Phal. x Arachnis x Vanda

Yapara = Phal. x Rhyncostylis x Vanda

Tetrageneric hybrids

Bogardora = Ascocentrum x Phalaenopsis x Vanda x Vandopsis

Bokchoonara = Arachnis x Ascocentrum x Phalaenopsis x Vanda

Edeara = Arachins x Phalaenopsis x Renanthera x Vandopsis

Pentageneric hybrids

Sutingara = Archnis x Ascocentrum x Phalaenopsis x Vanda x Vandopsis

Macekara = Arachnis x Phalaenopsis x Renanthera x Vanda x Vandopsis

Natural hybrids

Phal. amphitrita, Phal. intermedia, Phal. leucorrhoda, Phal. rothchildiana, Phal. singulifera

Inter-specific hybrids

Borneo Belle, Ceile, Fuscabell, Anna, T. H. Pearl, Renchy's Plastic Yellow, Gold Veins

Inter-varietal hybrids

Free Gold, Durga Ko Dil, Red Hot Girl, White Ghost, White Galaxy, Dotted Perfection, Hamana Gold, Tiraster Golden Lip etc.

Variety-species hybrids

Hemlata and Chris, Hama Snow, Berry Blossoms, Good Time Charlie, Stone Trail, Thirty Eight Special.

Environmental factors

Temperature

Being a tropical plant and *Phalaenopsis* performs best in warm and humid environmental conditions. However, they can adapt well to lower humidity and conditions found indoors. But temperatures lower than 10°C and higher than 35°C should be avoided. An average temperature range of 27 – 29°C during the vegetative phase and 20 – 25°C during flowering is ideal. If spiking plants are exposed to fluctuating temperatures or above 27°C for extended periods, the spikes can turn into a Keiki or the bud may be aborted.

Light

Phalaenopsis is a shade-loving orchid. In nature, many are found to grow below canopies, away from direct sunlight. High light can cause sunburn. 75% shade net is ideal for cultivation. In greenhouses, 7,500-15,000 lux is recommended. Good light during winter and avoidance of direct sunlight during summer should be ensured. Generally, the leaves are olive-green; dark green means the plant's not getting enough light and too much light causes leave with a red tinge. Too much shading (below 75,000 Lux) can delay spike initiation, and reduce the number of spikelets and length of the spike.

Carbon dioxide

Phalaenopsis is a CAM (Crassulacean Acid Metabolism) plant and it takes CO_2 at night. CO_2 requirement varies from 600 to 800 ppm.

Humidity

Humidity playsan important role in the good performance of *Phalaenopsis* orchids. About 50-80% RH is recommended for optimum growth. Prolonged dry conditions cause premature bud dropping, shriveled leaves, stunting of plants, etc. In greenhouses, humidity can be regulated by watering the planting area (benches, footpath, etc.) humidifier, misting or placing trays with water below or around the planting area. However, the trays should be cleaned from time to time to avoid algae growth and diseases. In homes, flower pots can be placed in a tray with pebbles, partially filled with water, so that the pot doesn't sit in the water completely. Indoor foliage plants can also be placed near the *Phalaenopsis* orchid to increase the humidity.

Air circulation

Pots/plants should not be kept congested. Circulation of air is important to dry out the leaves. Good air movement in the growing area facilities good growth and fewer pests and disease attack. If natural ventilationis restricted, ceiling or stand fans can be used to provide good air circulation, with constant changing of airflow direction and without excess leaf drying.

Cultivation

Containers for planting: Clay or plastic pots with broader basesare used. But perforated plastic pots are preferred owing to their ease of use and durability. Roots of *Phalaenopsis* orchids need light for their proper growth, thus, transparent pots are more preferred than dark or opaque ones.

Potting Media: Young *Phalaenopsis* orchids should be acclimatized first to the local growing conditions before planting. These orchids require shallow planting and the base of the plant should be at the level of the potting media. Care should be taken so that the growing tips of the young plants are not damaged during potting.

Irrigation: *Phalaenopsis* orchids don't prefer a profligate amount of water. Lavish watering can kill the plant. Younger plants require more watering than older ones. Irrigation should be provided when the pots are nearly dry. Care should be taken to keep the crown dry. Accumulation of water invites diseases and may create unfavourable growing conditions. During hot and dry months, 2 times watering in a week can be done and only 1 time per week during wet and winter months. Rainwater is considered good for plant growth. The ideal water for *Phalaenopsis* contains pH 6.6, $CaCO_2$ 80 – 120 ppm, Ca 30-50 ppm, Fe 1 ppm, Na less than 5 ppm, soluble salts 0.3 to 1.0 m mhos/cm, total dissolved solids 60 ppm, S 10-50 ppm, Cl 100 ppm.

Nutrition : The most common type of nutrient used for *Phalaenopsis* is the water-soluble form. Diluted nutrient solutions applied frequently are better than concentrated applications depending on the growth phase, dose and frequency of nutrient application is managed. Plants in the vegetative phase require one application per week of 20:20:20 NPK 200 ppm nutrient solution while exhausted plants, after flowering, require twice application of 100 ppm nutrient solution per week. The pH of the solutions needs to be maintained at 5.2 – 6.2. In dormant periods, nutrients should be applied 50% less than the recommended dose.

Repotting : Repotting should be done when the plants have outgrown the growing container, media is loose, flowering is reduced, browning of the leaf tips, etc. *Phalaenopsis* are best repotted after flowering in late spring or early summer. It should be done once a year in appropriate-sized pots. The plant should be taken out of the old pot carefully, so as not to damage the actively growing root tips. Old and dried roots are cut off using sharp secateurs. Plants should be air-dried before planting. It is then planted in a new pot with fresh media. Staking should be done, if required, to keep the plant stable.

Conclusion

Phalaenopsis orchid is a visually attractive, second most valuable, popular flowering potted plant and cut flower around the world. It is one of the most important economic floriculture species. Due to its easy cultural practices, diversity in flower colour, size and shape, year-round availability, delicacy, and lengthy vase life, it is a promising flower for farmers to initiate its cultivation to diversify and double their income.

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Herbal Medicinal Plants Suitable for Kitchen Garden

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Introduction

India is rich in diverse natural resources and treated as one of the 17th biggest natural biodiversity countries of the world. The details mentioned by the World Health Organization show that 80% of world's Population still depends on natural products of medicines as they are efficient, safe, cost-effective, affordable and easily accessible by the poor. Traditional drugs of herbal origin have been used since the dawn of civilization to maintain health and alleviate human suffering from disease. In India, history of medicine can be traced back in the past. In recent time's people from all walks of life are switching over to traditional medicines due to their no or less side effects, low cost etc. The basic traditional knowledge of medicine is based not only on plants but also on some animal products. Medicinal and aromatic plants play an important role in the country's agricultural profile due to quantitative and qualitative advantages. The medicinal and aromatic plants are an integral component of everyday life and culture in all over the world for centuries as these plants have pharmaceuticals, cosmetics and cooking properties. These plants have been used in developing countries for thousands of years. These are the important part of the treatment in the indigenous medicine systems such as Ayurveda, Unani, Siddha, Traditional Chinese Medicine, Tibetan Medicine and Julu etc. Therefore, cultivation of these crops in kitchen garden can help peoples to strengthen their immunity by consuming them. Previously it was found that a plant which is astringent in taste will arrest diarrhoea, a plant which is acidic in taste will control vomiting and a plant having aromatic properties will control nausea. In the olden days indigenous medicine had attained a very high standard, in Ayurveda and Homeopathy. Until now three countries including India, China and South Korea, have issued guidelines on traditional regimes for the prevention and management of COVID-19 (Ang *et al;* 2020). There are number of medicinal plants like Ashwagandha, Guduchi, Kalmegha, Tulsi, Ginger etc. The bioactive compounds of these plants play important role in immunity boosting as well as addressing healthcare issues in covid conditions. Therefore the following plant can be suitable to cultivate in kitchen garden

Aloe vera (family Alliaceae)

The Aloe vera is a succulent perennial herb of 80 - 100 cm in height which matures in 4 - 6 years and survives for nearly 50 years under favorable conditions. The plant is native to Southern and Eastern Africa. *Aloe vera* (L.) Burm. *f.* syn. *Aloe barbadensis* Miller, is most biologically active among 400 species. This plant has triangular, sessile stem, shallow root system, fleshy serrated leaves of 30 - 50 cm length arranged in rosette and 10 cm breadth at the base, colour is pea-green. The bright yellow tubular flowers, length 25 - 35 cm, axillary spike and stamens are frequently projected beyond the perianth tube and fruits contain many seeds.

Aloe extract represent a continuous effort to find new compound against pathogens and plants would be the best source for obtaining a variety of drugs. The active components of aloe include anthraquinones, chromones, polysaccharides and enzymes. The components like anthraquinones and chromones are responsible for the anti- inflammatory evacuating anti-cancer activity. The elements Fe, Mg, Na, P, Si, Al, B, Ba, Ca, etc., has also been reported to be present in *Aloe vera* gel. It's gel play important role in stimulation of the complement linked to polysaccharides, hydration, insulation and protection. Application of fresh aloe vera gel to normal human cells *in vitro* promoted cell growth and attachment whereas, a stabilized gel preparation was cytotoxic to both normal and tumour cells. The wound healing powers were due to a high molecular weighted polypeptide, so gel improves wound healing by increasing blood supply and increased oxygenation. The gel has been used to cure radiation burns and radiation ulcers. The fresh gel of aloe vera was more effective than the cream as its gel -treated lesions healed faster compared to burns treated with petroleum jelly.

Asparagus Racemosus (family *Liliaceae*)

Asparagus is commonly known as 'shatavari' and found at low altitude throughout india. Its dried roots are brown in color, tuberous, elongated and tapering at both the ends up to 30-100 cm long. The fresh roots of shataver are 5-15cm in length, 1-2 cm diameter cylindrical, fleshy tuberous straight or slightly curved, tapering towards the base & swollen in the middle, white in color while on drying it become shrinked longitudinal ridges appeared and the color turned light brown and mucilaginous in taste. The outer surface of the fresh root is soft and contains epidermal hairs. The powder drug swells on moistening with water. The dried root of plant are used as drug as it contain sapogenin, sarsasapogenins, flavonoids (kaempferol, quercetin and rutin) and poly phenols which is the precursor of many pharmacologically active steroids. It is also beneficial in female infertility is considered as a female tonic and widely used in diseases including dysentery, in diabetic retinopathy, inflammations, tumor, bronchitis, nervous disorder, hyperacidity, certain infectious diseases, neuropathy, conjunctivitis, spasm, chronic fevers and rheumatism. Increases, enhances folliculogenesis and ovulation, prepares the womb for conception, prevents miscarriages, acts as post partum tonic by increasing lactation and normalizing the uterus and the changing hormones.

Ashwagandha (*Withania Somnifera*, Family: Solanaceae)

Ashwagandha also known as Indian ginseng is an important medicinal plant, which is being cultivated for centuries in India. It holds important places in Indian traditional systems of medicine, Ayurveda and Unani. Its is erect, evergreen, branched shrub of height of 30-60 cm and commonly grows in dry and arid soil. In India it grows in Uttar Pradesh, Maharastra, Madhya Pradesh, Haryana, Rajasthan and few regions of Himanchal Pradesh. Ashwagandha root and herb are used as tonic, hypnotonic, sedative and diuretic has anticancer, anti-stress, anti-inflammatory, antitumor anti-oxidative properties and also used to treat various diseases associated with nerve tissue damage. It is an ingredient in many formulations prescribed for a variety of musculoskeletal conditions (e.g., arthritis, rheumatism) and as a general tonic to increase energy, improve overall health and longevity and prevent disease in athletes. Roots contain alkaloids, amino acids, steroids, volatile oil, starch, reducing sugars, glycosides, dulcitol, withaniol. The total alkaloidal content of the Indian roots has been reported to vary between 0.13 and 0.31 percent, though much higher yields (up to 4.3%) have been recorded elsewhere.

Mint (*Mentha piperita*, Family: *Labiatae*)

Peppermint is a medicinal plant originated in Eastern Asia. Peppermint commonly used as medicinal herb because was benefit in building

the immune system and fighting secondary infections. In addition, peppermint has been known as disorders improving including: analgesic, ulcer, anti-spasmodic, anti-bloat, irritable bowel syndrome or gastrointestinal motility and immune system stimulant and etc. Peppermint essential oil has biological activities, such as antibacterial, antifungal and antioxidant properties. Peppermint essential oil has antibacterial activities because it was contained menthol. Menthol is mostly helpful to cure digestive system disorders including: stimulation of bile flow, reduces the tone in the esophageal sphincter, facilitates belching and has antibacterial properties. Furthermore peppermint commonly used as a local anesthetic agent in cold and cough preparations and in liniments for insect bites, eczema, poison ivy, hemorrhoids, toothaches and musculoskeletal pain. This benefit of medicinal plant is due the presence of phytochemicals active components including vitamins, flavonoids, terpenoids, carotenoids, cumarins, curcumins, lignin, saponin, plant sterol and etc. Peppermint is one of the oldest and most highly regarded herbs for appeasing digestion and may also restore digestive efficiency. In addition, peppermint has been known as disorders improving including: analgesic, ulcer, anti-spasmodic, anti-bloat, irritable bowel syndrome or gastrointestinal motility and immune system stimulant and etc. Peppermint essential oil has biological activities such as antibacterial, antifungal and antioxidant properties.

Rosemary or *Rosmarinus officinalis* Linn. (Lamiaceae)

In natural conditions, it can reach from approx. 1 m to even 2.5 m in height. The stems are quadrangular, erect and tend to lignify in the 2nd year. They are densely covered with small needle-like leaves without stalks (sessiles), the leaves are linear with entire slightly revolute margins that are dark-green above. Rosemary blooms from early June to August. The flowers are very small, white or purplish-blue, gathered in terminal racemose inflorescences. Rosemary is cultivated in the Mediterranean region, as well as in the former Yugoslavia, along the Black Sea coast, in the USA and in Mexico. It is best planted in a sunny position and must be protected from cold winds (mainly in temperate climate zones). Rosemary is an aromatic herb surrounded by tradition and legends but with important culinary, medicinal and cosmetic properties. In folk medicine it is used to stimulate growth of hair as a rinse. The most important constituents of rosemary are thought to be caffeic acid and its derivatives such as rosmarinic acid these compounds have antioxidant effects (Aruoma *et al.*, 1996). The characteristic flaking and scaling of the scalp experienced by dandruff sufferers suggests that the desquamation process is impaired. Dandruff is also associated with a dramatic decrease in free lipid levels, with significant decreases in ceramides, fatty acids and cholesterol. Rosemary is claimed to be a conditioner for greasy hair, a rinse and a tonic that gives body and sheen to hair and infused fresh or dried rosemary and sage can be used as a daily rinse for dandruff treatment.

Garlic or Allium sativum (family: Liliaceae)

Garlic is a perennial bulb, thought to be indigenous to Central Asia, Siberia and west of the Himalayas. Garlic is a common food for flavor, spice and it is one of the herbs most commonly used in modern folkloric medicine. It has a tall, erect flowering stem that reaches 2- 3 feet in height. The plant has pink or purple flowers that bloom in mid to late summer. The part used medicinally is the bulb. It has been used since ancient times as a vegetable with many properties, including antiseptic, tonic, antioxidant, antiinflammatory (Agiga and Seki, 2,000), antibacterial and antifungal effects (Ankri and Mirelman, 1999; Hughes and Lawson, 1991). Garlic should not be placed directly on the skin since it may cause blisters and a burning sensation

in some people or contact dermatitis and allergic reactions in others (Siegers, 1992).

Alliin is an odorless sulfur containing chemical derived from the amino acid cysteine. When garlic bulbs are crushed, Alliin is converted into another compound called Allicin. Allicin is further broken down to a compound called Ajoene which may be the substance that inhibits blockage in blood vessels from clots and atherosclerosis. Allicin (released when crushed) an amino acid which gives Garlic its strong odor and is responsible for the powerful pharmacological properties of the plant. It contain Germanium, Magnesium, Selenium, Vitamin, Vitamin C. Volatile oil of which about 0.5% is composed of Sulfur-containing compounds Zinc. It also contain 65% water, 28% carbohydrate, 2.3% organosulphur compound and 2% proteins

Brahmi (Bacopa monnieri)

It is a non-aromatic, perennial and creeping herb has been praised in Ayurvedic and traditional medicines across the world for generations (Khare, 2003). The leaves of this plant are succulent, oblong and 4–6 mm (0.16– 0.24 in) thick. Leaves are oblanceolate and are arranged oppositely (opposite deccusate) on the stem. The flowers are small, actinomorphic and white, with four to five petals. Its ability to grow in water makes it a popular aquarium plant. It can even grow in slightly brackish conditions. Propagation is often achieved through cuttings. Bacopa is a medicinal herb used in Ayurveda (Dhanasekaran *et. al.,* 2007). Bacopa monnieri was initially described around the 6th century A.D. in texts such as the Charaka Samhita, Atharva-Veda, and Susrut Samhita as a medhya rasayana–class herb taken to sharpen intellect and attenuate mental deficits. The leaves of the brahmi plant can be chewed (only 2-3 at a time) in order to relieve stress and anxiety. The active ingredients in this herb can affect hormonal balance in the body and positively impact the balance of stress hormones in our body, thereby inducing a calm, relaxed state in a natural way, avoiding the side effects of traditional pharmaceutical options for stress and anxiety relief (Pravina *et. al.,* 2007). When the leaves of the Brahmi plant are rubbed topically on affected parts of the body, the compounds released can reduce swelling and eliminate irritation, as well as inflammation inside the body as well. This is ideal for people suffering from arthritis, gout and other inflammatory conditions (Singh and Dhawan, (1997). The antioxidants contained in brahmi are essential for promoting a healthy lifestyle. Antioxidants can eliminate free radicals, the dangerous by products of cellular metabolism that can cause cells to undergo apoptosis (cell death) or mutate into cancerous cells. These free radicals affect everything from our skin to our cardiovascular system, so a regular dose of brahmi in a daily or weekly diet can help to maintain a high quality of life and a healthy metabolism

Conclusion

The herbal products today symbolise safety in contrast to the synthetics that are regarded as unsafe to human and environment. Although herbs had been priced for their medicinal, flavouring and aromatic qualities for centuries, the synthetic products of the modern age surpassed their importance, for a while. However, the blind dependence on synthetics is over and people are returning to the naturals with hope of safety and security. The bioactive compounds of these plants play important role in immunity boosting as well as addressing healthcare issues in covid conditions.

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Preservation of Seeds of Local Landraces: A Step to Preserve Culture, Boost Nutrition and Protect the Environment

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Introduction

India has a predominantly huge agricultural sector. While the sector's contribution to Gross Domestic Product (GDP) has halved in the past 30 years to around 15 percent, it employs around half of India's human resources and accounts for much of the precariousness in Indian GDP. India has the second largest area of arable land in the world and is a major producer of a number of agricultural products. Escalation in agricultural output over the past three decades has been strong and significantly, crop production has been able to broadly keep pace with the demands from an increasing population. The introduction of high-yielding seeds (such as improved strains of wheat) from the mid 1960's and the augmented use of chemical fertilizers epitomized what became known as the 'green revolution'. Wheat production improved by nearly 150 percent between the mid 1960's and mid 1970's and the country became self-sufficient in grain production by the end of the 1970's. The enhancement in agricultural production boosted rural incomes while also causing food prices to fall overall reducing rural poverty.

Need For Local Landraces

Initially after introduction of hybrid seeds or HYV seeds gave good production despite the fact that demand for chemical fertilizers increased year by year. Again, these crops engrossed more pests forcing farmers to get chemical pesticides from the market to protect their crops. So, every year the farmer had to expend more to grow such crops. In order to ensure more yield, the government provides high yielding variety seeds to the farmers. But, farmers found these seeds to be highly sensitive to the climate with less ability to survive even minor climatic disturbances, a dry spell if there is no or scanty rain in the beginning of the season, the stem of the plants rot if there is more rain causing water logging in the fields in the middle of the season, in a drought-like situation they all wither in the field. In any case, the farmer repeatedly is the loser. Over the last few decades, with inconsistent rainfall and changes in weather patterns, production has dropped and become vague with more years of crop loss despite required speculation on labor, fertilizer and pesticides.

Moreover, much of the bio-diversity is lost from the food system due to high-yielding hybrid seeds pumped by the corporate and money-making organizations. Rapid commercialization of agriculture has led to the promotion of a few commercial crops at the expense of local crops, ensuing in the virtual extinction of nutritional biodiversity. Though Hybrid seeds amplify production for a shorter duration but in the long run it cannot stand extreme weather conditions, new pest or disease because HYV seeds, which

entered Indian fields during the green revolution, are less resistant to droughts and floods and need efficient management of water, chemical fertilizers, insecticides and pesti-cides. Some data also indicate that diseases like cancer, skin diseases and lifestyle diseases may be caused by eating food loaded with pesticides. There is every chance that not only urban dwellers, but rural poor will also be affected by these diseases as use of pesticides and chemicals is increasing in remote villages.

Living in upland regions, most farmers of the region depend solely on rainwater for all agricultural activities. "Moved by the situation, elderly farmers thought of abandoning HYV seeds and returning to their own traditional seeds.

Traditional or indigenous seeds, on the other hand, are produced or grown naturally in a particular country, area under a certain climate. Local and endemic crops that have evolved over time are a rich source of nutrition. There is a need to do characterization of seeds and segregate them based on their yield, climate elasticity and pest pliability; this will persuade farmers to use indigenous seeds. These seeds are preferred and managed by the indigenous people in the local growing environment. They are hardy, pest-resistant, withstand unfavorable conditions in the area of their origin, require less water and nutritional inputs, fit in better in the organic method of farming and may even have special characteristics such as nutrition, fragrance or color. The conservation of these indigenous seeds is very important to develop self-sufficiency and ownership of the farmers over their seed and its production.

Cultivation of indigenous crops has the potential to make agriculture climate smart, genetically diverse and sustainable. The most important benefits of local landrace crops are their field resistance to different prime pest and diseases, they are highly adapted to the climatic conditions of the land. Responsive to organic methods of agriculture, these crops are resilient to disturbed weather events and climate variability,

Initiatives for Promoting Native Seeds

Government has a policy to promote conservation of the seeds of native Indian varieties of various crops and trees. The National Bureau of Plant Genetic Resources (NBPGR) has conserved 94,609 native Indian varieties of diverse crops and trees in Gene Banks situated in different States.

The Protection of Plant Varieties and Farmer's Rights Authority (PPV & FRA) has also registered 1896 native Indian varieties of different crops enabling the farmer to commercialize these varieties. PPV & FRA encourages the community and individuals betrothed in conservation, improvement and preservation of plant genetic resources of economic plants and their wild relatives particularly in the areas identified as agro-biodiversity hotspots by awarding the community and individuals who have played astral roles in such activities.

But, by this time, these farmers had already lost most of the indigenous seeds. Somehow, the farmers jointly have collected certain varieties of indigenous paddy and grams seeds. The seeds were distributed among the farmers with the objective of conserving local landraces, restoring soil quality and local ecosystem. The tradition of exchanging indigenous seeds has become a part of the seed festivals observed by the farmers.

Farmers spread over various tribal hamlets are now growing about 100 varieties of indigenous food crops by adopting their traditional organic and crop diversification methods.

In order to ensure availability of native seeds and improve their usage by farmers Indian Council of Agricultural Research is developing high yielding and multi stress tolerant varieties of different crop including cereals, millet, pulses, oilseeds and fruits suited to different agro-climatic condition. In the last seven years, 1956 improved varieties have been developed out of which 924 of cereals, 291 of oilseeds, 304 of pulses, 239 of fiber crops, 118 of forage crops, 64 of sugarcane and 16 of under-utilized crops. In addition, 288 varieties of horticultural crops have been developed.

In order to enhance indigenous species of trees, this Department is implementing Scheme called Sub-Mission on Agro-forestry since 2016-17 to encourage and expand tree plantation. Prominent tree species including indigenous tree species like Indian rosewood, Teak, Eucalyptus, Malabar Neem, ailanthus, Poplar, etc., are promoted for plantation on farm land along with other species.

Department is providing assistance for seed production and distribution under various existing Schemes

- National Food Security Mission
- National Mission on Edible oil-oil palm
- Rashtriya Krishi Vikas Yojana
- Mission on Integrated Development of Horticulture
- Sub- Mission on Seeds and Planting Materials.

Methods Adopted For Storage of Seeds

The important traditional storage practices commonly followed by the farmers and tribes in India.

S. no	Method of traditional storage
1.	Sun drying of grains
2.	Use of ash
3.	Red soil coating method
4.	Plastering of storage bins with clay and cow dung
5.	Storage of pulses with common salt
6.	Turmeric application method
7.	Use of garlic cloves
8.	Mixing of leaves
9.	Stepping method or Stamping method
10.	Use of salt and chilli powder
11.	Use of Neem (Margosa) leaves
12.	Use of Neem (Margosa) leaves and dry chillies
13.	Use of Neem Oil /Margosa oil
14.	Use of camphor
15.	Use of castor powder
16.	Sand mixture method
17.	Use of dried red chillies
18.	Use of lime powder
20.	Use of matchbox
21.	Fumigation of the godown /store rooms
22.	Use of Neem (Margosa) seed powder
23.	Use of ginger rhizome
24.	Use of custard apple seed powder and
25.	Use of Tulsi (basil) seeds.
26.	Use of silica and lemon juice, one can prevent seeds from the insect.

A Long Journey to go a head to get Optimum Results

The need of conserving indigenous seeds which are getting extinct day by day farmers need to follow certain processes before sowing indigenous seeds in their fields – these include segregation, proper storage and testing of seeds before sowing on their field. Sometimes, due to fungus, farmers do not get the expected yield. If

farmers choose the right variety of indigenous seeds even if the yield is less, they can sell it at a premium price. One of the best methods to conserve seeds is seed selection. Because the price of organic food is higher than conventionally farmed food, he said. There are specific indigenous seeds proven to give more yield than hybrid seeds.

When farmers sow hybrid seeds, government provides subsidy for water, electricity, tractor, fertilizer, weeder, fuel and pesticide. But there is no subsidy for sowing indigenous seeds. To encourage the farmers, government needs to support them."

Community seed fair and seed exchange must be organized at large scale. It provided a greater platform for different farmers from different communities to interact and share their challenges and learn the adaptation and conservation techniques from each other. It is through this seed fair farmers will be able to revive and bring back the indigenous seeds into life. While adopting the seed-saving techniques, tribal women have also been holding seed swapping events to fulfil the need for climate-resilient seeds and make the farmers ready to face an emergency situation.

Conclusion

Ecological farming practices need to be strengthened and if farmers follow proper procedure in selecting indigenous seeds and practice organic farming, it will increase productivity and have a positive impact on soil health, biodiversity and human health. The indigenous seed varieties are inherently compatible with the local farming conditions and are economically practical and environmentally more sustainable than the high-yielding varieties being used in agricultural fields. Besides, these seeds are pest-resistant and require a very limited use of chemical pesticides. Cultivation of indigenous crops has the potential to make agriculture climate-smart, genetically diverse and sustainable. Local landrace crops are resistant to different prime pest and diseases and are highly adapted to the climatic conditions of the land.

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Aquaponics: A Sustainable Approach to Vegetable and Fish Production

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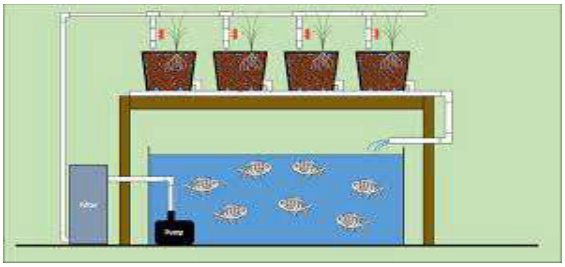
Introduction

Aquaponics is a system of farming which involves aquaculture and hydroponics in combination i.e., raising of fish and soil less plant culture. It is a method of farming in which both fish and vegetable crops to be raised sustainably. It is a type of indoor farming with less land, labour and water. It involves a cycle in which toxins produced from the fish waste converted into nutrients with the help of some beneficial bacteria. These nutrients are then absorbed by plants and help in water filtration and maintain livable environment for the fish. This is purely organic method of farming as there is no use of fertilizers because fish waste is used as nutrient for plant growth and development. It requires less land and grown large quantity of plants in small area. It is a sustainable method to grow fresh fish and vegetables year round in any climate.



Aquaponics System (Fish + Plants+ Bacteria)

History of Aquaponics

With the rise in population aquaponics system gaining popularity day by day. The word Aquaponics was first comes from ancient civilization, around 13th century. The Aztec civilization was the first to utilize aquaponics. Many countries around the world have started using this method of farming including USA, Asia, Africa, South America, Australia. Many educational, commercials or private organizations, Non for profits are using this method of farming.

India's first Aquaponics village

Cherai is a small village near Kochi in Kerala was become the India's first aquaponics village in 2016. Pallipuram Service Cooperative Bank (PSCB) launched aquaponics project here with the objective of helping farmers and to grow chemical free produce. In collaboration with MPEDA bank gave financial support and guidance to the farmers of Cherai. After a year of the project number of people taking interest and now more than 200 aquaponics unit running and the initiative expanded as 'Cherai Aquaponics Gramum.'

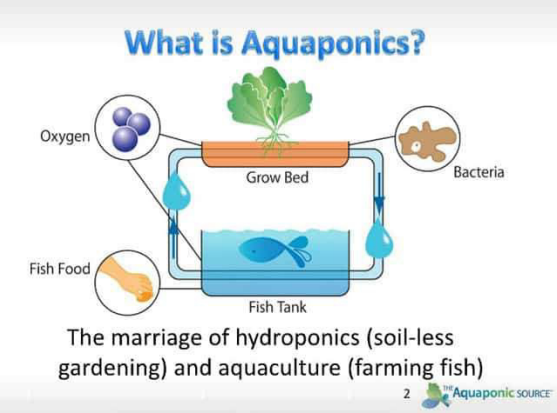
Important Components of Aquaponics

There are three components of Aquaponics viz., fish, plant and bacteria.

a. Fish: Barramundi, catfish, silver perch, Murray cod etc are the important fishes which are used in aquaponics but Tilapia is the most common species of fish which have ability to tolerate variable water and crowded condition.

b. Plants: Generally leafy crops like lettuce, greens & herbs are used but other vegetables like chilies, cucumber, tomatoes, kale, Chinese cabbage are also grown in aquaponics.

c. Bacteria: In aquaponics, for good nitrification two bacteria are very important: Nitrosomonas- Helps in transforming ammonia into nitrites. Nitrobacter- helps in transforming nitrites into nitrates.



Basic Requirements

a. Fish tank
b. Air pump
c. Fish feed
d. Ph balancer
e. Water

Advantages

- Helps in maintaining a natural cycle between plants & fish.
- It is eco-friendly, sustainable, efficient and highly productive method of farming.
- It grows 7-8 times more food per acre by using 1/6th of water.
- All natural fertilizers are obtained for plants from fish waste.
- This method of farming is free from harmful chemical pesticides, fertilizers and herbicides.
- There is no fear of any soil borne disease due to soilless farming.
- There is a continuous production of fish and vegetables.
- It is a year round production system in any climate.
- This system of farming ensures growth hormone & antibiotics free fish production.
- Plants thrive well due to the presence of biomass in fish tank.
- There is an efficient use of resources with less wastage.

Disadvantages

- It requires professional knowledge for raising plants fish & bacteria.
- Special care is required to the fish tank, any loss in the tank can affect plant production.
- Limited crops can grow in the system.
- High set-up cost.
- 24x7 electricity required for water circulation in the tank.

Design

There are five key components to set up any aquaponics system

A. Rearing Tank: There are three types of rearing tanks

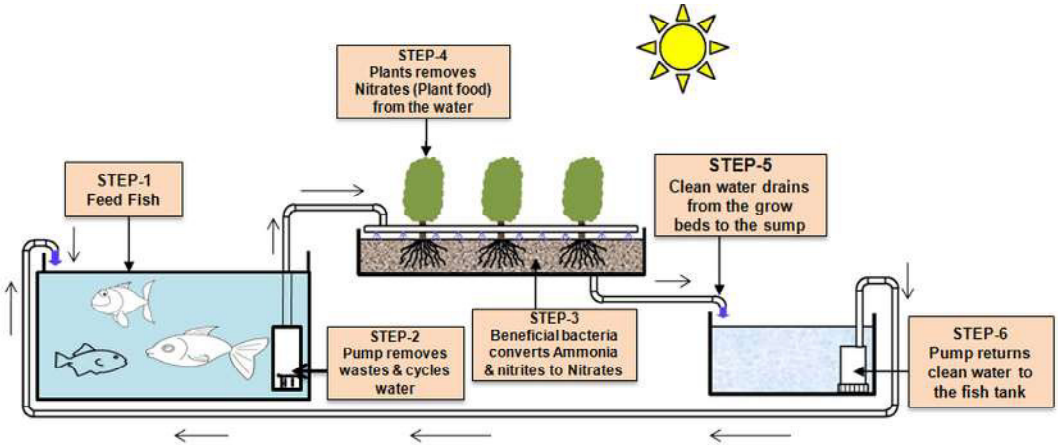
a. Sequential Rearing- It includes fishes of different age group in a single pond.
b. Stock Splitting- In this method, fishes are reared into two different tanks randomly.
c. Multiple Rearing- In this method, rearing starts from different age groups and when fish becomes large enough, they are transferred to larger tanks.

B. Solid Removal: It represents the amount of organic waste produce in the system. A solid removal device is used if fish produces more waste which maintains the number of plants in the system. Eg., Micro screen drum.

C. Bio-filters: The most important part of aquaponics is the removal of ammonia which is excreted as waste from fish. Ammonia nitrification is important as ammonia kills the fish. During nitrification, ammonia get oxidized to nitrite & then to nitrate. Bio-filters are used to maximize the bacterial growth in aquaponics. These are constructed from sand, perlite or gravel.

D. Hydroponics: In aquaponics system, plant roots are immersed in nutrient rich water. Hydroponics system is important to filter out ammonia which is harmful for fishes. Water after passing from this system becomes cleaned and returned to the aquaculture vessel.

E. Sump: It is the place where water is pumped back to the rearing tank.



Conclusion

Aquaponics is an eco-friendly system of producing quality and quantity of produce in a sustainable manner. When compare to traditional method of farming it uses less quantity of water with easy run. There is no use of any harmful chemicals in this system of farming. The produce obtained from this method are rich in nutrients and have no risk of any health & environment related issues. It is important to look towards better food production methods. If today we are not aware about current situation of food production then it will affect our future and we may see downfall in environment, health & agriculture industry as we are using harmful chemicals. Now a day's food security is a big issue and we have lots of ways to fix this issue but in my opinion aquaponics is the new efficient & eco-friendly method of farming which suits the entire climate and to satisfy the needs of people around the world.

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Role of Robotics in Horticulture

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Introduction

With the rapid increase of the human population in the next few decades, there is a high demand for more food production. To meet demand and increase crop productivity, mechanization plays a keyrolein sustaining the needs of a growing population. As the world farming people are moving toward emerging trends and adopting the newly invented machine, robotics, can overcome the lack of human resources to carry out farm activities and elevate productivity in both yield and quality parameters. Even robotics helps in increasing the export potential and standards of production. Thus, knowing the role, function, performance, and availability of robotics in horticulture will significantly impact farming and related activities. In 2016 the robotics market size in global agriculture was $2,927 million. In 2023 estimated at $11,050. CAGR is forecasting from 2017 to 2023 is 21%. (Allied Market Research, (2022)https://www.alliedmarketresearch.com). Thus, there is a higher scope for manufacturing and utility in the agriculture and horticulture sectors.

Why is robotics needed?

Although the machines in the farming sector are not new aspects, farmers are more familiar with some of them, such as tractors, puddlers, sprayers, seed extraction, processing equipment, etc. Major constraints in the upcoming farming community are the unavailability of labourers and skilled workers for farm activities. To replace the labour needs for farm activities, robotics plays a significant role. Though robotics will rule the future farming sector, human still remains the mastermind or the programming engineer behind developing the robotics.

Robotics function

Robotics is human-operated or programmed machines to perform the activities. Based on the type of work they perform, they are classified as harvesting robotics (used for the automatic harvest of produce), plant management robotics (maintaining the field by doing some intercultural operations like weeding, spraying), plant protection robotics (identifying the pest and disease infestation in crops), and miscellaneous robotics.

Fig 1: (1 & 6), Harvesting, (2) Weeding 3 & 4. Spraying 5. Crop inspection

Table 1: Robotics in Different Horticultural Crops (Fountas *et al*., 2020)

S. No	Crop	Purpose	Type of sensors	Remarks
1.	Potato, Beetroot, Grapes. Tomato	Weed detection	Webcam, solid-state gyroscope, Hall sensors, Electromechanical sensors.	98% accuracy
2.	Bell pepper, Tomato, Strawberry	Disease and insect detection	RCB camera, laser sensor, multispectral camera	72;95% accuracy
3.	Apple, Cheery, Strawberry, Tomato, Cherry tomato, Melon, Watermelon, Eggplant	Harvesting	Stereo camera, RGB camera, Proximity sensors, Vacuum sensor, High-frequency light, VGA(Video Graphics Array) class CCD camera	50-85% accuracy

Commercially available Robotics

- Harvey for capsicum picking (Harvey – Robotic Vision Legacy Jam https://www.roboticvision.org/legacy-jam/project/harvey/)
- AgBot11for crop and weed management (Robotic Vision Australia
- https://roboticvision.org/)
- LYRO Robotics (LYRO Robotics – LYRO https://lyro.io/author/lyro/)
- Diverscofor the strawberry industry (Robotics | Diversecohttps:/diverseco.com.au/robotics/)
- Lely for the Dairy industry(Lely Global - Lely https://www.lely.com/)

Pros of robotic technology

- High level of accuracy
- Time management
- Improve productivity
- Better performance
- Long-lasting and consistent

Cons of robotic technology

- In adequately skilled labour
- The initial investment is high
- Unaware among farmers
- Need regular maintenance

Conclusion

As India is advancing in science and technology, it becomes imperative to modernize the agriculture and horticulture sector of the country as well. Agriculture mechanization plays a key role in the future economic growth of the country. There is a great push from the Indian government to promote mechanization in agriculture. One of such promotions is Sub-Mission on Agricultural Mechanization (SMAM) which provides subsidies for drones and other mechanical instruments. Our article will add up the knowledge dissemination on the use of drones and the modernization of agriculture and allied sectors.

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Effect of Sulphur Nutrition on Crop Production in India

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Introduction

Oilseeds constitute the second major agricultural crop in the country next to food grains in terms of tonnage and value. According to an estimate, 68 m ha of cropped land is suffering from S deficiency in India (The Financial Express, 2006), needing 2.3 million tons of S fertilizers. However, only 0.7 million tons of sulphur is used in the country. The benefit of system based S management is that it enables the distribution of this nutrient among the component crops as per their requirement and also aims at taking residual effect into account while making recommendations to the farmers. Besides primary nutrients calcium and S also plays an important role in enhancing production and productivity of different crops. Sulphur is very crucial for the formation of S containing amino acids and oil synthesis. Development of modern agricultural technology has attracted the attention of scientists on S nutrition owing to cultivation of high yielding varieties, adoption of intensive cropping systems particularly involving oil seeds and pulses, use of high analysis fertilizers and decreased usage of organic manures (Jaggi, 2004).

Deficiency symptoms of sulphur in different crops

Role of S in Indian agriculture is now gaining importance because of the recognition of its role in increasing crop production, not only of oil seeds, pulses, legumes and forages but also of many cereals (Singh *et al.,* 2000). S deficiency in crops is gradually becoming widespread due to continuous use of S free fertilizers, high yielding crop varieties, intensive multiple cropping systems coupled with higher productivity. Plant nutrient S uptake is generally 9-15% of N uptake and similar to P uptake for several crops, but some leguminous and cruciferous crops take up more S than phosphorus. Among the different crops, S requirements of oilseeds are higher as compared to legumes, cereals and pulses, because of the critical role played by the S in the synthesis of oils and production of grains essential for oil production (Havlin *et al.,* 2004). S content in plant depends upon the growth stages and plant parts, besides crop species. Its concentration is higher in seeds/grains than in straws at maturity. In most of the crop species, the critical limits of S is 0.20-0.25% below which crops generally show deficiency symptoms and respond to application of S fertilizers. The response of different oilseed crops, cereals and legumes to application of S has been reported from a number of states in India. The transformation from traditional internal input based agriculture to the present day external input-based agriculture has caused wide spread deficiency of the element. It is becoming deficient particularly in the areas where crop is intensely cultivated with the use of S free fertilizers (Basak *et al.,* 2002). In early 1990s, S deficiencies in Indian soils were estimated to occur in about 130 districts (Tandon, 1991). At present, deficiency in soils of various Indian states varies from 5 to 83% with an overall mean of 41% (Singh, 2001). A timely and precise appraisal of S deficiency is necessary for monitoring and identifying deficient areas for taking prompt and appropriate corrective measures to obtain the best crop yields as well as

to increase the fertilizer use efficiency and better return from other costly inputs.

Immobilization and mineralization of sulphur

Sulphur is considered to be essential element for both flora and fauna, which is continuously being cycled between organic and inorganic forms in soils. The nature of the compounds formed and their transformations are strongly influenced by biologically mediated processes, which in turn are affected by environmental conditions. More than 95% of the total S in most aerobic soils occurs as organic S. But organic S is unavailable to plants and must be converted to inorganic S=SO4-2 before plant assimilation. Plants absorb S mainly in the form of inorganic sulphate (SO4-2) ions through the roots, thus sulphate S must be present in soils in sufficient amount in order to meet crop S requirements (Brady & Weil, 2002). Insufficient availability of S to crop plants not only declines their growth and yield but can also deteriorate nutritional quality of the produce (Hawkesford, 2000; Schonhof *et al.,* 2007). Sulphur fertilization may be needed to optimize yields of crop plants which grow on S deficient soils. Requirement of S strongly differs between crop species. Crucifers, which contain high amounts of the glucosinolates, have a high S demand (schnug *et al.,* 1990). In general, oilseed plants have also a high S need (Tandon, 1986; Kanwar & Mudahar, 1985). Sulphur fertilization has been shown to increase the oil content in seeds of groundnut (Singh, 1986). Soil characteristics particularly the texture, clay minerals, pH and organic matter may influence the contents of plant available S by controlling the retention and leaching characteristics of highly mobile SO4-2 S in soils (Haneklaus *et al.,* 2002; Biswas *et al.,* 2003). Also the climatic factors such as temperature, amount and distribution of rainfall in the area can affect the contents of sulphate S in soils either through the addition of S from atmosphere, controlling the rate of organic S mineralization or facilitating leaching losses of sulphate ions (Brady & Weil, 2002). A little amount of S in soils was derived from the weathering of plutonic rocks, sulphides in primary minerals were released and oxidised to sulphate during the weathering process (Whitehead, 1964). Some of the sulphate found its way directly to the oceans in rivers and much of the reminder was incorporated into organic forms by plants or other living organisms or accumulated in the soil as relatively insoluble sulphate salts in semi-arid or arid climates. Some was reduced back to sulphides in anaerobic environments. Soil snow exists in a great variety of forms and oxidation states. Takes part in a variety of chemical and biological reactions, and interacts with the lithosphere, hydrosphere and atmosphere either naturally or as a result man's interference.

Interaction of Sulphur with other nutrients

An intensive agriculture with use of improved cultivars and high analysis fertilization offers conditions of nutrients exhaustion resulting in nutrient imbalance in soils. Fazili *et al.,* (2008) reported that lack of S limits the efficiency of added N, therefore, S addition becomes necessary to achieve maximum efficiency of applied nitrogenous fertilizer. Kowalenko and Lowe (1975) noticed that a high N:S ratio (produced by addition of N) resulted in a decrease in mineralization of S in the soil sample during incubation. Janzen and Bettany (1984) indicated the optimum ratio of available N to available S to be 7:1 Ratios below 7 gave the reduced seed yields. A rapeseed and mustard crop under field conditions recovered 27-31% of added S without N, but 37-38% with 60 kg N ha-1 (Sachdev and Deb, 1990).

Sulphur interacts with phosphorus as phosphate ion is more strongly bound than sulphate, Hedge and Murthy (2005). Phosphorus fertilizer application result in increased of anion adsorption sites by phosphate, which releases

sulphate ions into the soil solution Tiwari *et al.,* (2006). Thus, it may be subjected to leaching if not taken up by plant roots. Studies have indicated both synergistic and antagonistic relationship between sulphur and phosphorus but their relationship depends on their rate of application and crop species Marok and Dev (1980); Sinha *et al.,* (1995). Synergistic effect of applied P and S was observed by Kumawat et al., (2004) for taramira, Kumar and Singh (1980) for soybean, Islam *et al.,* (2006) for rice, Deo and Khaldelwal (2009) for chickpea Antagonistic relationship between P and S was observed in moong and wheat by Islam *et al.*, (2006) and in lentil and chickpea by Hedge and Murthy (2005).

Conclusion

The productivity of crops in India remains very low because of low consumption of S fertilizers and a large propagation deficit. The transformation from traditional internal input based agriculture to the present day external input-based agriculture has caused wide spread deficiency of the element. The sulphur requirement of crops can be met by a number of S-containing materials, such as gypsum, phosphogypsum, S elements, pyrite and iron sulphate. It can also be added with fertilizers containing primary nutrients such as ammonium sulphate, SSP, potassium sulphate, etc.

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Pre Harvest Bagging for Quality Improvement in Fruit Crops

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Introduction

Bagging is a physical protection technique, which improves their visual quality and also reduces the occurrence of fruit cracking and changes the Micro environment for fruit development. Bagging affects the size and the weight of Fruits, e.g., Apple, Banana and Pomegranate. The increase in temperature inside bagging results in improving fruit size. The bagging technique was invented in Japan. The first bags they used were silk.

The bagging technique, which was first utilized in Japan in the 20th century for pears and grapes, is now widely applied in Asian countries (Japan, China, Korea), Australia and the USA, protecting fruits from the surrounding environment (mainly from light and pathogens, then stresses related to temperature, water/ humidity and air movement) with a sort of shield—a physical barrier around the fruit. In fact, bagging consists essentially of enclosing a young fruit in a food bag by capping the bag with a ribbon or a clamp on the fruit stalk. Isolating the fruit from the external environment protects it during development from mechanical or biotic damage, especially in regions where fruits are prone to attacks by fungi, bacteria, insects and even birds

How to bag a fruit?

- Blow in the bag to inflate it.
- Remove some of the fruits, leaving 1 on each cluster.
- Insert one fruit per bag then close the bag using coconut midrib or firmly tie top end of bag with string or wire.
- Push the bottom of the bag upwards to prevent fruit from touching the bag.
- Use a ladder to reach as much fruits as possible. Secure the ladder firmly on the ground and for bigger and higher fruits trees, secure or tie the ladder firmly on big branches.

Bagging Hard-Fleshed Fruits

- Thin fruits when they reach the size of a dime or nickel. Choose the strongest fruit in each cluster, typically the one with the thickest stem. Use clean, sharp shears to remove the rest of the fruits from the cluster. Do this in February or March, before the arrival of pests such as codling moths.
- Cut 1/4 inch off each of the two bottom corners of a plastic bag with scissors. This will facilitate drainage when rainwater gets into the bag.
- Poke a young fruit into the plastic bag, just far enough for it to clear the zip seal. Move the stem of the fruit against the closed half of the seal. Zip the other side of the seal tightly closed, right up to the fruit stem. Move both sides of the seal as close to the stem as possible. Staple over the zip seal, close to the fruit stem on both sides.

Bagging Soft-Fleshed Fruits

- Thin the fruits, leaving one in each cluster in very early spring before fruit pests become active.

- Poke your finger into the centre of a nylon footie. Stretch it slightly so, the fruit can nestle loosely inside the depression. Nylon footies are used in stores for trying on new shoes. Bagging for soft-fleshed tree fruits such as Plums, Peaches, Persimmons, Nectarines and Apricots which rot easily from retained moisture in plastic bags.
- Settle the fruit into the depression in the footie. Gather the ends of the footie just above the shoulders of the fruit. Secure to the stem with a wire twist tie.
- Toss the footies in a hot load of laundry with mild soap if you wish to reuse them next season. Tumble dry on the highest heat setting. Most of the footies will shrink back to their original size and shape from high heat.

Bagging material

- Paper bags (Black and Brown)
- White-coated bags
- Net bags
- Spun-bound light-yellow fabric bags
- Plastic boxes
- Leaves (e.g., Banana)
- Cellophane or fabric bags
- Orange and black bags for better skin colour
- Black or blue polyethylene bags
- Transparent polypropylene micro-perforated bags

Effects of Bagging on Fruit

Bagging technique is used specifically to enhance fruit appearance and quality, especially in Asia. There are different types of bags/bagging material. Initially, newspaper bags were used to wrap fruits to prevent damage from pests and diseases in Korea, but around 1985, artificially manufactured bags were introduced. Though the bag production cost is high and the practice labour intensive, bagging with new materials has shown excellent results. A bag around a fruit controls sunlight, temperature, humidity, evaporation and mechanical damage. Bagging may also regulate harvesting time and it can control pest attacks, especially fruit flies, minimizing residues of pesticides which is particularly important during the rainy-season. Thus, bagging is an excellent method to yield fruits with a very low input or residues of pesticide. In addition, bagging is able to promote the production of high-value organic fruits.

Physiological factors influenced by fruit bagging

- Fruit size and fruit weight
- Fruit ripening
- Fruit appearance
- Fruit colour development

Biotic factors influenced by fruit bagging: Pest control

- Pest control
- Disease control
- Bird damage

Biochemical factors influenced by bagging

- Physiological disorder
- Fruit nutrient concentration
- Eating quality of fruit
- Enzyme activities

Bagging of Different Fruit Crop

Mango: Mango fruit bagged with single white bag had highest contents of vitamin C, titratable acids, soluble solids, sucrose, glucose and fructose. Single white bag could be a promising practice for mango production.

Banana: Banana bunch protections by sleeving/bagging are used throughout the commercial banana growing areas of the world. Banana fruit protection bags also are known as banana ripening bags, banana bunch covers and

banana sleeves are used during the commercial banana growing areas of the world. Bunch covers are typically made of thin plastic (low density polyethylene; 5 to 40 microns) and are 81.3 to 91.4 cm (32 to 36 inches) wide and range in length from meters (3.3 to 5 feet).

Bagging which are used in Banana

Transparent bags: Transparent covers treated to block ultraviolet and infrared rays.

Blue polyethylene bags: Banana production regions mostly use blue covers as they let in the heat without causing sunscald because it blocks UV rays.

Half blue and half-silver plastic bags: These bags are half-blue plastic and half silver to reflect heat and are used with the silver colour facing the sun and the blue side closest to the "trunk".

Bagging and finger filling in banana

Apple: Covering apple fruit with paper bags, increased levels of Anthocyanin one month after flowering. Studies revealed that bagged apples had a fairly higher level of soluble solids and ascorbic acid content at harvest than non-bagged apples. Preharvest fruit bagging in apple influences fruit colour and quality of apple. Bagged fruits showed lower CA and lipoxygenase (LOX) activity at harvest.

Bagging in Apple

Litchi: Bagging of litchi fruit reduced the incidence or attack of birds, anthocyanin moths, and fruit flies. Fruit bagging is a good technique to maintain a physical separation between the

Polypropylene bagging in litchi

environment and the produce. Bagging in litchi reduced the direct penetration of light and also prevents sun burn of fruit cover or surface and improves the fruit colour. Bagging maintains the purity of cultivars of litchi.

Guava: Fruit bagging of guava was found maximum under yellow polythene, but maximum vitamin C content was recorded under white polythene. This technology was used in guava to get spotless fruit in the bagged ones. Covering with a two layers bag when fruit diameter reaches 2-3 cm helps reduce damages caused by diseases and insects.

Bagging in Guava

Merits of Bagging in Fruit Crops

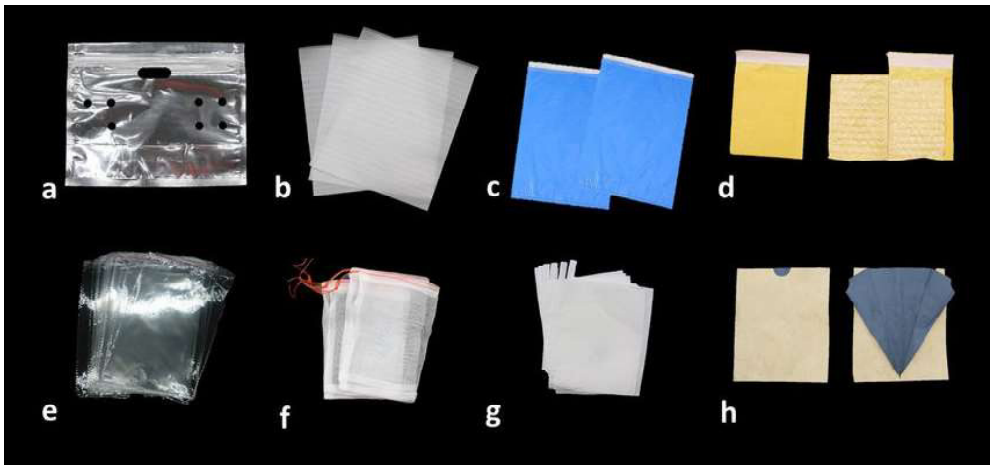
- Bagging reduces residues of pesticides, improves eating quality
- Bagging improves the appearance of fruit significantly, which helps in getting a good price in the market.
- It provides a cent percent control of fruit fly and bird damage.
- It is an environment-friendly technology, the paper bags are recyclable.
- Fruit bagging can be an integral part of organic fruit production.
- It can protect the fruit from sunburn of the skin, good way to eliminate fruit cracking.

Demerits of Bagging in Fruit Crops

- It requires a lot of labour and its quite time taking process.
- The method can only be used on fruits that don't need sunlight for their development.
- When using plastic there is a risk of water getting trapped in the bag, which may damage the fruits or promote the growth of fungi or bacteria.

Conclusion

We conclude that pre-harvest fruit bagging is a simple, grower-friendly technology which is safe to use and has several beneficial effects on the physical appearance and quality of fruit. Furthermore, it is the safest approach to protect fruit from insect pests, diseases and other disorders. This approach is an integral part of fruit production in some parts of the World. It is a laborious process and needs the development of biodegradable bags which decompose after use. Moreover, we need to standardise specifications for the type of bag to be used, the date of bagging, and the date of bag removal for growers to benefit from this technology.



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Importance of Forest Vegetation on Climate Change

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Introduction

Climate change is very much concerned issue in our world today. It is very important to understand and to know about the changes of the climate of this planet. How to solve, how it happen and what are our mandatory duty as a citizen of the planet. Climate change is a change in the usual weather found in a place. This could be a change in how much rain a place usually gets in a year. Or it could be a change in a place's usual temperature for a month or season. Climate change is also a change in Earth's climate. This could be a change in Earth's usual temperature. Or it could be a change in where rain and snow usually fall on Earth. Weather can change in just a few hours. Climate takes hundreds or even millions of years to change.

Forest take a very major important role in our climate change. Forests are protected vegetation and are integral part of our social system. In general context, the sacred forests is a piece of land associated with local deities, rituals and taboo.

Each forest systems are unique with regards to cultural and ecological aspects.

Forest help lean the air we breathe, filter the water we drink and provide habitat to over 80% of the world's terrestrial biodiversity. Forests provide jobs to over 1.6 billion people, absorb harmful carbon from the atmosphere and are key ingredients in 25% of all medicines. Other than that tree help to firm the soil and prevent from lot of crisis such as soil eroison, landslide, mud flow etc.

Benefit of Forest Vegetatation

Forest vegetation, including trees and other plants are extremely important because they benefit animals, air quality, soil quality and water quality. Forest vegetation slows soil erosion by reducing how much water impacts the land. It does this by providing ground cover during rain, slowing down the speed of the water and locking the ground in place with roots. This reduces soil pollution in streams, rivers and lakes, leading to cleaner/clearer water. Ground vegetation in forests also improves how much photosynthetic production the forest can create. Photosynthetic production is oxygen, which is incredibly important to the atmosphere and for living beings (including humans).

Additionally, about half of Earth's animals/ insects live in forests, and forest vegetation incredibly important to the natural functions of these animals. All animals rely on the vegetation for food and protection.

Multiple benefit of forest

Large forests can increase rainfall, which provides more fresh water for the ecosystem.

Tree roots and ground vegetation help the ground absorb water, reducing the effects of floods.

Forest plants can also clean out some pollutants from the soil by isolation or breaking down certain toxins. This helps keep the land clean for plants, animals and humans.

Impact of Forest on Climate Change

Forests cover about 30% of the Earth's land surface. As forests grow, their trees take in carbon from the air and store it in wood, plant matter and under the soil. If not for forests, much of this carbon would remain in the atmosphere in the form of carbon dioxide (CO_2), the most important green house gases driving climate change.

Each year since 2000, forests are estimated to have removed an average of 2 billion metric tons of carbon from the atmosphere. This "carbon sink function" of forests is slowing climate change by reducing the rate at which CO_2, mainly from fossil fuel burning, builds up in the atmosphere. Careful forest management can therefore be an important strategy to help address climate change in the future. Healthy forests also provide a host of other benefits, from clean water to habitat for plants and animals that can live nowhere else.

Over the past 8,000 years, humans have cleared up to half of the forests on our planet, mostly to make room for agriculture Cutting down or burning forests releases the carbon stored in their trees and soil, and prevents them from absorbing more CO_2 in the future. Since 1850, about 30% of all CO_2 emissions have come from deforestation. Deforestation can also have more local climate impacts.

There are three ways to reverse these losses: afforestation, reforestation, and the natural regeneration of forest ecosystems. Afforestation refers to planting forests where there were none before, or where forests have been missing for a long time—50 years or more. Reforestation is planting trees where forests have been recently cleared. Natural regeneration, on the other hand, does not involve tree-planting. Instead, forest managers help damaged forests regrow by letting trees naturally re-seed and through techniques like coppicing, in which trees are cut down to stumps so new shoots can grow.

Forests as a climate solution

There is no doubt that these strategies can help remove CO2 from the atmosphere, but their impact is hard to measure. Even for China, which has done more afforestation and reforestation than the rest of the world combined, there are still large uncertainties about how much carbon these projects are storing.6

Looking at China also shows some of the unintended consequences of large-scale tree-planting projects. In the dry northern part of the country, people have planted trees to fight desert expansion. But because the tree species that were planted were ill-suited to a dry climate, this effort has depleted water supplies and degraded soils. In the south of China, reforestation with monocultures—that is, just one species of tree—has led to loss of biodiversity.7

Natural regeneration of forests, on the other hand, has few unintended consequences and large potential to store carbon over the coming decades. If done worldwide, natural regeneration of forests could capture up to 70 billion tons of carbon in plants and soils between now and 20508—an amount equal to around seven years of current industrial emissions. Combining natural regeneration with thoughtful afforestation

and reforestation is an important option for combating climate change.

Conclusion

Forest have an unbreakable relation with all the biotic and abiotic components of Earth. Not only did the forest give impact on climate change, it also maintains the ecosystem and food chain. The some percent of our planetn iodiversity also depend on the forest; Conserving biodiversity is also an important priority for the human kind. Forest also give revenue from the forest products. Every individual has its duty to conserve forest because the forest help a lot in our environment. The world is sinking and we are all boarding in a sinking ship, now is the time to fix the climate issue or else the sun may fall and never rise again.

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Parsnip- An underexploited Exotic Vegetable

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Introduction

Parsnip (*Pastinaca sativa* L.) is a hardy cool-season root vegetable crop closely related to carrot and parsley. Parsnip comes under the Apiaceae family. In the 14th century, the name "parsnip" was acquired from Middle English as a derivation of the Old French word *pasnaie*, which was taken from the Latin word *pastinaca*, which meant "parsnip" or "carrot." The earlier form of "turnip," "nepe," may have affected the Middle English spelling of "parsnip" ("passenep"). *Pastinaca sativa* is known by many names including parsnip, Chirivia, Grand Chervis, Panais and Pastenade. To bring out its best flavoured potential, it is left unpeeled and boiled. Parsnips are a negligible crop in most developed countries when compared to carrots. Although it is a biennial crop, it is commercially farmed as an annual crop. Its long tuberous root has cream-colored skin and flesh and when matured, it can be left in the ground since it gets sweeter in flavour after winter frost. It was a starchy vegetable of choice before the potato replaced it. It is mostly grown in temperate climates around the world, with a few exceptions in cooler tropics like Eastern and Southern Africa. It's an underexploited crop that the Food and Agriculture Organization doesn't recognise (FAO).

The parsnip develops a thick creamy white root that tapers slightly from the crown and produces an erect stem. It has a distinctive aroma and reaches a height of nearly 1.5 metres (59 inches). The solitary green stem is smooth and hairless, measuring 2 to 5 cm (0.8 to 2 inches) in diameter. Compound leaves are grouped in pairs and have mitten-shaped highly serrated leaflets. The margins of the leaves are highly serrated, and the undersides are lightly hairy. Similar to carrots, the Umbrella-shaped clusters of dark yellow flowers produced in inflorescences at the ends of the stalks. Flowers are unisexual. June – August is main flowering season. For optimum root growth and quality, parsnip needs cool (16–20°C) temperatures and may be sown in the early spring and left in the field all summer, ready to harvest in the fall or the following spring. Its roots can withstand freezing temperatures. The quality of the roots degrades rapidly as the temperature rises and temperatures above 30°C are prone to causing root damage. The crop gets damaged

when the temperature rises above 30°C. Parsnip seeds grow best when the soil temperature is between 10°C and 21°C. Germination is slow in general, even in perfect field circumstances. Germination takes about 14 days at ideal temperature, but it can take up to 4 weeks in freezing conditions. Parsnip has a 35–50 cm average rooting depth, so it thrives well in sandy or sandy loam soils. Deep, loose and fertile soils with good water-holding capacity and pH 6 or above are suitable for the development of long and straight roots. Parsnips are commonly direct seeded. The viability of seeds is generally limited to two years. It requires 3.3-4.6 kg of seeds for 1 ha. Sowing of 2 seeds per inch, ½ an inch deep is desirable. In new muck soils, the crop may be prone to boron deficiency. Because excessive boron deficiency can induce leaves and root tissue collapse, borax can be treated at a rate of 15–20 kg/ha. Parsnips can be grown in a similar way, but as they are larger, they should be thinned to 15 cm

Effects of different mulches on soil temperatures

Mulch colour	Night-time effect on soil	Daytime effect on soil
Clear	warms	warms
Black	warms	warms
White	warms	cools
Aluminum	warms	cools

In addition to controlling weed development, opaque mulches regulate soil temperature. Aluminum mulches are also utilized to disrupt aphid movements and reduce the risk of disease transmission by aphids. All mulches aid in soil moisture conservation and erosion control.

Origin and Distribution

Parsnip is a root vegetable native to Europe. The ancient Greeks and Romans utilized it for therapeutic and culinary uses. Early colonists and Indians grew parsnip after it was introduced to North America in the early 1600s. Because it tastes better after a frost, it is thought to have originated in the Mediterranean region, where it was transferred to the rest of the world by the Romans. Parsnips were extremely important in medieval European kitchens as a source of both carbohydrate and sweetness.

Nutrient Status of Parsnip

Parsnip is low in calories, fat, and sodium, has no cholesterol and is high in minerals, mainly potassium and vitamins. The majority of the B vitamins are present, although vitamin C is lost to a large extent after cooking. Many minerals and vitamins are lost unless the roots are properly peeled or boiled whole, because they are found near to the epidermis. Furano and coumarin are chemicals found in parsnip roots and leaves that can cause skin irritation. It also includes antioxidants and dietary fibre, including cellulose, hemicelluloses, and lignin.

Table: Nutritional Composition of Parsnip (per 100 g Edible Portion)

Constituents	Contents
Energy (kcal)	75
Carbohydrates (g)	17.99
Protein (g)	1.20
Fat (g)	0.30
Potassium (mg)	375
Phosphorus (mg)	72
Calcium (mg)	36

Constituents	Contents
Iron (mg)	0.59
Sodium (mg)	10
Thiamine (mg)	0.090
Riboflavin (mg)	0.050
Vitamin C (mg)	17
Vitamin K (µg)	22.5

Uses and Health benefits

Roots can be eaten raw or cooked. The cooked root has a fairly soft texture if it is well grown, however it is somewhat chewy fresh. It's also used in soups and stews as a flavour enhancer. The seeds, which have a dill-like flavour, are sometimes used as a condiment. It's consumed in the same way that carrot roots are, but it's sweeter, particularly if cooked. It's also useful for making wine. Without a roast parsnip, a roast supper is incomplete. Insecticide is made from the leaves and roots and used against aphids and red spider mite. Parsnip is a good human food item, but fattening pigs love it as well. It's also fed to dairy cows in the winter to ensure that they produce as much delicious milk and butter as when they're fed grass.

Women's complaints have been treated with a tea produced from the roots. Falcarinol, falcarindiol, panaxydiol and methyl-falcarindiol are antioxidants found in parsnip that have anticancer, anti-inflammatory and antifungal activities. Its high fibre content may aid in the prevention of constipation and the reduction of blood cholesterol levels. Inflammations and wounds have been treated using a root poultice. The root includes xanthotoxin, which is used to treat vitiligo and psoriasis. The leaves have diuretic properties.

Cultivated varieties

Archer Agm

It has smooth-skinned roots that are wedge-shaped and have an average length of 33 cm and breadth of 7 cm are well-flavoured and resistant to canker. The foliage reaches a height of around 80 cm.

Gladiator Agm

It's a high-yielding type with wedge-shaped, flavorful roots that thrive in heavy soils. The foliage is 70 cm in height, with a root length of 28 cm and a width of 7 cm.

Albion

It grows equally tapered wedge-shaped roots that are about 33 cm long and 6 cm wide at the top. The height of the foliage can reach 75 cm. It's suitable for organic agriculture. It's resistant to diseases like parsnip canker.

Palace Agm

high yielding canker resistant variety

Hollow Crown

It has long roots. Slow to germinate. The fully developed roots are varying from 25 cm to 40 cm long, tapered and relatively free of hair like side roots. It has 150 days to maturity

White Spear

White roots like Albion. White top portion with a tapered bottom half

Avon Resistor

Canker resistant variety and excellent for heavier soils

Harvesting

Parsnip is ready for harvesting after 100-130 days after sowing. Harvesting is done in the same way as with carrot roots. It has chemicals in its roots and foliage that cause skin irritation. It may be necessary to wear protective clothing with long sleeves and hand gloves when handling parsnips. Some of the cultivars' roots are harvested in late August and marketed fresh, just like other root crops. In Oct-Nov, the roots are harvested for winter storage. Occasionally, the roots of frost-resistant types are left in the field during the winter and collected in March or April. Overwintering

parsnip roots, on the other hand, will not endure soil freezing, which could occur in April. Such conditions cause the roots to degrade in quality and become split and bitter. The ideal time to pick parsnips is in early winter, after a decrease in the soil temperature. Average Yield is 25 to 35 t/ha.

Splitting and "Fanging" (Forking)

Splitting of the periderm or cracking because of uneven growing conditions. It is generally 9 agreed that symptoms of secondary root proliferation are due to damage to the taproot at the seedling stage.

Post-harvest Management

The roots are topped and cleaned before being graded and placed into bags or cartons with a plastic sheet on the bottom and sides and a 10 kg capacity. Roots should not be allowed to completely dry out because this can result in root discoloration. The length and quality of the roots are assessed. Only straight, sound, white roots are supplied to the market once the leaves have been removed. Healthy roots can be kept for 4–6 months in a cold storage at 0°C and 90–95 per cent RH. Parsnips are usually packaged in 11-kg film bags, or 5-kg cartons, holding 12 cello bags, 454 g each.

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Incidence of Spot Blotch of Barley Caused by Bipolaris Sorokiniana in Eastern Uttar Pradesh

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Introduction

Barley (*Hordeum vulgare* L.) is popularly known as "*Jau*" in hindi. It is originated from Asia and Ethiopia. It can be grown over a wide range of latitude covering diversified agro-climatic conditions. In India, major barley growing states are U.P., Rajasthan, Punjab, Haryana, M.P., H.P., Bihar, Uttaranchal, Jharkhand and Jammu & Kashmir. India ranks 20th in world in respect to total area and production. Barley was grown over an area of 0.671 lacks hectares with a production of 17.30 lacks tons and productivity of 25.80 q/ha during *Rabi* 2013-14 while in Uttar Pradesh barley covered an area of about 0.160 lacks hectares with a production of 42.40 lacks tons and productivity of 26.50 q/ha (Anonymous, 2014). Barley has become an important crop due to its demand for manufacture of alcoholic beverages, varied utility in food, feed and ayurvedic medicines. Besides, it is most dependable cereal under extreme conditions of drought, salinity and even frost. Its grain is used as animal feed either alone or in combination and also consumed as a food by poor classes as pure flour or mixed with Barley or gram flour for making chapattis. Its chapattis are highly palatable and digestible as compared to the Barley. It is self-pollinated crop and grain contains about 75 percent carbohydrate, 9 percent protein, 2 percent fat and each gram provides about 3.3 Kcal energy. Barley grain is rich in zinc (up to 50 ppm), iron (up to 60 ppm) and soluble fibres and has a higher content of Vitamins A and E than other major cereals (Wondimu, 2011). The barley crop in Eastern India, suffers from number of fungal foliar diseases, namely Alternaria leaf blotch (*Alternaria alternata*), Curvularia leaf spot (*Curvularia lunata*), Net blotch (*Drechslera teres*) Singh and Singh (2006), leaf spot (*Drechslera victoria*), spot blotch (*Bipolaris sorokiniana*) Kumar and Singh (1999) and Stripe disease (*Helminthosporium gramineum*) Atheya (1974). Jayasana *et al., (*2007) reported 23-44 percent yield loss by spot blotch disease caused by *Bipolaris sorokiniana*. Among the entire above diseases spot blotch is one of the most important disease of barley.

Methods and Material

The survey was done in district Jaunpur and adjoining area of Jaunpur mainly Varanasi, Chandauli, Azamgarh and Bhadohi. The survey is done to record the severity of disease in percentage of disease incidence by the formula given below.

$$PDI = \frac{\text{Number of infected plant}}{\text{Number of plant screened}} \times 100$$

Result and Discussion

The survey was done in year 2021-22 of district Jaunpur and adjoining area of Jaunpur mainly Varanasi, Chandauli, Azamgarh and Bhadohi. The survey is done to record the severity of disease in percentage of disease incidence

in year 2020-21. The results are presented in (Table-1) with its corresponding histogram (Fig.1), reveal that the disease incidence varied from 48.00% to 25.20% in different location. The highest incidence of disease was recorded at Farmer's field Sikrara, Jaunpur (48.00%) followed by Chandauli (45.10%), Varanasi (40.00 %), Azamgarh (30.00 %) and minimum was found in Bhadohi (25.20 %). Present findings is in close agreement with the finding of the Singh *et al.,* (2001) and Srivastav *et al.,* (2012).

Table-1-: Incidence of spot blotch of barley caused by Bipolaris sorokiniana at different location in Eastern Uttar Pradesh 2021-22.

S.N	Location	Village	Percent Disease Incidence (PDI %)	Average Percent Disease Incidence (PDI %)
1.	Jaunpur	Sultanpur Mehroopur	49.0 47.0	48.00 %
2.	Varanasi	Arjunpur Balipur	35.0 45.0	40.00 %
3.	Chandauli	Basantpur Basupur	35.20 45.0	45.10 %
4.	Azamgarh	Idilpur Karanpur	35.0 25.0	30.00 %
5.	Bhadohi	Abholi Balikapur	20.0 30.20	25.20 %

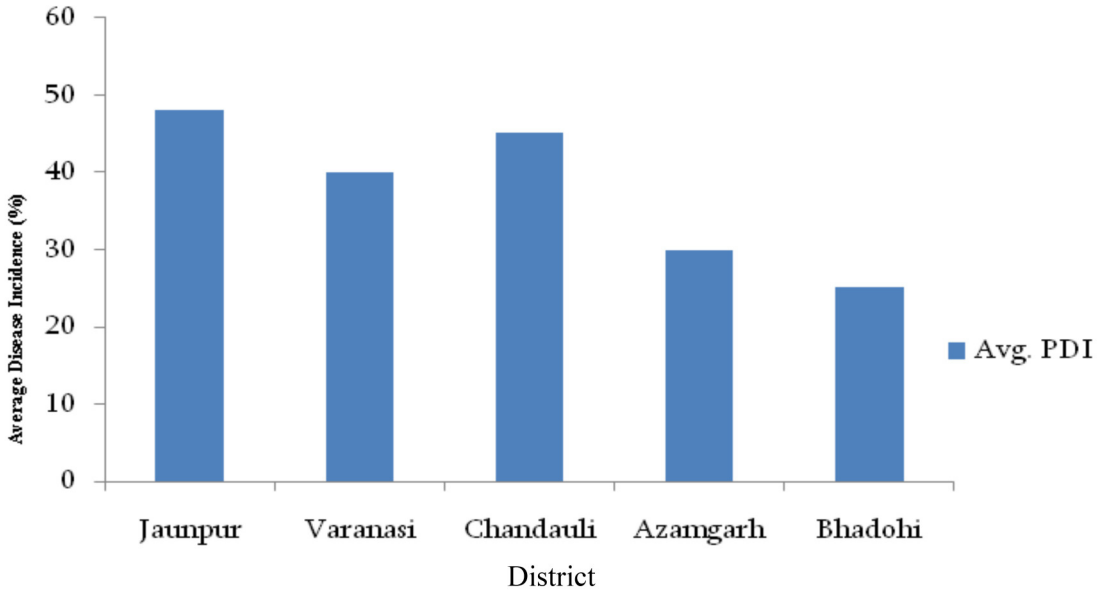

Fig. : Incidence of Disease in Eastern Uttar Pradesh (2021-22)

Conclusion

While conducting the survey it was seen that the disease was very destructive and causes much loss to barley crop and is a major problem in eastern U.P. The survey result confined that the highest incidence of disease was recorded at Farmer's field Sikrara, Jaunpur (48.00%) and minimum was found in Bhadohi (25.20 %).

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Layer Farm Management for Poultry

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Introduction

A layer is an egg-laying bird that is commercially viable. Because of their nutritional richness, ease of preparation and use as a co-ingredient in a wide range of dishes, eggs are in high demand (house-hold and commercial). As a result, layer farming has emerged as the fastest-growing livestock business. Eggs offer the highest protein quality, including nearly all of the necessary amino acids required by our bodies. It contains nearly all vitamins, including vitamin "A" which is necessary for good vision and vitamin "D" which aids calcium absorption for strong, healthy bones. It contains a variety of minerals, including iodine, which is necessary for normal thyroid function. Iron is obtained from eggs, which aids in the production of hemoglobin in our bodies. The yolk of an egg helps to prevent age-related macular degeneration and vision loss. It contains antioxidants such as lutein and zeaxanthin, which can help prevent cataracts. According to research, teenage females who consume eggs on a regular basis are less likely to get breast cancer later in life. The Leucine (amino acid) concentration of eggs aids in fat burning and muscle preservation, keeping one lean and fit. It contains choline, which aids in memory enhancement.

Commercial hybrid layers produce much more eggs than pure breeds, hence they are employed for commercial egg production. The following are some examples of hybrid layers to consider:

a) Babcock	b) B V 300	c) B V 380
d) Babcock	e) Babcock	f) Babcock
g) Bab	h) N & H	

i) Golden keystone Hyline W-36, Hyline Brown, Bovans White, Lohmann, CARI Priya Layer (Golden - 92) and CARI Sonali Layer (Golden - 92), among others. Various agencies in Assam market these hybrid layers, which are accessible as day-old-chicks.

(A) Layer House

- Rearing house: For starters and growers of age group 0 to 20 weeks.
- Laying house: For birds above 20 weeks and for round the year egg production.
- Adopt 3:1 housing system that is three laying house for one rearing house.
- Rearing house should be 45 meters away from the laying houses.
- Average distance between two laying houses 10.5 m

(B) Chicks

- Should come from healthy parents.
- Vaccinated at hatchery for Marek's.
- Alert, active with round bright eyes with leg no leg deformities.
- Start baby chicks on 8% sugar water for first 15 hours and soluble electrolytes be use for first two days

(C) Light

- 15-16 Hours lighting period per day for maximum egg production.
- Bulb height 2m above the floor.
- Distance between two bulbs- 2.5 to 3 m.

  40 watt bulbs for 9.3 m^2 floor space

(D) Ventilation

- Side walls- Height 1.8 m; 1/3 closed by brick wall (60 cm.) and 2/3 open (1.2 m) covered with hexagonal wire netting.
- End wall slid with doors both sides
- Door must be covered with wire netting to prevent sparrows and rodents

(E) Temperature

- Most comfortable for chickens 55°F – 75°F (13°C-21°C)
- Preferable temperature 18°C (65°F)

(F) Floors

- Provide 0.18 m2 (2 sq.ft) per bird.
- Keep floor 30 cm above the surrounding level to prevent water seepage and flooding or water stagnation

(G) Feeders

- Circular drum type- hanging one.
- Trough type with supporting legs
- Keep distance between feeders and waterier- maximum 1.5 m

Age (week)	Feeding space/ bird in cm. (minimum)
0-8week	2.5 cm
9-12 week	4.0 cm
13-20 week	7.5 cm
Above 20 week	10.0 cm

- Waterier : Water space requirement per 100 birds.

Age of bird (Weeks)	Waterier space	Water requirement
0-2 weeks	25 cm	9.0 liters
3- 12 weeks	100 cm	18.0 liters
Above 12 weeks	250 cm	22.5 liters

(H) Nests

- Size: Depth- 0.6 m (2.0 ft)
- Length – 1.5 m (5.0 ft)

(I) Litter

- Arrange 3" (8 cm) depth of litter
- Material: Saw dust, Paddy husk, Straw

(J) Vaccination of layer

Age	Vaccination type ad strain	Route	Dose
Day 1	MD HVT-3 (Live)	S/C neck region	0.2 ml
Day 5-7	ND Lasota/F/B1 LIVE)	Eye drop/nasal/water	*
Day 14	IBD Intermediate/ Intermediate plus (live)	Eye drop/drinking water	*
Day 28	IBD Intermediate standard (Live)	Eye drop/drinking water	*
Day 35	ND Lasota/F/B1 (Live)	Eye drop/drinking water	*
Day 42	Fowl pox (live or killed) depending upon the diluent	Wing web or I/M	0.2 ml
Day 56-70	ND R2B (LIVE)	S/C or I/M	0.5 ml
Day 112	ND (Killed)	S/C or I/M	0.5 ml
Day 116	IBD (KILLED)	S/C or I/M	0.5 ml
Day 120	EDS-76 VACCINE (KILLED)	S/C or I/M	0.5 ml
45-50	Ranikhet disease vaccine (RDVK/Lasota)	Eye drop/nasal/ Drinking water	
Week	Repeated every once in 2 month		

(K) Culling of poor layers

- Culling is the procedure of selection and rejection of unproductive and poor producers
- Poor layers should be culled to minimize the cost of production. By doing so farmer can save some amount of money for not needing to buy feed for the non-layers
- The healthy bird is more active, more alert, vigorous, well fleshed but not fatty, tight feathering with tail and wings carried up. Deviation of any of these characteristics is the indication of poor layers
- Moulting provides an indication about the laying capacity of a bird. It is natural and physiological process to renew old feathers at the end of first year of laying. Early moulters are usually poor layers, whereas late moulters are usually good layers.
- There may be a few broody birds in a flock. A broody bird will sit in the nest box but will not come out unless forced. They are non-layers and thus cullable.

(L) Bio-Security Measures Fencing

- Keep visitors to a minimum.
- Limit visits to other poultry farms.
- Keep all animals and wild birds out of poultry houses.
- Practice sound rodent and pest control program.
- Inspect flocks daily and recognize disease symptoms.
- Good ventilation and relatively dry litter.
- Keep areas around houses and feed bins clean.
- No exchange of feed and equipment.
- Disinfection and sanitization of poultry house & types of equipment.

Conclusion

Layer poultry farming refers to the production of commercial eggs from egg-laying poultry birds. Layer chickens are a unique breed of hen that must be raised from the time they are one day old. A layer is an egg-laying bird that is commercially viable. Because of their nutritional richness, ease of preparation and use as a co-ingredient in a wide range of dishes, eggs are in high demand (house-hold and commercial). As a result, layer farming has emerged as the fastest-growing livestock business.

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Three Dimensional Benefits of Mushroom

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Introduction

Agriculture is the single largest primary industry, which imparts a sense of soil involved cultivation system in our mind. It is though not only limited to the field for production but also reached highly equipped controlled houses, where one can produce Agri-goods without involving soil and harsh field conditions and such new world methods of farming is known as smart farming. Smart farming involves enterprises such as vegetables, flowers, fruits, medicinal plants and mushrooms. Mushrooms are macro fungi, with distinct fruiting body which can either be hypogeous, or epigeous. These are the fleshy Basidiocarps, produced by numerous Basidiomycetes and Ascocarps produced by few Ascomycetes.

Approximately 35 species of mushrooms are grown commercially throughout the world and of these; only 20 species are widely cultivated and only 3-6 varieties are cultivated on an industrial scale. Five main genera constitute around 85% of the world's mushroom supply, these are *Lentinula*, *Pleurotus*, *Auricularia, Agaricus*and *Flammulina*where, genus *Pleurotus*holds second position in terms of production.Mushrooms have been used since centuries not only for food but also appreciated for their nutritional value, bioactive compounds and therapeutic properties. The water and dry matter ratio of mushroom is generally 9:1. Mushrooms are rich in protein, fibres and minerals.

Mushroom cultivation plays an important role to improve the livelihood of rural people through economic, nutritional and medicinal contributions. Mushroom since, is a source of multiple vitamins and minerals, can be a blessed option to eradicate the malnutrition in the developing countries. Mushroom production is simple, low cost, and suitable for rural areas, is labour intensive and can provide employment in both the rural and semi-urban areas. Mushrooms on the other hand have a unique character to detoxify the environment through a peculiar process called mycoremediation. The three dimensions of the benefits of mushrooms *viz.* eradicating malnutrition, strengthening livelihood and mycoremediation have been highlighted in the article.

Account of Malnutrition

Malnutrition is still a matter of serious concern worldwide especially in the developing countries. The State of Food Insecurity (SOFI) estimates that around 870 million people globally have been undernourished (in terms of dietary energy supply) in the period 2010–2012. The vast majority of these, 852 million, live in developing countries, where the prevalence of under nourishment is around 14.9 %. Deficiencies of essential vitamins and minerals are widespread and have substantial adverse effects on child survival and development. Recent studies support that all degrees of stunting, wasting, and underweight are associated with higher mortality, while under nutrition can be considered the cause

of death in a synergistic association with infectious diseases; all anthropometric measures of under nutrition were associated with increased hazards of death from diarrhoea, pneumonia, measle and other infectious diseases, except for malaria.

According to World Health Organization (WHO) estimates, globally about 190 million preschool children and 19.1 million pregnant women are vitamin A deficient. Globally, 0.9 % or 5·17 million preschool age children are estimated to have night blindness and 33.3 % or 90 million to have subclinical vitamin A deficiency. Approximately 82 % of pregnant women worldwide have inadequate zinc intakes to meet the normal needs of pregnancy. Iron deficiency is widespread and globally about 1.62 billion people are anaemic, and 18.1 % and 1.5 % children are anaemic and severely anaemic, respectively. Suboptimal vitamin B6 and B12 status have also been observed in many developing countries (Das *et al.,* 2016).The Indians are not only deficient in the vitamins and minerals but also in protein. At most 73% of the Indians are deficient in protein where Indian Council of Medical Research (ICMR) recommends 48 gms/day. The recommended dietary allowance of protein for an average Indian adult is 0.8 to 1 gm per kg body weight, however, the average intake is about 0.6 gm per kg body weight (Suri, 2020).

Mushrooms in Eradicating Malnutrition

Crude protein content in mushrooms is high. The mushroom protein contains all the nine essential amino acids required by humans and is considered as a potential substitute of muscle protein due to their high digestibility. In a country like India, where major portion of the population is vegetarian, mushroom protein can eradicate the deficiency of proteins and amino acids. mushrooms are also rich source of vitamin B1, B2, B12, C, D and E and relatively good sources of nutrients like phosphorous, iron and vitamins including thiamine, riboflavin, ascorbic acid, ergosterol, niacin and vitamin D which otherwise not available in other food supplements. Due to wide range of vitamins and mineral contents mushroom can be a good eradicant of malnutrition for every age group.

Mushrooms are non-photosynthetic, therefore, sugars, carbohydrates are present in lower proportions than vegetables such as carrots and sprouts. Edible mushrooms contain high levels of oligosaccharides and very low level of total soluble sugars. Mushrooms are with low fatty acid content (2-8% of distilled water). The level of PUFA is comparatively higher than that of saturated fatty acids, constituting more than 75% of total fatty acids of which oleic and linoleic acids are the most significant while palmitic acid is the main saturated acid. Table 1 shows different nutrient contents in different varieties of edible mushrooms (Gupta *et al.*, 2018).

Table 1. Nutritional value of some commercial edible mushrooms (on dry wt. basis)

Nutritional parameters	Mushroom *Agaricusbisporus*	*Pleurotus*spp.	*Volvariellavolvacea*	*Lentinula edodes*
Protein (%)	29.14	19.59	38.10	18.85
Carbohydrates (%)	51.05	64.34	42.30	63.60
Fat (%)	1.56	1.05	0.97	1.22
Vitamin D (IU/g)	984	487	462.04	205
Sodium (mg/kg)	500.8	208.87	345.34	82.49
Potassium (%)	4.21	2.70	4.16	2.10
K:Na	84:1	129:1	120:1	255:1

Iron (mg/kg)	85.86	183.07	72.51	37.55
Manganese (mg/kg)	7.97	6.47	–	17.48
Zinc (mg/kg)	79.64	162.18	94.28	89.63

Source: Gupta *et al.*, 2018

Role of Mushroom in Upgrading Livelihood

The global market for the mushroom industry in 2005 was valued at over $45 billion, while in 2013 was valued at nearly $63 billion, the world market for edible mushrooms continues to rise from US$ 34.1 billion in 2015 to US$ 69.3 billion by the end of 2024 due to the nutritional, culinary and health benefits of mushrooms. Cultivated, edible mushrooms are the main component (54%) responsible for approximately $34 billion, while medicinal and wild mushrooms account for $24 billion (38%) and $5 billion (8%) of the total respectively. The consumption of mushrooms increased on a global scale from 1 to 4.7 kg of cultivated edible mushrooms per capita between 1997 and 2013. Global market consumption in 2018 was 12.74 million tons and is expected to hit 20.84 million tons by 2026, with a forecast CAGR (Compound Annual Growth Rate) of 6.41%.

Cultivation of mushrooms can help decrease susceptibility to poverty and improve livelihoods by producing a fast yielding and nutritious food source and a stable source of income. Since mushroom cultivation does not require access to land, it is a practicable and appealing activity for both rural farmers and peri-urban residents. Small-scale production does not need any large capital investment as mushroom substrate can be prepared from any clean agricultural residue material and can be grown in temporary clean shelters. They require little maintenance and can be cultivated as a part time activity. Mushroom cultivation is labor intensive agriculture, it creates great job opportunities (Niazi and Gafoor, 2021).

Mycoremediation

Bioremediation through fungi is also called as mycoremediation that exploits the ability of mushrooms and their enzymes degrade a wide variety of environmentally persistent pollutants, transform industrial and agro-industrial wastes into products.

The mushrooms and many other fungi since possess enzymatic machinery for the degradation of waste/pollutants, can be applied for a wide variety of pollutants.

Various methods employed by mushrooms to decontaminate spots and stimulate the environment through the following methods:

a. Biodegradation
b. Biosorption
c. Bioconversion

Biodegradation: It is the conversion of complex bio molecules into simpler ones with the help of different types of enzymes. Mushrooms produce enzymes such as extracellular peroxidases, ligninase (lignin peroxidase, manganese dependent peroxidase and laccase), cellulases, pectinases, xylanases and oxidases, which are able to oxidize recalcitrant pollutants in vitro. Many of these enzymes are also involved with the degradation of non polymeric, recalcitrant pollutants such as nitrotoluenes, PAHs, organic and synthetic dyes and pentachlorophenol under in vitro conditions. It is reported that certain mushroom species are able to degrade plastic polymers.

Biosorption: The process of removal of metals/pollutants from the environment by the mushrooms is called as biosorption. It is based on sorption ofmetallicions/xemobiotics/pollutants from effluent by live or dried biomass which

generally exhibits a marked tolerance towards metals and other adverse conditions.

The uptake of pollutants/xenobiotics by mushrooms involves a combination of two processes: (i) bioaccumulation i.e., active metabolism-dependent processes, whichincludes both transport into the cell and partitioning into intracellular components; and (ii) biosorption i.e., the binding of pollutants to the biomass without requiring metabolic energy. Several chemical processes including adsorption, ion exchange processes and covalent binding may be involved in biosorption. The polar groups of proteins, amino acids, lipids and structural polysaccharides (chitin, chitosan, glucans) may be involved in the process of biosorption.

Bioconversion: Conversion of industrial and agro-industrial wastes into some other useful products is called bioconversion. Mushrooms have an efficient unique ability to utilize lignocellulosic wastes and convert into either edible high protein and nutrients containing fruiting bodies or numerous bioactive compounds of health and pharmaceutical importance. Any kind of lignocellulosic industrial waste can be used for mushroom production. The species of the mushroom preferred and substrates used depend upon the regional climate and local availability of the substrates (Kulshreshtha *et al.,* 2014).

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Response of Field Crops towards Changing Climate

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Introduction

Climate change in IPCC usage refers to "a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer". Any change in climate over time, whether caused by natural variability or human activity, is referred to as climate change.

This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.

Causes of climate change

Anthropogenic causes

Greenhouse Gases

Concentrations of the key greenhouse gases have all increased since the Industrial Revolution due to human activities. Carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) concentrations are now more abundant in the earth's atmosphere than any time in the last 800,000 years. These greenhouse gas emissions have increased the greenhouse effect and caused the earth's surface temperature to rise. Burning fossil fuels changes the climate more than any other human activity.

Deforestation

Deforestation is the clearance of woodland and forest, this is either done for the wood or to create space for farms or ranches. Trees and forests turn carbon dioxide into oxygen, so when they are cleared like the stored carbon is then released into the environment.

Power plants

Power plants burn fossil fuels to operate, due to this they produce a variety of different pollutants. The pollution they produce not only ends up in the atmosphere but also in the water ways, this largely contributes to global warming. Burning coal which is used in power plants is responsible for around 46% of total carbon emissions.

Agricultural Practices

The agricultural practices that produce food for the people on earth is another of the human causes of climate change. The use of both commercial and organic fertilizers releases nitrous oxide, a powerful greenhouse gas. Methane, another important greenhouse gas, comes from many natural sources, but also from the digestive systems of livestock raised for meat production as well as the decomposition of waste in landfills and the burning of biomass.

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Industrialization

Industrialization is harmful in a variety of ways. The waste this industry produces all ends up in landfills, or in our surrounding environment. The chemicals and materials used within industrialization can not only pollute the atmosphere but also the soil underneath it.

Natural Causes

Changes in the earth's orbit

Changes in the earth's orbit and its axis of rotation have had a big impact on climate in the past. At the peak of the last interglacial period, however, the average global temperature was at most 2°F warmer than it is today.

Volcanic Activity

Volcanoes have played a noticeable role in climate, and volcanic eruptions released large quantities of carbon dioxide in the distant past. Some explosive volcano eruptions can throw particles (e.g., SO_2) into the upper atmosphere, where they can reflect enough sunlight back to space to cool the surface of the planet for several years.

Variations in Solar Activity

Changes in the sun's energy output can affect the intensity of the sunlight that reaches the earth's surface. While these changes can influence the earth's climate, solar variations have played little role in the climate changes observed in recent decades.

Changes in the Earth's Reflectivity

The amount of sunlight that is absorbed or reflected by the planet depends on the earth's surface and atmosphere. Dark objects and surfaces, like the ocean, forests, and soil, tend to absorb more sunlight. Light-colored objects and surfaces, like snow and clouds, tend to reflect sunlight. About 70 percent of the sunlight that reaches the earth is absorbed.

Ocean currents

As the horizontal currents are moving south or northwards, they carry with them cool or warm water over an extended distance. It is the displaced water that affects the air, by warming or cooling it, thereby transferring the same effect to the land surface over which it blows.

Global Warming

Carbon dioxide concentration of the troposphere has been increasing steadily due to industrial growth. Nearly hundred years ago the CO_2 concentration was 275 ppm, today it is 350 ppm and by the year 2040 it is expected to reach 450 ppm. Certain gases in the atmosphere, known as 'green house' gases like CO, CO_2, CH_4 are able to absorb and emit heat. When sunlight strikes the earth's surface it warms up, emits heat, which radiates upwards into space. This heat warms up the green house gases so that they also emit heat, some into space and some back down to earth, which results in heating up of the earth atmosphere, also known as Global warming.

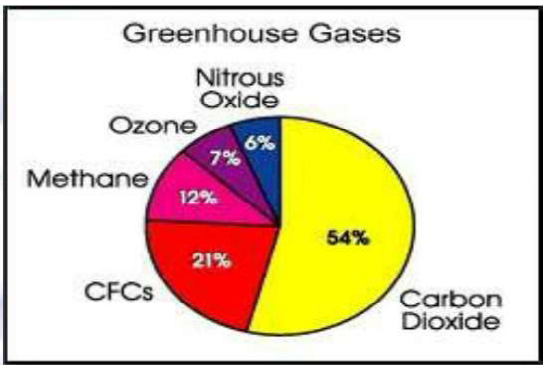
Integrated simulation modelling studies indicated that under Representative Concentration Pathway 4.5, maximum temperature is expected to increase by 1 to 1.3 % in 256 districts, by 1.3 to 1.6 % in 157 districts (2020-2049). The increase ranged from <1.3 ! in 199 districts to >1.6 % in 89 districts. Cultivation of wheat in these districts is likely to be affected by heat stress.

Greenhouse effect

greenhouse effect, a warming of Earth's surface and troposphere caused by the presence of water vapour, carbon dioxide, methane, and certain other gases in the air. Of those gases, known as greenhouse gases, water vapour has the largest effect.

Under normal conditions 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 reradiated back into space. However when there is an increase in CO_2 concentration, the thick layer of the gas prevents theheat from being reradiated out. This thick CO_2 layer functions like the glass panel of a green house, allowing the sun light to filter through but pre-

venting the heat from being reradiated into outer space. Therefore, it is warmer inside the green house than outside. Similar condition is resulted in the troposphere of the earth and termed as 'Green house effect'.



Major effects of climate change on crop production

Effect of rising temperature on crop production

Negative effects

- High temperature and mineral nutrition- High temperature stress causes reduction in absorption and subsiquent assimilation of nutrients.
- High temperature and shoot growth- High temperature, even for short period, affects crop growth especially in temperate crops. High air temperature reduces growth of shoots and in turn reduces root growth.
- High temperature and pollen development- High temperature during booting stage results in pollen abortion. Temperature of 30^0C for two days at reduction division stage decreased grain yield by drastic reduction in grain set.
- Higher temperature generally decrease yield by speeding up plant's development so it matures sooner thus reducing the period available for yield production.
- Increased temperature leads to increased crop respiration rate and evapo-transpiration, higher pest infestation and a shift in weed flora.
- Increase evaporation rates and reduces the moisture availability.

Positive effects

- Extending the length of the potential growing season.
- Reducing the growing period required by crops for maturation.
- Increasing the possibility of completing two or more cycles during the same season
- Crop producing areas may expand.

Effect of rising CO_2 concentration on crop production

Negative effects

- CO_2 is currently responsible for over 60% of the enhanced greenhouse effect.
- Increased CO_2 concentration will decrease the rate of germination.
- Food quality is declining under the rising levels of atmospheric carbon dioxide that we are experiencing.
- For most plants, elevated CO_2 can alter the internal balance between carbon and nitrogen.
- The concentrations of mineral nutrients and protein are reduced.
- The concentration of nutrients (N, Fe, Zn and S) mainly found in protein is reduced in non-leguminous C_3 crops with an elevated level of CO_2.

Positive Effects

- Increase the photosynthetic rate and carbon fertilization effect is enhanced.
- Water use efficiency will increase as a result of closing stomata.
- Decrease transpiration rate.
- Accelerate crop development.

Effect of changing rainfall pattern on crop production

- Regional averaged rainfall analysis over whole Indian subcontinent reveals that, rainfall in annual and monsoon has decreased while there is a sign of increment in the winter, pre monsoon and post monsoon season.
- Since 1901 planet earth experienced increased precipitation despite a reduced number of rainy days which shows that there are an increased intensity and spatial variability of rainfall (IPCC AR5, 2014).
- The crop water regime may further be affected by changes in seasonal precipitation, within-season pattern of precipitation and inter annual variation of precipitation.
- Too much precipitation can cause disease infestation in crops, while too little can be detrimental to crop yields, especially if dry periods occur during critical development stages (Kalra *et al*., 2008).

Positive effects

- Reduce the number of irrigations in rabi season.
- Reduce the cost of cultivation.

Solar radiation and crop production

- Reduction in radiation may reduce net assimilation and subsequent reduction in yields to some extent.
- Under low light intensities, photosynthetic rate, relative growth rate, net assimilation rate and specific leaf weight are less resulting in lower dry matter production.
- Low light intensity during flowering increases spikelet sterility in cereals.
- At low light intensity, grain yield is reduces by 25-68% compared to normal light intensity.

Effect of climate change in major field crops

Effect of climate change on wheat

- The effect of temperature on wheat yield for past eight years indicated that a rise in temperature by 1% in the month of march could reduce wheat yield to about 8%.
- Climate change is projected to reduce the timely sown irrigated wheat production by about 6% in 2020.
- Negative impacts of higher minimum temperature on grain filling duration and grain size leading to reduces yield.
- At an elevated level of CO_2, the zinc and iron content of wheat is decreasing.
- Starch content in wheat increased with rise in CO_2 level.

Effect of climate change on rice

- Climate change is likely to reduce irrigated rice yield by 4% in 2020, 7% in 2050, and by 10% in 2080 climate scenario in India (Naresh Kumar *et al*., 2013).
- In Madhya Pradesh, the impact will be lower than the all India average at >5%.
- High temperature in rice reduced plant height, test weight and root elongation.
- Water shortage in rainfed rice during Kharif due to long dry spells. Pollination and grain filling in transplanted rice to be affected due to high temperature.
- Low light during ripening reduces yield due to lesser number of filled grains per panicle and lower grain number.
- Enhanced CO_2 is known to cause reduction in rice milling percentage, protein content and nutritional quality of grains in rice.

Effect of climate change on soybean

- The maturity duration of the crop is extended by 3-4 days in all agro- climatic zones.

- Increase in temperature is most likely to significantly reduce the soybean yield due to accelerated growth and effect on rate and duration of grain filling (Mohanty *et al*., 2017)
- The prolonged dry spells during monsoon season led acute water stress or heavy rainfall could be the critical factors for the soybean productivity (Mohanty *et al*., 2017).
- Lower solar radiation during reproductive growth was the primary cause of reduced yield of soybean. Shading reduced the number of pods per plant in soybean.

Effect of climate change on pulses

- In lentil high temperature at the flat pod stage reduced yield by 33% under both ambient and elevated CO_2 (Bourgault *et al*., 2018).
- High temperature imposed for 10 days at pod development caused plants to add fewer pods during post recovery than equivalent stress imposed at early flowering.
- In green gram, high temperature causes seed hardening due to incomplete sink development.
- The failure of anthesis at high temperature is primarily caused by poor pollen germination.
- Lentil is particularly sensitive to high temperature (>30%) during the reproductive phase, causing pod and flower abortion and significant reduction in grain yield and quality (Sita *et al*., 2017).
- With every 0.1 %increase in maximum and minimum temperature the yield of chickpea, lentil and pigeon pea declined considerably (Dubey *et al*., 2011).
- Heavy rainfall events during kharif to cause water logging and impacts yield in pigeon pea.
- The average increase in chickpea yield is projected be 24% by 2030. This increase is attributed mainly to projected increase in winter rains and elevated CO_2 levels.
- In chickpea exposure to high temperature for a fortnight at flowering period reduce the sterility of pods and had a beneficial effect on growth and yield.

Effect of climate change on mustard

- Increasing temperature lowered days to flowering and days to maturity, which in turn lowered total crop duration. In plants, warmer temperature accelerates growth and development leading to less time for carbon fixation and biomass accumulation before seed set resulting in poor yield (Boomiraj *et al*., 2010).
- The reduction in days to flower initiation due to increasing temperature and decreasing rainfall ranged between 1 to 4 and 5 to 13 days for 2020 and 2050, respectively.

Effect of climate change on pea

- The field pea crop when exposed to high-temperature (>25°C) at the end of its crop cycle leads to seed abortion, seed weight, and yield losses.
- Loss in pollen viability, pollen number, pollen germination, pollen tube growth, empty pollen grains, failure in fertilization are some of the abnormalities associated with high-temperature stress in pea.
- Reduction in seed set of field pea at high-temperature stress of 36°C, attributed to reduced pollen germination and subsequent pollen tube growth.

Effect of climate change on maize

- Irrigated *kharif* maize is projected to reduce yield by up to 18% in 2020.

- Soil moisture stress prior to silking, during silking and after silking reduces the yield, respectively by 25, 21 and 50%.
- Decrease in solar radiation hastens silking.

Government initiatives for climate change adaptation

National Innovations in Climate Resilient Agriculture NICRA

The Indian Council of Agricultural Research (ICAR) inaugurated the National Innovations in Climate Resilient Agriculture (NICRA) network project in February 2011 with the Hon'ble Union Minister for Agriculture and Food Processing Industries Shri Sharad Pawarji. Through strategic research and technological demonstration, the initiative aims to improve Indian agriculture's resilience to climate change and climatic vulnerability. Crops, cattle, fisheries, and natural resource management are all part of the adaptation and mitigation study. Strategic Research, Technology Demonstration, Capacity Building, and Sponsored/Competitive Grants are the four components of the initiative.

National Mission on Sustainable Agriculture (NMSA)

This Mission was structured under the National Action Plan on Climate Change (NAPCC) and made operational during 2014-15. It aimed to synergize resource conservation, enhancing or restoring the soil fertility, thereby, improving productivity with focus on soil health management, Integrated Farming System (IFS), integrated animal component and Water Use Eûciency (WUE) speciûcally in drylands or rainfed agriculture areas.

National Adaptation Fund for Climate Change (NAFCC)

This Scheme was implemented during 2015-16 mainly for supporting concrete adaptation activities dealing with mitigating the adverse eûects of global climate change in sectors such as agriculture, water, forestry, animal husbandry, tourism, etc.

Pradhan Mantri Krishi Sinchayee Yojna (PMSKY)

This Scheme was designed and developed to place a greater emphasis on water conservation and management in agriculture, with the goal of increasing the area irrigated by 1 July 2015. The Scheme's principal motto is 'Har Khet Ko Paani,' which means 'More crop per drop,' which means providing end-to-end solutions in water source creation, distribution methods, and management.

Green India Mission (GIM)

This mission began in February 2014, and it is defined in the NAPCC (National Action Plan on Climate Change). The mission's major goal was to maintain, restore, and enhance India's dwindling forest cover, as well as to combat climate change through adaptation and mitigation methods.

Pradhan Mantri Fasal Bima Yojna (PMFBY)

This Scheme was introduced on 14 January 2016 to reduce agricultural distress and farmer welfare without influencing substantial hikes in the Minimum Support Prices (MSP) on agricultural produce during monsoon fluctuations or any other natural calamity by providing full insured amount on crop losses during monsoon fluctuations or any other natural calamity.

National Water Mission (NWM)

A mission was launched to assure Integrated Water Resource Management (IWRM) in order to conserve water resources and reduce waste, as well as to improve Water Use Efficiency (WUE) by 20% in the agriculture sector.

Mobile apps for weather data and weather based agro-advisory

Gramin Krishi Mausam Sewa (GKMS) and mKisan

The GKMS initiative is being implemented by the India Meteorological Department (IMD) at 127 locations across the country. Every Tues-

day and Friday, IMD publishes a 5-day weather forecast as well as weather data from the previous week. The technical officers prepare a weather-based agro advisory bulletin (both English and regional language) for the coming week and distribute it to their designated districts via the State Department of Agriculture, Research Stations, Krishi Vigyan Kendra, and IMD Web portals based on previous weather and forecasted weather information. The essential message is transmitted straight to farmers' mobile phones via the Ministry of Agriculture's mKisan online portal as a Short Message Service (SMS). Currently, about 11 lakh farmers benefit from this service, which has assisted them in not only raising crop production but also lowering losses due to adverse weather.

NiceSSM

NiceSSM is a network for climate-relevant information and Sustainable Soil management (SSM). The platform uses weather data, Seasonal conditions and soil health parameters to calculate which measures for sustainable soil management are particularly well adapted to the respective location. This information can be accessed via PC or tablets and smartphones. Farmers who have the appropriate IT equipment can access this vital data and the resulting recommendations directly. In addition, experts are also available to provide personalized advice tailored to individual needs via the platform. Farmers thus have access to relevant knowledge and to tailored, comprehensible and timely advice. In this way, they improve the ability to adapt to the impacts of climate change by being able to plan and secure their harvest.

Uzhavan App

It is a bilingual Smartphone application that was launched by the Tamil Nadu Government's Department of Agriculture in 2018 for the benefit of farmers. Farmers and other stakeholders can get valuable information on agricultural inputs (quality seeds, synthetic fertilizers, and pesticides are available at the Government and local private shops), weekly weather forecasts and related information, availability of farm tools and equipment, and the latest information on farm and crop subsidies and suitable crop insurance schemes through the 'Uzhavan app'.

Meghdoot App

Meghdoot is a simple and easy-to-use smartphone application that offers farmers with crop advisories based on meteorological data. The India Meterological Department (IMD), the Indian Institute of Tropical Meterology (IITM), and the Indian Council of Agricultural Research have collaborated on the project (ICAR). This software was first released in August 2019 and covers 68 districts.

Mausam App

The Indian Ministry of Earth Sciences has released "Mausam," a new mobile application that will allow users to track weather updates as well as receive enhanced forecast and warning services from the government. ICRISAT's Digital Agriculture and Youth team, the Indian Institute of Tropical Meteorology (IITM) in Pune, and IMD collaborated to design and create the app.

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Soil the Most Wondrous Gift of Nature to Human Society

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Introduction

Hindus believe that man was borne from soil and will end with soil. In reverence they say, 'Mata Bhumih Putroham Prithivyah' meaning 'soil is my mother, I am her son'. This filial allegiance confirms that soil and humanity have evolved together. In fact, if there is life on the planet Earth, it is because there is a thin layer of soil on its top.

On 26 February 1937, the 32nd President of the USA, President Franklin D Roosevelt, stated the powerful phrase: "The nation that destroys its soil destroys itself. Sustainable development depends on good soil health, which needs to be protected, conserved and enhanced by bringing past admiration and experience in front of the present day science and technology. Soil is obtained from weathering of minerals and unconsolidated rocks from 'ma' Earth. The formation of soil process is very slow it takes between 80 to 750 years to generate one cm of soil. Soil is a mixture of powdered mineral particles, organic matter, water and air.

Indians treat soil as 'mother' and belive that they were brought into being by it (soil). That explains why they call soil Vishwagarbha (world's womb) (Prithvi Sukta, Atharva Veda, AV 1000 BC). "mitti se aye the mitti mein mil jao ge", meaning; took birth from soil, when dead will be part of soil. Soil is epicentre of life on the planet Earth. A handfull of soil contains billions of soil microorganisms. Commenting on the complexities of soil, Leonardo de Vinci remarked "We know more about the movement of celestial bodies than about the soil underfoot". Word of the father of nation, M.K. Gandhi,"To forget how to dig the earth and to tend the soil is to forget ourselves". In the US DA Yearbook of Agriculture 1938, Charles E. Kellogg said "Essentially, all life depends upon the soil. There can be no life without soil and no soil without life; they have evolved together". A Chief from Nigeria stressed the need for maintaining soil in good health for posterity. He stated, "I conceive that the land belongs to a vast family of which many are dead, few are living and countless numbers are still unborn".

According to Blum (2002) soil holds more biodiversity than any terrestrial system. Egression of CO, from soils is the biggest source of climate change/ global warming. Hence, crucially for the welfare of mankind, soil performs a number of economic and environmental functions. More than inherited attributes, man's imposed management plays the key role in encouraging or disturbing soils in carrying out the natively assigned ecological functions and services.

Impact From an economic/agronomic angle

Symptoms of a soil's falling health show up as follows:

- Fall in output without fall in inputs.
- Stagnating output but increasing inputs.
- Fall in use efficiency of inputs.

- Excess or sub-optimal build-up of certain elements of productivity
- Loss of ability to recover from a shock.

In India, since the dawn of agriculture, a few pro-nature soil management techniques were developed.These are called Rishi Krishi or Vedic farming. In nutshell, Vedic Farming preached use of organic manures called 'Panch Kavya' prepared from 5 cow-based product. Other versions of Vedic farming are agnihotra and biodynamic agriculture.

Soil is part of an ecosystem. It performs a host of functions and renders a number of environmental services that connects it with the human society - entire web of life on planet earth. Soil is the basis of food and biomass production for non-autotrophs.

Soil supporting perennial vegetative shield in the form of forests is a big economic and ecological reservoir. By generating a vast variety of public goods, forests are a big source of life and living. Additionally, value of forests in sustaining biodiversity, preserving soil integrity and maintaining healthy climate is indescribable.

Soil scientists describe soil as a:

a. Natural body derived from decay of rocks,

b. Three dimensional

c. Multiphasic entity made up of pulverized minerals and rocks, organic matter living and dead, water and air

d. Anisotropic (having different properties across directions)

e. Supports plant growth, which is sensitive to certain properties, conditions and management interventions.

For a Pedologist, soil is a natural body, both spatial and temporal, forms at the surface, is a result of complex biogeochemical and physical processes, is capable of supporting life and can be mapped at an appropriate scale.

Engineers define soil as the unconsolidated material above the bedrock.

Geologists define soil as the natural medium for the growth of plants on lands.

Soil microbiologists rightly define soil as a polis (society or community) that is "governed" by soil organisms where fungi are the "governing" organisms in forest soils whereas other microbes are the "governors" or "soil managers" in other ecosystems.

Conclusion

Ancient Hindu scripture Prithavi Sukta carries the oldest commandments that link soil to Human society and its sustainable growth.The need of the hour is to reemphasize an awareness on soils by imparting right knowledge and skills.

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Physical Changes during Growth and Development of Punjab Nectarine Fruits

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Introduction

Nectarine (*Prunus persica* L.) Batsch, smooth skinned peach belongs to the subfamily Prunoideae of the family Rosaceae. It is diploid and has a chromosome number of 2n = 2x = 16. A genetic variant of common peaches, the nectarine was most likely domesticated in China more than 4,000 years ago. The nectarine has smooth and fuzzless skin, while the peach has fuzzy skin. Moreover, the expression of a recessive allele is thought to be responsible for the smooth skin of nectarine fruits, which lack the fuzzy trichomes characteristics of peach fruits. When peaches are crossed or self pollinated, resulting seeds that carry the recessive allele for smooth skin will give rise to nectarines, while those that carry the dominant allele will be peaches. Nectarine is a fleshy fruit consisting of a thin exocarp or skin, fleshy mesocarp and lignified endocarp (pit or stone) that encloses a seed. Botanically peach fruit is classified as a drupe.

Maturation and Maturity

Maturation is the time between final fruit growth and the beginning of ripening and senescence. Maturity is the end point of maturation. Maturity is defined as the stage of development giving minimum acceptable quality to the ultimate consumer.

Types of maturity of fruits

Physiological maturity: It is the stage of development, when a plant or plant parts will continue ontogeny even if detached. It is the stage of development when maximum growth and maturation takes place.

Horticultural maturity: It is the stage of development, when a plant or plant parts possesses the pre-requisite characteristics for utilisation by the consumer for a particular purpose.

Changes in fruit weight (g)

While studying the fruit growth and development of peach cv. Shan-i-Punjab under environmental conditions of Meghalaya, Babu and Yadav (2002) recorded the lowest fruit weight (9.0 g) on 47 DAFB (days after full bloom), while the highest fruit weight (32 g) on 82 DAFB. In a research study on the growth and development of peach fruits in cultivars Partap and Flordasun, Bhatnagar and Kaul (2002) observed a double sigmoid growth curve pattern. The entire growth period of fruit can be categorized into three distinct phases, *i.e*, with rapid growth (10 to 40 days after fruit set (DAF: phase I), with slow growth (40 to 60 DAF: phase II) and a period of final swell with faster growth from 60 to 80 DAF followed by a depressed growth till ripening (phase III). Babu *et al* 2011 reported that the fruit weight of TA-170, Flordasun and Shan-e-Punjab changed from 9.49 to 37.20 g, 8.24 to 32.85 g and 8.20 to 31 62 g respectively, during the fruit growth and development.

A. Increase in fruit weight (g)

The weight of Punjab nectarine fruits increased throughout the development of fruits. The major increase in fruit weight might have been due to both the increase in cell size and amount of intercellular spaces in the flesh (Kumar *et al* 2017). Accumulation of carbohydrates and other photosynthates has also resulted in an increase in fruit weight was observed by Babu *et al* (2011). A slight reduction in fruit weight, represented a post-maturity stage, may be due to dehydration of fruit after optimum maturity which results in loss of moisture from fruit (transpiration) and dis-integration of pulp tissue (Kumar and Chitkara 1988).

Changes in fruit length and diameter (mm)

B. Increase in fruit length (mm)

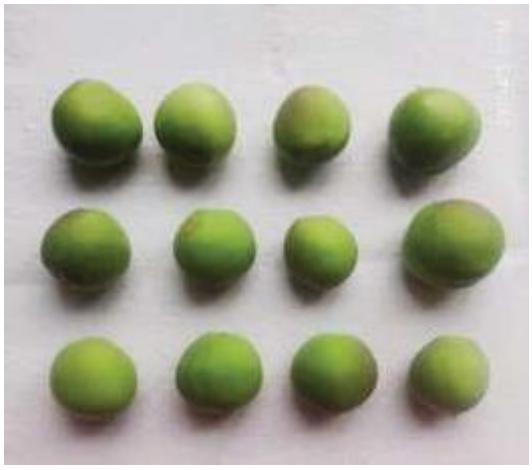
Babu and Yadav (2002) reported that the fruits picked at 47 DAFB had minimum length (23.00 mm) and diameter (21.33 mm), while fruits harvested at 82 DAFB had maximum length (33 mm). Fishman *et al* (2002) described that peach fruit growth starts after bloom with intensive cell division, but the proliferating activity of cells slows down as development proceeds and then the cell enlargement of cells begins to take place. During the ripening of very late season Spanish peach cv. Calanda, Ferrer *et al* (2005) reported that fruit diameter increased from 64.9 mm to 81.0 mm. Zuolian *et al* (2005) observed that cell division in the mesocarp of fruit continued up to 6 weeks after anthesis in 'Okuba' peach fruit. The increase in fruit size was due to the intensive cell division in the fruit mesocarp at the early stage of fruit development (3 weeks after anthesis) and thus resulted in increased number of mesocarp cell layers.

During the growth and development of Punjab Nectarine fruits, the fruit length and diameter increased rapidly. The increase in length and diameter may be probably due to increase in cell size, *i.e*, both the cell enlargement and the amount of intracellular spaces (Singh *et al* 2001).Moreover, the increase in fruit length and diameter may be probably due to more biogenesis of naturally occurring growth substances like auxins, gibberellins, cytokinin and others was observed by Mishra *et al* (2018). According to the findings of Bhatnagar and Kaul (2002) the increase in fruit length and diameter during the phase II (40-60 DAF) was slow due to retardation in pericarp growth and hardening of endocarp, while during phase III (60-80 DAF), the increase in length and diameter was rapid because of final swell due to pronounced increase in pericarp.

Changes in fruit colour

According to Eccher *et al* (1994), a good harvesting index for peaches and nectarines is the background skin colour, which turns yellow from green as chlorophyll content decreases. Cantin *et al* (2009b) reported that white flesh fruits showed higher blush percentage than yellow flesh fruits, which agreed with the higher anthocyanin content found in these fruits. Iglesias *et al* (2009) noticed that the non-acid cultivars of peach always present a more intensity of red skin colour than the acid and they developed red colour earlier on all of the harvest dates. However, the acid cultivars showed greater differences in red colour between the exposed side and shade side of the fruit. Cantin *et al* (2010) demonstrated that nectarines had a higher percentage of skin blush and endocarp staining than peaches, while the flat fruit showed higher skin blush than round fruit, but lower endocarp staining.

(a) Brownish crimson and green



(b) Pea green with just light pink tinge

(c) Light yellowish green with reddish tinge

(d) Orange buff with Jasper red tinge

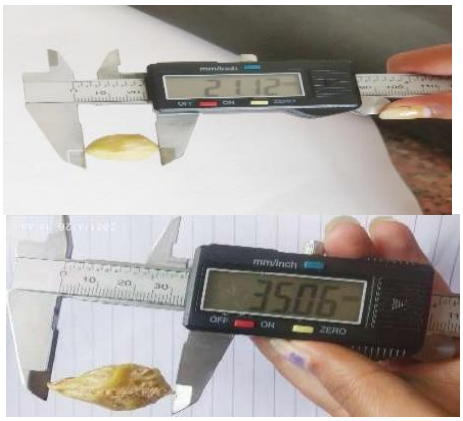
(e) Orange yellow ground with 80-90 % red blushes

C. Changes in fruit colour

Gradual change in colour from pod-green to blush rose-opal with the advancement of maturity was noticed by Dhuria *et al* (1978). A gradual decrease in chlorophyll content of fruit was observed upto 55 days after full blooming and then marginal change was noticed till maturation of fruit. Abrol *et al* (2015) noticed that the background skin colour of peaches and nectarines turns yellow from green as the chlorophyll content decreases and have a red blush which masks the background colour. Singh *et al* (2001) observed the dramatic changes in fruit colour due to replacement of chloroplast by chromoplast and carotenoids which caused reduction in the level of chlorophyll during the maturation and ripening stages.

Changes in stone weight (g) and size (mm)

Bhatnagar and Kaul (2002) reported that the stone weight ranged from 1.08 g in Shan-e-Punjab to 1.89 g in Pratap. An experiment was carried out by Dubey (2003) on three peach cultivars (TA-170, Flordasun and Sharbati) in Arunachal Pradesh. It was observed that the fruits of TA-170 had highest stone weight (6.02 g) as compared to Flordasun and Sharbati fruits. While evaluating the performance of some low chill peaches under eastern plateau regions of India, Jana (2015) reported that stone weight was maximum in Prabhat (7.62 g), whereas it was minimum in Florida sun (2.86 g).



D. Changes in stone size during fruit growth

The maximum increase in stone weight and size took place in the initial phases of fruit development (phase I and phase II). However, the increase was negligible during the later stages of fruit maturity (phase III). These results are inline with the results of Kumar *et al* (2017), who noticed that the maximum increase in stone size took place during the growth period I.

Changes in pulp stone ratio

According to Kher and Dorjay (2001), the maximum pulp to stone ratio was found in Shan- e-Punjab as compared to Flordasun. Rathi *et al* (2003) showed that peach fruit at maturity had attained a pulp weight (70.94 g), stone weight (6.20 g) and pulp : stone (11.40). According to the research findings of Bhatnagar and Kaul (2002), the mature peach fruits of cvs. Pratap and Flordasun had 63.72 and 85.54 pulp/ stone ratio respectively. An investigation was conducted to evaluate the physico-chemical characteristics of three low chilling peach cultivars (TA-170, Flordasun and Shan-e-Punjab) in Meghalaya by Patel *et al* (2007) and they found that the fruits of TA-170 had maximum pulp to stone ratio (13.83). A continuous increase in the pulp: stone was observed by Abrol *et al* (2015) in all the cultivars of nectarine with each successive harvesting date.

E. Pulp of Punjab Nectarine fruits

The maximum pulp: stone ratio was recorded in May Fire (12.20), followed by Silver King (11.50), Snow Queen (10.50) and Red Gold (6.60) on the last sampling date. Jana (2015) found that Florida sun has the highest pulp to stone ratio (6.382), while Prabhat has lowest pulp : stone ratio (2.544) among the low chill peach cultivars.

F. Size of stones of Punjab Nectarine fruits

According to the research findings of Singh *et al* (2001), a marked increase in fruit pup

with the progress of maturity period may be attributed to accumulation of metabolites which results in increasing its weight, whereas, reductionin stone weight resulted from the strong competition for assimilates between pericarp and stone, in which stone was weaker competitor.

Changes in specific gravity (g/cc)

According to the Gangwar and Tripathi (1973), the specific gravity of newly set fruits was very high and then decreased

G. Determination of specific gravity of fruits by water displacement method

rapidly during the first month, but increased until maturity (about 5 weeks later). During fruit growth and development of low chilling peach cultivars under mid hill conditions of Meghalaya, the increase in specific gravity from 0.42 to 0.86, 0.40 to 0.84 and 0.41 to 0.85 in TA-170, Flordasun and Shan-e-Punjab respectively was reported by Babu *et al* (2011).

The specific gravity of Punjab Nectarine fruits decreased throughout the growth and development. The decrease in specific gravity may be probably attributed to the fact that fruit volume due to the expansion of cells increased more rapidly than fruit weight (Bal *et al.*, 1981). Moreover, an increase in intracellular space in the fruit with advancement of maturity period resulted into a more increase in fruit volume than fruit weight. While studying the biochemical changes during ripening and storage of peach cv. Sharbati, Gangwar and Tripathi (1972) reported that specific gravity of fruits decreased from 1.08 to 1.01 as the fruits advanced from immature to ripe stage.

Changes in dry matter (%)

Dry matter percentage was studied by Chalmers and Ende (1975) in peach cv. Golden Queen and they noticed a change from increasing percentage dry weight to decreasing percentage dry weight at 15 to 20 days after full bloom and at fresh weight II-III transition. However, Chalmers and Ende (1977) once more confirmed that the opposite changes in dry weight percentage occurred at the end of fresh weight III transition.

H. Determination of dry matter %

These results are in conformity with the findings of Singh *et al* (2001). Kumar and Chitkara (1988) observed that a slight increase in dry matter percentage on the last harvest date may be due to a slight decrease in weight which might have been due to loss of moisture from fruit through the process of transpiration.

Changes in fruit firmness (lbf)

A research trail was carried out to determine the fruit maturity indices in apricot (*Prunus armeniaca* L.) cv. New Castle by Singh *et al* (2001). The result was concluded that the firmness of fruits declined from 13.20 kg/cm^2 at 55 DAFB to 2.05 kg/cm^2 at 73 DAFB.According to the research findings of Cascales *et al* (2005), the firmness of peach cv. 'Caterin' decreased from 7.9 kg/cm^2 at unripe stage to 3.3 kg/cm^2 at ripe stage. While determining the maturity stage for peach cultivars under Ismailia conditions,

El-Khoreiby *et al* (2011) noticed that firmness of peach cv. 'Flordaprince' declined from 19.0 to 13.5 lb/in² between 77 and 91 days from full bloom, whereas firmness of peach cv. 'Meet Ghamr' reduced from 17.4 to 12.5 lb/in² between 114 to 128 days from full blooming. An experiment was conducted by Abrol *et al* (2015) to standardize the maturity at harvest for nectarine fruits. They noticed that firmness of nectarine cv. 'May Fire' reduced from 7.75 at 64 DAFB to 6.83 kg/cm^2 at 76 DAFB, while the firmness of nectarine cv. 'Silver King' decreased from 7.67 to 7.13 kg/cm^2 between 76 and 88 DAFB.

According to the research findings of Rooban *et al* (2016), the highest fruit firmness was observed in immature stage and lowest was measured in fully mature fruits. Ali *et al* (2011) reported that the decreasing fruit firmness might be associated with fruit softening. Shewfelt *et al* (1987) noticed that fruit softening was attributed to breakdown of insoluble protopectins into soluble form of pectin, resulting from enzymatic degradation *i.e*, polygalacturonase activity, which is not found in immature fruits but it's activity increases rapidly as the fruits mature. Singh *et al* (2001) reported that the solubilization of protopectins ultimately affects the cell wall structure through degradation of cell wall constituents namely cellulose and hemicellulose. Moreover, Nikolic and Mojovic (2007) also found that cell wall breakdown caused by the conversion of insoluble pectin into soluble forms is also a factor that is responsible for loss of firmness.

Conclusion

It can be concluded that the fruit growth followed a double sigmoid curve. Thus the entire growth period of the fruit consist of three distinct phases *i.e*, the fruit grew with rapid growth (Phase I), the growth was slow (Phase II) and again the growth was at faster rate (Phase III). The fruit weight and size in terms of length and diameter increased continuously throughout the growth and development of fruit by following double sigmoid curve. The fruits were brownish crimson and green in colour in the initial stages of observation, then the fruit developed an orange yellow ground with 80-90 % red blushes which indicates the period of attainment of full maturity.

Stones in fruits of Punjab Nectarine attained maximum size in terms of weight, length and diameter by the time of stone hardening during the earlier stages (Phase II) of fruit development and later on, it increased negligibly. Pulp stone ratio changes showed it's pattern which is related to the fruit growth and it followed an increasing trend with the progress of maturation. Specific gravity of Punjab Nectarine fruits decreased continuously throughout the growth and development. Dry matter percentage increased markedly during phase ll. Dry matter percentage declined with the beginning of stage III. There was little variations in dry matter percentage near the maturity time of fruit and followed an erratic pattern during the entire period of fruit development. The firmness of Punjab Nectarine fruits declined with the advanced stages of fruit maturity.

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Natural Promising Medicinal Reservoir: An Overview *Piper Betel* L.

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Introduction

At present, the rapidly growing population of the world is facing many challenges from various infectious and non-infectious diseases. Medicinal plants are of undoubted has pharmacological value, as they have been used for centuries to treat various diseases and health disorders all around the world. Since ancient times, people have been exploring the nature particularly plants in search of new drugs. This has resulted in the use of large number of medicinal plants with curative properties to treat various diseases [Verpoorte, 1998].

The screening of plant extract products for antimicrobial activity has shown that higher plants represent a potential source of novel antibiotic prototypes [Afolayan *et al.,* 2003].

Nearly 80% of the world's population relies on traditional medicines for primary health care, most of which involve the use of plant extracts [Sandhya *et al.,* 2006].

Plants products Studies stimulated the development of separation techniques, spectroscopic approaches to structure elucidation, and synthetic methodologies and based on biosynthetic origins, major groups: terpenoids, alkaloids, and phenolic compounds [Hussain *et al.,* 2012].

Plants have biological activity in health care management like Anti-microbial, Insecticidal, Antioxidant, Anti-diabetic and Gastro protective Activities [Arawwala *et al.,* 2014].

In the past decade, due to the problems that chemical drugs have caused the side effects to many people, the tendency to using and paying attention to plant derived medicinal products have increased so for certain diseases, herbal remedies have better effects and for some others, only herbal remedies are available [Rabiei *et al.,* 2015].

Plant biotechnology techniques, and plant in-vitro systems, offer reliable, desired secondary metabolites in high yield and consistency, with much shorter production cycles undercontrolled aseptic conditions, thus assuring safe end products that lack genetic or environmental contaminations [Inyai, 2019].

Piper betle L.

Piper betle Linn. an important species of the Piperaceae family and has over 2000 species. The plant is indigenous to India. The Piper betle leaf is known is Paan in Assamese / Urdu / Hindi /Odia / Bengali and Tambula and Nagavalli in Sanskrit (Vidyache pan – Marathi) and ayurvedic – pippalikul. It is an evergreen and perennial creeper, with glossy heart-shaped leaves that are reservoirs of phenolic compounds with anti-proliferative, anti-mutagenic, anti-bacterial and anti-oxidant properties. Phytochemical studies show that Piper betle contains a wide variety of biologically active compounds. The scientific classification of Piper betle Linn. is as follows: Kingdom: Plantae, Order: Piperales, Family: Piperaceae, Genus: Piper, Species: Piper

betle [Rekha, *et al.,* 2014].

The presence of hydroxychavicol acetate, allylpyrocatechol piper betol, isoeugenol, anethole, stearic acid, methyl eugenol, carvacrol, polyphenol, alkaloids, saponin, tannin, steroids and other compounds like chavicol, allylpyrocatechol, are also found in Piper betle [Lakshmi, *et al.,* 2005].

Biopoent Pharmacological Activities

a. Antiulcer property

S Bhattacharya *et al.,* (2007) studied the Anti-ulcerative property of the Piper betle against indomethacin induced stomach ulceration and its mechanism of action. They also evaluated the protective activity of allylpyrocatechol (APC), the major antioxidant constituent of Piper betle, against the indomethacin induced stomach ulceration in threat model and correlated the data obtained with its anti-oxidative and mucus protecting properties. The models used were Male Sprague-Dawley rats. The study revealed that the treatment with APC (2 mg/kg body weight per day) and misoprostol (1.43 µg/kg body weight per day) for 7 days could effectively heal the stomach ulceration as revealed from the ulcer index and histopathological studies [Bhattacharya, *et al.,* 2007].

b. Anti-Allergic Activity

The inhibitory effects of Piper betle on production of allergic mediators by bone marrow derived mast cells and lung epithelial cells were studied by Wirotesangthong *et al.* The effects of Piper betle ethanolic extract on the production of histamine and granulocyte macrophage colony-stimulating factor (GMCSF) by murine Bone Marrow Mast Cells (BMMCs) and on the secretion of exotoxin and IL-8 by the human lung epithelial cell line, BEAS-2B, were investigated in vitro. The extracts significantly decreased histamine and GM-CSF produced by an IgE mediated hypersensitivity reaction, and inhibited exotoxin and IL-8 secretion in a TNF-α and IL-4-induced allergic reaction. The results suggest that Piper betle may offer a new therapeutic approach for the control of allergic diseases through inhibition of production of allergic mediators [Wirotesangthong *et al*., 2008].

c. Antibacterial Activity

Nalina, T., *et al.,* investigated the anti-bacterial effect of Piper betle. The antimicrobial influence of crude aqueous extract of Piper betle L. on Streptococcus mutans was investigated. The focus of the antimicrobial effects includes the ultra-structure and acid producing properties of S. mutans. From the micrographs of the transmission electron, it was found that the crude extract of Piper betle L. leaves causes plasma cell Membrane damage and coagulation of the nucleoid and the extract was found to significantly reduce acid producing properties of the bacteria. It was concluded that the crude extract of Piper betle L. leaves may exert anti-cariogenic activities that are related to decrease in acid production and changes to the ultrastructure of S. mutans [Nalina, *et al.,* 2007].

d. Insecticidal Activity

Insecticidal activities of essential oil from Piper betle against storage insect pests were studied by Ma. Cristina *et al.,* The insecticidal activity of essential oil extracted from the leaves of Piper betle Linn, was evaluated against the bean weevil (Callosobruchus maculatus F.), corn weevil (Sitophiluszeama is Motchulsky) and lesser grain borer (Rhizopertha dominica F.) using aged grain assay. The efficacy of treatments was assessed by determining the acute toxicity on adult insects and the extent of preventing or suppressing the production of progenies. The volatile oil in 30% dust formulation exhibited toxicity against adult C. maculatus, S. zeamais and R. Dominica at varying application rates, such as 0.2g/100g, 1.75g/100g and 2.0g/100g, respectively. Survival of adult C. maculates was prevented until six months by 52%, while the treatment allowed six months protection of corn

against S. zeamais and R. Dominica. Although eggs were visible in the treated mung bean, the treatment prevented them to develop further. The data revealed that Piper betle leaf oil is a fecundity-reducing agent to adult S. zeamais and R. dominica. Likewise, the oil's ovicidal effect cannot be discounted. It was suggested that the essential oil from Piper betle leaves is a promising grain protectant [Ma, et al., 2009].

e. Antilarvicidal Activity

Anti-larvicidal activity of *Piper betle* was observed by L. S. R. Arambewela, *et al*. Arambewela *et al.,* introduced the *piper betle* essential oil at different concentrations, i.e., 500, 100, 50, 25, 12.5, 6.25 ppm concentrations and motility was recorded between 1 to 24 hours. Mortalities of 43% and 100% were observed for 100 and 500 ppm concentrations, respectively, within 1 hour. Compared to the control, significant mortality was observed even at lower concentrations, 25 and 50 ppm, after 24 hours. The concentration of oil used was 1%, 0.8% and 0.5% respectively, and the mortality rate of 100% was observed in 1% *betel* oil solution within 1-hour.

Piper betel solutions ranging in concentration from 1% to 4% were prepared using 1% Tween 80, sodium lauryl sulfate (0.05 gm/100 mL, as a stabilizer) and methyl paraben (0.01 g/100 ml, as a preservative). The 4% and 3% preparations of the oil of betel were effective in killing 100% of the larvae of C. megacephala within 3hours, while betel oil at 2% concentration killed 97% of C. megacephala larvae within 4 hours. The positive control, mineral turpentine, also killed the larvae within 4 hours. This shows that betel oil is effective in the treatment of wound myiasis [Arambewela, et al., 2011].

f. Antioxidant Activit

Antioxidant activities of *Piper betle* Linn, extracts with different solvents and extraction times were done. Total phenolic content was evaluated according to the Folin-Ciocalteu procedure. The polarity of the plant extract from various solvents was assessed by determining the oil water partition coefficient by high-Performance Liquid Chromatography (HPLC). The extract showed the highest antioxidant activities, total phenolic content and yield. *Piper betle* leaf phenolics were found to have less polarity than other phenolic antioxidants due to their high value of oil-water partition coefficient. The results indicated that the extraction solvent and time are important for the preparation of the *betle* leaf extract for use as a natural antioxidant [Nabasree, & Bratati, 2004].

g. Gastro protective Activity

The Arambewela LSR *et al.,* (2004) study evaluated the gastro protective activity of HWE and CEE of Piper betle leaves in rats. To determine the gastro protective activity two components Hot Water Extract (HWE) and Cold Ethanolic Extract (CEE) with three different concentrations (200, 300 and 500 mg/kg) were fed to rats to induce ulcer. Oral administration of HWE and CEE gave information about an activity which is dependent on dose-age and significant protection against gastric damage caused by absolute ethanol. The HWE significantly increased the mucus content (by 49%) adhering to the wall of the gastric mucosa. Mucus layer is considered to be important in the mucosal defense against endogenous aggressors, e.g., acids and also as an agent in facilitating its repair. It is generally believed that enhanced acid secretion is the most important factor for the induction of gastric lesions [Arambewela, *et al.,* 2004].

In this study, the highest dose of HWE did not cause significant inhibition in acidity (both total and free) or pH of gastric fluid. From the investigation, it was concluded that the gastro protective effect of *Piper betle* was not mediated via inhibition of acid secretion in the gastric mucosa but by increasing its mucus content [Wan, *et al.,* 2014].

Conclusion

Determination and analysis of phytochemical components present in the selected Piper betle medicinal plants of active crude and pure extracts which shows more defined pharmacological activities.

In-vitro callus inductions and secondary metabolites productions by suspension cultures will be deep option to further detail studies in Piper betle as excellent reservoir.

New opportunities will be opened in the field of medicine for developing new formulations after getting such vast positive research results of Piper betle to treat the diseases or disorders in health care management.

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Shivansh Khad : Good Approach to Recycle and Reuse of Agricultural Waste

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Introduction

Due to excess use of chemical fertilizers, pesticides the bacterial life of the soil totally gets destroyed which results in poor quality or infertile soil. The reduction in soil quality forces the farmer to apply more and more chemical fertilizers which ultimately driving cost up and revenues down. Compost is very important part of Agriculture. It involves breakdown of organic waste material into the humus substances which is very beneficial for soil. It also improves physical, chemical and biological environment of soil. Now a days, new type of compost i.e., Shivansh Khad became very popular and use by most of the farmers. It is a free cost sustainable approach which changes the infertile soil into fertile soil and also reduces the dependency of farmers on harmful chemical fertilizers. It requires 18 days duration which convert agricultural green and brown raw material into dark compost which is beneficial for getting higher yield.

Benefits

- It is a low cost technology which is available throughout the year.
- It reduces water requirement of the crop by improving water holding capacity of the soil.
- It reduces leaching losses and evaporation.
- It reduces the chemical requirement of crops.
- Suppresses the weed growth.
- It is ready just in 18 days. Short duration method of compost preparation.
- Reduce dependency of farmers on fertilizers and pesticides.
- Reduce the expenses of irrigation, labour, fertilizers, pesticides etc.
- It improves microbial activity.
- It uses farm waste both green (grasses, weeds, trimmings) and brown material (dry leaves, rice and wheat stalk) with cow dung.

Tools Required

- Chaff /hand cutter- to chop the ingredients.
- Spade – to turn the pile.
- Plastic Sheet (3m x 3m) - to cover the pile and protect it from sun and rain.
- Metal Pan (tasla) - to mix or measure the ingredient.
- Water
- Steel cage (12ft long and 4ft wide).

Materials required

Brown Material	Green Material	Manure
Dry plant waste	Any green plant material	Cow
Rice stalk	Green grasses	Goat
Wheat stalk	Green weeds	Poultry
Dry leaves	Tree trimmings	No human excrete
Dry grass, weeds	Water grown plants	
Animal bedding	No Neem or Eucalyptus	

Key points to remember

- A well drained, dry, shaded area should be selected for its preparation.
- The brown and green material should be chopped properly with chaff or hand cutter.
- Metal pan should be used for measuring purpose and make sure it should not be overfilled.
- The water should be applied accordingly.
- The pile should be covered properly with plastic sheet.
- Total seven turnings should be done till 18th day.
- Turnings should be done properly so that outside layer goes inside and inside layer comes outside.
- Fresh cow dung is required or not more than 1-2 weeks old.
- Proper temperature maintenance is necessary.
- 6-8 layers should be made upto shoulder height with 1.5m in diameter
- On 4th day different types of test to be done to check temperature and moisture content present in it.
- Do not use Neem or Eucalyptus leaves.

Procedure

Day 1

a. Take 9 metal pans of properly chopped brown material for preparing 1st layer with 1.5 diameters and press it with the help of spade and add 1.5 pan water to it.

b. Add a layer of 6 pans of properly chopped green material for preparing 2nd layer with 1.5 m diameters and press it with the help of spade and add 1 pan water to it.

c. Add a layer of 3 pans of dung over it and add half pan of water to it.

Material	Quantity	Water
Brown material	9 pans	1.5 pan
Green material	6pan	1pan
Dung	3pan	0.5pan

d. Repeat the process and make 6-8 layers same as above upto the shoulder height.

e. Now apply cap layer to the pile with 3 metal pans of brown material.

f. Now cover the pile properly with the help of plastic sheet and left it for 3 days.

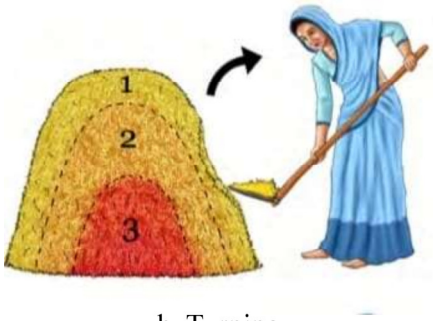
Day 4

a. Temperature test: In this test, we have to check that the pile is warm or not by putting the hand inside the pile. If the pile is warm that means it is good but if the pile is little warm then we add 3 pan dung and proper turning should be done.

b. Squeeze test: Always do squeeze test at different levels of the pile. Take handful of material from different layers and squeeze it, if the material is too dry then add 3 pans of water to it, if the material is too wet and give drippings when squeeze, then dry it in sunlight and again make pile. If only few drops come when squeeze then it is a good sign.

c. Turning : After temperature and Squeeze test, turn the pile properly and again cover it with plastic sheet.

a. Layer by layer pile



b. Turning

c. Covering

Turning Process

7 turnings is required. Turning should be done by the following process

Day	Turning
0 day	Build
4th day	Temperature+ Moisture test + Turn+ Cover
6th day	Temperature+ Moisture test + Turn+ Cover
8th day	Temperature+ Moisture test + Turn+ Cover
10th day	Temperature+ Moisture test + Turn+ Cover
12th day	Temperature+ Moisture test + Turn+ Cover
14th day	Temperature+ Moisture test + Turn+ Cover
16th day	Temperature+ Moisture test + Turn+ Cover
18th day	Ready

Application and Storage of Shivansh Khad

- It should be applied before 3 days of sowing at the time of field preparation
- It should be applied at the time of sowing.
- It should be applied as top dressing.
- It may be stored upto 3 months at cool, shaded and dry place.

Demerits of Shivansh Khad

- It requires more quantity of green and brown material and fresh cow dung all the time.
- Chaff cutter is very important tool in the process.
- Timely turning, temperature and moisture test is required.
- Sometimes duration depends on quality of material.
- Require only cool dry and shady area for preparation and storage.

Conclusion

Shivansh Khad is a very good approach used by many farmers now days. IT can maintain physical, chemical and biological characteristics of soil. It increases soil health, soil quality and finally crop production. With the excess use of harmful chemical fertilizers, yield may be increased but it can degrade the soil health, human and animal health and causes environment pollution. Shivansh Khad is free cost compost which not only saves money but also conserve natural resources, dependency on harmful chemical fertilizers, quality and quantity of agriculture produce. It generates employment and gives economic and social benefit to the country by getting higher price for organically produced food.

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Crop Improvement in Tuberose

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Introduction

Scientific Name : *Polianthes tuberosa* L.

Family : Asparagaceae

Origin : Mexico

Common Name : Tuberose

Hindi Name : Rajanigandha/Gulashabha

Tuberose (*Polianthes tuberosa* L.) is one of the most important tropical ornamental bulbous flowering plants cultivated for production of long-lasting flower spikes. It is popularly known as Rajanigandha or Nishigandha. It belongs to the family Amaryllidaceae and is native of Mexico. Tuberose is an important commercial cut as well as loose flower crop due to pleasant fragrance, longer vase-life of spikes, higher returns and wide adaptability to varied climate and soil. They are valued much by the aesthetic world for their beauty and fragrance. The flowers are attractive and elegant in appearance with sweet fragrance. It has long been cherished for the aromatic oils extracted from its fragrant white flowers. Tuberose blooms throughout the year and its clustered spikes are rich in fragrance; florets are star shaped, waxy and loosely arranged on spike that can reach up to 30 to 45 cm in length. The flower is very popular for its strong fragrance and its essential oil is important component of high- grade perfumes. Tuberose is a widely cultivated crop grown in India for use as a cut flower, loose flower and in perfumery industry. The haploid chromosome number of tuberose is 30, among these 5 are large and 25 are small. The somatic chromosome number is 2n=2x=50. Single cultivars are fertile used in perfumery and seed setting erratic with 2n=2x=60. Double cultivars are fertile and used as cut flower. Seed setting is not observed in double cultivars. The genetic variability available in tuberose is very limited and available named varieties are very few in India. Non-availability of genetic variability has become a major constraint in conventional breeding of tuberose.

Morphology and Floral Biology

Tuberose is a half-hardy, bulbous perennial perpetuating itself through the bulbs and division of bulbs. Bulbs are made of scales and leaf bases and the stem is condensed structure with remains concealed within scales.Roots are mainly adventitious and shallow andthe leaves are long, narrow, linear, grass-like, light green and arise

in rosette pattern. The flower is funnel shaped perianth and are fragrant, waxy white, about 25 mm long single and double and borne in a spike. Stamens are six in number, anthers dorsifixed in the middle; Ovary 3 locular, ovules numerous and fruit are capsule. The determination of the family to which the genus *Polianthes* belongs had long been a matter of difference of opinion among taxonomists Baker (1888) placed the genus in family Amaryllidaceae.

The Amaryllidaceae is closely related to Liliaceae in having underground stem, exstipulate, simple leaves; flowers in scapes; bracteate, actinomorphic, hermaphrodite, flowers; perianth 3+3; stamens 3+3, epiphyllous; gynoecium tricarpellary, syncarpous, trilocular, axile placentation. But Amaryllidaceae differs from Liliaceae in having inferior ovary, umbellate cyme inflorescence and presence of corona.

Species and Cultivars Diversity

Polianthes is a monotypic genus and is closely related to Bravoa from which it differs in having a perianth tube which is widened upwards. According to Rose (1903-05), however, the genus contains about a dozen species but they are not clearly distinct. Nine of the species described by him had white flowers, one was white and red and two were red.

Polianthes tuberose: An erect herb, 60-120 cm high with stout bulbs.

P. palustris: This species having oval to oblong bulb. stems approximately 38 cm high.

P. durangensis: The bulbs are small in this species and the flower arranged in one to six pairs are all sessile, erect at first but becoming curved and purplish with age.

P. Montana: Bulbs oblong, the stem long and slender and possessing 12 pairs of flowers all with pedicels.

P. longiflora: This is a tall species with flowers in three to five pairs.

P. platyphylla: The florets are arranged in four to seven pairs with tube of the floret bent at the base and with short, rounded lobes.

P. graminiflolia: Leaves are long and grass-like. The flower are in 8 to 15 pairs, the lower ones often on peduncles, deepred, bent downward near the base and the filaments are slender and attached low down in the tube.

P. geminiflora: Stems are smooth through with several basal leaves flowers are light orange –red in colour and arranged in pairs of 6 or more.

P. gracilis (P. tuberosa var. gracilis): Narrow leaves, perianth tubes are long and slender. Possibly this was the original form of P. tuberose.

P. plisslli: This is a garden hybrid between Bravoa geminiflora and P. tuberosa and was grown by Bliss in 1905.

Cytogenetics

- The haploid chromosome number (n=x) of tuberose is 30, which falls under four groups i.e., 5 large pairs, 4 medium pairs, 7 medium small and 4 small pairs.
- Single cultivars are fertile used in perfumery and seed setting erratic with 2n=2x=60.
- Double cultivars are infertile and used as cut flower. Seed setting is not observed in double cultivars. 2n=2x=50 (derived from single by loss of 5 pairs of smallest chromosomes due to abnormal mitotic and meiotic division).
- Double tuberose has been reported sterile and cannot be used as pollen parents. double cultivar is fertile in early flowering stage, when the female parent in 2–3 days after anthesis can be used as both pollen and seed parents (Shen *et al*.,1987).

Breeding Constraints

The major problems encountered during tuberose breeding are listed as under :

Non-availability of genetic variability has become a major constraint in conventional breeding of tuberose. The genetic variability available in tuberose is very limited and available named varieties are very few in India.

- Low seed set is observed in case of tuberose.
- Seed setting not observed in case of double cultivars.
- Tuberose exhibits dichogamy and self-incompatibility (GSI).
- Breeding for development of new varieties in India is restricted to single and double varieties.
- Breeding has successfully developed high yielding varieties, but there are no new coloured varieties.

Breeding Objectives

Taking into account the importance of tuberose as a loose flower, cut flower, extraction of essential oil, pot culture and beautification of surrounding the following objectives are suggested in breeding of tuberose.

a. Uniform response to environment.
b. Earliness in flowering.
c. More number of florets / spike for loose flower.
d. More number of spike / plant for cut flower.
e. Long spike length.
f. Higher amount of oil per cent.
g. Small and variegated plant for pot culture and landscaping.
h. Development of coloured flower spike.
i. Long shelf life and vase life of spike.
j. Resistance to pests and diseases.

Crop Improvement and It's Achievements in Tuberose

A. Plant Introduction

Introduction or growing of a genotype or a group of genotypes into a new place or environment where they were not grown previously. It involves new varieties of a crop already grown in that area, a wild relative of the crop species or totally a new crop species for that area. Tuberose seems to have been introduced into India by Europeans. It is thought it was introduced into England by the end of sixteenth century. Irulappan *et al*., (1980) at TNAU, Coimbatore, studied 11 tuberose type and recorded Calcutta single (456 flowers per clump) as the highest yielder followed by Mexican single (447 flowers), while Calcutta semi-double was found to be very poor (43 flowers). Bankar and Mukhopadhay (1980) in Bangalore tried four tuberose cultivars and found single to be the best, followed by double and variegated.

B. Selection

Selection is one of the oldest methods of crop improvement. It refers to the process that favours survival and further propagation of some plants having more desirable characters than others. Selection is more efficient when genetic variation is present in the base population. It utilizes the variation already present in the population. Effectiveness of selection depends mainly on the amount of variation present for and the heritability of the trait. The mean of the character under selection changes in the direction of selection. Variability decreases due the selection. The effects as well as objectives of selection depend mainly on the mode of pollination of the crop species. In India, several local selections of tuberose cultivars were made according to their suitability and better performance in particular agro climatic conditions.

S.No. Varieties	Characteristics
1. Hyderabad Single	Single florets
2. Hyderabad Double	Double florets
3. Pune Single	Single Type variety
4. Pune Double	Double Type variety
5. Calcutta Single	Single Type variety
6. Calcutta Double	Florets have double petal

C. Hybridization

It is a process of crossing two genetically different individuals to result in new individual with different traits. Major objectives of hybridisation involves creating genetic variation and combining desired characters into single individual. Bundrant (1925) during his hybridization work mentioned that he collected tuberose from a local nurseryman in San Antonio, Texas around 1972. During that period only one 'Mexican Single' was in commerce.The genus *Polianthes* now includes, according to Shiners (1966) not only those species originally included in *Polianthes*, but all those formerly placed in the genera *Bravoa, Pseudobravoa, Manfreda, Prochyanthes, Runioniaand* the herbaceous species of *Agave*. In 1899, the first hybrid in this group was produced using *Polianthes virginica* with *Polianthes bulliana*, but the first cross involving the tuberose was reported in 1911 as *Polianthes× blissii*, a cross between *Polianthes geminiflora* and *Polianthes tuberosa.* After many years, Verhock-Williams (1975) reported having crossed *Polianthes virginica* with *Polianthes tuberosa*, obtaining self-fertile plants that looked much more like the seed parent, *Polianthes virginica* and *Polianthes tuberosa.*While they were intensely fragrant, these hybrids were not thought to have as much value as horticultural introductions.Tuberose has the character of dichogamy and self-incompatibility, but some improved varieties have been evolved in India through hybridization. MPKV, Pune released improved variety 'Phule Rajani' in 2005.

S. No.	Variety	Parentage
1.	Shringar (IIHR)	Mexican Single x Pearl Double
2.	Suvasini (IIHR)	Mexican Single x Pearl Double
3.	Prajwal (IIHR)	Shringar x Mexican Single
4.	Vaibhav (IIHR)	Mexican Single x IIHR – 2
5.	Phule Rajani (MPKV)	Local Single x Shringar
6.	Arka Nirantara (IIHR)	-

D. Mutational Breeding

Mutation refers to a sudden heritable change in the phenotype of an individual. Mutation may be the change in gene, chromosome or plasmagene (genetic material inside mitochondria and chloroplasts). Mutation breeding is commonly used to produce traits in crops such as larger seeds, new colors or sweeter fruits, that either cannot be found in nature or have been lost during evolution. It is sometimes also called as hit and miss method of breeding. Mutation breeding can be utilized to develop improved strains and some attempts have already been made in this respect. Several mutagens like radiation, ultraviolet light and a variety of chemicals have been utilized for this purpose. Abnormalities like trifurcated spikes, three flowers at one place instead of two were recorded in bulbs treated with 1.5 kR gamma rays (Patil *et al., 1975)*. By treating the bulbs with gamma rays and fast neutrons, several mutants of ornamental value have been obtained. It all showed colour variation in leaves and not in flowers. Similarly, two gamma induced mutants, the single-flowered cultivar Rajat Rekha and the double-flowered cultivar Swarna Rekha ware developed at NBRI, Lucknow, India. Irradiation with gamma rays at 10 Gy or above reduced growth rate and percentage of bulblet survival. All irradiated plants had leaf chimaeras but no flower colour mutations were found.

Importance of mutation in inducing colour in tuberose

Pigment analysis of a large number of mutant/hybrid ornamentals confirmed qualitative and/or quantitativedifferences between the pigments of original and mutants/hybrids. A schematic representation has been suggested which explains the probable manner in which

differences in pigments of original and mutant cultivars.

Flower colour in ornamental plants will arise in four major directions, i.e., when there is any new flower colour variety (developed either through induced mutagenesis or hybridization) it has to follow one of the four paths:

a. New mutant/hybrid flower colour may be due to either an increase or decrease, or both, in the concentration of one or more existing pigments.

b. Mutant/hybrid colour may be due to blockage in synthesis of one or more pigments; this may also be associated with an increase or decrease in the concentration of one or more existing pigments.

c. Mutant/hybrid colour may be due to the origin of new pigments, which may be associated with an increase or decrease in the concentration of one or more existing pigments.

d. Mutant/hybrid colour may develop as a result of synthesis of a new pigment and the blockage in development of one or more existing pigments; this may be associated with either an increase or a decrease, or both, in the concentration of one or more existing pigments.

Future Thrust

- Overcoming problems like low seed setting and self-incompatibility through non-conventional breeding techniques.
- Scientists/breeders working on tuberose should collect available germplasm with different flower colour. This is because acquisition, propagation, preservation and utilization of coloured tuberose germplasm should be primary for creating further genetic variability.
- Molecular breeding is another option to develop new flower colour in tuberose using sense and anti-sense strategy or incorporation of new coloured genes in tuberose.
- Quantitative Trait Loci (QTL) analysis and marker assisted selection techniques are the present interest in genomics for crop improvement.

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Gene Pyramiding for Plant Health Management

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Introduction

The green revolution in late 70's especially in Indian subcontinent has resulted in substantial yield improvement of important staple food crops like wheat and rice. The Food and Agriculture Organization estimated the demand of food production to 70% by 2050. Thus, in order to meet the increasing food demand, smart and rapid plant breeding tools are required to improve multiple agronomic and nutritional traits simultaneously. The advancement of molecular genetics and related technologies are promising tools for the selection of new crop cultivars and hybrids.

Gene pyramiding or stacking can be defined as a process of combining two or more genes from multiple parents to develop elite lines and varieties. Pyramiding entails stacking multiple genes leading to the simultaneous expression of more than one gene in a variety. There are conventional methods to transfer gene for disease resistance in to new cultivars. Those are as below-

A. **Pedigree breeding** is a method of genetic improvement of self-pollinated species in which superior genotypes are selected from segregating generations and proper records of the ancestry of selected plants are maintained at each stage of selection.

B. **Backcross breeding** crossing of hybrid with one of their parent lines.

C. **Recurrent selection** is an efficient and modified form of progeny selection, where selection for some specific trait(s) is conducted within consecutive segregating progeny generations on the basis of phenotypic characteristics.

But by using conventional methods we can transfer one or two genes for disease resistance. These breeding techniques are time consuming. In order to transfer many genes for disease resistance in short possible time, we have to go for gene pyramiding.

(a) Marker Assisted Selection (MAS)

Crop breeding techniques has been improved to a great extent in recent years. Now precision breeding has become possible in a shortest possible time with the advent of modern molecular tools. Gene pyramiding through Marker Assisted Selection (MAS) has accelerated the development of durable resistant/tolerant lines with high accuracy in the shortest possible period of time for agricultural productivity. Selection of a trait in plants through molecular markers normally involves genomic regions identification, which play important role in the expression of desirable genes. The marker assisted selection involves DNA-based markers that are directly linked with the targeted gene to help phenotypic evaluation and improvement of breeding efficiency by selecting the target genes within the germplasm.

(b) Marker-Assisted Backcrossing (MABc)

Marker-assisted backcrossing (MABc) is currently being widely applied in molecular

breeding. Marker-assisted backcrossing targets one or more genes or QTLs transfer from one donor parent into superior cultivar or genotype to improve a targeted trait. In comparison to conventional backcrossing, MABc depends on the alleles of a marker linked with desirable genes or QTLs instead of phenotypic performance. Through MABc, the gene can be transferred within a shorter period of time (about two years). It can be utilized in any crop breeding programme. Markers are helpful in the backcross selection for the desired genes, which are difficult to select based on phenotypic observations. MABC gene pyramiding involves three levels of selection. Crossing is done between the recurrent parent donor parents for the F_1 hybrid, which is then backcrossed up to three generations to obtain best parent. It is further crossed with another donor parent for pyramiding two or more genes for disease resistance. Although this technique is considered to be time consuming, its precision for gene pyramiding is precise. In conventional breeding technique, the recurrent parent is crossed with donor parents for 6 to 7 backcross generations.

(c) Marker Assisted Recurrent Selection

Recurrent selection is considered an efficient approach for pyramiding multiple traits in plants. However, its efficacy of selection is not satisfactory because phenotypic selection depends on environments while genotypic selection takes much time. Marker assisted recurrent selection is an improved system that enables genotype selection and intercrossing in one cropping season, which can facilitate the efficacy of recurrent selection and expedite the selection process, and help in integration of many favourable genes. Maker assisted recurrent selection F_3-derived individuals are generally satisfactory and multiplied through a single-seed decent strategy for increasing the seed to conduct multiplication trials. Large numbers of plants are preferred, to rely on the accuracy of QTL mapping. QTL can be evaluated after geno-phenotypic analysis for the selection of markers and suitable alleles. The best population is selected for recombination. At each cycle, genotyping is performed to identify the best F1 individuals, which could be used again in the next cycle of recombination

Through the use of random amplified polymorphic DNA (RAPD), restriction fragment length polymorphism (RFLP), microsatellite markers and sequence tagged sites have been developed successfully in tomato (*Lysopersicon esculentum* L.), rice (*Oryza sativa* L.), wheat (*Triticum aestivum* L.) and many other food crops.

Rice (*Oryza sativa* L.) is considered a major staple food crop for billions of population across the globe. Bacterial blast is the common disease causing substantial yield loss in rice around the world. The host-plant resistance can be ideally improved through pyramiding of major *R*-genes/QTLs for multiple diseases. Till date, 46 resistance genes have been identified from the different sources of rice. The genes are most frequently utilized in hybridization programme are *Xa4*, *xa5*, *Xa7*, *xa13*, *Xa21*, *Xa33*, and *Xa38* for developing bacterial blight resistant cultivars.

In case of wheat it is used to develop genotypes for leaf rust resistance. The gene stacked was Lr 41, Lr 42 and Lr 43. For powdery mildew resistance of wheat the genes stacked were Pm2 + Pm4a, Pm2 + Pm21 and P4a + Pm21.

In case of soybean the technique is used to develop genotypes for resistance soybean mosaic virus. The gene sacked was Rsv 1, Rsv 3 and Rsv 4.

In case of barley gene pyramiding is used to develop genotypes for resistance to yellow mosaic virus. The gene sacked were rym 5, rym, rym 9 and rym 11.

Advantages of gene pyramiding

Widely used for combining multiple disease resistance genes for specific races of a pathogen. It is useful when we want to develop

'durable' disease resistance against different races. It is mainly used to improve existing elite variety. It eliminates extensive phenotyping. It can be used to nullify the effect of linkage drag. It reduces breeding cycle duration.

Conclusion

Gene pyramiding is an important strategy for germplasm improvement.

It requires that breeders consider the minimum population size that must be evaluated to have a reasonable chance of obtaining the desired genotype.

Molecular marker genotyping can facilitate the gene pyramiding process by reducing the number of generations that breeders must evaluate to ensure they have the desired gene combination.

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Sustainable Farming Practices in India

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Introduction

Sustainable farming is a broad umbrella term for growing food using methods that will also nurture society, the environment and the economy. It is an alternative to mainstream, industrial agriculture practices. Sustainable farmers seek to support community health and well being and to work with nature, while still being profitable businesses. In simpler terms, sustainable farming is farming ecologically by promoting methods and practices that are economically viable, environmentally sound and protect public health. It does not only concentrate on the economic aspect of farming, but also on the use of non- renewable factors in the process thoughtfully and effectively. This contributes to the growth of nutritious and healthy food as well as brings up the standard of living of the farmer.

Importance of Sustainable Farming

Sustainable farming is important because it offers a solution to the problems caused by the way most of the food is grown today.

Therefore sustainable farming is important in the following manner.

- Sustainable farming promises to protect and preserve soil health.
- Reduce continued health disparities among people.
- Increase animal welfare.
- Sustainable farming movement is creating the space for a food system that respects the dignity of farmers and workers.
- Most efficient use of non-renewable resources like coal, nuclear energy, oil and natural gas.

Like the biodiversity of a forest, sustainable farmers are also diverse and creative as they attune their practices to their local communities and environments. Recent techniques empowering farmers, promote sustainable agricultural practices, reduce crop wastage and deepen domestic and international market linkages along with improving farmers income. Agriculture is often attributed as the backbone of the Indian economy as nearly half of the work force depends on the agricultural sector to earn their livelihood, contributing 19.9% to GDP. It is the world occupation, necessitates resilence and innovation to boost productivity and ensure the sector's overall sustainability.

Sustainability Farming Practices and their methods

Sustainable agriculture offers a much needed alternative to convention input-intensive agriculture, the long-term pmpacts of which include degrading topsoil, declining groundwater levels and reduced biodiversity. It is vital to ensure India's nutrition security in a climate-constrained world.

There are most promising practices in sustainable agriculture.

- Adopting Agro Forestry Practices.
- Applying integrated pest management.
- Aquaponics and hydroponics.
- Avoid soil erosion.
- Better water management.
- Managing whole system and landscapes.
- Permaculture.
- Removal of weeds manually
- Rotating crops and embracing diversity.

- Urban agriculture.
- Using renewable energy resources.

Strategy for sustainable agriculture development

Sustainability in action recommends the following ways and strategies that should be adopted to facilitate and promote sustainability agriculture development.

Strategy 1. Promote and facilitate innovation and adoption of best farming practices:

- Design and implementation of agriculture production projects.
- Participatory agriculture research and learning.
- Publication and workshops.
- Propagation of agricultural innovation in training and facilitation.
- The use of approaches that enable innovations.

Strategy 2. Strengthen the link between farmers, agro-dealers, input suppliers and agriculture institutions.

- Facilitate communication and collaboration of farmers, agro-dealers, input suppliers and agriculture institutions.
- Strengthen the business and technical skills of smallholder farmers to increase the quality and quantity of their farm products.
- Increase smallholder farmer access to larger markets to distribute their products.

Strategy 3. Support rural agriculture commercialization for sustainability development.

- Facilitate surplus production aiming at market prospects.
- Support agricultural extension in a commercialized agricultural system.
- Promote small farm diversification, commercialization and risks.
- Facilitate diversification of production costs.

Strategy 4. Facilitate agriculture financing and marketing.

- Financial inclusion.
- Facilitate access to institutional credit.
- Promoting cross-border and regional agriculture value chains.

The 16 most promising practices in sustainable agriculture are:

- Organic farming.
- Agro Forestry.
- Natural farming.
- System of rice intensification.
- Precision farming.
- Conservation agriculture.
- Crop rotation and intercropping.
- Cover crops and mulching.
- Integrated pest management.
- Vermin composting.
- Biodynamic farming.
- Contour farming.
- Integrated pest management.
- Rainwater harvesting.
- Research of groundwater.
- Floating farming.
- Permaculture.

Sustainable Agriculture Practices and system in India

The key emerging themes in India's sustainable agriculture are-

- The role of knowledge.
- The reliance on farm labour.

- Motivation.
- Role in food and nutrition security.
- Extend short-term transition support to individuals.
- Make sustainable agriculture visible by integrating data and information.

Conclusion

Sustainable agriculture is beneficial because it uses the land; reduces pollution; crates a stable food supply and promotes local communities. Technology has enhanced the growth of sustainable agriculture and with new innovations coming out all the time the future of sustainable farming will continue to grow. Methods of sustainable agriculture and regenerative farming include crop rotation; permaculture; conservation tillage; cover crops and soil enrichment.

Sustainable agriculture is a complex system that brings together water management; maintenance of soil and minimization of pollution or other damaging environmental factors.

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Salicylic Acid: An Immerging Miracle in the Water Deficit Stress Areas

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Introduction

Under a globally changing climate, the associated extreme events jeopardize the sustainable growth and production of crops worldwide. The abiotic pressures such as salt stress, drought, and temperature extremes are typical examples of such events. Drought poses a potential threat to agricultural productivity throughout the world. Plant growth and reproduction are adversely affected by water deficit stress. As a result, developing plants with increased survivability and growth during water stress is a major goal of any research project seeks for high yield. Since water deficit stress remained the greatest constraints for crop production, it is a well-founded fact that SA potentially reduces the risk of crop failure in water deficit stress areas. SA was also observed to be very useful in alleviating oxidative stress under adverse environmental conditions. Understanding the physiological role of SA would thus aid in the development of tolerance in plants against water deficit stress. Mostly farmers avoid cultivation practices in dry areas due to requirement of maximum % of water for the better crop growth. That's why in this article, we will shed light on the amazing progress on the regulatory role of SA in mitigating water deficit stress in plant.

Plants usually face simultaneous abiotic pressures rather than single stress like drought, salinity, excess heat etc. In these uncertain environmental pressures, survival of the plant becomes an issue. Nowadays water deficit stress is the most common abiotic stress mostly faced in farmer's field due to unsure climate change. Adequate water supply is of utmost importance for growth and yield of plants. In order to cope with water deprivation, plants have to adapt their mechanisms and metabolism to ensure survival. To maximize water use efficiency, under water deficit stress plants need to use a large array of signalling mediators such as SA. The role of SA in the plant-stress relationship has been extensively investigated from last few decades through many researches. Salicylic acid treatments effectively ameliorated the negative effects of drought stress on plants via improving the photosynthetic performance, keeping membrane permeability, induction of stress proteins and enhancing the activity of antioxidant enzymes.

The term "salicylic" is derived from the Latin word, Salix (*Salix alba*). Salicin, the glucoside of salicylic alcohol, was isolated from willow bark for the first time in 1826, and a huge amount of the substance was successfully isolated in 1828. Salicin was then broken down into a sugar and an aromatic compound, which when oxidised becomes SA. SA is a colourless crystalline structure and is widely used in organic synthesis, including the synthesis of aspirin, also known as acetylsalicylic acid. Salicylic acid is a water-soluble secondary metabolite and polyphenol produced by a variety of organisms, including plants. SA plays a versatile job in stress tolerance where it can act as a signalling molecule that induces resistance. It is a phytohormone, which modulates the antioxidant defence

system, transpiration rates, stomatal action, and photosynthetic rate in plants. SA is clearly a stress signalling molecule that activates abiotic stress-responsive gene expression and stimulates the expression of biosynthetic enzymes and proteins in plants under environmental stress. Several studies have shown that the use of SA had a significant impact on declining the oxidative damage caused by drought stress in water-stressed areas. Thus, it has been suggested that SA has great agronomic potential to improve the water deficit stress tolerance of horticultural crops. It can be considered as a panacea in water deficit stress areas in reference to climate change for the farmers. Specially In dry areas SA performs as a key factor to escalate farmer's production by reducing the risk of crop losses and also boost socio economic growth of farmers. This article has the aim to expand such innovative technique to the farmers fields it should not be limited to the laboratory.

However, the utility of SA is dependent on the concentration of the applied SA, the mode of application, and the state of the plants and environment condition. Despite SA may be applied with different methods as root or foliar application, seed soaking (priming), soil application etc. In general, low concentrations of SA could enhance crop antioxidant capacity, whereas high concentrations of SA may cause cell death or make plants more vulnerable to abiotic stresses. Currently, there are many information is available about the significance effect of SA in yields characteristics of horticultural crops in response to water deficit stress condition(Table 1).

Defence Mechanism of Salicylic acid in water deficit stress

Plant system, in reality, have indeed evolved various molecular measures in order to reduce resource consumption and adjust growth to acclimatise to extreme environmental conditions. Water deficit stress causes a wide range of physiological changes and metabolic process impairments, resulting in an accumulation of Reactive Oxygen Species (ROS) in the plant system. SA is known as natural endogenous signalling molecule that plays a key role in governing and mediating the responses of plants in diverse abiotic stresses such as water deficit stress.

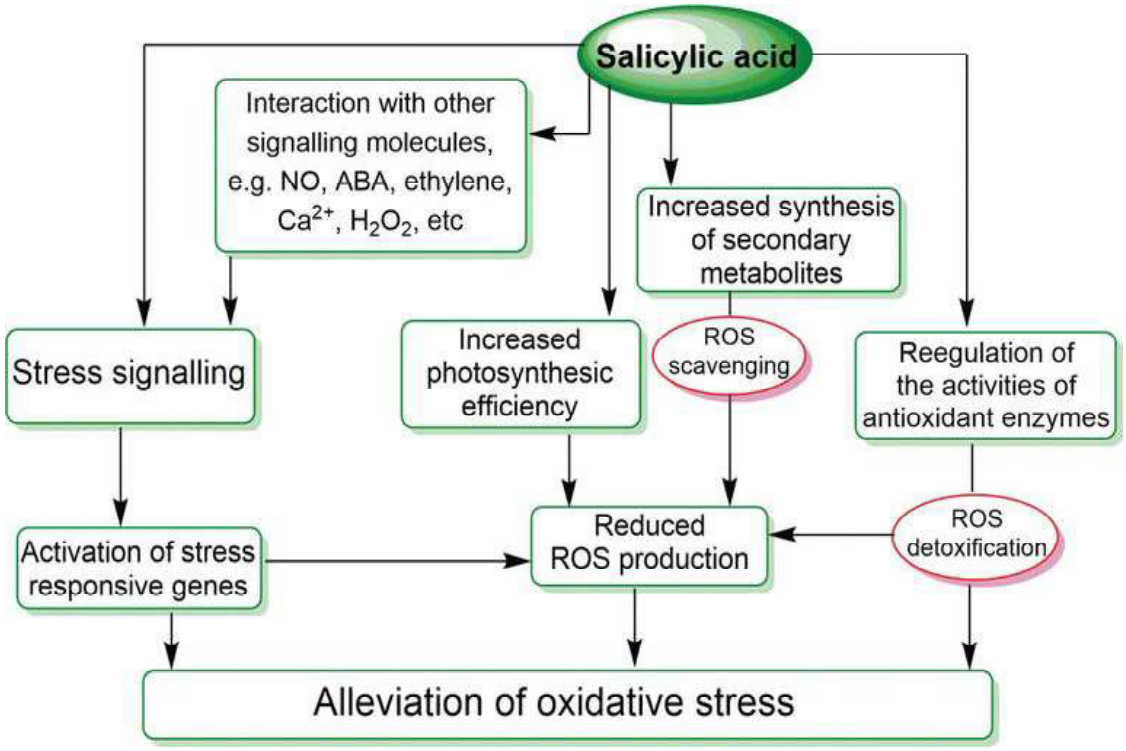
Stomatal regulation by SA

Several studies have suggested that stomatal function is also regulated by SA. Stomata are crucial in the uptake of CO_2 and transpiration. During water deficits stress, the stomata usually close to slow transpiration and conserve moisture in the plant, and limits CO_2 supply. The osmotic swelling or shrinking of guard cells causes stomatal opening or closure, respectively. SA influence stomatal closure, which is assisted by extracellular ROS production facilitated by SHAM-sensitive guaiacol peroxidases, intracellular ROS build-ups in guard cells, and K^+ in channel inactivation. SA hinders catalase activity and raises the level of H_2O_2 in the cytoplasm of guard cells. H_2O_2 oxidises the plasma membrane, increasing membrane permeability of K^+. The loss of turgor pressure caused by K+ mass efflux results stomatal closure. Several studies gives the evidence about SA is able to mitigate the effect of water deficit stresses on plants and increase crop productivity through morphological, physiological and biochemical mechanisms. This technique is an effective aid to get rid of water deficit stress condition.

Activation of antioxidant

The most important impact of salicylic acid is that it activates antioxidant production. Antioxidant acts against the effect of free radicals from the group Reactive Oxygen Species (ROS), when exposed to water deficit stress. Application of salicylic acid induces the SAR in plants, thereby provides a considerable protection against water deficit stress condition. Relatively low concentration of salicylic acid were found to be beneficial in optimising photosynthetic activity and various other physiological and biochemical attributes of crops, resulting in high yields.

Salicylic acid as a Signalling Molecule in plants



Impact of SA in water deficit Response

Water stress has a significant impact on plant growth and production efficiency. Water Use Efficiency (WUE) is an effective selection attribute because this is a parameter of crop quality and reliability under water deficit stress. Drought tolerance refers to a plant's ability to withstand moisture loss and regenerate when moist conditions return. Water deficit stress is a principle environmental factor limiting growth and yield of crop and its effect is more pronounced on reproductive stage than other growth stages which decreased yield drastically (fig 1).The deleterious effect of water deficit stress may be due to the reduction of relative water content, total chlorophyll content, and efficiency of photosynthesis, translocation and ion uptake which usually decline under water deficit stress. The useful effect of SA improves the relative water content and efficiency of photosynthesis as well as increases the growth and yield production.

Table 1. Analysis of variance for the influences of exogenous application of salicylic acid on pod yield and its components of pea under water deficit stress and irrigated condition

Source of Variation	df	No. of pods plant^{-1}	Pod weight (g)	Pod length (cm)	Pod width (cm)	Pod yield plant^{-1} (g)	Pod yield (q/ha^{-1})
Replication	2	3.03	0.035	0.437	0.0185	1.395	0.964
Water stress condition (W)	1	11.99*	5.95**	0.83	0.01	506.16**	1,558.55**
Error (W)	2	0.35	0.03	0.59	0.04	1.74	3.44
Level of salicylic acid (S)	4	17.31**	4.30**	5.31**	0.37**	161.70**	122.25**
Interaction (W× S)	4	0.40	0.53**	0.10	0.002	9.82*	12.64**
Error (S)	16	0.67	0.01	0.25	0.01	2.78	0.97

* and **: significant at pd"0.05 and pd"0.01, respectively.

Source:Soni*et al*., 2021. Salicylic acid induced drought tolerance and yield stability under water deficit stress condition in pea (*Pisum sativum* L. var. Kashi Nandni).

Water scarcity further reduces nutrient uptake due to declines in water migration and the quantity of ions transmitted by the water, as well as the retardation of root growth in dry soil. However, the investigators have reported enhancement of drought tolerance by SA application. The mobilisation of starch retained in the chloroplasts is a characteristic symptom of water deficit. During drought stress, the translocation of carbohydrates decreases, leading to a change in source–sink relationships which ultimately cause reduction in yield. The avoidance of water deficit stress can be achieved by application of SA which witnessed itself for maximise yield in several study. A number of plants can withstand a moderate dehydration of approximately 30% water loss but in the farmers' fields' results is catastrophic. That's why there is a need of scientific methodology which can establish a proper network against crop failure.

Future prospectus

Salicylic Acid does not only stimulate physio-morphological changes in the plants but also immunize the plant through 'Systemic Acquired Resistance' (SAR) to withstand several

disease infection, as a result the overall production cost can be reduced by eliminating fungicide costs. Thus, more intensive study needs to conduct.

· Salicylic acid is not much expensive chemical but farmers need to be trained for how much concentration along with how to apply this chemical in field.

· Interaction of SA with other phytohormone and other signaling molecules (NO, H_2O_2) were not studied extensively. In the biosynthesis of SA, There are unknown steps and enzymes which is not known.

· An integrated approach combining the knowledge of genetics, molecular biology, biochemistry, genomics, and bioinformatics techniques is a useful tool to study the functioning of SA in plants.

Conclusion

Indian agriculture sector is facing difficulty due to extreme of drought and unseasonal rains. This lead to exceptionally dry start to the *Rabi* seasons that severely effect plant yield. In such situations use of SA is emerging as a stress mitigation tool for water deficit stress areas. Hence it proved that application of salicylic acid can help plant to inbuilt tolerance against water deficit stresses. According to the study it can concluded that salicylic acid can be used for increasing the yield of horticultural crop with a specific concentration because after a certain concentration, effect of salicylic acid can be responsible for declining the yield parameters. SA application will be fruitful for farmers use in drought areas like water defict stress areas where generally crop losses become the hurdle for farmers but with the use of SA famer can conquer the production issue. Farmers need to understand the basic principle, recent approaches, and applications methods regarding salicylic acid to get rid of either crop losses or low yield factor. To establish a better connection between farmers and the technology demonstration programmes should be conducted. Training programme, workshop, Kisan Mela for farmers should be organized in such way farmers will be aware that how they can grow their produce even in extreme stress situation as well as how they generate high income by the use of SA.

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Robotic Technology: Fate of Agriculture in Future Scenario

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Introduction

Modern farms are supposed to deliver larger yields with higher quality at reduced costs in a sustainable manner that is less labor-intensive. Digital farming and site-specific precision management are two possible replies to this expectation, which is dependent not just on sensor technology but also on the constant collection of field data, which can only be accomplished with the right use of agricultural robots. Agricultural scientists, farmers and growers are also confronted with the challenge of producing more food on less land in a sustainable manner to meet the needs of the 9.8 billion people expected by 2050. This is the equivalent of feeding a 2,00,000 persons city every day. Agricultural robotics research has been expedited thanks to the integration of digital tools, sensors and control technologies, exhibiting considerable promise and benefits in modern farming.

Benefits of robotics over Conventional Agriculture

A) Socio-economic factors

- Ever-increasing human population resulting in shrinking of agricultural resources
- Non availability of laborer in peak time of season
- Population drift from rural to urban regions

The ageing population of agriculture work force, with younger generations opting for urban careers, the use of agriculture land for biofuel and alternative energy

B) Environmental issues

a. Effect on Soil : Soil compaction has wider environmental costs; increasing water logging, surface run-off and nitrous oxide emissions, soil erosion, reduced soil fertility and restricting the habitat for soil fauna.

b. Effect on water : Agriculture uses 70% of all global fresh water supplies, and yet 4bn people living lobal regions with water scarcity. Traditional agricultural practices like surface irrigation practices, spraying of agrochemicals as well as changing weather situations like climate change, global warming etc., reduces water availability through wastage of irrigation water, drying of surface water resources whether it is surface water or ground water. Exploitation of ground water for different purposes like irrigation, domestic uses reduces and no or less recharge of water table leads to reduction in ground water. These all problems can be resolved by use of robotics.

C) Indiscriminate use of pesticides

The number of new pesticides entering the agr icultural market has decreased due to increas ed regulation and licencing fees.As a result, there is a global need to develop innovative methods for growing crops that do not require or minimise the usage of pesticides. Crop weeding robots are now available that use camera guided hoes, precision sprayers, or lasers to manage weeds, reducing the need for herbicides.

D) Soil, water and air pollution

Traditional farming practices cause pollution of soil, water and air pollution through leaching, runoff, drift hazards, eutrophication process of different agrochemicals. Overuse of agrochemicals leach out with water and reach to ground level where they cause ground water pollution and these chemicals mix with surface water causes eutrophication in water bodies

DEFRA (Department for Environment, Food and Rural Affairs, UK) estimates that the UK cost of diffuse pollution (nitrate, phosphorous, pesticide and sediment run-off, etc.) amounts to c. £311mperannum.

What is a robot?

A mechanical, artificial agent that is usually an electromechanical system and a device that, because of software programming, makes complicated tasks easy to perform is called robot.

According to official RIA (Robotic Institute of America), "A reprogrammable, multifunctional manipulator designed to move material, parts, tools or specialized devices through various programmed functions for the performance of a variety of tasks."

Components of Agricultural Robots

a) Sensor: The work of sensors is to send information to the controller in the form of electronic signals.

- The robot can get information about its surroundings with the help of these sensors.
- Designing and programming of robots has done in such a way that they can get specific information that is beyond the human senses.

b) Controller: It is also called as computer and also called "brain" of the robot.

The controller also allows the robot to be networked to other systems, so that it may work together with other machines, processes, or robots.

c) Actuators/ Drives: The drive or actuator is the "engine" of robot that provide power for motion of robot or it is also called a mechanical device that produces motion.

Types- Hydraulic motor
Pneumatic motor
Stepper motor
DC motor
Servo motor

d) Arms: Usually, it is like a human arm with same parts like a shoulder, elbow, wrist and fingers.

The end effectors are attached to the arm and the sensors present in end effectors do their pre-programmed business.

e) End Effectors: It is main part that interacts with the work environment. It can also define that effector is the last link (or end) of the robot.

At this endpoint the tools are attached

Examples: Gripper, Vacuum pump, Tweezers, Scalpel, Blowtorch

Table : Difference between Robotic and conventional techniques

Content	Robotic technique	Conventional techniques
Power	Machinery power	Human power and old techniques
Work capacity	High	Low (Human need rest)
Time	Less	More
Product quality	High	Low
Cost of cultivation	Initially high but in long run low	Initially low but in long run high
Yield	High	Low

Major categories of agricultural robots

Crop and Soil Monitoring : Low cost and accurate assessment of crop and soil health has long been key to a successful farm and agricultural economy. Recent advancements in drone and satellite technology enable the acquisition of cost effective, timely and localized high resolution multispectral imagery of agricultural land. AI and machine learning offers the ability to recognize highly valuable patterns in this and similar imagery. Governments often want to understand where soil is degrading and inventory which crops are present (crop identification) in which areas. NGOs and hedge funds often want to predict future yields [1], the former to predict food scarcity, the latter to modify purchases in wheat, corn and other futures. Farmers want to know exactly which crops to spray with fertilizer or pesticide, thus reducing cost and impact to the environment. Companies are leveraging sensors and various IoT-based technologies to monitor crop and soil health.

Predictive Agricultural Analytics: Various AI and machine learning tools are being used to predict the optimal time to sow seeds, get alerts on risks from pest attacks, and more.

Supply Chain Efficiencies

Autonomous robots are helping to shape the supply chain of the future by reducing lon gterm costs, increasing worker productivity, reducing mistake rates, reducing inventory checks, optimising picking, sorting, and storing times, and increasing access to difficult or risky locations. Companies are using real-time data analytics on data-streams coming from multiple sources to build an efficient and smart supply chain.

Agricultural Robots: Companies are developing and programming autonomous robots to handle essential agricultural tasks such as harvesting crops at a higher volume and faster pace than human laborers.

Techniques involving Agricultural Robots

Processes like ploughing, seeding, fertilizing, weeding, harvesting, spraying etc. require large amount man power. Hence in order to reduce this need and save time and money, robots are used.

Ploughing (Seed bed preparation) : primary process, the top soil is mixed and turned to prepare a seed bed, burying the surface crop residue.

Seed mapping : Recording geospatial position of each seed as it goes under ground is "seed mapping"

Checking and counting seed by placing an infrared sensor below the seed chute. Seed cuts infrared beam and triggers a data logger that records a position orientation of seeder.

Reseeding : This is the concept of being able to identify where the seed was not placed and can automatically place another seed in same position.

Seed placement -Placing seeds so that they get maximum air, light, water.

A hexagonal or triangular seeding pattern or less space in row n more between rows may be applied by using robots.

Types of Robots used in Agriculture

Demeter- Robot farmer

- Demeter is a crop cutting robot that appears like a regular harvester but can operate regardless of human supervision.
- Demeter is equipped with cameras that can distinguish between crop that has been cut and crop that has not.
- This information directs it where to drive, where to set its cutter head and when to turn around when it reaches the end of a crop row.
- The Demeter robot can also be controlled from a distance. Demeter may also be taught a path and then follow it with the

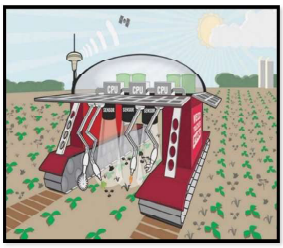
help of its onboard sensors and computer control systems.

The Demeter system strives to provide three levels of automation:

- First, harvester operators will have access to a "cruise control" option that will automatically steer, drive and control the harvesting header.
- A "drone" capability will be available, allowing the user to operate multiple harvesters from afar.
- A fully autonomous machine will be developed, allowing a harvester to harvest an entire field without the need for human intervention.

Weed Controller

- A four-wheel drive weed seeking or weed remover device with the purpose of removing or destroying the weed.
- Crops planted in rows can be used by ploughing between the rows using a hoe.
- Weed recognition is based on colour photography and an intelligent hoe employs vision systems to distinguish the rows of crops and drive itself properly between them, greatly decreasing the need for herbicides.
- The equipped robot aids in the creation of weed maps for plant identification.



Robotic Gantry

- Traditional spraying can be quite effective, especially when huge areas are being sprayed.
- The robotic gantry could apply both liquid sprays and fertilizer and it would be able to control itself based on current weather conditions.
- Sensing systems might be put on a trolley that could travel along the spray boom, like in the crop scouting portion, if it became too windy, the gantry could simply stop and wait till conditions improved.

Forest Robots

A. Treebot

- A fearless mobile robot is assisting scientists in monitoring forest environmental changes.
- A treebot is made up of network of sensors, a webcam, and a wireless network connectivity.
- It is solar powered and transports samples and measurements for vital analysis up and down specific cables.
- Understanding the interaction between the atmosphere and the forest environment is critical in biology, but 90% of all interaction between the environment and atmospheric conditions occurs high up in the forest canopy.

- The treebot contributes by being able to navigate through the forest canopy at all hours of the day and night using specially built cabling.

B. Forester robot

- A special type of robot that used for cutting up of wood, tending trees and pruning of X- mas tree and for harvesting pulp and hard wood in the forests.
- It consists special jaws and axes for chopping the branch.

C. Robot in Horticulture

- Robot is used for cutting the grass in lawns.
- In automatic mode, a fully charged Robo-mower has the capacity to mow a lawn of 2,500 to 3,200 sq. ft., depending on the number of obstacles in its path, slopes, height of grass, humidity, etc.
- It operates electrically on rechargeable batteries, mulching blades, whisper quiet operation and without any pollution.

D. Fruit picking robot

- The fruit picking robots should pick ripe fruit without damaging the leaves or branches at the tree.
- The roots must be able to access all sections of the tree being harvested and they must be able to tell the difference between fruit and leaves by recording video images.
- The camera is attached on the robot arm and the colours it detected are compared to memory attributes.
- If leaves are obscuring the fruits, an air jet can be utilized to blow the leaves out of the way, allowing for a better view and access.
- It has the ability to move in, out, up and down as well as in cylindrical and spherical motion patterns.
- The pressure exerted the fruit is just enough to get it off the tree but not enough to crush it.
- The gripper's shape is determined by the type of fruit plucked.

Advantages of using agricultural robots

- **High capacity of working :** Robots can work 24X7, everyday with no breaks.
- **Money saving :** No need to pay wages to robots.
- **High accuacy :** Robots are extremely accurate compared to humans, so product quality is high i.e., site specific application of inputs
- **Time saving :** Roots can perform tasks more quickly to humans, so more product can be made.
- **Capacity to work in adverse environment:** Robots can work in adverse conditions even than when the situation is inaccessible to human.

- **Ease in full coverage of work:** The machines could easily work around trees, rocks, ponds and other obstacles.
- **Suitable for all types of land holdings:** Small suburban fields could be worked almost as efficiently as large tracts of land.

Disadvantages of robotics

- Energy issues, costly (initial cost is high).
- Timely maintenance of robots is needed.
- If any part of robot is damaged then it is difficult to repair it due to no or less availability to part in that area.
- **Unemployment issues:** People are made unemployed because robots are doing job.
- **Need of skill development:** Person needs special trainings to operate a robot in field condition.
- Robots cannot easily adapt to unusual conditions like a human being can (e.g. if an item on the line is not in correct place, a human worker would notice and correct it).

Future Scope of robotics in agriculture

- Future scope of robotics in agriculture are very bright because it is very useful like time saving, energy saving, more accurate and even a single person can operate a large land holding without the help of labors so it reduces the dependency on labors when it is the peak time of farm workingin agriculture, reduce the workload. It will help the farmers to do work in any season and conditions.It will reduce danger for farmers from different health problems.

Flying Micro Ueucts

- Midget robots are being developed by scientists all throughout the world to scout battlefields, hunt for victims buried in rubble and record photographs in agricultural fields.
- The world's tiniest micro robot, which comprises of a propeller that allows it to soar to great heights, has been entered into the genius's book of world records.
- It is likely to be used in agriculture to eradicate weeds and insects because of its ability to zero in and land precisely on a potato chip before flapping their wings and buzzing away at breakneck speed.

Agriculture VONA Suit

- The robot suit features eight motors installed over the shoulders, elbows, back and knees to deliver a power boost to the wearer, making it ideal for the demanding agricultural tasks like pulling radishes.
- The present model weighs 55 pounds and is controlled by 16 sensors.
- Designers hope to continue working on the suit to make it lighter.

Vitirover Solar Robot Used in Vines to Cuts Crass and Weeds

- Robots have been employed in agriculture for a long time and the number of robots used in various agricultural fields will continue to grow in the future.
- Vitirover is a smart autonomous robot created by French business.
- The electrical motors of the small robot are powered by the sun.
- Because the vineyard is so huge, it was a horrible idea to store the energy in a battery and the return to base to recharge it when the battery was low on power
- This agricultural autonomous machine might work for hundreds of hours without stopping if it was powered by a solar panel.
- It has the ability to cut grasses and weeds to within 2-3 cm of the vine and can work at a speed of 500 m /hr.
- It is crucial for the owner not to damage the vines, so the robot have sensors that

keep the grass cutting blades away from the vines.

- Vitirover can work on 15% slopes and uses GPS coordinates for each parcel to determine when it should work.

Some examples of Agricultural Robots

a. Green seeker sensor: Green Seeker is a machine which uses the sensors to let the plant tell us that what it needs This machine is based on NDVI principle. This smart machine reads a plant's needs and then applies precisely the amount of fertilizer or herbicides needed.

b. Robot drone tractors: A new generation of robot drones is revolutionizing the way we farm, with manufacturing of different robots, announcing the firstever robot drone tractor becomes part of the agricultural mainstream. Robot will decide where to plant, when to harvest and how to choose the best route for crisscrossing the farmland.

c. Flying robots to spread fertilizer: A flying robot monitors the growing condition of the crops over farmlands in Ili, a Kazak autonomous prefecture in Northwest China's Xinjiang Uygur autonomous with camera equipment and an automatic fertilizing system in the front, the robot can fly autonomously and apply fertilizer independently.

d. Fruit picking robots: The research is still in full progress, especially as the robots need to be carefully designed so that they do not bruise the fruit while picking. One solution is the use of suction grippers, used on automated fruit picking machines manufactured.

e. Robot cattle grazing and automatic milking: Is the milking of dairy animals, especially of dairy cattle, without human labour. Automatic milking systems (AMS), also called voluntary milking systems (VMS), were developed in the late 20th century. They are commercially available since the early 1990s.

Research and development in agricultural robotics

Weed control and targeted spraying robots

a. BoniRob: An integrated multipurpose farming robotic platform for row crops weed control developed by interdisciplinary teams which is also capable of creating details map of the field.

b. AgBot: An innovate field robot prototype developed by the Queensland University of Technology for autonomous fertilizer application, weed detection and classification and mechanical or chemical weed control.

c. Autonome roboter: A research effort robot developed by Osnabrück University of Applied Sciences for weed control.

d. Tertill: A fully autonomous solar powered compact robot developed by Franklin Robotics for weed cutting.

e. Hortibot: A robot developed by the Faculty of Agricultural Sciences at the University

of Aarhus for transporting and attaching a variety of weed detection and control tools such as cameras, herbicide and spraying booms.

f. Kongskilde robotti: A robotic platform equipped with drive belt operating based on the FroboMind software that can be connected to different modulesand implements for automated and semi-automated mechanical weed control, precision seeding, furrow opening and cleanings.

g. Rippa: A solar-powered Robot for Intelligent Perception and Precision Application developed by the Australian Centre for Field Robotics at Sydney University.

h. Spray robot: Developed by Holland Green machine for smart chemical application in greenhouses. Some of these robots can reduce weed chemical use by 80%-90%.

Field scouting and data collection robots

a. Trimbot 2020: A an outdoor robot based on a commercial Bosch Indigo lawn mower platform and Kinova robotic arm for automatic bush trimming and rose pruning.

b. Wall-Ye: A prototype vineyard robot for mapping, pruning and possibly harvesting the grapes.

c. Ladybird: an autonomous multipurpose farm robot for surveillance, mapping, classification and detection for different vegetables.

d. MARS: The mobile agricultural robot swarms are small and stream-lined mobile robot units that have minimum soil compaction and energy consumption and aim at optimizing plant specific precision agriculture.

e. SMP S4: A surveillance robot for bird and pest control developed by SMP Robotics.

f. Vine agent: Vine agent, a robot equipped withadvanced sensors and artificial intelligence to monitor the field for plant's health assessment.

g. HV-100: A light weight robot developed by Harvest Automation for moving of plants and potted trees in greenhouses and small orchards developed by Harvest Automation.

h. VinBot: An all-terrain mobile robot with advanced sensors for autonomous image acquisition and 3D data collection from vineyar for yield estimation and information sharing.

i. Mantis: A flexible general purpose robotic data collection platform equipped with RADAR, liDAR, panospheric, stereovision and thermal cameras.

j. Grape: A Ground Robot for vineyard monitoring and Protection funded by the European Union's for smart autonomous navigation, plant detection and health monitoring, and manipulation of small objects.

Harvesting robots

a. Harvey: An autonomous mobile robot platform with UR5 manipulator for harvesting sweet peppers grown in greenhouses and other protect cultivation systems

b. Crops: The crops harvesting platform for sweet pepper

c. Sweeper Platform: For harvesting of pepper

d. Citrus harvesting robot: For Citrus harvesting

e. Shibuya Seiki robot: That can harvest strawberry fruits every 8 seconds

f. Tomato harvesting robot: From Suzhou Botian Automation Technology

g. Cucumber harvesting robot: Developed at the Wageningen University and Research Center.

(i) Slope Helper : Multipurpose from tilling the ground to harvesting the crop, it was developed to operate unsupervised in a wide range of harsh conditions, including muddy fields and steep hillsides of up to 42 degrees, all while carrying as much as 2 tons of weight uphill, downhill or on flat land. Farmers can put the autonomous robot to work without worry

(ii) ARA Sprayer by eRobotix: ARA is an ultra-high precision sprayer that is mounted behind a tractor, this technology can detect the weeds and the culture, so it can spray only the weeds or only the culture. The spraying footprint is 3x8 cm on the ground, which allows ARA to deliver products with increased accuracy.

(iii) Ted by Naio Technologies: Ted is the first mechanical weeding robot to provide winegrowers with an alternative to the use of a traditional straddling machine.

(iv) ERIC Suspended Robots by Farm boy labs: It suspends robots over farmland to help grow crops. Our product removes weeds, plants seeds, spreads fertilizers, cares for crops and harvests them. Farmboy Labs is working on ERIC, a large-area cable-driven robot that substitutes mechanical tools and manual labour in organic farms.

Table: Different Startups involving in Robotics

Startup	Location	Year	Purpose
Field robotics	Cambridge, UK	2016	Harvesting robots
Tibots	France	2016	Poultry management
Farm Droid	Denmark	2018	Seeding robots
Nexus Robotics engineers	Halifax, Canada	2017	Weeding
Blue white Robotics	Tel Aviv, Israel	2017	Autonomous tractors
Arva Intelligence	Houstan, US	2018	Crop planning
Deep planning advances	Oxford, UK	2018	Precision viticulture
Wakan Tech Agricultural drones	Muscat, Oman	2018	Crop pollination
Octo Vision	Jacksonville, US	2019	Crab health monitering
Arugga manufacturers	Kfar Monash, Israel	2017	Robotic pollination
Asimo Multi-tech	Chennai, India	2014	Field mapping, AI-based soil testing, crop suggestions, spraying, harvesting, seeding, nutrition assessment
Tartan Sense	Bengluru, Karnataka	2015	Agricultural Robots

Jivabhumi : IT creates a smart Agriculture marketplace for optimizing the supply and demand for agricultural products, which is often inadequate. It is an innovative food aggregation solution that integrates agricultural products, e-marketplace services and innovation. It uses technologies such as block chain to collect information about products at various stages of the supply chain.

Case Study by Pederson *et al.,* (2006)

Pedersen *et al.,* (2006) considered three scenarios. Key results included:

a. Robotic crop scouting: They estimated an initial investment of € 7799 for the robot scout and, for 500 ha, annual costs of €15.60/ha/yr. They indicated that manual scouting with the same intensity would cost about €19.40/ha/yr for a cost savings of €3.80. Pedersen *et al*., (2006) did not estimate the pesticide cost saving with site-specific weed control, but noted that **research indicated herbicide cost savings from 30 to 75%**.

b. Robotic weeding: For horticultural crops, they estimated an initial cost of €64,939

for a weeding robot and, for a total area of 80 ha, an annual cost of €260.40/ha/yr. Their robotic weeder was a micro-spray system. They estimated the cost of conventional weed control with broadcast herbicides and manual inter-row hoeing at €296.6/ha/yr, resulting in a cost saving of €36.20/ha/yr for the robotic system.

c. Robotic grass cutting: They estimated an initial cost of €43,069 for a golf course grass cutter. With a total area of 36 ha, it had an annual cost of €283/ha/yr. Manual grass cutting was estimated to cost €586.30/ha/yr, for a savings of €303.30/ha/yr.

The profitability of robots for early seeding and reseeding of sugar beets was estimated by Pedersen *et al*., (2017). Early seeding is a possibility with small robotic equipment because it is relatively light weight and could be in the field when it is too wet for conventional machinery. The study assumed that a robotic seeder could plant about 4 weeks earlier than conventional equipment. Based on planting time studies, they estimated a 2.67% yield increase from earlier planting. Assuming that the robotic seeder is used on 500 ha, they found that early seeding with the robot increased gross margin by about €95 or about 7.7%. Of that increase, €75/ha was due to the yield increase and the remainder was cost savings mainly from reducing laborer.

Is robotics is suitable in Indian Condition?

- Due to small and fragmented landholding
- Costly
- Lack of awareness
- Need of skill, training to operate robots
- On farm demonstration is not available
- Lack of will-power in farmers to adopt new technologies

Conclusion

The agricultural revolution will undoubtedly be ushered in by robotics. Although the road ahead is not without its bumps. We need to figure out how to meet the world's food needs in terms of feasibility, sustainability and efficiency. However, it will be fascinating to observe how farmers, agribusinesses and consumers will use the power of robotics and digital automation to determine the industry's future.

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Role of Watershed Management in Sustainable Development of Land and Water Resources in India

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Introduction

Watershed is the hydrological unit and area from which runoff, resulting from rainfall or precipitation, flows past a single point into a large stream, a river, lake or an ocean. The terms watershed, Basin, catchment area or drainage basin are used in the same sense. All watersheds can be divided into smaller sub-watersheds. As each watershed or sub-watershed is an independent hydrological unit.

Efficient and optimum utilization of land and water is fundamental to growth and sustainable development. The concept of watershed Planning, management and development has evolved to ensure effective use of both natural and social capitals.

Thus, the watershed development programmes include land, water, vegetation and human resources as essential components of it. The watershed programme is primarily a land or soil-based programme, which is increasingly being focused on water, with its major objective is to enhance the production of Agricultural through increased in situ moisture conservation (Khet-ka-Paani-Khet-me) or balance the conservation and protective irrigation for socio-economic development of rural people. It has been essential in a country like India where the majority of the population depends on agriculture and about 60 percent of total arable land (142 million ha) in the country is rain-fed. A large portion of the rain-fed areas (65% of arable land) in India is characterized by low productivity, high risk and uncertainty, low level of technological change and vulnerability to degradation of natural resources. Common benefits or impact from successful watershed development projects include improved agricultural yields and increased access to drinking water.

The overall attributes of the Integrated watershed development approach are Soil and Water Conservation, Land use planning, promoting economic development of the rural people who do not have much source of income, employment generation and restoring ecological balance.

The above concepts showing that sound watershed management involves economic and institutional interrelationships as well. These concepts also illustrate the focus of a watershed management approach and they guide the design of the practices and institutional mechanisms needed to implement the approach on the ground.

Components of Watershed Development Programme

The components of watershed development programme would include

(i) Soil and land management through agronomical or mechanical measures

(ii) Water management

(iii) Crop management

(iv) Afforestation

(v) Pasture or fodder development

(vi) Livestock management

(vii) Rural energy management

(viii) Other farm and non-farm activities and Development of community skills and resources trough awareness, Training and Demonstrations. All these components are interdependent and interactive.

Watershed Development Programmes (WDPs)

Watershed Development Programmes (WDPs) are the very important programmes placed under the purview of Department of Land Resources (DoLR), Ministry of Rural Development (MoRD), NABARD and by various Civil Society Organization. Three important schemes namely, IWDP, DPAP and DDP are widely implemented by the State Governments with due priority.

Watershed Management Practices or activities and Their Socio-economic Impacts

In a watershed management framework, various Natural Resource Management practices are undertaken to

(i) Protect a watershed or prevent damage to it;

(ii) Mitigate the effects of land use to an acceptable level;

(iii) Restore degraded environments.

Activities or practices such as vegetative measures or management, controlled grazing, erosion control structures, terracing and selected agro-forestry practices are carried out to:

(i) Stabilize soil or reduce soil erosion from flat and steep slopes

(ii) Stabilize/modify water yield and stream flow

(iii) Maintain or improve water quantity as well as water quality.

Institutional Mechanisms

In terms of project design, there are three types of institutional mechanisms which can be used for ensure that the needed practices are carried out :

a. There is direct public investment to implement the practices. Examples include tree planting on public lands or government land or barren land, building dams and investment in streambank stabilization.

b. There are regulations and laws which guide the actions of individuals and groups. Examples include the regulation of grazing of Ban free grazing, forest cutting or cutting of wood, Tree cutting for road construction, mining on public land, and, of course, tenure laws which govern private and communal ownership and land use.

c. There are incentive mechanisms. These can involve subsidies linked to certain practices, or market prices or direct payment for services, e.g., when upland land users are paid to carry out certain conservation activities that mainly benefit downstream residents.

Barriers to Adopting of a watershed management framework

Lack of awareness or understanding of watershed management concepts, principals, objectives and practices by development professionals and the public also has limited the application of watershed management theory and concepts. There has been a lack of interaction of technical experts in this field with development practitioners and administrators. Only recently have technical experts made a concerted effort to explain, in language understood by the pragmatic development professional, how watershed management concepts and practices can aid in development programs aimed at increasing Water and food security, employment opportunities, economic growth and poverty alleviation, all within a sustainable development framework.

The challenges: Overcoming the barriers

The barriers to wider adoption of a watershed management framework are being broken down slowly but surely. Many decision makers now recognize the imperative of environmentally sound and sustainable development. Ignoring the boundaries and interrelations set by the forces of nature will inevitably lead to serious, if not disastrous problems.

Immersing Public Awareness and Concern

The public is becoming increasingly aware of environmental matters and rightfully concerned about the condition of the country or world for future generations. This concern is translated into increased political awareness and action. It also has led to the creation of more effective and politically acceptable resource transfer mechanisms to distribute the costs and benefits associated with watershed management activities. Incentives are being created to encourage more environmentally sound land use on watersheds.

Increasing Use of Watershed Management Approaches in Development Projects

The challenge in introducing a watershed management approach is not to change the country or world by replacing current practices with some cure-all "watershed management" formula. Development within a watershed management framework does not mean populating the world with professional watershed managers who direct projects and the activities of people living in a given watershed; nor does it mean establishing a great number of isolated watershed management projects. Rather, watershed management principles and practices should be and have been, introduced mainly as integral components in rural, agricultural, forestry development, hydropower and irrigation projects.

Watershed Management Training Needs

Future training activities are needed that can

(a) Provide information for high-level administrators, policy makers, and sector planners-the very people that have the political clout to get watershed management programs and projects implemented at the national or Regional level

(b) Build upon the increasing experience base of watershed projects using case studies of actual projects that allow us to better understand the impact of social economic, and political factors and how they mesh with technical solutions in the planning and implementation of watershed management projects

(c) Build upon local experience and adaptations for a particular country or region what works for one group of farmers and herdsmen may not be feasible elsewhere

(d) Involve national agencies in the development of cadres of teachers that can make continue educational programs for a particular target group, country or region; and

(e) Provide teachers of teachers with an educational process rather than an assemblage of facts.

Conclusion

Watershed Management is the management of natural resources like soil, water, vegetation etc., on sustainable basis for maximizing production of various community required for livelihood of rural population. Watershed Management is used for conservation, Development and optimal utilization of land and water resources for the benefit of people. Management of natural resources at watershed scale produces multiple benefits in term of increasing food production, improving livelihoods, protecting environment, addressing gender and equity issues along with biodiversity concerns.

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Hydroponics : An Eco-friendly Approach to Vegetable Production

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Introduction

Hydroponics, is a technique of cultivation of plants without using soil by using only water as a growing medium for plants. In this system water is responsible for growing plants systematically without using soil, by adding nutrient medium or growing medium into the water only. Hydroponics is also known as Aquaculture, Soil- less culture or a Tank farming culture because water is only responsible for this type of culture. Hydroponics is practiced in those areas where there is a scarcity of land or farm generally they adapt this soil- less farming method and get better yielding.

Hydroponics System

History

William Frederick Gericke is a father of Hydroponics, working at a University of California, at a very first time he gave the idea of Hydroponics system by saying that plants could also have ability to grow in a solution of nutrients and water instead of using soil. Hydroponics had a long back history, from the ancient civilization to raising the high level products which have a great value in this present era. Hydroponics technique first used in ancient city of Babylon which was situated at Iraq, with its famous hanging garden , this garden also counted as one of the seven wonders of the ancient world. In ancient period Hanging garden which was situated at Babylon city are totally depend upon the Hydroponics system as they only use hydroponic system to raise all the plants and flowers to decorate the garden and makes it attractive and unique, after that they spread the idea of hydroponics to grow decorative purpose flowers and plants for the garden decoration which makes it more attractive and beautiful.

How Does Hydroponics Works?

Hydroponics system works , by controlling all the environmental conditions, which was best suited for a particular plant and enhancing the growth and development of the plant efficiently like

- Maintain accurate temperature of a particular plant.
- Maintaining the pH level of the nutrient media so that plants grow un-effectively and efficiently.
- Maintaining the availability of the nutrients and water for the plants, because they both are prime factors which are responsible for better growth and development of the plant.
- Also maintaining the type of nutrient required for a particular crop in adequate quantity.

Why Do Hydroponics?

Due to rapid increasing Population there is a scarcity of land for cultivation, so that people simply take a step towards Hydroponics system because this system does not need any land for cultivation, the only requirement for Hydroponics system is water which is used as a growing medium for plants and give them a platform to grow efficiently.

- Hydroponics system gives better output (yield).
- It needs less space requirement.
- It needs less labor requirement.
- It needs less water requirement as compare to traditional method of farming, because it reuse the water for a longer duration of time.

Kitchen gardening is also successfully done by using Hydroponics system.

Requirements to Set-up Hydroponics System

a. Lightning System: Some of the hydroponics system are setup outdoor, they do not require any artificial light as it use natural sunlight, but some Hydroponics system are setup indoor and they need artificial light facilities like plant grow light bulbs, which regulates the growth of plants efficiently.

b. Air: It is essential for photosynthesis process, in Hydroponics system air is supplied through fans and filter system.

c. Grow room: Construction of good grow room is necessary for providing different types of growing environment to different plants for getting high yield on a large scale.

d. Substrate: Different types of substrate are used in Hydroponics system like

- Coir peat
- Perlite
- Sand grave
- Wood fibre
- Rise husk

i. Pumps: Pumps are essential in Hydroponics system as it regulates the nutrient media directly to the root zone of the plant.

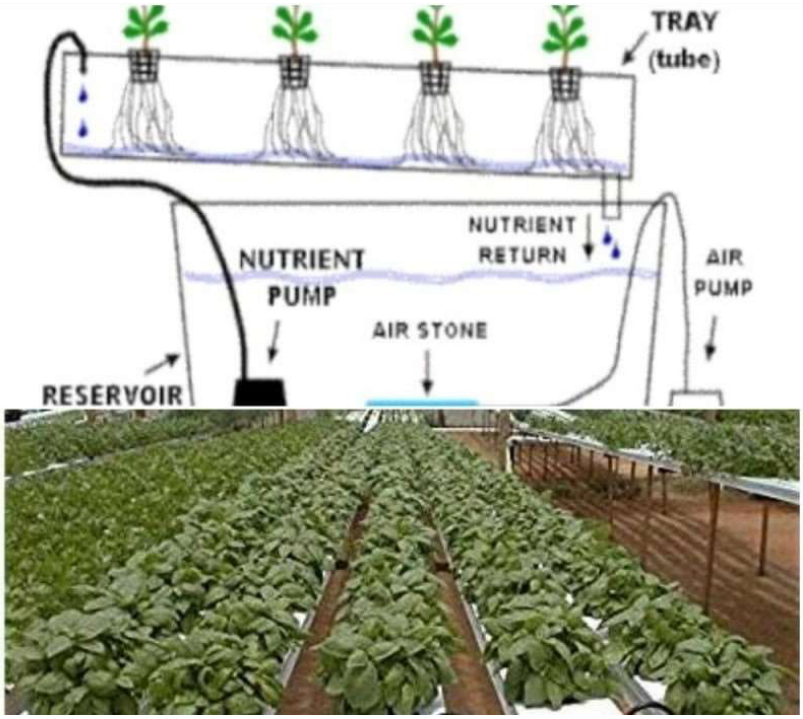
ii. Reservoirs: It is used to store the nutrient media.

iii. Nutrient Media: Nutrient media includes essential nutrients that are macro and micro- nutrients, which directly enhance the growth of plants.

Macronutrients: Phosphorous, Calcium, Magnesium, Nitrogen, Potassium.

Micro-Nutrients: Iron, Boron, Copper, Zinc, Chlorine.

Electronic Meters: It helps to accurately maintain the pH level, temperature and Conductivity of the media.



Crops grown in Hydroponics System

a. Leaf lettuce
b. Tomatoes
c. Peppers
d. Cucumbers
e. Strawberries
f. Spinach
g. Beans
h. Grapes

Merits of Hydroponics System

a. Gives high yield.
b. No use of harmful chemical substances.
c. There is no chance of soil born diseases and pest as it is a soil-less farming.
d. It needs less labour.
e. Also helps to save money which was spent.
f. Field preparation operations.
g. Harvesting operations.
h. Insecticides, pesticides and weedicide operations.
i. Irrigation operations.
j. Sustainable and eco-friendly approach.
k. It also conserves water in adequate quantity.
l. Responsible for growing best and high quality and quantity of product.
m. Crops grown with a faster rate when compare to traditional method.

Demerits of Hydroponics system

a. Initial investment to setup a Hydroponics system is comparatively high which was spent on containers, filter pumps, lightening system, nutrient media so on.
b. It required high technical knowledge to use Hydroponics system.
c. Plants and Vegetables grown in this system are sensitive, if there is any fluctuation occurs in the nutrient media or in hydroponics system they directly effects the whole plant yielding.
d. It needs constant maintenance and
e. Monitoring facilities without any break.
f. Might be a chance of water born disease.
g. Needs 24 hours electricity facility.

Conclusion

Hydroponics system is a modern technique of cultivation of plants, by using water as a growing medium for crops, without using soil. So we all have to adopt this modern technique and take one step towards Hydroponics system, because as the population increases rapidly day by day there is a scarcity of lands and farms and we do not have enough land for the cultivation of agricultural crops and we are not be able to fulfil the demand of rapidly increasing population. In my opinion we should adopt Hydroponics technique for sustainable and eco-friendly production of crops, and by using this technique we are able to successfully fulfil the food demand of our country.

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Microclimate and its Modification in Horticulture

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Introduction

Microclimate modification refers to any artificially prompted adjustments withinside the composition, behaviour or dynamics of the surroundings close to the floor so as to enhance the surroundings wherein vegetation is grown. Any cultivar's ultimate overall performance is decided through its genetic capacity as well because the beneficial environmental situations to which it's been exposed. Microclimate manipulation has the capacity to offer the best viable surroundings for crop plants. We can extrude the agricultural microclimate without spending plenty of cash through making easy adjustments/ changes in crop control. By making such adjustments, the microclimate can be progressed and permit greater crop improvement and output (Mahi *et al.,* 2013). A destiny trend in agro meteorological take a look at is artificial control of plant surroundings to keep most desirable situations for enhanced plant boom and crop output. Microclimate amendment strategies may be useful adaptive techniques in horticulture for handling severe climate sensitivity and climatic risks. Farm-degree adjustments and covered cultivation enhance crop improvement and yield overall performance through editing the bodily surroundings, sun radiation, soil temperature, soil moisture and wind speed, amongst different factors. Mulching aids within side the law of soil temperature and the conservation of soil moisture through proscribing evaporation losses, consequently shielding the crop from adverse climate situations. For the maximum efficient use of sun energy, Plant density and spatial association may be changed. Wind breaks play a critical position in decreasing the wind. Improved irrigation control and a changed crop micro-surroundings end result in elevated warmth and water consumption efficiency. As an end result, microclimatic amendment performs a considerable position in weather extrade control.

Microclimate

Crop microclimate refers to the weather simply above and within side the crop cover and within side the soil root region that may be prompted via way of means of daily management practices at diverse time scales (Stigter, C.J. 1994) It refers to any climatic circumstance that exists inside a few metres or much less above and beneath the Earth's surface, and inside flowers canopies. The satisfactory crop microclimate is one that gives the maximum benefit. Crop microclimate amendment to deal with weather extrade surroundings for the favored plant reaction, this is, the reaction that maximizes crop productivity. The word is maximum commonly used to explain the surfaces of terrestrial habitats; however, it is able to additionally be used to explain the surfaces of oceans and different our bodies of water. Microclimate amendment is a try to extrade or modifies the elements of weather on a micro scale, ensuing in a weather this is beneficial for plant growth. Temperature, humidity, wind and turbulence, dew, frost, warmness balance and evaporation all have an effect on microclimatic conditions. Key plant responses to microclimate may be controlled for either radiation budgets, warmness balances and moisture balances (Stigter, C.J. 1994). Microclimates are significantly prompted via way of means of soil type. Sandy soils, in addition to different coarse, loose and dry soils, are prone to extremes in surface temperature, with

excessive most and low minimal temperatures. Vegetation is additionally essential as it regulates the quantity of water vapour launched into the atmosphere thru transpiration (Britannica). Furthermore, flowers have the capability to insulate the soil underneath it and decrease temperature variability. Microclimates modify precipitation and manipulate evaporation and transpiration from surfaces, making them important to the hydrologic cycle, this is, the mechanisms worried within side the flow of the Earth's waters.

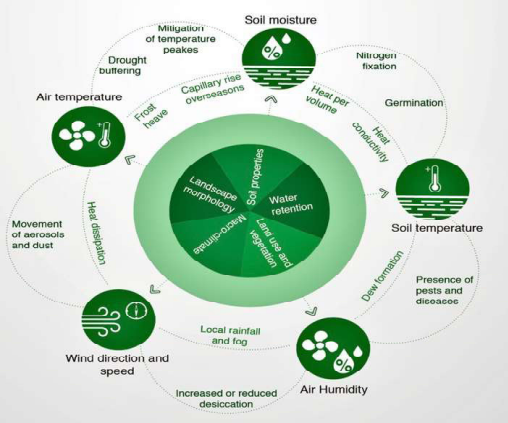

Fig: Mosaic of interactions

Component of Microclimate

Soil moisture and microclimate

One of the maximum important microclimate determinants is soil moisture. When soil moisture is present, the thermal conductivity and warmth potential of the soil are substantially boosted (Bonan, G. 2016). As a result, soil moisture-wealthy places have a more balanced microclimate with decrease air and soil temperatures. This now no longer best enables plants develop, however it additionally has an effect on climate and neighbourhood rainfall patterns. There has been quite a few studies within side the ultimate decade at the hyperlink among a loss of soil moisture and the occurrence of intense temperatures and warmth waves, each regionally and regionally (Seneviratne *et al.,* 2010) Soil biotic existence can thrive whilst there is sufficient moisture within side the soil. Micro-organisms assist soil fertility by breaking down natural substances and liberating nutrients. When moisture occupies more or less 60% of the to be had soil moisture, finest situations are achieved. An abundance of water obstructs the shipping of oxygen, inflicting microbial interest to stall, cease, or flip anaerobic, negatively impacting plant growth. Bot *et al.,* 2005).

Soil attributes and microclimate

The relative quantities of clay, silt, and sand debris within side the soil have an effect on the texture. Clay debris are the tiniest, have the most important floor area, and feature the finest cap potential to take in water. Sand has the largest debris and the least cap potential to take in water. As a result, sandy soils have decrease moisture availability and a faster evaporation fee than clay soils. Clay soils, on the opposite hand, can harden in drought prone locations, lowering infiltration and growing runoff, lowering water availability. The soil shape is made up of soil texture, soil natural matter, and organic pastime at the floor and below ground. The shape has to do with the improvement of micro- and macro aggregates, which might be the approaches that distinct debris is held together. An accurate shape can lessen the wind and water erosion, as nicely as result in water infiltration and storage.

Soil temperature and microclimate

Incoming radiation, in addition to the soil's thermal conductivity and warmth capacity, decide the temperature of the soil. Soil shade has an effect on how much incoming radiation is absorbed or reflected. Darker soil absorbs an extra percent of sun energy, while lighter soils reflect daylight and are colder. During the day, warmth switch into the soil movements warmth far from the direct floor, ensuing in lower temperatures. When the floor temperature drops at night, the

soil's warmth switch course reverses and warmth is launched to the floor, bringing the extremes lower back into balance. Over longer time scales, the same system happens, with warmth being stored all through hotter months and launched all through cooler months (Bonan, G. 2016). The temperature of the soil promotes crop increase with the aid of using imparting the warm temperature required with the aid of using seeds, plant roots, and soil micro-organisms. Plant increase can be hampered with the aid of using excessive soil temperatures, while immoderate temperatures can halt micro-organism organic processes (FAO 2016). Low soil temperatures, on the alternative hand, impede plant water intake, avert nitrification, diminishing soil fertility, and exacerbate desiccation whilst air temperatures are extra (Gliessman, S.R. 2015). High and coffee soil temperatures each have an effect on plant evapotranspiration with the aid of using growing or decreasing it.

Air temperature and microclimate

The maximum essential issue of neighbourhood air temperature is incoming and outgoing radiation. Local flowers can promote transpiration, which lowers the temperature. Vegetation also can offer shade, stopping radiation from achieving lower lying flora or floor levels (partially). Using the cooling impact of soil moisture to lessen general air temperature can end result in better crop yields via way of means of lowering extreme temperatures. The reflectivity of a floor determines how lot daylight is absorbed, that's called albedo. It has a giant effect on figuring out neighbourhood air temperatures, and its adjustments greatly relying at the weather. Local location has a giant effect on incoming radiation including the path wherein a slope faces, impacts the quantity of energy acquired in addition to shade. The albedo of the soil is decided via way of means of its moisture content. Because precipitation adjustments the neighbourhood albedo and presents moisture for evaporation, the interplay among rainfall and air temperature is giant. A dry soil has a better albedo than a moist soil in general. Croplands have a better albedo than forests, because of this that they mirror more daylight returned into the sky and bring less floor heat (Jackson *et al.,* 2010). Surface strategies and traits engage with temperature, moisture, and wind. Through shade, flowers alter the radiation stability while additionally performing as a wind barrier (Gliessman, S.R. 2015). The higher crown has the best air temperature, which takes place one to 2 hours after neighbourhood noon (Foken, T. 2008). Daytime temperatures are lower underneath the crown. The cooling of the earth's floor and the air close to the ground, known as radiation cooling, reasons minimum temperatures within side the higher crown at night. This is particularly real while the sky is clear, the wind is quiet, and the humidity is low.

Air humidity and microclimate

High humid air absorbs water vapour greater slowly than dry air, thus lessen plant transpiration. The lifestyles of neighbourhood wind are essential to combine the surroundings because it actions damp air away from the vegetation (Nicholson, S.E. 2012). Dew formation was proven to be aided through slight breezes in unsheltered areas; however dew formation was discovered to be inhibited through slight to high winds (Richards, K. 2004). Dew manufacturing and length are motivated through the presence of vegetation that acts as a windbreak or gives shade. Windbreaks can assist generate dew through decreasing wind speeds, however they are able to also minimise it due to the fact neighbourhood hotter air layers aren't eliminated. Vegetation provides shade, which serves to decrease neighbourhood surface temperatures, growing the chances of dew formation (Agam, N. *et al.,* 2006). The capacity of wind to move air humidity could have a huge impact on neighbourhood humidity levels, each growing and decreasing.

Wind and microclimate

Wind has the cap potential to chill plants through disposing of the nice and cozy air-bound-

ary layer that surrounds them. The elimination of the layer and substitute with unsaturated air, reasons better transpiration, might also alter the plant's water intake. Furthermore, air movement withinside the flora cover is essential for retaining exact CO_2 ranges for growth, disposing of extra humidity, and decreasing the overall humidity level, minimising the chance of illness. Depending on the ambient temperature, wind can make temperatures hotter or cooler (Bonan, G. 2016). In addition, many cereal plants are pollinated through the wind. Bacteria and fungi, like pollinators, depend upon wind to transport to new hosts, even as bugs use wind to extend their range (Gliessman, S.R. 2015). Dew formation is likewise influenced through nearby winds. Sediments carried through the wind collided with plant leaves and stems, inflicting structural damage. wind have a cascading impact at the microclimate thru the amendment of flora cap potential and soil moisture garage capacity (Ong *et al.,* 2015).

Major Field Microclimate Modifications Techniques

Extreme climate situations exist above and underneath best climate condition. Climate alternate is projected to extend the frequency, intensity and outcomes of positive forms of severe climate events. These variables have an effect on the improvement and increase of the plants. Rainfall/moisture, temperature, sun radiation, evaporation and evapotranspiration and wind are all vital meteorological characteristics. If one of these functions is out of the box, the increase of the crop will suffer. Excessive rainfall for example, reasons floods, whereas a loss of rainfall reasons drought. Cold wave situations will arise if the temperature is appreciably underneath normal. On the other hand, if the temperature is appreciably better than normal, a warmth wave may also arise. Similarly, cyclones have a bad impact on crop increase. Weather risks are an enormous chance to each vegetation and human activities. As a result, climate risks must be changed the usage of quite a few strategies in order to lessen losses.

Modification for wind

Windbreaks and shelter-belts provide the protective shelter against desiccating winds to extent of 5-10 times the height of the tall tree on windward side and up to 30 times on leeward side. For example, a 10-11-meter-tall windbreak when encountered by 45-50 km /hr wind, it reduces on windward side to 20-30 km /hr and to 10 km / hr on just leeward side.

Windbreaks Windbreaks are such structures which break the wind-flow and reduce wind speed. A wide range of materials was used for windbreaks, including rigid bark sheets inserted in sand, piles of grass or foliage and stone wallsTo protect field crops / livestock from cold / hot wind. To prevent soil erosion. To reduce evaporation from farmlands. To improve the microclimate. For fencing and boundary demarcation. For productive role-fuel, fodder, etc.

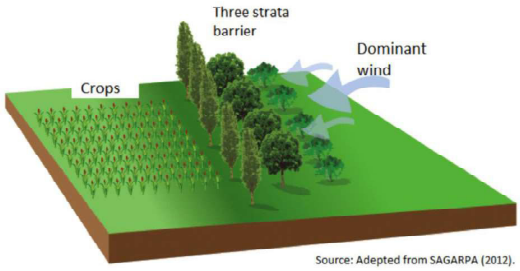

Fig: Windbreaks

Shelter belts

These are belts / blocks consisting of several rows of trees or shrubs planted for protection of crop against wind. To deflects air currents, need to reduces the velocity of winds. To provides general protection to the leeward areas against the effects of wind erosion. To protects the lee-

ward areas from desiccating effects of hot wind. To provide fuel, fodder timber etc. A typical shelterbelt has a triangular cross-section which can be achieved by planting tall trees in the centre, flanked on both sides successively by shorter trees, tall shrubs and then low spreading shrubs and grasses. (TNAU).

Fig: shelterbelt

(1) Modification for heat load

Heatwaves, or extended hot climate periods, may have vast social outcomes which includes better deaths because of hot climate. Temperatures of days and nights have become extra as weather change will become extra common. Increases in intense warmth occasions may also bring about a growth in warmth-associated ailments and deaths, ensuing in reduced productiveness and lower-first-class produce. Protected cultivation makes it viable to achieve elevated crop productiveness through preserving favourable surroundings for the flowers through decreasing the warmth waves. The use of netting and other form of protecting has been proven to restrict air motion across the developing seedlings in better temperature (Majumder, A. 2010). Protected cultivation, on the opposite hand, is used to guard flowers from harsh climatic situations through imparting most appropriate lighting, temperature, humidity, CO_2 and air flow for most appropriate plant increases and first-class. Increased air temperatures inside the residence mixed with advanced moisture fame and root development, elevated nutrient uptake, favouring leaf conductance and chlorophyll content.

(2) Modification of plant growth through Fertilizer management

Crop vitamins, whether or not natural or mineral, are the meals that nourish the plants, which in flip nourish the people. As a result, fertilisers are crucial for food security. Damage because of frost is more befell in dangerous crops, and fertilisation improves plant health. Fertilization with nitrogen previous to a frost, on the opposite hand, promotes boom but growing susceptibility to frost damage. To enhance plant hardening, keep away from the use of too a whole lot nitrogen fertiliser. Nitrogen fertilisation, on the opposite hand, offers the crop a brand-new flush of boom after waterlogged situation. Phosphorus which is crucial for molecular department and tissue improvement be a boon after freezing injury. Phosphorus additionally facilitates in drought situation with the aid of using enhancing the leaf water content, photosynthesis rate. Potassium has a high-quality impact on plant water law and photosynthesis. Some encouraging results have currently been acquired with post flowering foliar utility of various vitamins on wheat yield. It became suggested that spraying 0.5 % KNO_3 at 50% flowering degree of the crop led to better grain and straw yield (Das *et al.,* 1981). Nowadays one of the reasons for crop yield discount is an absence of micronutrients. Zinc is one of the micronutrients that perform a critical role in maximum plants' metabolic activities. Zinc spraying in drought situations will increase the quantity of grains in step with spike, grain weight, and harvest index while in comparison to no spraying.

(3) Modification for frost

Frost is the ice coating or deposit that may generate, commonly overnight, in wet air below bloodless conditions. This happens whilst the Earth's floor temperature and any earth-sure item drops under zero degrees (freezing). For centuries, hearth place and smoke had been utilized in traditional agricultural systems. Heaters provide extra warmth to atone for strength losses. Heat-

ers, in general, both enhance the temperature of metallic objects (e.g., stack heaters) or feature as open fires. If enough warmth is brought to the crop extent to atone for all strength losses, the temperature will now no longer drop to dangerous levels. They are value powerful for excessive price crops (sugarcane, coffee, tea etc). Biomass residues (crop straw, residue, waste etc) are extensively utilized to warmth the crop surroundings in windy condition. Straw burning within side the wind creates a smoke layer over the crop floor that absorbs lengthy-wave radiation launched via way of means of the soil, protective the mustard crop from frost via way of means of boosting the ambient temperature. Smoke debris are commonly much less than 1 ìm in diameter, mirror seen mild however are impervious to lengthy wave radiation, and as a result save you fast cooling of the ground floor (Mee, T. R. *et al.,* 1979). In frost time even mild watering or sprinkling facilitates in frost safety via way of means of releases latent warmth and forestalls the tissues of the flowers it coats from freezing. Sprinkler irrigation presents properly frost safety and increases the temperature of the microclimate. Sprinkler irrigation will increase lengthy-wave radiation and practical warmth transmission to the flowers whilst in comparison to an unprotected crop. By wetting the soil, it will become darkens, which will increase the absorption of sun radiation and keep away from the chilling injury. Using effective blowers to lessen wind, stopping the formation of bloodless air accumulations, Crop protecting or wrapping (excessive-price crops), heat to keep the temperature from losing too quickly, Smoke manufacturing to lessen radiation cooling are Some different Typical measures to save you frost or lessen its severity.

(4) Modification of water balance

During summer season the atmospheric water demand increases, resulting in high evapotranspiration (evaporation from wet soil surface and transpiration from crop canopy). Thereby rate of depletion of soil moisture increases. The water loss by this way is reduced by mulching and use of different types of antitranspirants.

a. Anti-transpirant

Anti-transpirants are the materials or chemicals which decrease the water loss from plant leaves by reducing the size and number of stomata. Nearly 99 percent of the water absorbed by the plant is lost in transpira tion. Antiranspirants and any natural substance applied to transpiring plant surfaces for reducing water loss from the plant. There are of four types. (Agriinfo. in. N.p., 2016).

- **Stomatal closing type**

Most of the Transpiration occur through the stomata on the leaf surface. Some fungicides like Phenyl Mercuric Acetate (PMA) and herbicides like Atrazine in low concentration serve as antitranspirants by inducing stomatal closing. (Agriinfo.in. N.p., 2016).

- **Film forming type**

Plastic and waxy material which form a thin film on the leaf surface and result into physical barrier. Example: ethyl alcohol. (Agriinfo.in. N.p., 2016).

- **Reflectance type**

They are white materials which form a coating on the leaves and increase the leaf reflectance (albedo). By reflecting the radiation, vapour pressure gradient and thus reduce transpiration. Example: Application of 5 percent kaolin spray reduces transpiration losses. (Agriinfo.in. N.p., 2016). Example : Diatomaceous earth product (Celite), hydrated lime, calcium carbonate, magnesium carbonate, zincs sulphate etc.

- **Growth retardant**

These chemicals reduce shoot growth and increase root growth and thus enable the plants to resist drought. They may also induce stomatal closure (Agriinfo.in. N.p., 2016). Example:

Cycocel is useful for improving water status of the plant

Mulch application

Mulch is a layer of material applied at the soil surface, which leads to conserve soil moisture, moderate soil thermal regime, reduce weed growth and improve fertility and soil health. (Mohammad *et al.,* 2012) observed significant increase in grain and straw yield of wheat when the crop residues were retained in the field than when they were removed. (Iqbal *et al*., 2008) observed increase in water use efficiency of maize with increase in mulch amount from 2 to 6 Mg ha-1. Yaseen *et al*., (2014) also observed increase-in water use efficiency of maize with mulch-application. Wang *et al.,* (2011) reported increase-in water use efficiency of maize under reduced tillage with residue incorporation. Similarly, Ram *et al.,* (2012) observed increase in water use efficiency of maize under no tillage with mulch. (Sarkar *et al*., 2007) observed effect of mulch type on moisture depletion rate and observed water-hyacinth mulch to be more effective than rice straw mulch by retaining more moisture in the soil profile. Mulching has potential to enhance soil quality over the long-term as well as increase-in production. Crop residues placed on the soil surface shade the soil, serve as a water vapour barrier against evaporation losses, slow surface runoff, and increase infiltration (Mulumba and Lal, 2008). Mulching with crop residues improved water-use efficiency by 10-20% as a result of reduced soil evaporation and increased plant transpiration. In the case of winter wheat, straw mulching has been shown to increase water-use efficiency from 1.72 to 1.94 kg m-3 (Deng *et al*., 2006) Example: Strawberry (*Fragariaananassa)*,Pineapple (*Ananas comosus*)

Conclusion

Artificial control of field environment to keep the optimum condition of plant growth and crop production that is practice of environmental control requires a complete knowledge of physiology of plants and physical environment. Wind, precipitation, sunshine, temperature, humidity, and soil moisture are the primary factors involved to establish the existing climate or microclimate. The profitable production of crops and efficient use of water require a microclimate suitable for plant growth. Aspect i.e., direction that a slope faces and angle of slope on a geological feature are major factors in determining the influence of wind and water on a site. By the use of different types of microclimate modification techniques, like windbreak, shelter-belt, anti-transparent, mulching we protect our crops, increase the production and quality as well.

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For the welfare of the Farmer's, the society "Society for Advancement in Agriculture, Horticulture and Allied Sectors" willing to publish E-magazine in the name of "Krishi Udyan Darpan E-Magazine (Hindi) / **Krishi Udyan Darpan** E-Magazine (English**, Innovative Sustainable Farming**.)**, which covers across India.**

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9. Not more than five authors of one article.
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11. The text should be clear, giving complete details of the article in simple Hindi/English. It should contain a short introduction and a complete methodology and results. **Authors must draw Conclusions and the Reference of their articles at last**. The abbreviation should be written in full for the first time. Scientific names and technical nomenclature must be accurate. Tables, figures, and photographs should be relevant and appropriately placed with captions among the texts.
12. Introduction must present main idea of article. It should be well explained but must be limited to the topic.
13. Avoid the **Repetitions** of word's, sentences and Headings.
14. The main body of an article may include multiple paragraphs relevant to topic. Add brief subheads at appropriate places. It should be informative and completely self-explanatory.
15. Submitted manuscript are only running article and contains the field of Agriculture, Horticulture and Allied sectors.
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ABOUT THE SOCIETY

Father of Nation Mahatma Gandhi's concept of rural development meant self-reliance, and least dependence on outsiders. India is an agrarian country and about 65% of our population lives in rural areas. But unfortunately, most of us do not have any idea about the extent of poverty and the real conditions of rural India.

With the purpose of serving the agricultural fraternity and farming community the Society for Advancement in Agriculture, Horticulture and Allied Sectors (SAAHAS) was founded in 2020 (under Society Registration Act, 1860). Among multifarious ways of serving farming community we are involved in training of the farmers by organising technology dissemination programmes in villages, guiding them to adopt good agricultural practices involving planned crop management. It helps in reducing farm base losses and motivating them to become farmer level entrepreneur rather than a simple producer. It involves initiating skill based knowledge to the student of agriculture, horticulture and allied sectors to encourage them to serve the farmers in the best possible ways.

SAAHAS calls us to look into the genuine problems of farmers and address those issues for their betterment in the arena of Agriculture, horticulture and allied sectors. Besides agriculture, horticultural crop production has been given a major focus by Govt. of India in future crop diversification, improving livelihood through doubling farmers' income, economic opportunities through export and job opportunities. While good beginning is made, much is to be achieved in different areas in agro-horticulture sector.

Apart from that, SAAHAS helps developing the culture to involve more number of women in farming, processing of crops and value addition thereof for higher returns in terms of total income. SAAHAS eagerly involves with the farmers and agriculture entrepreneur to motivate them for introducing hi-tech farming, which includes growing of high value horticultural crops in hydroponics, aeroponics, polyhouse, net house and greenhouse. The society has geared up its activities to take up the challenges of biotic and abiotic stresses, emerging needs of quality seeds and planting material and reducing cost of production.

There are several government and non-government organisations intended of farmer's welfare; still there is dire need for more involvement and attachment with the farmers. Our society's noble initiative can ensure diminishing of the persistent gap between agro-technocrats, scientists with the needy farmers. We not only ensure that the farmers choose right variety of right crop, better nutrient management through diagnosis recommended system and pest diagnosis but we also help them to sale their produce at premium rates. There is a major issue of chemical residues in food, soil and ecology which is also a big concern of the century. The Society also aims to motivate the farmers either for minimal use of chemical inputs or total adoption of organic farming. Consultancy, training, awareness programs, national and international seminars and symposia and technical services are the prime activities of the SAAHAS.

Society for advancement in Agriculture, Horticulture and Allied Sectors publishes peer reviewed scientific journal, 'Journal of Applied Agriculture and Life Sciences (JAALS)', biannually since January 2020 focusing on articles, research papers and short communications of both basic and applied aspect of original research in all branches of Agriculture, horticulture and other allied sciences. To apprise the scientists and all those who are working in the field of Agriculture, horticulture and allied sectors about recent scientific advancement is the aim of the Journal.