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SEAWEED CULTIVATION AND IMPORTANCE

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Seaweed is a loose colloquial term encompassing macroscopic, multicellular, benthic marine algae. The term includes some members of the red, brown and green algae. Seaweeds can also be classified by use (as food, medicine, fertilizer, industrial, etc.). Most people know two general categories of seaweeds: wracks (Members of the brown algal order Fucales such as Fucus) and kelps (Members of the brown algal order Laminariales such as Laminaria), and some have heard of Carrageen or Irish moss (A red alga, Chondrus crispus). Seaweeds are particularly important ecologically: they dominate the rocky intertidal in most oceans, and in temperate and Polar Regions cover rock surfaces in the shallow subtidal. Although only penetrating to 8-40 m in most oceans, some are found to depths of 250 m in particularly clear waters.

Phytomorphology of seaweed : Seaweeds appearance somewhat resembles non- arboreal terrestrial plants.

Thallus: The algal body

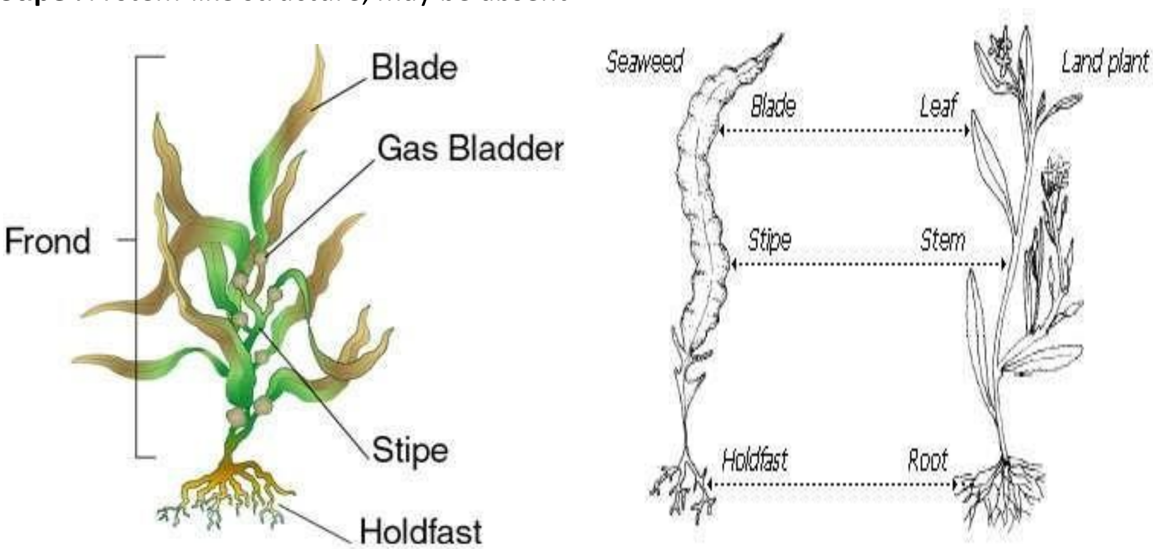
Lamina: A flattened structure that is somewhat leaf- like

Sorus*:* Spore cluster know as sorus.

Fucus, air bladders: Float-assist organ (on blade)

Kelp, floats : Float-assist organ (between lamina and stipe)

Stipe : A stem-like structure, may be absent



Structure of Sea weed

Holdfast : Specialized basal structure providing attachment to a surface, often a rock or another alga.

Haptera : Finger-like extensions of holdfast anchoring to benthic substrate. The stipe and blade are collectively known as the frond.

Blades : The leaf-like, flattened portions of the thallus of seaweeds.

Pneumatocysts : Gas-filled bladders that sometimes keep the blades close to the sea surface maximizing the exposure of blades to the sunlight gases include carbon monoxide.

Types of Seaweed

Three types of seaweed are:

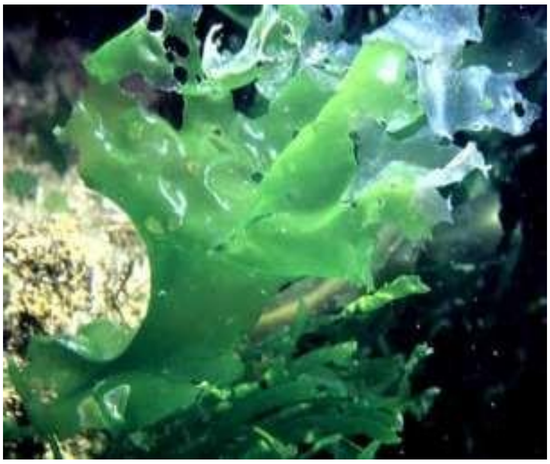
- Green seaweed
- Brown seaweed
- Red seaweed

Green seaweed

- Green seaweed are belong the chlorophyta group. The green seaweed mostly lives in freshwater and terrestrial environments the group from which embryophytes (higher plants) emerged only 10 percent are marine and most of green seaweed have a simple thallus.
- Pigments and food reserves are the same as terrestrial plants.

Enteromorpha

Sea Lettuce



Ulva

Brown seaweed

- Brown seaweed are belong the phaeophyta group. Brown seaweed color varies from olive green to dark brown.
- Almost brown seaweed 1,500 species are marine almost always the dominant primary producers on temperate and polar rocky coasts.

- Brown seaweed belongs to the group Heterokontophyta, a eukaryotic group distinguished by chloroplasts surrounded by four membranes.
- Play an important role in food supplies and environment development.

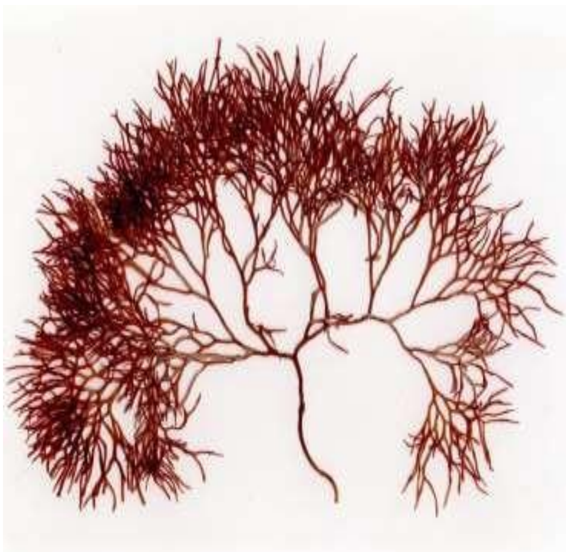
Kelp

Sargassum

Red algae

- Red algae are belonging to Rhodophyta group.
- Red algae have to more species compared than green and brown algae.
- Red algae have red pigments called phycobillins.
- Red algae have to 4,000 species live in freshwater or soil inhabited most shallow- water marine environments.
- It is harvested for food and for the extraction of various products.
- Most of red algae are filamentous, many branches with intricate patterns, increases light-gathering surface for the seaweed.
- In red algae dense clumps are more common some have lost almost all traces of chlorophyll.

Palmaria



Chondrus

Site selection of seaweed farming

- Choose a location where there is a good water movement or where there is a rapid water turnover.

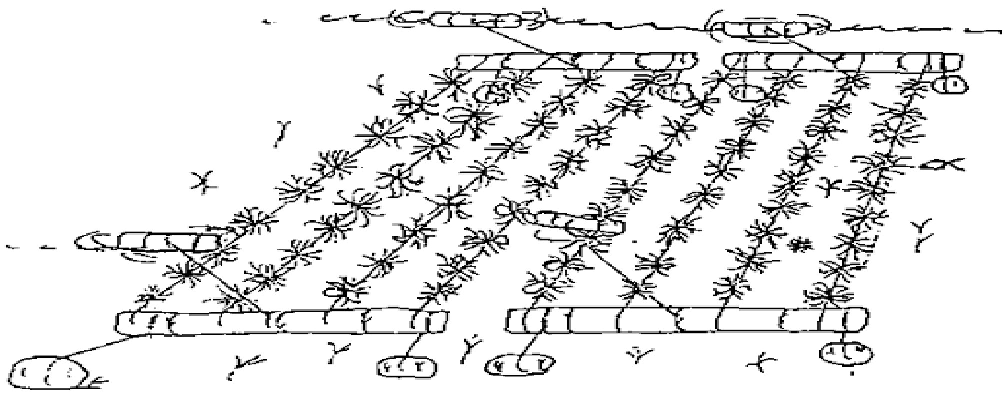
- Hence, water current speed should be between 20 to 40 m/min.
- Area should be sheltered from very strong wave action, current and winds.
- Avoid areas that are near the mouth of rivers or where there is a heavy freshwater runoff.
- The area should have a water temperature range between 25°C and 30°C.
- Water depth in the farm should not be less than 2 feet during the lowest tide and more than 7 feet during high tide.
- The ground should be stable enough to permit easy installation of stakes or bamboos.
- Farm bottom composition should be sandy and rocky depending upon the variety of seaweed.
- Take note of the other marine plants and animals that are associated with seaweed, for they are good indicators of possible site for its farming.
- Consider also the availability of labor, materials, accessibility to transportation and communication as well.

Culture Techniques for Seaweed:

1. Short stake and line method
2. Long stake and longline with float method
3. Suspended rope and line with rope
4. Bamboo raft method
5. Raft method
6. Spider web method
7. Lantay method

Short stake and line method

1. Short stake and line method are used in short stakes (60cm long) erected on seabed and arranged in rows.
2. In the short stake and line method seeded line has no floats.
3. It is used in very shallow area at spring low tide.

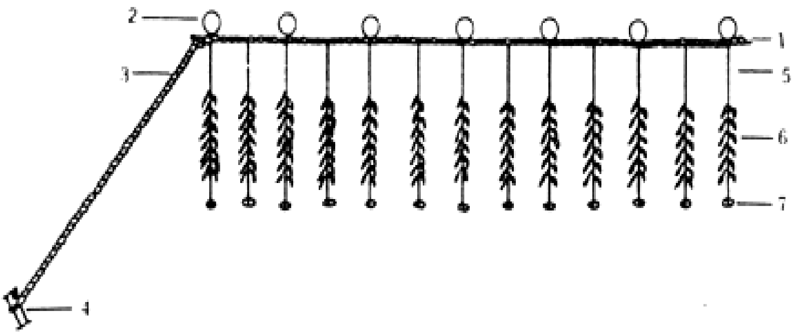


Long stake and longline with float method

1. Long stake and longline with float method are uses long stakes (1-1.5m long) erected on seabed and arranged wide distance between rows.
2. In the long stake and longline with float method uses long seeded lines with floats.

Suspended rope and line with rope

1. Suspended rope and line with rope are mainly uses ropes suspended by floats and anchored by weights.
2. In this method seeded lines have floats.

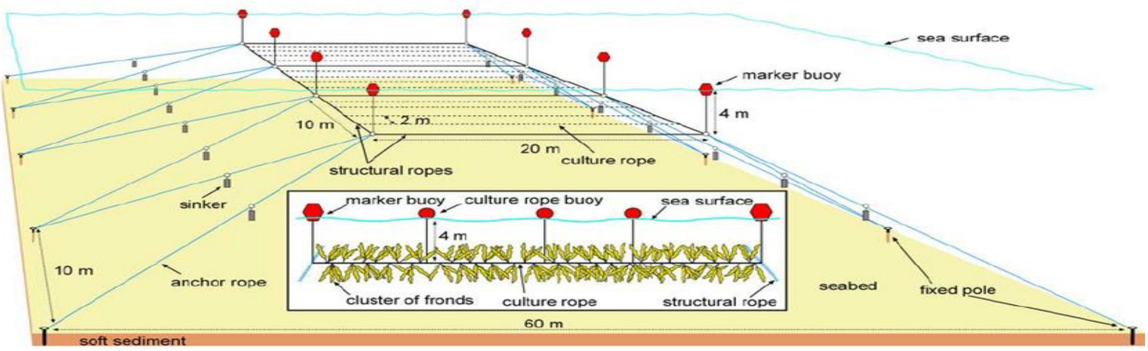


Bamboo raft method

1. Bamboo raft method are used in bamboo poles as floats and weights as anchors.
2. In this method seeded lines may or may not have floats.

Raft method

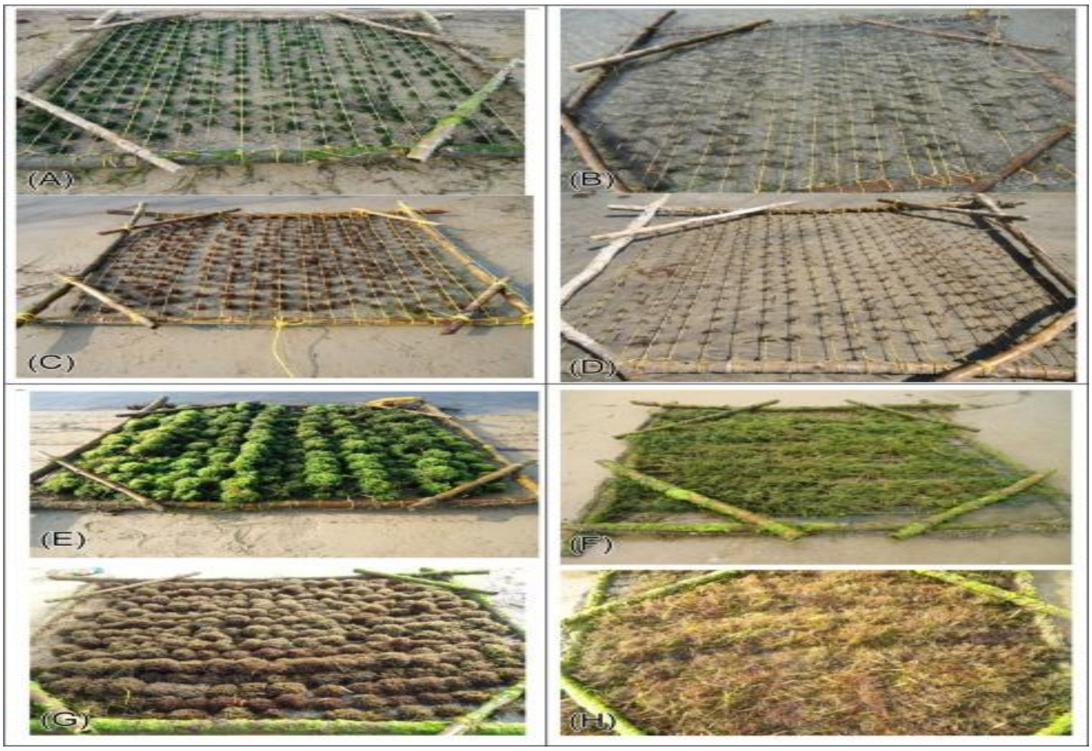
1. In the raft method uses bamboo poles as floats and iron stakes as anchors.
2. Styrofoam balls to keep seaweeds at desired level.
3. In the raft method water depth of 10-20m.
4. It is used in wide channels and open bodies of water.
5. Apply in moderately strong waves and water current



Spider web method

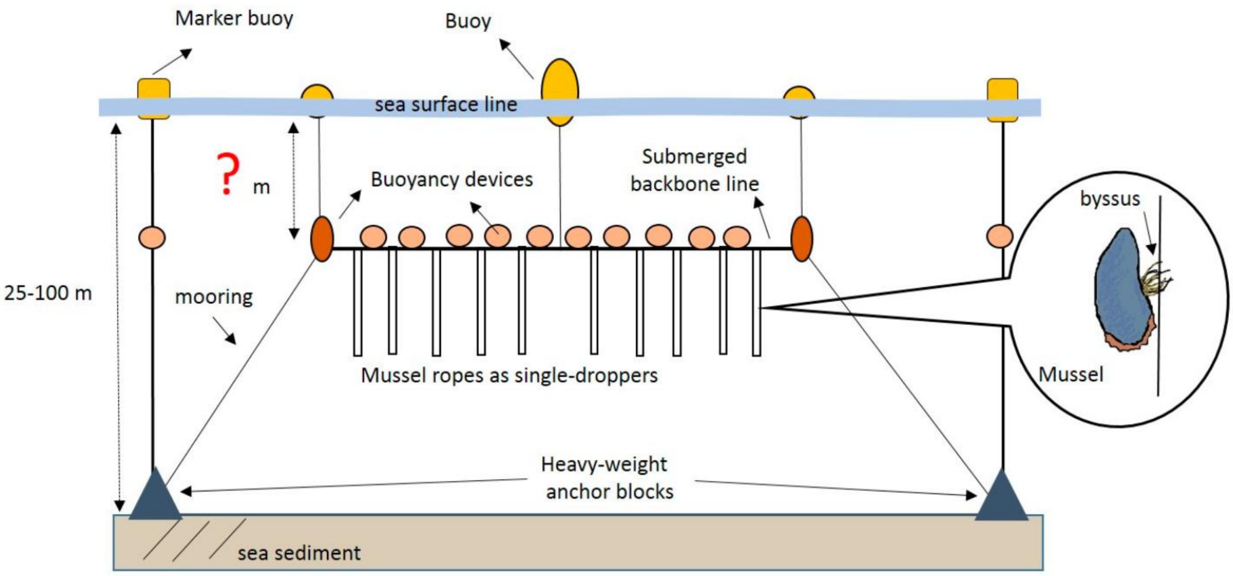
1. Spider web method similiar to raft method without bamboo.

2. It is used in open bodies of water with depth of 10-20 meter.
3. It is mainly used in moderately strong waves and water current.
4. It is having to high yield and greater flexibility.



Lantay method

1. The lantay method used bamboo as a frames.
2. In this method used net to cover the whole structure.
3. It is used in nursery and seed holding purposes.
4. It is not used in commercial purposes.



Benefits of seaweed:

1. Seaweed has to contain iodine and tyrosine, which support thyroid function.
2. Seaweeds are good source of vitamins and minerals.

3. Seaweeds are also act antioxidant.
4. Seaweed provides fiber and polysaccharides that can support gut health.
5. It may help lose weight by delaying hunger and reducing weight.
6. It may help with diabetes by reducing blood sugar.
7. Phycocolloids: gelatinous chemicals produced by seaweeds that are used in food production and product manufacturing.
8. Seaweed acts as stabilizer and emulsifier.
9. Seaweed have to medical use many people swear by the efficacy of seaweed baths in the treatment of rheumatism and arthritis.

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INTEGRATED PEST MANAGEMENT OF COCONUT RHINOCEROS BEETLE *ORYCTES RHINOCEROS L* (DYNASTIDAE: COLEOPTERA)

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Introduction

Coconut (*Cocos nucifera*) is a member of palm tree family Aracaceae. It is originated in Indonesia. It is widely distributed in tropical regions of the world, ranging between 20^0N and 20^0S latitude. The major three coconut producing countries are Indonesia, Philippines and followed by India. In India, top three coconut producing states are Kerala, Karnataka and Andhra pradesh respectively. Coconut is prominent crop in India with area 21 lakh hactres, production is 21,288.24 million nuts and productivity is 9897nuts/hactre (CDB, 2018-19). Coconut is often referred as 'tree of life' because of its wide range of uses(Jalani et al., 2003). Not only fruit, every part of tree including leaves, flowers and trunks are also useful. Coconut is major crop in southern states of India because of its commercial purposes and home uses.

But major threat for coconut crop is pest and diseases. The coconut crop is being attacked by 830 insects and mites species, 173 fungi and 78 species of nematodes attack the palm during different phases of growth and incur substantial crop loss (CPCRI, 1979). Among various insect pests rhinoceros beetle (*Oryctes rhinoceros L)* is the major pest distributed widely in all coconut growing tract.

The adult beetle cause serious damage by boring into spindle leaves and spathe causing characteristic 'v' shaped geometric cuts on leaves and oblong shaped holes on spathes(Rajan et al., 2010). Frequent infestation results in stunting of trees and death of growing point in young plantations. The infestation can be easily made out by the chewed fibrous material present near holes. The damage made by this pest provides egg laying site for another lethal pest viz., red palm weevil and entry for fungal pathogen. The grub breeds in the manure pits, compost, cattle dung and dead and decaying palm.

Figure 1: Characteristic 'V' shaped geometric cuts on leaves

Figure 2: bore holes near crown region

Integrated pest management

IPM is a pest population management system that utilizes all suitable techniques and methods in as compatible manner as possible and maintains the pest populations at levels below those causing economic injury level (FAO, 1972). And main components of this IPM are cultural control, mechanical control, biological control and chemical control. The chemical control always must be the last strategy.

Cultural control:

- Decaying trunk of trees in the coconut gardens should be burnt as they serve as breeding ground.

Mechanical control:

- At the time of peak infestation(June-sept) beetles should be extracted from the crown region with the help of iron hook. And holes has to be filled with a mixture of sand + mancozeb at 3g/kg.
- Setting up of light traps are recommended.
- Installation of pheromone traps for monitoring and mass traping @20/ha.

Biological control:

- The potential breeding sites like manure pits are treated with fungus *Metarrhizium anisopliae* which are effective against grub stage causes disease called as green muscardine disease.
- Release 10-15 beetles inoculated with Orycetes virus in 1 hactre of garden.
- Release natural enemy *Platymeris laevicollis* against rhinoceros beetle.
- Castor cake at 1kg is soaked in water in small mud pots and when kept in coconut garden attracts beetle. Slurry should be changed once in a month.

Chemical control:

- Treat the manure pits with carbaryl dust 0.1% solution at least once in 3 months.
- Mixture of sand + carbaryl dust in equal proportion should be filled in the axils of innermost 2-3 leaves on the crown twice a year during pre and post monsoon periods.
- Beetles should be trapped with a attractive breeding materials treated with diflubenzuron 0.025%.

Conclusion

Coconut is one of the prominent crop of India which contributes 27,900 crore to the country's GDP in 2018. Due to attack of pest and improper management of crop leads to the loss of crop. Rhinoceros beetle is one of the major pest of coconut and the control of this pest is must. In India, the pest control strategy was more oriented towards chemical control. Due to increased awareness on side effects of indiscriminate use of chemical pesticides had made the IPM the need of present era. IPM is holistic approach aimed to minimize pest impact and to maintain the integrity of ecosystem. And for effective result management strategies should be followed in a larger area through community based pest management approaches (Srinivasan et al., 2018).

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PARTICIPATORY APPROACHES FOR DEVELOPMENT OF FARMERS

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Abstract

Agriculture is main source of income in rural areas of India. Indian agriculture contributes 48 per cent of the total National production in the last two decades. Around more than half per cent of rural population in India depend on agricultural related activities as their main means of livelihood. Government has initiated various programme for development of rural people. Researches revealed that most of the people were not aware on many aspects. Thus, a participatory medium can aware and inform the community.

Key words : Participatory approaches, farmers

Introduction

Agriculture has great importance to run the Indian economy smoothly. About 50 percent of India's geographical area is under agriculture, which proves that India is an agricultural country **(Arjun, 2013)**. Agriculture plays an important role in meeting the basic needs of humans and animals. India has a wide variety of geographical conditions, which are unique to agriculture as well as provide a wide range of favorable conditions. Various favorable conditions encourage farmers to do agriculture related work throughout the year. It is an important source of raw material supply for many agro-based, small and large industries. The use of science and technology in India for the betterment of the agricultural sector is also commendable, which is constantly making inventive efforts. The use of science and technology is playing an important role in increasing production as well as saving farmer's time.

In India, agriculture sector accounts of 15.2 per cent of India's Gross Domestic Product (GDP) and it provide employment to more than half population of the country directly or indirectly. More than half population in India directly and indirectly depends on the agriculture. According to **Kekane, 2013,** the food grain production has risen from 51 million tonnes (MT) in 1950-51 to 250MT during 2011-12 highest ever since independence**.** India is one of the largest producers of many crops in world such as wheat, sugarcane, rice, pulses, and cotton, as well as the highest producer of milk and second-largest producer of fruits/vegetables **(Deshpande, 2017)**. In India, Agriculture supplies the raw material like jute, cotton, sugar to various agro based industries. All food processing industries are directly dependent on agriculture. Agriculture sector is providing high employment opportunities to the unemployed people and labour force that reduce the high rate of unemployment in the developing countries. In India Agriculture contributes to economic development leading to increased national income levels as well as the living standard of people have been improved.

The impact of agriculture and agricultural activities plays an important role in developing countries and strengthening the economy. The activities related to agriculture are many but production of fruits and vegetables is the main among them.

Importance of Vegetable in India

Vegetables in India are counted as an important food crops for food trade. Due to the wide variety of climatic conditions available in India, different types of food products (grains, fruits, vegetables, legumes, seeds, etc.) are available in sufficient quantity for consumption at any time. The fruit and vegetable sector is acting as a driving force for India's agricultural sector. It plays an important role in India's economy by increasing the income of rural people (**Neeraj *et.al,* 2017**). In the world rankings, India continues to be the second largest producer of fruits and vegetables. Exports have played an important role in India's economy. Exports affect the economic growth, employment, and balance of payments of the country. India has a lot of ability to export vegetables, due to which it is also a good source of earning foreign exchange and increasing annual income of farmers. People from rural areas continue to get regular employment opportunities due to the inclusion of intensive cultural activities, from sowing of vegetables to marketing. Vegetables are used in the processing industry. Demand for commercial products (sauces, jams, jellies, pickles, etc.) in the market has steadily increased over the past two decades. Therefore, the processing industry can emerge as a new income option among farmers. Due to shortage of raw materials, changing lifestyles, and lack of new agricultural techniques, Indian farmer is committing suicide today. Keeping these problems in the middle, the Government of India has started working on some policies to reduce these barriers. In view of the huge demand of vegetables, some important decisions have been taken by the Central and State Governments in the last few years to improve agriculture and agriculture related activities like setting up community canning centers, setting up centers for training, research centers and promotion of commercial production etc. At present, agriculture and agriculture related activities have attracted the attention of people as a result of the steps taken by the Central and State Governments.

Vegetable production in Uttarakhand

Uttarakhand is primarily a mountainous state. Further 78 % of its total population dependent on agricultural-related activities for livelihood. Agriculture is an important sector in the state's economy and it contributes 15.5 per cent to Gross State Domestic Product (GSDP). The yield from field crops is not very high in the hilly areas and it is mainly due to the mountainous terrain that makes it difficult to adopt mechanized modern agriculture techniques and methods in these areas. Thus, these crops are produced in hilly areas mostly to fulfill the subsistence needs of farmers, and sectors like horticulture (fruit and vegetable) have a comparative advantage in the region due to its agro-climatic conditions.

There are various constraints faced by the farmers in commercial farming of potatoes in Uttarakhand state viz. unavailability of quality seeds, pest management, lack of farm machinery, Field management, lack of post-harvest management techniques, marketing problems, lack of transportation facility, irrigation facility, lack of storage facilities, lack of technical knowledge for scientific cultivation, lack of extension workers and lack of research, technical guidance and sufficient capital. Vegetable production improves the economy of the country as it is a very good source of income and employment, as well as providing nutritional benefits. India is second-largest producer of vegetables and the presence of India in global market is considered significant. Today, exports of fresh vegetables like onions, peas and potatoes are increasing from India which can bring new opportunities for India. The geographical features and climatic conditions of the state provide an ideal climate for the production of vegetables. Potato, cauliflower, tomato, onion, brinjal, peas, cabbage and ladyfinger are grown mainly in Uttarakhand. During year 2015 -16, total production of vegetables was 9.45 lakh metric tonnes in an area of about 0.898 lakh hectare in the state, which increased to 9.89 lakh metric tonnes in 2017-18 in an area of about 1.0006 lakh hectare **(Horticultural Statistics at a Glance 2018)**.

As we know, the proportion of extension workers per farmer in India is very less, which is a big challenge of the present time. Keeping this challenge in mind, it becomes important to seek a participatory approach in the process of building strategy to meet the farmers' own information needs. The biggest problem of the farmers is the information gap. To fill this gap, it is necessary to provide services as per their requirement through the participation of the farmers at the grassroots level. Media can prove to be a good tool to make these services available to farmers. The mass media and agricultural sector are interlinked. Mass media has disseminated many agricultural programs and information especially for the farmers through radio, printed media, television, and internet **(Gorg, 2001).** Printed media has its own power to disseminate the valuable information.

The role of media is widely accepted in terms of providing information but information dissemination role is not sufficient for development related activities. Decentralization of media is very important to connect with people at grassroots level. Through participatory media, people get an opportunity to share their problems, needs, culture and aspirations with others. The development of people at the grassroots requires need assessment, message designing and use of information through the participation of people in media production **(Sharma, 2013)**. In participatory media, Message is designed by the participation of the people thus making the development process effective.

Needs of Participatory Communication : According to **Uphoff, (1985),** generally, the following types of participation can be observed in most development projects. The four ways of participation are given below:

1. **Participation in decision-making :** people initiate, conceptualize, discuss, and plan activities that they will do as a community.
2. **Participation in implementation :** people are highly encouraged, motivated, and mobilized to take part in implementation of project. Responsibilities are also distributed among them with set objectives.
3. **Participation in benefit :** encourage people to take part and enjoy output of project, such as establishment of community radio station, water from hand pump, hospital facilities, roads, transportation, education facilities etc.
4. **Participation in evaluation :** after completion of a project, people are invited for feedback on its success or failure.

The use of posters, leaflets, newsletters, and other publications as part of the participatory approach proves to be an important tool. Complete information about a recently changed situation or a recent event is called news. In another word, Information that is published in newspapers and broadcast on radio and television in country or world or about activities in a particular region is called news.

Conclusion

On the basis of above discussion, this can be concluded that Participatory community media can empower the vegetable growers. Vegetable growers are facing many problems due to lack of knowledge on many aspects. Thus, there is an urgent need to develop extension and communication strategy to disseminate information among vegetable growers.

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ORGANIC AGRICULTURE-AIM, NEED AND IMPORTANCE

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Introduction

Organic Agriculture is a production system that sustains the health of soils, ecosystems, and people. It depends on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation, and science to benefit the shared environment and promote fair relationships and good quality of life for all involved. Organic agriculture focuses on locally grown products and large scale use of local products and local wisdom. It excludes the need and demand for external fertilizers for crop production and management. In order to re-establish previously damaged or destroyed ecological balance in nature, organic agriculture aims to correct unwanted results of wrong production practices by using; biological methods to control pests and diseases, to improve soil fertility, to contain environment and human friendly production systems, to ban the use of synthetic and chemical fertilizer and pesticides while encouraging organic and green fertilizing, crop rotation and soil conservation. From farm to table, organic farming has control methods for each and every farm practices and provides certificates for organic products and their producers. Organic agriculture can provide quality food without adversely affecting the soil's health and the environment; however, a concern is whether large-scale organic farming will produce enough food for India's large population. Certified organic products including all varieties of food products including basmati rice, pulses, honey, tea, spices, coffee, oilseeds, fruits, cereals, herbal medicines, and their value-added products are produced in India. Non edible organic products include cotton, garments, cosmetics, functional food products, body care products, and similar products. Organic Agriculture also is known as "Organic Farming".

Aim of Organic Agriculture

The aims for organic farming are:

- Conserving environment and natural resources, re-establishing ecological balance, encouraging sustainable agriculture, improving soil fertility, conserving flora and fauna, increasing genetic diversity, and putting an end to chemical pollution and toxic residues.
- In addition to banning the use of every kind of synthetic and chemical pesticides and fertilizers, organic agriculture encourages practicing organic and green fertilization, crop rotation, soil conservation, improving plants resistance to pests and diseases, benefiting from parasites and predators. The main goal of organic agriculture is not raising the quantity, but improving the quality of food products.
- Now, by practicing organic agriculture, it is possible to produce agricultural goods without polluting soil, water resources, and air while protecting environment, plant, animal, and human health.

Need of Organic Agriculture

Lots of agricultural land have been affected from pollution and instability in nature as a results of synthetic chemical inputs (synthetic mineral fertilizers and synthetic chemical pesticides, etc.) and their excessive use without any control, Besides loss of soil, erosion decreases the amount of organic material and humus in soil and causes loss of horizon A in soil profile. And this results the loss of beneficial soil microorganisms. The use of environment friendly organic Farming Practices is essential to prevent these harms while producing and consuming nutritious food. Following all these negative effects, conscious consumers in many countries, especially in the most developed countries, have been getting organized to urge and encourage farmers to practice environment and human friendly organic agricultural production.

Advantages of Organic Agriculture

- It helps to maintain environment health by reducing the level of pollution.
- It reduces human and animal health hazards by reducing the level of residues in the product.
- It helps in keeping agricultural production at a sustainable level.
- It reduces the cost of agricultural production and also improves the soil health.
- It ensures optimum utilization of natural resources for short-term benefit and helps in conserving them for future generation.
- It not only saves energy for both animal and machine, but also reduces risk of crop failure.
- It improves the soil physical properties such as granulation, good tilth, good aeration, easy root penetration and improves water-holding capacity and reduces erosion.
- It improves the soil's chemical properties such as supply and retention of soil nutrients, reduces nutrient loss into water bodies and environment and promotes favourable chemical reactions.
- It creates higher natural levels of resistance to pests and disease.
- Organic farming allows for specialization opportunities.
- This farming process supports a healthier soil and supports pollinators.
- There are no worries about genetically modified foods with organic farms.
- The working environment for organic farmers is healthier.
- Organic farmers can often create their own fertilizers at their farming location.
- It can be implemented in almost any geographic location or growing season.

Techniques Involved In Organic Agriculture

Figure 1: Techniques involved in Organic Agriculture

Importance of Organic Agriculture

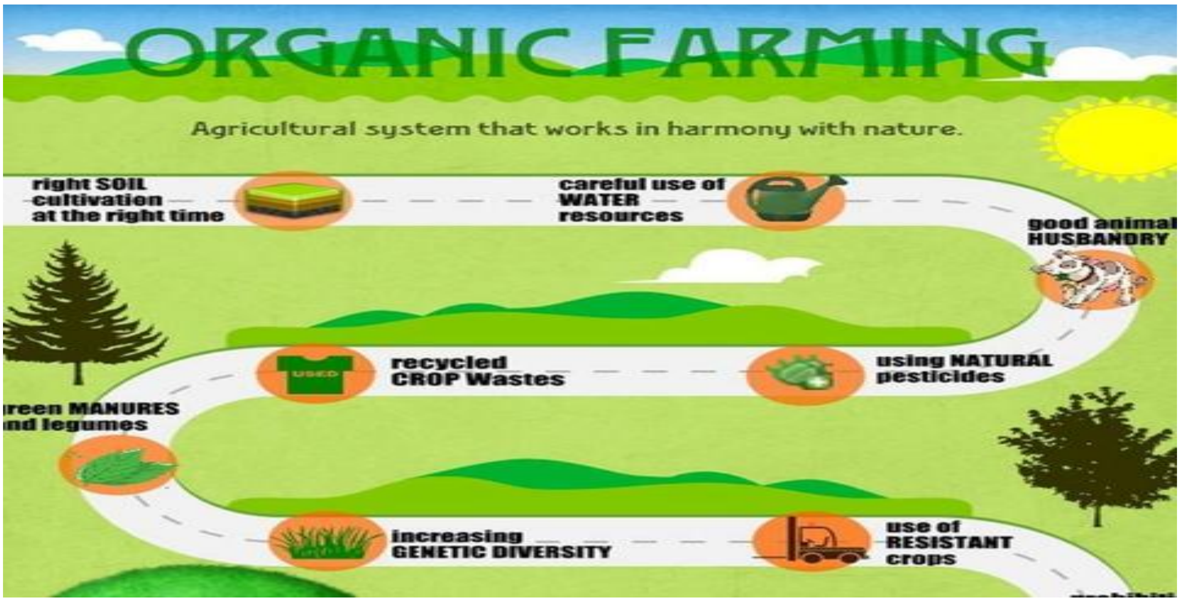

Figure 2: Importance of Organic Agriculture

- Organic agriculture ensure better productivity and more profit to the local farmers.
- Organic agriculture also helps in strengthen the people's belief in them, encourage them to use their knowledge to improve the productivity of their fields.
- Introduction of sustainable agriculture, which means an integrated approach to increasing farm yield and managing resources in an efficient way that future generations should not bear its consequences.
- The practice of organic farming ensures the productivity and sustainability of the field and field crops.
- Organic agriculture ensures the use of organic wastes like crop, animal and farm wastes and other biological components to make the farming more environment-friendly.

Strategies to successful Organic Agriculture

- In organic production, farmers choose not to use some of the convenient chemical tools available to other farmers. Special attention is being given for choosing crop rotation and tillage practices to avoid or reduce crop problems.
- Cereal and forage crops can be grown organically relatively easily to due to relatively low pest pressures and nutrient requirements. Corn is being grown more frequently on organic farms but careful management of weed control and fertility is needed. Meeting nitrogen requirements is particularly challenging.
- Fruit and vegetable crops present greater challenges depending on the crop. The yield reduction varies by crop and farm.
- Livestock products can also be produced organically. Animals must be fed only organic feeds Feed must not contain mammalian, avian or fish by-products. All genetically engineered organisms and substances are prohibited. Antibiotics, growth hormones and insecticides are generally prohibited. If an animal becomes ill and antibiotics are necessary for recovery, they should be administered. The animal must then be segregated from the organic livestock herd and cannot be sold for organic meat products. Vaccinations are permitted when diseases cannot be controlled by other means.

Conclusion

Organic agriculture is viable alternative because it enlivens the soil, strengthens the natural resource base and sustains biological production at levels to commensurate the carrying capacity of the managed agro eco-system. Organic agriculture utilize practices that: Maintain and improve fertility, soil structure and biodiversity, and reduce soil erosion. Farmers can reduce their production costs because they do not need to buy expensive chemicals and fertilizers. Yield of organic agriculture is more nutritious and safe food. The popularity of organic food is growing dramatically as consumer seeks the organic foods that are thought to be healthier and safer. Thus, organic food perhaps ensures food safety from farm to plate.

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IMPACT OF CLIMATE CHANGE ON PLANT DISEASE MANAGEMENT

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Abstract
Climate change has become the burning issue in the present situation, as it changes the properties of the atmosphere like precipitation, humidity, temperature, etc. Climate affects the interaction between crops and pathogens in various ways. There is no doubt that this change will also affect the timing, efficiency, preference of chemical, physical, biological measures of disease management. Recently, developed experimental and modeling techniques improve the capability for climate change impact assessment and mitigation. Compared with other significant agriculture products like technical and social-economic changes, climatic change seems to be of little importance. But it will definitely add an invisible layer to the complexity and uncertainty of the system, which is already difficult to manage on a sustainable basis. Intense studies on climate change and other related issues could help to understand and manage plant diseases.

Keywords : climate variability, impact models, global warming, host-pathogen interactions.

Introduction
Even though advances in agricultural technologies like high yielding, resistant varieties, and pest management, etc. Climate still is the main issue causing the fluctuations in the crop yield. Climate also indirectly affects the plant by influencing pathogens, insects, vectors, and weeds that decrease the crop yields. Variations in the climate over the past few decades resulted in the growth of climate research to know if and why the world climate is changing. New research started to determine the impact of climate on crop production. The rise in interest is due to recognizing the fact that variability in climate might have impacted the epidemiology.

Weather is the current and predictable meteorological state of the atmosphere. Temperature, precipitation, relative humidity, radiation, wind speed, wind direction, cloud cover, and atmospheric pressure, etc., fall under the weather. Traditionally, the word “climate” is used for the average of weather conditions at a particular location. To describe the climate of a given area, average temperature and precipitation of 30 years were frequently used. But averages give no idea about a year-to-year variation. In 1970, the definition of climate changed from "average of weather" to "dynamic physical system that produces the weather." Climate change means "the average conditions that are changing over time and never return to those previously experienced. Stephen (1975) described the climate theory, theories of climate changes and classified natural and manmade causes. In 1980, climate variability was accepted as expected. Still, at present, global warming would occur due to the rise in the emissions of atmospheric carbon dioxide produced by burning fossil fuels.

Shreds of evidence for climate change
Solar radiation is the chief source of energy on earth, anything that changes the incoming solar radiation alters the planet's climate. Atmospheric temperature is increasing, which leads to global warming due to greenhouse gases. Among them, CO2 becomes the main culprit of the scenario. Earth's climate responds to changes in greenhouse gas levels. The planet's average temperature has risen about 1.62 degrees Fahrenheit since the late 19th century. Human induced warming reached approximately 1 degree Celsius above pre-industrial levels in 2017, increasing at 0.2 degree

Celsius per decade. It is ten times faster than the average rate of ice age recovery warming. Most of the regions are undergoing greater temperatures than the global average. In the past 35 years, there were five warmest years on record taking place since 2010. Not only was 2016 the warmest year on paper, but eight of the twelve months that make up the year from Jan. to Sept. except for June, were the warmest on record.

Impacts on disease management

Without knowing the effect of climate change on patho-systems, it is impossible to make necessary changes in plant disease management. However, the changes may be through disease resistance, chemical, biological control agents. Identifying the cases where the efficiency of disease management is reduced under climatic changes is necessary.

Impact on host resistance

With the change in climate, host resistance became more effective against a pathogen, as increased defense mechanisms have been identified, which produces a change in physiology, nutrition status, and water availability. However, in contrary, host resistance is broken down by the emergence of the new race of the pathogen. Within a growing season, the number of infections is increased due to the rise in fecundity, more generations per season, and a more favorable microclimate for disease development. All these factors may lead to the evolution of aggressive pathogen races. Chakraborty et.al (1999) conducted experiment on *Colletotrichum gleosporoides* on *Stylosanthes scabra* under high CO_2 concentration. In this experiment, susceptible variety was raised under controlled environmental conditions of high CO_2 concentration and inoculated repeatedly for eight infection cycles with conidia isolated from the previously infected same susceptible variety. They found that in high CO_2 conditions, there is increasing fecundity after eight infection cycles. Increase in fecundity increases the possibility of increasing more aggressive races that can overcome the host-resistance.

Impact on chemical applications

Chemical control efficiency is affected by climate change. The fate of fungicide residue on crop foliage is affected by two factors. One of them is temperature and precipitation, the increasing frequency of rainfall wash- off the fungicide and results in reduced control. Fungicide dynamics are complex, and they depend on the interactions of precipitation frequency and intensity. For few fungicides, the increased efficiency is seen if they are applied after precipitation. Neuhaus et al. (1974) applied stimulated rain at two intensities on the potato crop. They observed that there is reduced fungicide residue on the leaf with high intense rainfall, but there is no difference in the disease intensity.

The second factor is a morphological and physiological change in crops grown under elevated CO_2 conditions that affect the uptake, translocation, metabolism of systemic fungicides. For example, increased cuticle wax thickness and crop canopy size are negatively correlated with chemical uptake and spray coverage, respectively, which leads to dilution of the chemical in host tissue. Research shows that the rise in temperature results in the degradation of pesticides alters the morphology and physiology of plants and increases the uptake of fungicide, high metabolic rates, and toxicity to the target organism.

Impact on Microbial interactions

Climate change can change the makeup and dynamics of microbial communities in aerial and soil ecosystems, influencing plant organ health. Changes in the phyllosphere and rhizosphere microbial populations may have an impact on plant disease through natural and augmented biological control agents. In a soil environment, a direct influence of elevated CO_2 is impossible since the microflora is routinely exposed to levels 10 to 15 times greater than ambient CO_2. Trees grown in nutrient-depleted soils, especially nitrogen-depleted soils, encourage arbuscular mycorrhizal fungi to colonise their roots. The association between elevated CO_2 and mycorrhizae is unclear, and there are conflicting studies about how it could be affected by plant and soil nutrient status. If a lower nitrogen status of plant tissue under increased CO_2 results in further mycorrhizal colonisation, this could boost plant health by increasing nutrient uptake. Temperature changes have a non-linear relationship with interactions of host pathogen and biological control agent.

Geographical impact on disease

Some diseases of economic concern don't occur in few regions like wart disease of potato, karnal bunt of wheat, Golden nematode, etc because the climatic conditions inhibit the causal agents from being established in certain regions. However, if the pathogen comes in contact with a conducive environment, there are high possibilities of an outbreak of these diseases. Exclusion, a plant disease control strategy, and quarantine agencies bear the pressure in managing these diseases. So, this strategy will play important role in managing the diseases due to climate change. Geographical information systems and climate matching tools guide quarantine agencies in deciding the threat caused by pathogens under current and future climates. Sansforth and Baker et al. (1998) used this approach to know the risk of establishing karnal bunt pathogens in the cereal-growing regions of the European Union.

Impact Models

Much has been said about plant disease and climate change relies on qualitative, rule-based logic. This impact model seems to be attractive because of the already available information regarding the environmental requirements of plants and their pathogen. For example, It is reasonable that raising temperature results in directional expansion of the geographical range of pathogens and more generations per year. The rise in winter temperature would increase the chance of survival and inoculum. Greater continental dryness in summer leads to reduce infections by the pathogen, which requires the wetness of the foliage or soil moisture for infection. But the process of infection depends on the interaction of atmospheric, climatic, biological factors with technical and social-economic interventions that are difficult to predict. These interactions are not amenable to qualitative analysis hence impact models comes into picture which is quantitative and allows to investigate multiple scenario and interactions simultaneously. Biological impact evaluation is a method that routinely evaluates the potential or current impact, including risks and advantages, of the occurrence, arrival, or entry of particular endemic or exotic species into a biological environment. Surtherst et al. (1996) and Teng and Yang et al.(1993) have given a framework on impact models. The analytical tools are needed for quantitative impact assessment in plant pathology.

Conclusions

Climate change has both positive, negative, and neutral impacts on the specific nature of the interaction of host and pathogen interactions. This limits the research on the effects of climate change on plant diseases. In this changing climate scenario, modified chemical, biological practices have to be adopted. Breeders have to begin gene expression analysis for developing varieties against biotic and abiotic stress. Climate prediction models have been developed for plant disease management. Climate change is at a global level from a plant disease management point of view, and it requires disease specific information at the field scale level. To mitigate the problem of climate change, a collaboration of all the disciplines is necessary. More rational approaches have to be taken to know the actual mechanism for plant disease management.

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PLANTS DEFENSE RESPONSE AGAINST RECOGNITION OF A VIRAL PATHOGEN

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Abstract

Plant viruses are infective particles considered obligate intracellular parasites usually composed of positive single-stranded ribonucleic acid (ssRNA) and only in a few cases by single stranded or double-stranded deoxyribonucleic acid (ssDNA and dsDNA, respectively). Viruses can only enter the plant cell passively through wounds caused by physical injuries due to environmental factors or by vectors. Among vectors, several species of insects, mites, nematodes and some soil inhabitant fungi can transmit specific viruses. In the cytoplasm, the RNA disassembles replicates, converts its mRNA to proteins, and mobilizes locally and systemically.

Keywords : Plant immune, Infection, defense, pathogens.

Introduction

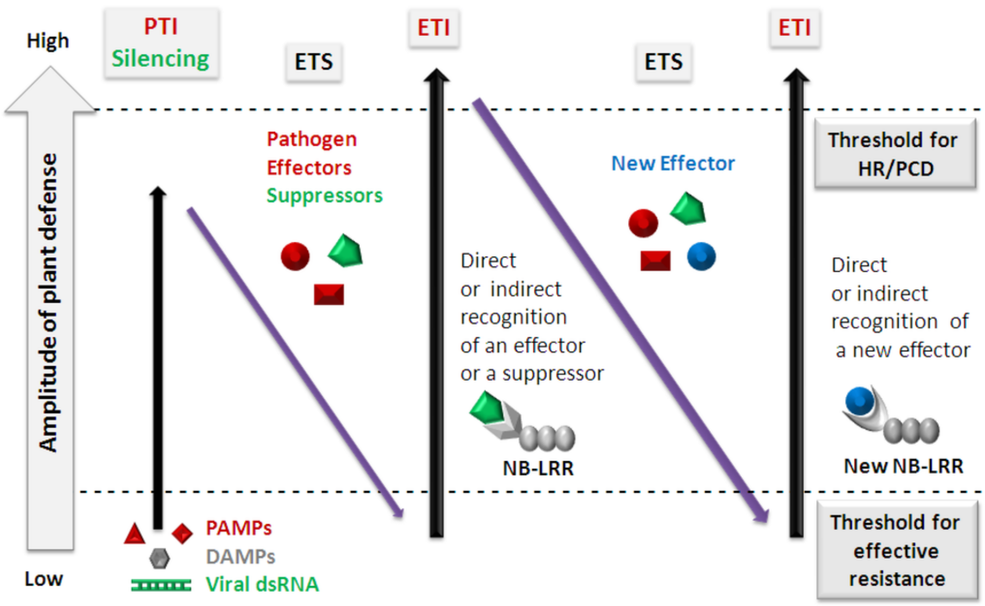
Viruses use energy and proteins from the host cell to perform these processes. If the viral particle is not recognized by the host plant, a compatible interaction between the plant and the virus is established. However, if the plant recognizes the viral particle, an incompatible interaction that is unfavorable for the virus is established. It is known that plants can recognize the virus, limiting it to the site of the infection. A series of complex cascade defense reactions can be induced, limiting virus replication and virus movement within the host plant (Hammond-Kosack and Jones, 2000).

Plant virus recognition

All plant cells are naturally and frequently exposed to microorganisms. To cope with invading pathogens, plant cells evolved a sophisticated immune system under constant pressure for dominance over the pathogens' virulence strategies, which in turn coevolved to escape the host recognition system (Jones and Dangl, 2006). Plants have developed recognition mechanisms that allow them to defend themselves against parasites (parasitic plants, insects, and some invertebrate animals) and pathogenic agents like viruses, viroids, bacteria, phytoplasms, fungi, and nematodes. Some of these mechanisms act as physical and chemical barriers that prevent infection by pathogens. Compatibility and incompatibility reaction Plants have developed a defence mechanism at the molecular level based on the gene for gene theory described by Flor (1971). This model is defined by the expression of a resistance gene (R) in the plant, which can bind directly or indirectly to the product of the avirulence gene(avr) of the pathogen (Ellis *et al*., 2000a). R proteins act as receptors and AVR ligands as elicitor proteins (Ellis *et al.,* 2000b).

The first layer of the plant immune system is represented by the pattern recognition receptors (PRRs) at the cell surface, which recognize either conserved signature molecules produced by the pathogens, designated pathogen associated molecular patterns (PAMPs), or endogenous damage/danger signals associated with pathogen invasion, designated danger or damage associated molecular patterns (DAMPs) (Choi and Klessig, 2016; Ma *et al*., 2016). The sensing of PAMPs by PRRs activates PAMP triggered immunity (PTI), leading to a rapid, non-specific response to a broad range of pathogens (Ma *et al*., 2016). To counterattack this first layer of defence, adapted pathogens deliver virulence effectors in the host cell cytoplasm, which prevent the activation of PTI and elicit effector triggered susceptibility (ETS) Wang and Wang, 2018.

The plants are respond by the activation of defense gene, the formation of reactive oxygen species (ROS), the synthesis of pathogenesis-related (PR) proteins, localized cell wall reinforcement and the production of antimicrobial compounds. Recognition of a pathogen often triggers a localized resistance reaction, which is knows as hypersensitive response (HR), which is characterized by rapid cell death at the site of infection (Hammond-Kosack and Jones, 1997). During the HR, chemical oxidant species are produced (Lamb and Dixon, 1997), cellulose (Shimomura and Dijkstra, 1975) and lignin are synthesized, the levels of salicylic acid increase (Naylor *et al*., 1998) and pathogenesis related proteins are produced (Yalpani *et al.,* 1991). In response, plant cells have evolved intracellular nucleotide binding leucine rich repeat (NLR) receptors, which recognize the virulence effectors in a highly specific manner to activate the second level of plant defence and are designated as effector triggered immunity (ETI; Jones and Dangl, 2006). As a result, plants limit the short and long-distance movement of the pathogen.



plant defensive model against virus pathogen Zvereva & Pooggin, 2012

Systemic Necrosis Responses

The resistant (or incompatible) host–virus interactions, most susceptible (or compatible) virus infections do not trigger hypersensitive response (HR) and do not produce localized necrotic lesion phenotypes to limit the virus spread in the host plants. However, a similar or dissimilar form of necrosis, termed systemic necrosis, is observed in susceptible interactions. For example, systemic necrosis was reported in *Nicotiana benthamiana* with mixed infections of potexviruses, PVX, or Plantago asiatica mosaic virus (PLAMV) isolate Li1 and Potato virus Y (Ozeki *et al.,* 2006); Cucumber mosaic virus (CMV) and satellite RNA-D infected tomato (Xu and Roossinck, 2000); and Panicum mosaic virus (PMV) and its satellite virus (SPMV) infected *Brachypodium distachyon* and millet species (*Panicum miliaceum*, *Pennisetum glaucum,* and *Setaria italica*) Mandadi and Scholthof, 2012.

Systemic necrosis resembles necrosis commonly observed in lesion mimic mutants, resulting either from constitutive or uncontrolled cell death (Moeder and Yoshioka, 2008). Systemic necrosis is thought not to preclude virus multiplication or its systemic movement, thereby resulting in a susceptible infection. The relatively well understood mechanisms leading to HR and associated necrosis, we are just beginning to understand the molecular processes that underlie systemic necrosis responses and how systemic necrosis responses relate to antiviral immunity. Recent findings revealed that despite the differing roles or outcomes, systemic necrosis and HR-associated necrosis share remarkable similarities at the biochemical and molecular level. For example, both systemic necrosis and HR-associated necrosis involve programmed cell death, alter expression of similar defense-related genes, and trigger ROS accumulation (Xu *et al.,* 2012). Komatsu *et al*. (2010) investigated the molecular determinants leading to systemic necrosis elicited by infection with PLAMV, a potexvirus, in *N. benthamiana*.

Systemic Acquired Resistance

SAR is triggered during an incompatible interaction involving Avr and R proteins in the primary infected cells. The resistance is transduced to the noninfected distant tissues. Although the exact mechanisms of SAR are not defined, it is initiated through a local interaction among Avr and R proteins and results in accumulation of phytohormones such as SA and JA in the distant tissues (Vlot *et al.,* 2008).

SAR is a long-lasting immune response primed to provide distant tissue resistance against subsequent infections. In the case of TMV-triggered SAR, the response persists up to 3 weeks (Ross, 1961). Interestingly, the transgenerational stability of SAR requires NPR1, as progeny of the SA-insensitive npr1-1 mutant plants failed to possess SAR in the next generation. This induced resistance phenomena is also triggered in the progeny of plants exposed to caterpillar herbivory (Rasmann *et al.,* 2012). In this case, the stable resistance response is dependent on intact JA signaling and requires the biogenesis of short interfering RNA that could mediate the epigenetic chromatin modifications (Rasmann *et al.,* 2012).

In viral infections, in addition to the dominant R gene–related resistance responses, another form of recessive resistance exists that is typically derived by a loss of function in host proteins critical for the establishment of disease (Gururani *et al*., 2012). For example, amino acid mutations in the eukaryotic translation initiation factor, eIF4E, mediates resistance against several viruses in Arabidopsis, tomato, pepper, pea (*Pisum sativum*), melon (*Cucumis melo*), and barley (*Hordeum vulgare*) (Piron *et al*., 2010).

Hypersensitive response

The term hypersensitivity indicates that the host cells are ‘over-sensitive’ to the presence of the pathogen. Host cells suicide in the presence of the pathogen, preventing further spread of the infection. Virus-associated chlorotic lesions or spots, ringspots, and necrotic lesions on leaves, stems, and fruits are various symptomatic manifestations of host immune responses triggered in the infected cells. In the instances of HR and necrosis, virus accumulation is limited to a few hundred infected cells. Classically, HR-mediated resistance is known to be triggered when a pathogen-encoded avirulence factor (Avr) is recognized in plants by a host R gene product.

According to current plant immunity descriptions, there are two layers of plant immune responses against microbial pathogens. First, the recognition of certain conserved pathogen- or microbe-associated molecular patterns (P/MAMPs) by plant pattern recognition receptors (PRRs) initiates the so called P/MAMP-triggered immune (PTI) response, which may occasionally result in HR. As a counter-response to plant PTI defenses, adapted microbes deliver specific effector proteins into plant cells, which compromise PTI defenses and interfere with host defense signaling. To further defend the action of the microbial effectors, plants evolved specific surveillance systems involving receptor-like proteins (R proteins) that directly or indirectly recognize the microbial effectors or monitor their activities in the cell to trigger the so-called effector-triggered immune (ETI) response. Paradoxically, an effector protein can also be the elicitor of ETI defense. Whether the effector or elicitor role of an effector protein prevails is primarily predicated on the presence of the complementing R gene in the plant. The ETI responses, and to a somewhat lesser extent the PTI responses, are closely associated with or even culminate in HR, thus imparting resistance against the invading pathogen (Jones and Dangal, 2006).

HR and necrotic responses impart resistance against diverse plant pathogenic fungi, bacteria, and viruses, and, to some extent, use similar mechanisms. During a viral infection, in a manner similar to nonviral infections, an HR response is initiated by Avr/R protein interactions that lead to metabolic changes in defense hormone levels, such as salicylic acid (SA), jasmonic acid (JA), and nitric oxide (NO), and the accumulation of reactive oxygen species (ROS), such as $O^{2-}$and hydrogen peroxide, both in the infected and noninfected tissues (Mandadi and Scholthof, 2012). At the cellular level, HR affects calcium (Ca^{2+}) ion homeostasis and alters membrane potential and permeability (Mur *et al*., 2008). For example, TMV and turnip crinkle virus (TCV) infections both induce cellulose deposition at the plasmodesmata and alter membrane permeability permitting electrolyte leakage in tobacco and Arabidopsis, respectively (Zavaliev *et al*., 2011).

Summary

Several host plant proteins participate during the viral cycle. Some of these proteins (i.e.microtubules, filaments of actin/myosin, calreticulin) facilitate the infective process and virus movement through the plant. Others, like the receptors encoded by resistance genes, interact with viral proteins in the virus recognition process. The recognition of the pathogen by the host plant induces a hypersensitivity reaction (HR) and a systemic defence. This is unfavorable for the development of the virus cycle, avoiding massive and systemic virus dissemination in the host plant. If host not able to recognized the pathogen then this is favorable condition for pathogen, pathogen easily spread infection in host plant and cause disease to plant and ultimately plant died.

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MANAGEMENT APPROACHES OF RED PUMPKIN BEETLE

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Introduction

Red pumpkin beetle is one of the common and foremost pest of cucurbits which has a wide host range, as in sweet gourd, bottle gourd, the cucurbit crop group includes vegetable species like pumpkin, Snake Gourd, Bottle Gourd, Bitter Gourd, cucumber, Ridge Gourd, Round Melon, Pointed Gourd, Ash Gourd, Sponge Gourd as well as Watermelon and Muskmelon.

Cucurbits are the most widely grown and important crops in the tropical and subtropical countries of the world. In India, it occurs throughout the country but is more common in northwestern parts. It is an important cash crop. Cucurbits in India are grown on about 4,290,000 ha with productivity of 10.52 t/ha (https://plantix.net). And cucurbit cultivation accounts for about 5.6% of total vegetable production in India. Haryana has the highest production and shares about 22.01% of the total production followed by MP 12.39%, Karnataka 10.58%(http://agriexchange.apeda.gov.in).

Several insect pests are infesting the cucurbits crop such as red pumpkin beetle, fruit fly, leaf minor, etc. Out of which the red pumpkin beetle (*Aulacophora*), the *A. foveicolis* is the commonest beetle found in India.

Mark of identification

Grub : The grub leads a subterranean (underground) life and full-grown grub measure about 12 mm in length.
Freshly hatched grub dirty white with a slightly darker oval shield at the back, fully grown grub creamy yellow.

Adult : The dorsal part of the body of the adult beetle is deep orange, while the ventral side is black. The beetle appears to be oblong measuring 5-8 mm in length and 3.5- 3.75 mm in width. The posterior part of the abdomen bears soft white hairs.

Aulacophora foveicollis : red in colour
A. cincta **(**Purple beetle)**:** grey having a glistening yellow-red border
A. intermedia **(**Ash beetle)**:** blue

Figure.1:-Adult of red pumpkin beetle

Life-cycle

Nature of damage

Red pumpkin beetle infests a wide variety of vegetables like pumpkin, gourds, cucumber, sponge gourd but has most damage in pumpkin. Grub and adult stage is the damaging stage of the red pumpkin beetle. The pest, however, occurs throughout the year and causes severe damage to the crops, especially at the seedling stage.

Adult insects feed voraciously on the leaves, flowers, and fruits. The beetle makes an irregular hole in the plant tissues, causing death or retardation of growth. The damage done to young seedlings is often devastating. The beetles may kill seedlings and sometimes the crops have to be resown 3-4 times. The grubs of this pest remain in the soil and feed on roots and stem of the plant as well as fruits touching the soil and thus making such fruits unsuitable for human consumption.

Figure.2:-Damage symptom of red pumpkin beetle

The pest, however, occurs throughout the year but they are active from March to October though the peak period of activity is between *April* to *June* and causes severe damage to the crops, especially at the seedling stage. It may cause up to 70 % damage on leaves and 60 % damage on flowers of cucumber.

Management strategy

- Deep ploughing of the infested fields should be done to expose the grub and pupa from the soil to sunlight and predators in the soil and destroy the pupa also.
- Avoid staggered sowing to manage the red pumpkin beetle .
- Collection and destruction of adult beetle.
- Spray the bait on the maize plants grown as trap crop ,
- Sown the crop in November to avoid the damage of these pests
- Antixenosis – Hairy varieties of cucumber and melon.
- Spraying of methyl parathion 0.05% are effective control of red pumpkin beetle.
- Apply 7kg of carbofuran 3G per ha 3-4 cm deep in the soil near the base of the plants just after germination and irrigate.

Conclusion

Cucurbits is an important cash crop. In India, it occurs throughout the country but is more common in north western parts.Many insect-pest are attack on cucurbits crop but Red pumpkin beetle is a major pest of Cucurbits. Due to attack of pest and inadmissible management of crop leads to the loss of crop. In India pest control stretargy are based on chemical control, so more chaotic use of chemical pesticides result in harmful effect on the environment. According to situation integrated pest management is best approach to manage the pest and environment innocence.

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STEVIA NODAL EXPLANT INJECTED WITH 6-BENZYLAMINOPURINE SHOWED NEW EMERGENCE IN THE ARTIFICIAL SOIL MEDIA

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Abstract

A number of reports are available to show successful micropropagation in *Stevia rebaudiana* Bertoni. Mainly, MS (Murashige and Skoog, 1962) media supplemented with different types of hormone was followed under aseptic condition for new emergence and subsequent hardening the plantlets. In the present study, the *Stevia* explant having single and double nodes were considered directly for injection with different concentration, mg/mL and mg/L dose and fixed volume (1.2 µl) of 6-Benzylaminopurine (BAP) with the help of microinjection. The node injected by 0.50 mg/mL of BAP only showed response and emergence is recorded. The mg/L dose of BAP does not work. This is an initial observation. Further experiment will be required for repetitions as well as optimization of factors for achieving efficient new plant emergence bypassing MS based tissue culture mediated new planting material production.

Key Words : Stevia, 6-Benzylaminopurine (BAP).

Introduction

Stevia, botanically known as *Stevia rebaudiana* Bertoni belongs to family- *Asteraceae* is a sweet herb. The leaves are mild green and intensely sweet. It is a perennial, photoperiod sensitive, insect-pollinated, self-incompatible bushy shrub (Yücesan et al., 2016). The sugar present in stevia is a non- caloric and used as an alternative to artificially produced sugar substitute (Ahmed et al., 2007). Stevia leaf is 300 times sweeter than sugar, obtained from sugar beet & sugar cane with zero caloric value (Richman et al., 1999). It has attracted economic and scientific interests due to its sweetness and therapeutic properties present in leaves. Despite the need of good production with high active component content, it has poor germination rate (Goettemoeller and Ching 1999).

Over the many years researchers mainly focused on the direct and indirect organogenesis in invitro condition (Sreedhar et al. 2008; Ahmad et al. 2011; Mathur and Shekhawat 2013; Khalil et al. 2014; Gantait et al. 2015; Ramírez-Mosqueda and Iglesias-Andreu 2015; Yadav et al., 2016; Thilakarathne et al., 2019). But, in the present study mainly focus on bypassing of MS artificial media dependent aseptic culture for clonal proliferation. This will also bypass the down line hardening of the tissue culture derived plant. Moreover, the present process is a very low-cost process for proliferating suitable superior line.

2. Materials and Methods

2.1 Selection of source material

The explants of *Stevia rebaudiana* were collected from the field plants at Uttar Banga Krishi Viswavidyalaya, Pundibari. The investigation was carried out at a laboratory situated in the foothill region of the Himalayas, known as the Terai zone in West Bengal, Eastern India. The geographical details were 28°19'N latitude and 89°23'E longitude with an altitude of 43 m (141.076 ft) above the Mean Sea Level (MSL).

2.2 Preparation of explants

All the treatments used in the present experiment was presented in Table.1. Various amounts of 6-Benzylaminopurine (BAP) are dissolved in the required amount of solvent i.e., 1N NaOH. Then the volume makes up to 1 ml and 1 liter by adding the required amount of Millipore water. After that 1.2 µl of each treatment of BAP is injected into the one node and two-node cuttings of stevia and planted in the square pot contains artificial soil. A total of six nodes were injected for each treatment. Later they were kept in transparent boxes to maintain humidity in the boxes for 14 days.

Table-1 : List of treatments used in the present experiment.

Sl. No.	Treatments	Sl. No.	Treatments
1	0.25 mg/ml BAP	9	0.25 mg/L BAP
2	0.50 mg/ml BAP	10	0.50 mg/LBAP
3	0.75 mg/ml BAP	11	0.75 mg/L BAP
4	1.00 mg/ml BAP	12	1.00 mg/L BAP
5	1.25 mg/ml BAP	13	1.25 mg/L BAP
6	1.50 mg/ml BAP	14	1.50 mg/L BAP
7	1.75 mg/ml BAP	15	1.75 mg/L BAP
8	2.00 mg/ml BAP	16	2.00 mg/L BAP

2.3 Place of Experiment carried out

The controlled environment provided in the entire experiment was 9000 lux lights intensity for 14 hours per day, 22°C temperature, and 70% relative humidity.

2.4 Statistical analysis of data

At least six cultures were developed for each treatment in a Completely Randomized Design. The data recorded on various characters subjected to analysis as per standard statistical methods.

3. Results and Discussion

Stevia single node injection : The data recorded for various traits is presented in Table.2.

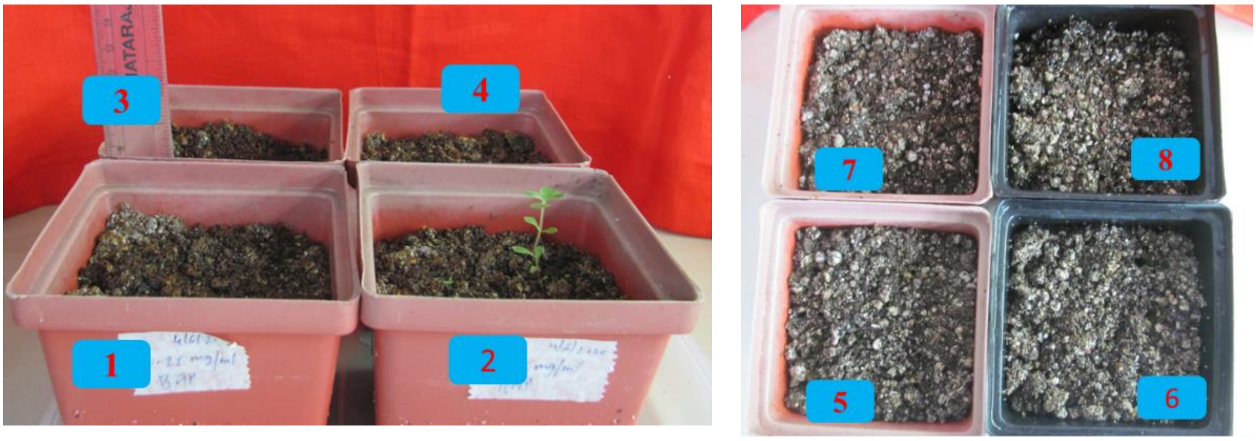
14th-day data: Only one treatment responded i.e., 0.50 mg/ml BAP. The plant height (1.3 cm) and the number of leaves (4.0) were recorded by the stevia 1 node injected with 0.50 mg/ml BAP.

28th-day data: Only one treatment responded i.e., 0.50 mg/ml BAP. The plant height (2.1 cm), number of nodes (4.0), number of leaves (6.0), largest leaf length (0.3 cm), and largest leaf breadth (0.2 cm) were recorded by the stevia 1 node injected with 0.50 mg/ml BAP.

42nd-day data: Only one treatment responded i.e., 0.50 mg/ml BAP (Picture.1). The plant height (3.4 cm), number of nodes (6.0), number of leaves (10.0), largest leaf length (0.8 cm), and largest leaf breadth (0.6 cm) were recorded by the stevia 1 node injected with 0.50 mg/ml BAP.

Table-2 : Stevia single node injection

	Treatments (mg/ml)	Plant Height (cm)	Number of Nodes	Number of Leaves	Number of Branches	Largest leaf Length (cm)	Largest leaf Breadth (cm)
		Mean	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**
14th Day	0.50 mg/ml BAP	1.3		4.0	-		
28th Day	0.50 mg/ml BAP	2.1	4.0	6.0	-	0.3	0.2
42nd Day	0.50 mg/ml BAP	3.4	6.0	10.0	-	0.8	0.6



Pic-1 : Stevia at 42th day from single node injection experiment.

Stevia double node injection: The data recorded for various traits are presented in the Table.3.

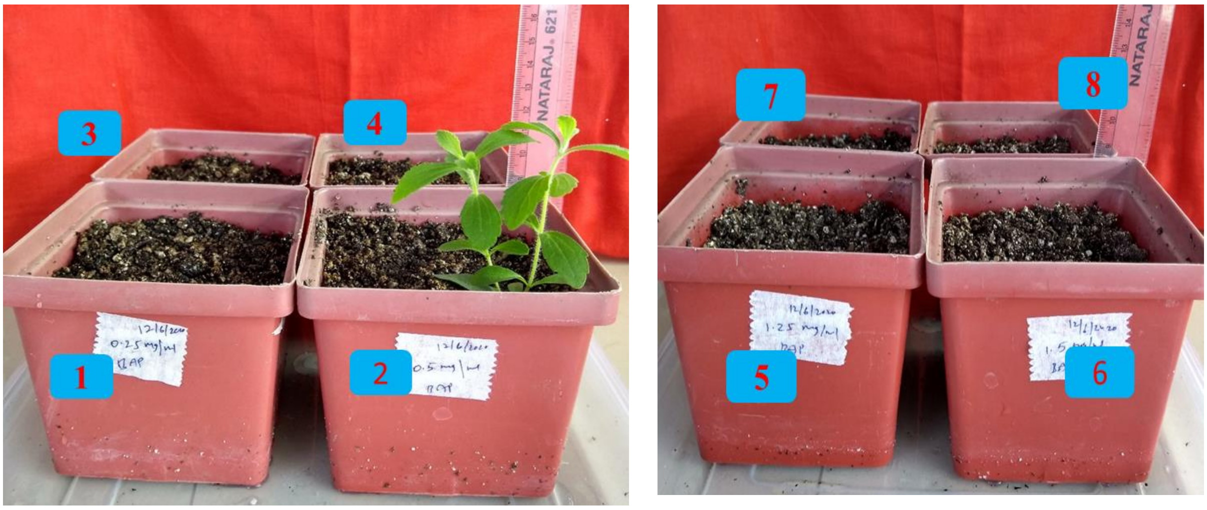
14th-day data: Only one treatment responded i.e., 0.50 mg/ml BAP. The plant height (3.4 cm), number of nodes (4.0), number of leaves (7.0), largest leaf length (1.6 cm), and largest leaf breadth (0.8 cm) were recorded by the stevia 2 node injected with 0.50 mg/ml BAP.

28th-day data: Only one treatment responded i.e., 0.50 mg/ml BAP. The plant height (5.0 cm), number of nodes (6.0), number of leaves (12.0), number of branches (1.0), largest leaf length (2.1 cm), and largest leaf breadth (1.1 cm) was recorded by the stevia 2 node injected with 0.50 mg/ml BAP.

42nd-day data: Only one treatment responded i.e., 0.50 mg/ml BAP (Picture.2). The plant height (6.2 cm), number of nodes (9.0), number of leaves (18.0), number of branches (1.0), largest leaf length (2.7 cm), and largest leaf breadth (1.3 cm) was recorded by the stevia 2 node injected with 0.50 mg/ml BAP.

Table-3 : Stevia double node injection

	Treatments (mg/ml)	Plant Height (cm)	Number of Nodes	Number of Leaves	Number of Branches	Largest leaf Length (cm)	Largest leaf Breadth (cm)
		Mean	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**
14th Day	0.50 mg/ml BAP	3.4	4.0	7.0	0.0	1.6	0.8
28th Day	0.50 mg/ml BAP	5.0	6.0	12.0	1.0	2.1	1.1
42nd Day	0.50 mg/ml BAP	6.2	9.0	18.0	1.0	2.7	1.3



Pic-2 : Stevia at 42th day from double node containing explant injected with hormone.

4. Conclusion

The main objective of the present study is to bypass the aseptic environment mediated tissue culture which requires huge initial cost for creating the facility as well as maintaining the facility. The present study considers the nodal explant for direct injection with hormone and incubate the injected nodal explant initially in humid condition under controlled environment and light intensity. Surprisingly, it was evidenced that only one dose was working on nodal explant mediated new emergence. This pilot scale experiment indicates that hormone could be directly injected into nodal explant and produce planting material without following the aseptic mediated new plant emergence which requires long term hardening in addition to costly tissue culture chemicals and process. This is very pilot scale experiment which requires repetitions and optimization of the process for achieving efficient plant material production. The present is an observation which have huge scope for fine tuning.

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6. Compliance with ethical standards (e.g., Conflict of interest)

The communicating author (HAM) declared that there is no conflict of interest.

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FERTIGATION : AN EFFECTIVE TOOL FOR ENHANCING WATER AND NUTRIENT USE EFFICIENCY IN FRUIT CROPS

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Fertigation has great potential for the enhancing the efficient use of water and fertilizers. Application of water and nutrients through drip irrigation promotes maximum water and nutrient efficiency by reaching the active root zone of plants and thus minimizing the wetting area and therefore reducing various losses pertaining to nutrients and water. Fertigation minimizes the losses of nutrients through leaching. Additionally, application of fertilizer along with drip irrigation water also reduces the costs associated with irrigation and fertilizer application. Through fertigation, water use efficiency could be achieved as high as 90% as compared to 30-40% in comparison to other conventional methods of application.

What is Fertigation?

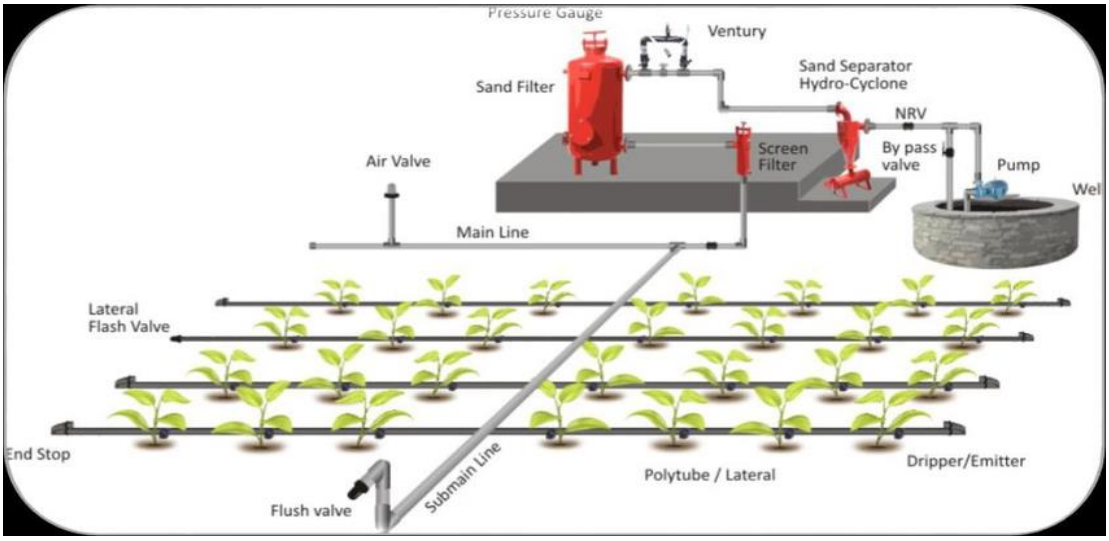
The technique of fertigation was first observed in late 1960s in Israel. Fertigation is a process that combines fertilization and irrigation. Fertilizer is added to an irrigation system. It is most commonly used by commercial growers. Fertigation rather than traditional fertilization approaches is purported to target the plant's nutrient deficiencies more effectively. It also reduces soil erosion and water consumption, reduces the amount of fertilizer utilized, and controls the time and rate it is released. But does fertigation work in the home garden?

Why Fertigation?

- Higher yields and better quality crops:
- Increased efficiency of nutrients:
- Reduction of groundwater pollution:
- Greater convenience and economy:
- Efficient application of microelements:

Fertilizer Used in Fertigation

Urea, potash and highly water soluble fertilizers are available for applying through fertigation. Application of super phosphorus through fertigation must be avoided as it makes precipitation of phosphate salts. Thus phosphoric acid is more suitable for fertigation as it is available in liquid form. Special fertilizers like mono ammonium phosphate (Nitrogen and Phosphorus), poly feed (Nitrogen, Phosphorus and Potassium), Multi K (Nitrogen and Potassium), Potassium sulphate (Potassium and Sulphur) are highly suitable for fertigation purpose as they are highly soluble in water. Fe, Mn, Zn, Cu, B, Mo are also supplied along with special fertilizers.



Effect of Fertigation on Soil Nutrient Status

Sustainability of any production system requires optimal utilization of resources. Fertilizers are one of the most important farm inputs, which need to be utilized most judiciously and efficiently. It is well known fact that nitrogen (N) is the most required nutrient in nitrate (NO_3^-) form. However, nitrate form of N does not adsorbed on the exchange sites of soils and is loosely held in the soils and therefore vulnerable to various losses. Whereas, Nitrate fertilizers applied through drip irrigation system as per the requirement of the plants' following the uptake of nutrients has positive effects on reducing leaching losses. Potassium, however, is less mobile than nitrate, but its distribution in the wetted soil volume may be more uniform due to interaction with soil's binding sites. Phosphorus, in contrast to K, is readily fixed in many soils although movement of applied P differs with soil texture. Potassium fertigation of prune trees resulted in better K movement to a depth of 60-70 cm where the soil was wet and roots were abundant, thus enhancing K uptake.

Conclusion

Fertigation has greater impact on enhancing fertilizers use efficiency over conventional fertilization methods besides saving about 30% in irrigation water. Higher initial installation cost and comparatively low technical skills of Indian farmers are some of the major constraints limiting the large scale adoption of drip fertigation technology in the country. But, with increasing concerns of water scarcity and escalating fertilizer prices may lead to greater adoption of the technology especially in high return fruit crops.

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