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*Meena Thakur*
*Kiran Rana*
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*Article ID: 23/01-02/100723*

# THE TRACHEAL MITE OF HONEYBEE

Department of Entomology, Dr. YSP UHF Nauni Solan (H.P.)

## INTRODUCTION

The tracheal mite (*Acarapis woodi*) has been considered as the serious pest of honeybees in Europe and other countries. It was first described by Rennie (1921) in England who gave it the name *Tarsonemus woodii* which was later changed to *Acarapis woodii.* Rennie believed it to be the causal organism of **Isle of Wight disease** but later studies showed that the tracheal mite was not the cause of the "Isle of Wight" disease (Bailey 1964). The disease caused by honeybee tracheal mite is also called as **acarine** or **acariosis**. *Acarapis woodii* is called as tracheal mite because it lives within the trachea of respiratory system of adult honeybees. The tracheal mite infested colonies produce less number of workers which ultimately lowered the colony productivity.

## TAXONOMIC CLASSIFICATION

**Kingdom**: Animalia; **Phylum**: Arthropoda; **Subphylum**: Chelicerata; **Class**: Arachnida; **Order**: Trombidiformes; **Family**: Tarsonemidae; **Genus**: Acarapis; **Species**: *A. woodii*

## SPREAD AND DISTRIBUTION

Tracheal mites breed and spend most of their life inside the trachea of all castes of adult honeybees. However, mated female tracheal mites spend time outside the honey bee's tracheae, although this is usually only for a few hours. Spread occurs rapidly within the hive through bee to bee contact, such as trophallaxis. Upon leaving the breathing tubes mated female mites climb to the tip of a body hair and then attach themselves to the hairs of a passing young bee, entering the tracheae through the thoracic spiracles. The mite needs to locate a new host within 24 hours otherwise it will die. Once an infestation is established, Tracheal mites can spread rapidly from colony to colony in an apiary, through drone and worker bee drift between hives, or through the robbing of hives. Tracheal mites can also spread to new areas through swarming or absconding honeybee colonies. Beekeepers can also inadvertently spread tracheal mites through their apiary through normal management practices including the movement of infected colonies and bees between hives and apiaries. They can also be dispersed long distances *via* infected honeybees hitchhiking on clothes, equipment and vehicles.

With the exception of Australia, New Zealand, Scandinavia, and Canada, *Acarapis woodi* has been found wherever honeybees are found.

## LIFE CYCLE AND BIOLOGY

The entire life cycle of the mite occurs within the honey bee's tracheae (breathing tubes), except for brief migratory periods. Within the 24 hours after worker bees emerge from their cells, female mites migrate between adult bees into their tracheae and remain there for their life span or until their host bee dies. The invading mites are attracted to the current of expired air coming from the first thoracic spiracle. Once inside the host bee, each female mite lays 5 to 7 eggs over a period of 3 to 4 days and continues to lay eggs throughout her life. Eggs hatch in 3 to 4 days and progress through a larval stage, then a nymphal stage before finally reaching adult form. The male takes 11 to 12 days to fully develop, whereas the female takes 14 to 15 days. Mating then

occurs within the breathing tubes. The female is capable of laying almost one egg a day, each of which is about two thirds the weight of the female herself. There are usually 2 to 4 times more females present than males and as many as 21 offspring from each female are possible. Once mated, the female mites leave the tracheae, moving to the external surface of the bee to locate a new bee and begin the reproductive cycle again. Only the female mites disperse from the host to attach to other bees, with approximately 85 per cent of the mite transfers occurring at night. Females are particularly attracted to adults less than 3 days old with this infestation of younger bees enabling the mite more time to complete its life cycle before the host bee dies. Increasing temperatures result in an increased number of mites transferring amongst bees. The mites cannot survive longer than a few hours in this transfer process outside of an adult bee. Honey bees more than 9 days old rarely become infested. Queens also exhibit a rapid decline in susceptibility to mite infestation with increasing age.

**Table 1: Characteristic features of male and female tracheal mite**

| Properties | Male mite | Female mite |
|---|---|---|
| **Length** | 125 - 136 microns | 140 - 175 microns |
| **Width** | 60 - 77 microns | 75 - 84 microns |
| **Apodeme** | **Apodemes I:** forming Y-shaped structure with anterior median apodeme (a conspicious transverse band crossing the thorax in front of the scutellum), not joining transverse apodeme.<br>**Apodemes III:** weakly extending laterad to bases of trochanters III. **Apodemes IV:** extending to bases of trochanters IV.<br>**Posterior median apodeme**: rudimentary, sometimes as faintly formed Y- shaped structure. | **Apodemes III to IV:** not developed, barely discernible.<br>**Posterior median apodeme**: indistinct, sometimes forming weak Y-shaped structure.<br>**Apodemes V:** Present as weakened transverse apodeme barely discernible |
| **Legs** | Leg 1 robust with single hooked claw, Legs II and III each with paired claws. Leg IV stubby, widely spaced; femur-genu and tibiotarsjus functioning as one segment; tibiotarsus IV two times as long as broad; femur-genu broader than long, with three setae unequal length; tibiotarsus abruptly narrowed, almost straight, about two times as long as broad. | Leg I more robust than others. Leg IV short, about 3/4 as long as leg III, without claw; trochanter large, slightly longer than wide, with seta; femur-genu slightly more than two times as long as wide, without flanges, three setae of unequal length; tibiotarsus nearly straight, slightly shorter than femur-genu; apical with slender pointed solenidion and 1 very long seta. |

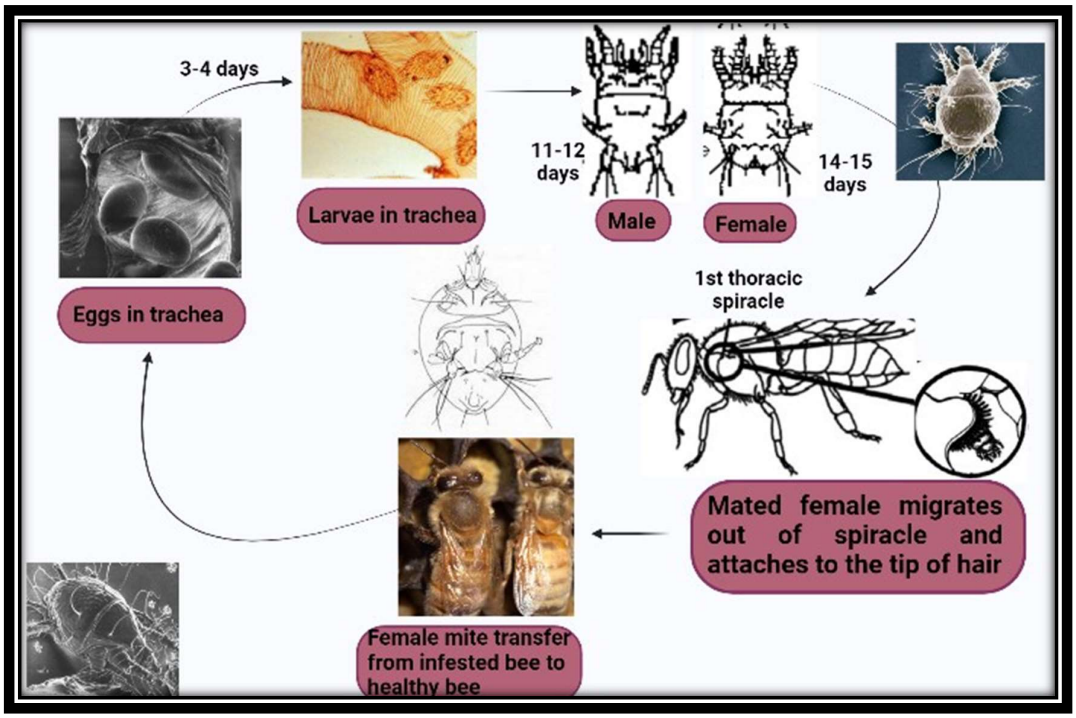


Fig..1: Life cycle of tracheal mite

**SYMPTOMS**

- Large number of bees crawling near the hive entrance
- K wing condition of the honeybees
- Drastic drop in hive population

**Fig. 2. K-wing condition of honeybees**

**DIAGNOSIS OF TRACHEAL MITE**

**Dissection method:** This method involves separating the thorax from the rest of the body and then removing prothorax. The remaining part of thorax is placed in 7.5 per cent potassium hydroxide at 37°C for 24 hours to dissolve muscles, after which the exposed trachea are examined under microscope. Following this, stain the cleared tubes to enhance mite detection. Most mites infest the area between spiracular opening and the first bifurcation of the first pair of tracheal tubes.

a) The head of a live bee is removed and the fresh tracheal tubes are extracted using forceps. Trachea are dissected under magnification with fine needles and number of live and dead adult mites are examined.

b) **Immobilization of a bee using forceps**: The pulling off the flat lobe covering the first thoracic spiracle. This extract internal tissues, including the main tracheal trunk, which can then be examined for mite.

c) Break honeybee thorax apart in water with a household blender and that the air-filled trachea woult float to surface. Detect mite through ELISA test.

**MANAGEMENT**

**a) PHYSICAL CONTROL**

- Keep colony strong with adequate food reserves for better overwintering
- Prevent robbing and drifting of colonies
- Maintain proper spacing between colonies
- Prevent exchange of combs and equipments between healthy and diseased colonies
- Avoid hiving stray swarms
- Isolate healthy colonies from infested ones
- Adopt good colony hygiene, cleanliness, handling of diseased and healthy colonies
- Check the colonies periodically for any abnormality
- Dequeening from diseased colonies

**b) CULTURAL CONTROL**

- Close all cracks and crevices at the time of fumigation
- Reduce hive entrance
- Create broodlessness in colonies by caging queen for 15 days
- Burning of diseased frames or colonies

**c) GENETIC CONTROL**

- Multiply resistant stock or disease resistant colonies

**d) CHEMICAL CONTROL**

- Fumigate colonies with folbex (chlorobenziliate) at weekly intervals (5-7 fumigations)
- Fumigate colonies with formic acid (85 per cent) @ 5mL/colony for 15 days

Crystalline menthol 50 gram or thymol 15 gram is placed in a gauze bag on the top bars and kept for 1-2 months. External temperature should not be around 21 degree Celsius otherwise the menthol vapours will not reach the mites in trachea

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# RESPONSE OF PLANT GROWTH REGULATORS IN ORNAMENTAL CROPS

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Plant growth regulators are the natural compounds, which at low concentration, results changes in plant development. There are usually present in form of auxins, gibberellins, cytokinin, ethylene, abscisic acid and in form of other plant hormones like brassinosteriods, salicylic acid, jasmonates and polyamines. Auxins regulate apical dominance, promote lateral and adventitious root development, regulate floral bud development and phyllotaxy, whereas gibberellins are responsible for stem and leaf expansion via cell enlargement and division. Cytokinins delay leaf senescence, regulate nutrient allocation and promote root nodule development, while ethylene stimulates defence responses, breaks dormancy and produces adventitious roots. Abscisic acid acts as an antagonist with auxin, cytokinin and gibberellins and regulates seed and bud dormancy.

Among other hormones, brassinosteriods reduce stress, promote xylem differentiation and prevent abscission of leaves and roots. Salicylic acid and plant peptide hormones promote defence mechanism and jasmonates and karrikins promote seed germination. Polyamines are essential for plant growth and development, whereas strigolactones inhibit shoot branching. Florigen and anthesins are flowering hormone primarily responsible for flowering in plants, while veralins is used to induce vernalisation in plants. Morphactins are also effective in flowering stimulation.

## PLANT GROWTH REGULATOR APLICATIONS IN ORNAMENTAL PLANTS

Indole Butyric Acid usually applied through dip method and it promotes root development in rose and chrysanthemum @1000 ppm, whereas in carnation does the same function @200 ppm. However in marigold IBa @ 400 ppm enhances plant height and flowering. On the other hand, gibberellic acid @ 150 ppm via dipping method promotes plant height tuberose and enhances salinity tolerance in rose (Ali *et al*., 2019). In carnation and balsam @20 ppm it promotes seed germination and in marigold promotes vegetative growth @300 ppm. In chrysanthemum and china aster it leads to vigorous plant growth with high flower yield @50 ppm foliar spray, whereas in gladiolus via dipping method @25 ppm promotes vase life of spikes. Cytokinins promotes plant height and number of shoots per plant in chrysanthemum @ 1ppm, carnation @ 4 ppm via dipping method and in marigold @ 25 ppm via foliar spray. Via dipping method, it induces primary callus in anthurium @1 ppm and enhances floret diameter and vase – life @ 100 ppm.

Among other hormones, putrescine, spermidine and salicylic acid in gerbera through foliar application @ 100 ppm, 100 ppm and 200 ppm, respectively enhanced dry matter in leaf and flower production (Saeed *et al*., 2019). In rose, foliar spray of salicylic acid @150 ppm promotes chlorophyll and anthocyanin production along with total nitrogen, phosphorous and potassium content, whereas in gladiolus, polymines (spermine) through foliar spray @ 500 ppm improved average feash weight, water uptake and vase life of spikes.

## CONCULSION

Plant growth regulators have a diverse role in ornamental plants. It affects the physiological processes of plants via a very small dose and can alter plant development, flowering pattern along with yield improvement. PGRs are beneficial for cutting-based rooting as well as in vitro rooting of flowering and foliage

plants. Plant growth regulators and novel class PGRs have been very successful in enhancing lateral branches, extending the shelf-life and vase life of flowers and reversing dormancy in diverse ornamental planting material. Plant growth regulators can be used for a variety of objectives, including accelerating germination, boosting plant height and prsentability of flowers, producing more corms and bulbs per plant and shortening the crop cycle.

**FUTURE AND PROSPECTS**

In addition to being used for adornment, fresh flowers and foliage plants are increasingly utilized in producing various products such essential oils, cosmetics, aromatherapy, dry flowers, potpourri, natural colours, and medications. Therefore, expanding decorative production requires specific consideration. The use of new class plant growth regulators and the identification of new PGRs can be beneficial for controlling growth, extending vase life and shelf life and increasing flower production in a variety of ornamental crops. In light of this, greater study on new class PGRs like polyamines, brassinosteroids, jasmonic acid, and methyl jasmonate is needed. In order to obtain desired results, combined treatments of growth regulators may be beneficial in improving post-harvest care of floral and foliage plants. PGRs applied exogenously can replace lengthy days to keep short-day plants alive or short, natural days to encourage flowering in a variety of long-day and short-day plants.

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# THE FUTURE OF FARMING: HYDROPONICS

Lovely professional university Punjab

**ABSTRACT**

Hydroponic systems are employed in the commercial production of several crops, including lettuce and tomatoes, and have been one of the go-to techniques for plant biology research. Many hydroponic systems have been developed in the plant research community to examine how plants react to biotic and abiotic challenges. Here, we describe a hydroponic procedure that is simple to use in labs looking to conduct research on plant mineral nutrition. . In-depth instructions on how to set up a hydroponic system and prepare plant material are provided in this procedure. The majority of the supplies included in this protocol can be acquired without the assistance of a specialist scientific supply company, making the setup of hydroponic experiments more affordable and practical. When the nutritional medium needs to be tightly managed and whole roots need to be harvested for later uses, using a hydroponic growth system is most advantageous. We also show how nutrient concentrations can be changed to cause plants to respond to both poisonous non-essential elements and necessary nutrients.

**INTRODUCTION**

In India, hydroponics is gradually gaining acceptance and drawing more and more farmers. Crops are given nutrient-rich water instead of using soil to feed plants, which greatly reduces the drawbacks of soil-based methods. The technique of hydroponics involves growing plants without soil in a nutrient-rich fluid. In addition to the shrinking amount of arable land caused by growing urbanisation and industrialization, traditional agricultural methods are also having a wide range of negative effects.

This fact is utilised by hydroponics, a method of growing plants, which provides all of the nutrients in a liquid solution, in their inorganic form, with or without solid substrate. Scientists have made considerable use of hydroponic systems to investigate the nutritional needs of Arabidopsis and other plant species, as well as the toxicity of certain components. Additionally, hydroponics has industrial uses for crops like lettuce and tomatoes.

Here, we discuss how hydroponics is used in research, potential modifications in the approaches that are now accessible, and lastly, we propose a system that is easily scalable and practical for research labs interested in analysing plant mineral nutrition.

**HYDROPONIC:** Hydroponics is the practise of growing plants in a lack of soil. This technique encourages quick development, greater yields, and improved quality. When a plant is growing in soil, its roots are constantly looking for the food it needs to survive. A plant doesn't need to expend any energy to maintain itself if its root system has direct access to water and food. As a result, fruit, flower, and vegetable blooming as well as leaf growth flourish. Photosynthesis is the process through which plants maintain themselves. Plants using chlorophyll to absorb sunlight (a green pigment present in their leaves). They split water molecules that they have absorbed by their root system using the energy of the light. Carbon dioxide and hydrogen atoms combine to form carbohydrates, which plants utilise for energy. The subsequent release of oxygen into the atmosphere is

essential for maintaining the habitability of our planet. Soil is not necessary for photosynthesis in plants. They depend on the soil to provide them with nutrients and water. When nutrients are dissolved in water, they can be sprayed, immersed, or flooded directly onto a plant's root system. Direct contact with nutrient-rich water can be a more efficient and adaptable way of growth than standard irrigation, according to hydroponic advancements.

**CLASSIFICATION OF TECHNIQUES**

1. Liquid hydroponics: In this method, the minerals are solely delivered to the plant by way of a mineral solution. The nutrition solution could be passive, flowing, or stagnant. To restore the soil nutrients, the fluid must also contain both organic and inorganic components.

Although there are hundreds of other hydroponic techniques, they are all variations or combinations of the six fundamental hydroponic systems.

**Deep-Water Culture Systems**: Hydroponic plants that are suspended in aerated water are known as deep water culture systems. Deep water culture systems, usually referred to as a DWC system, are among the simplest and most widely used hydroponic techniques available today.

A deep reservoir of oxygen-rich nutritional solution is covered by a DWC system that suspends net pots housing plants. The plant has constant access to food, water, and oxygen thanks to the roots being immersed in the solution. Some people believe that deep water culture is the purest type of hydroponics. The longevity of the plant depends on the water's ability to oxygenate properly because the root system is always floating in it. The plant will drown in the fluid if its roots are not supplied with enough oxygen. . Some people believe that deep water culture is the purest type of hydroponics. The longevity of the plant depends on the water's ability to oxygenate properly because the root system is always floating in it. The plant will drown in the fluid if its roots are not supplied with enough oxygen. To provide oxygen to the entire system, add an air stone connected to an air pump at the bottom of the reservoir. Without pricey hydroponics equipment, assembling a deep-water culture system at home or in a school is relatively simple. Only the roots of plants in DWC systems should be immersed in the solution. There should be no section of the stem or vegetation submerged. Even better, you can leave the roots sticking up above the water by approximately an inch and a half. In order to prevent them from drying out, air stone bubbles will burst from the surface and splash onto the exposed roots.

**Wick systems**: A wick system involves the nesting of plants in growing medium on a tray that is placed on top of a reservoir. A water solution with dissolved nutrients is kept in this reservoir. From the reservoir, wicks move to the growth tray. The growing medium surrounding the roots of the plants is saturated with water and nutrients as they flow up the wick. These wicks may be constructed from such basic materials as rope, string, or felt. By far, wick systems are the most basic type of hydroponics. Wick systems are passive hydroponics, which means they don't operate by using mechanical components like pumps. Thus, it is ideal for use when there is either no electricity available or it is unavailable. Wicks systems function through a mechanism known as capillary action. The wick acts as a sponge, absorbing the water it is submerged in and transferring the nutrient solution when it comes into touch with the porous growing medium. Wick system hydroponics can only be effective when used with growing material that can efficiently transmit nutrients and water.

The fibres from the coconut's outer husk, known as coco coir, are great at holding moisture and have the added advantage of being pH neutral. Perlite is perfect for wicking systems since it is highly porous and pH neutral. Vermiculite has a high cation-exchange capacity and is also quite porous. It can therefore preserve nutrients for later use. The best growing media for hydroponic wick systems are these three types. Wick systems operate more slowly than other hydroponic systems, which restricts what can really be grown using them. Make sure there is at least one wick running from the reservoir for each plant in the growth tray. These wicks ought to be positioned close to the plant's roots. Although the wick system can function without aeration, many users still decide to add an air stone and air pump to the reservoir. The hydroponic system gets more oxygenation as a result.

**Nutrient film technique systems:** Systems using the nutrient film technique (NFT) hang plants over a continuous stream of nutrient solution that washes over the ends of the plant's root systems. Water may flow down the length of the grow tray before emptying into the reservoir below thanks to the tilted channels holding the plants. The reservoir's water is then aerated using an air stone. The nutrient-rich water is then pumped back

to the top of the channel by a submersible pump from the reservoir. The hydroponic system used in the nutrient film technology circulates water. In contrast to deep water culture hydroponics, an NFT system does not submerge the plant roots in water. Instead, only the ends of their bodies are covered by the stream (or "film")" just passes over the roots' ends. While the exposed root system is given plenty of access to oxygen, the tips of the roots will wick the moisture up into the plant. The grooved channel bottoms allow the thin film to easily flow over the root tips. Water cannot accumulate or dam up against the root systems as a result of this. Despite the fact that systems using the nutrient film approach are constantly recycling water, it is advisable to drain the reservoir and replace the nutrient solution about once every week. This guarantees that your plants are receiving enough nutrition. A steady slope must be used to angle NFT channels. The water will rush down the channel if it is too steep, failing to properly hydrate the plants. If too steep, the water will rush through the channel without providing the plants with adequate nutrition. The system will overflow and the plants risk drowning if there is an excessive amount of water being pumped down the channel. Since NFT hydroponic systems can support multiple plants per channel and are simple to mass-produce, they are common commercial systems. Lightweight plants like mustard greens, kale, lettuce, and spinach are the greatest candidates for nutrient film technology systems.

**Ebb and flow systems:** In order to produce plants, ebb and flow hydroponics fill a grow bed from a reservoir below with a nutrient solution. The pump starts to fill the grow bed with water and nutrients when the timer goes off. When the timer expires, gravity gradually empties the grow bed's water supply and flushes it back into the reservoir. The device has an overflow tube to make sure flooding doesn't go above a specific point and harm the plant stalks and fruits. An ebb and flow system differs from the previously stated systems in that the plants are not constantly exposed to water. The plants absorb the nutrition solution through their roots as the grow bed is flooded. The roots become dry when the water level drops and the grow bed empties. The time before the subsequent flood allows the dry roots to oxygenate. The size of your grow bed and the size of your plants determine how frequently floods occur. One of the most well-liked hydroponic growing techniques is the use of ebb and flow systems, often known as flood and drain systems.

**Drip systems:** The aerated and nutrient-rich reservoir in a hydroponic drip system delivers fluid through a system of tubes to individual plants. The most common and widely used hydroponics technique, particularly among commercial growers, is drip irrigation. Recovery and non-recovery are the two types of drip system hydroponics. Recovery systems, which are more common with smaller, at-home growers, drain extra water out of the grow bed and into a reservoir so that it can be recirculated during the following drip cycle. The extra water in non-recovery systems drains from the growth media and is wasted. Commercial growers prefer this technique more frequently. Large-scale producers are extremely cautious with their water usage, despite the fact that non-recovery drip systems may seem inefficient. These drip systems are solely intended to give precisely the right amount of solution to maintain moisture in the growing medium surrounding the plant. Non-recovery drip systems minimise waste by using complex timers and feeding schedules. You must be aware of changes in the pH of the fertiliser solution if you are growing plants in a recovery drip system. This holds true for any system that circulates waste water back into the reservoir. The grower will need to check and adjust the solution reservoir more frequently than they would in a non-recovery system since plants will reduce the nutrient content of the solution and change the pH balance. Growing media will need to be cleaned and replaced from time to time because they can become oversaturated with nutrients.

**Aeroponics:** Aeroponics systems are enclosed structures, such as cubes or towers, that have the capacity to house several plants simultaneously. A reservoir holds the water and nutrients, which are then pumped through a nozzle where the mixture is atomized and dispersed as a fine mist. Usually, the top of the tower is where the mist is discharged, allowing it to cascade down the chamber. Some forms of aeroponics spray the plant's roots continuously, similar to how NFT systems constantly expose the roots to the nutrient film. Others operate more like an ebb and flow system, periodically misting the roots. Substratum media are not necessary for aeroponics to exist. The roots' continuous contact to air enables them to take up oxygen and grow more quickly. In actuality, growing a crop aeroponically uses 95% less water than growing it in an irrigated area. Their vertical structure is made to take up the least amount of space possible and enables the housing of several towers in one

site. Even relatively small settings, aeroponics can generate high yields. Additionally, aeroponic plants grow more quickly than traditional hydroponically produced plants because of their increased oxygen exposure.

**2. Media culture:** In medium culture method a solid medium is used or the anchoring of roots. The culture is usually named after the inert medium. The media can be biotic, such as rice husk, wool, or coir, or abiotic, such as sand, gravel, or rock. For each medium, sub-irrigation and top-irrigation are the two primary variations. However, it is classified as follows:

1. Hanging bag technique
2. Grow bag technique
3. Trench or trough technique

**LIST OF CROPS THAT CAN BE GROWN IN SOIL-LESS CONDITION**

| Types of crops | Name of the crops |
|---|---|
| Cereals | Rice, Maize |
| Fruits | Strawberry |
| Vegetables | Tomato, Chili, Brinjal, Green bean, Beet, Winged bean, Bell pepper, Cabbage, Cauliflower, Cucumbers, Melons, Radish, Onion |
| Leafy vegetables | Lettuce, Kang Kong, Spinach |
| Flower crops | Marigold, Roses, Carnations, Chrysanthemum |
| Medicinal crops | Indian Aloe, Coleus |
| Fodder crops | Sorghum, Alfalfa, Barley, Bermuda grass, Carpet grass |

**ADVANTAGES OF HYDROPONICS**:

1. Hydroponic farming is that it produces healthy, high-yield crops without the risk of soil-borne illness or weed infestation.
2. Food grown in soilless cultures is organic, and no dangerous toxics or pesticides are used.
3. Gardening requires less room since plants with short roots can be cultivated near to one another.
4. Crops grown in hydroponic systems grow twice as quickly and produce twice as much, allowing for increased productivity in the same amount of space.
5. There is no water waste because the process only applies 1/20th as much water to the crops as conventional farming does.
6. Demands less work.
7. Crops can be cultivated without concern for the varying seasons.
8. Hydroponics is an agricultural method devoid of abiotic stress.
9. Ecologically sound practices that don't affect the environment.

**HYDROPONICS LIMITATIONS**: Hydroponics does have some restrictions, despite its numerous benefits-

1. Technical expertise, which is either harder to come by or more expensive, is needed for commercial hydroponic crop growth.
2. A significant initial expenditure is needed.
3. To maximize net returns, only high-value crops are produced in hydroponic systems due to the high cost.
4. The system requires substantial energy inputs to function.

**THE FUTURE IMPACT OF THIS TECHNOLOGY**

The fastest growing industry in agriculture is hydroponics, despite the fact that it may not have a substantial market share. It is anticipated that it will control future food production globally. As more and more farmland is destroyed by inadequate management and abuse, leading people to resort to more cutting-edge

techniques of agriculture production, hydroponics is likely to flourish. The most sophisticated production technology currently used to grow crops is hydroponic protected culture. Ruthenberg (1980) categorised hydroponic farming as a "high input-high output-high risk" form of farming. In fact, in order to achieve predicted output potential with the techniques currently available, significant specialisation, sophisticated management and know-how, as well as substantial financial inputs, are required; otherwise, crop failures can be disastrous. Before using a large-scale hydroponic system, producers need be much more selective when it comes to site selection, building designs, growing methods, pest management, and market conditions. In general, a 1% reduction in light causes a 1% reduction in yield. More than 500 tonnes of winter tomatoes can be produced annually per ha in a greenhouse in an area with strong light levels. The only way to get such yields in northern latitudes is to cultivate the crops throughout the summer, when market prices are at their lowest. Due of its shortage of arable land and growing land prices, Japan, an island nation, has already taken a proactive approach to these technologies. The majority of Japan's hydroponics is carried out using NFT or sand/gravel techniques.

The Japanese have developed better and more productive plants for hydroponic rice cultivation using bio-technological techniques, such as those provided by hydroponics. Instead of the customary one harvest each year, four harvests can be carried out thanks to environmental control.

Cities like Indianapolis are investing more in local food production systems as the world's population moves into cities. These systems provide chances for economic growth and lower cities' carbon footprints by using 90% less water than conventional farming techniques. Even some very large companies have seen the benefits of hydroponic systems. In the spring of 2017, hydroponic gardens were erected at a few locations of the global retail chain Target as part of a series of trials. With little water use, these gardens can offer consumers incredibly fresh veggies and herbs.

**GLOBAL HYDROPONIC MARKET AND COMMERCIALHYDROPONIC PRODUCTION**

According to estimates, the global hydroponics market would surpass USD 21203.5 million in 2016. Tomato, cucurbits, lettuce & leafy vegetables, peppers, and other food crops are included in the global hydroponics market by crop type. In 2018, the largest market sector was the tomato, which accounted for 30.4% of the global market. Tomatoes, lettuce, and other leafy vegetables are among the crops that hydroponics is predicted to produce more of. The demand for hydroponics culture is growing in Europe and Asia-Pacific as customers become more aware of the superiority of high-quality greenhouse-grown veggies. Europe has historically been the biggest market for deploying cutting-edge methods hydroponics. The second-largest hydroponics market, which is anticipated to expand steadily, is in Asia-Pacific. Netherlands, Australia, and France are the top three nations using hydroponic technology. Israel, Canada, the USA, and England. According to the Netherlands Department of Environment, Food and Rural Affairs (NDEFRA), the Netherlands is the world leader in commercial hydroponics, with a total area of 13000 ha under tomato, capsicum, cucumber and cut flowers. This accounts for 50% of the value of all fruits and vegetables produced in the nation. According to the Rural Industries Research and Development Corporation, Australian hydroponic vegetable, herb, and cut flower production is valued at between $300 and $400 million, or roughly 20% of the overall value of Australian vegetable and cut flower production (RIRDC). Australia produces the most hydroponically grown lettuce in the entire globe, as well as more strawberries than the USA and nearly as many cut flowers as the USA.

Both Spain and Canada are enlarging the area covered by commercial hydroponic systems. Japan has begun using hydroponics to produce rice in order to feed its citizens. Due to its dry and arid climate, Israel produces a lot of berries, citrus fruits, and bananas.

In both wealthy and developing nations, there is currently a greater need for hydroponic farming. In India, it is possible to use hydroponics over large areas of wasteland with poor soil but abundance of water. People are now growing leafy greens, small herbs, and spices on their roofs and balconies for fresh consumption in a number of major cities, including Delhi, Chandigarh, Noida, and Bangalore. The future of hydroponics seems brighter now than it has in the previous 50 years. Although the start-up costs for a hydroponic farm can vary greatly, they are typically higher than those for soil-based farming. Thus, it is crucial to deploy

technologies that decrease reliance on human labour and lower overall start-up costs in order to promote the expansion of the hydroponics business.

**SCOPE OF HYDROPONIC FARMING IN INDIA**

India's population is indiscriminately growing, which is one of the main causes of the shrinking amount of available agricultural land. Producing staple crops for a population that is expanding quickly is becoming more challenging as the area of arable land decreases regularly. The lack of arable land in India will one day be remedied thanks to hydroponic gardening. It will be possible to cultivate more varieties of staple crops, and less soil and water will be needed—or even not needed at all. The evolution of hydroponic farming in India will also significantly improve the environment, the poor, and our ability to breathe and survive. How will this go place? Since hydroponic plants require less land and water and grow alarmingly faster than traditional farms, Fruits and vegetables will grow swiftly thanks to conventional farming. There won't be a war against hunger if there is sufficient food available for everyone. Water is also conserved in this novel technique, increasing the amount of water that is available for numerous additional uses. Finally, the production of weeds and pests will decline to alarmingly low levels thanks to hydroponic farming. As a result, less pesticide, insecticide, and weedicide use will be necessary. No lands will be contaminated. This technological revolution is now a fringe movement, and considerable research is being done.

**CONCLUSION**

Hydroponics is emerging as a significant method to address these issues in a sustainable and ecologically responsible manner in a society where fresh water and food supplies are becoming increasingly scarce. The hydroponics sector is predicted to develop enormously in the future, especially as the circumstances for soil-based cultivation become more challenging.

Soilless culture will eventually replace conventional agriculture in a country like India where urban growth is outpacing all predictions, increasing the amount and quality of the produce and ensuring the country's long-term food security. However, increased attention through governmental action and the emphasis of research organisations might speed up the development of hydroponics.

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# ROLE OF ARTIFICIAL INTELLIGENCE (AI) IN AGRIBUSINESS MANAGEMENT

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**ABSTRACT**

The agricultural industry is changing rapidly as technology advances. Artificial intelligence (AI) is becoming increasingly important in agribusiness management, as it allows for more efficient and effective management of resources. AI can be used to identify trends in crop production, optimize the use of resources and labour, and improve the quality of products. This article will discuss the various ways in which AI is helping to revolutionize agribusiness management.

## INTRODUCTION

Artificial intelligence-based business models can enable a more equitable and sustainable food system while assisting in meeting the increasing global demand for food **(Cook, P.A., & O'Neill, F. 2020)**. The development of artificial intelligence (AI) and related sectors has created new opportunities in the agricultural sector. They are enabling intelligence to be merged in networks of devices connected via the internet, and real-time agricultural data **(Vadlamudi, S. 2019; Bali, N., & Singla, A. 2022)**.

### A. DEFINITION OF AI

Artificial intelligence (AI) is a system of computer technology that enables machines to learn from their environment and experiences, and to act autonomously **(Eli-Chukwu, N.C. 2019)**.

### B. ROLE OF AI IN AGRIBUSINESS MANAGEMENT

AI has been used in many industries, including agribusiness management, for more efficient and effective management of resources. **(Ennouri, K. et al., 2021)**. AI can be used to identify trends in crop production, optimize the use of resources and labour, and improve the quality of products **(Di Vaio et al., 2020)**.

## BENEFITS OF AI IN AGRIBUSINESS MANAGEMENT

### A. IMPROVED EFFICIENCY AND PRODUCTIVITY

The use of AI in agribusiness management has several benefits. First, it can help improve efficiency and productivity by automating mundane tasks such as data entry and analysis. This frees up time for employees to focus on more important tasks. Additionally, AI can be used to identify trends in crop production, allowing farmers to adjust their strategies accordingly **(Chandra, S.V. 2022)**.

### B. ENHANCED QUALITY CONTROL AND QUALITY ASSURANCE

AI can also be used to enhance quality control and quality assurance processes. By using machine learning algorithms, AI can detect defects or anomalies in products before they reach the consumer. This helps ensure that only high-quality products are sold to customers.

### C. AUTOMATION OF PROCESSES

Finally, AI can be used to automate processes such as harvesting and packaging. This reduces the need for manual labour and increases efficiency.

## CHALLENGES OF AI IN AGRIBUSINESS MANAGEMENT

### A. HIGH COST OF IMPLEMENTATION

Although there are many benefits to using AI in agribusiness management, there are also some challenges associated with it. The first is the high cost of implementation. AI systems require significant investments in hardware, software, and personnel training in order to function properly.

### B. LACK OF SKILLED PERSONNEL

Additionally, there is a lack of skilled personnel who are able to develop and maintain these systems.

### C. SECURITY CONCERNS

One of the main security concerns associated with using AI in agribusiness management is the potential for malicious attacks or data breaches. AI systems are vulnerable to hackers who may be able to access sensitive information or disrupt operations. Additionally, AI systems may be vulnerable to errors due to incorrect data or programming mistakes. To mitigate these risks, it is important to ensure that AI systems are properly secured and monitored.

## IMPLICATIONS

The use of AI in agribusiness management has several implications. First, it can help improve efficiency and productivity by automating mundane tasks such as data entry and analysis. This could lead to cost savings for businesses as well as improved customer satisfaction. Additionally, AI can be used to identify trends in crop production, allowing farmers to adjust their strategies accordingly. This could lead to improved yields and higher profits for farmers. Finally, AI can be used to enhance quality control and quality assurance processes, leading to higher-quality products being sold to customers.

## ETHICAL CONSIDERATIONS

The use of AI in agribusiness management raises several ethical considerations. First, there is the potential for AI systems to be used to exploit workers or reduce wages. Additionally, AI systems may be used to discriminate against certain groups of people or to manipulate markets. Finally, AI systems may be used to collect and store personal data without the user's knowledge or consent.

## POTENTIAL RISKS

In addition to the ethical considerations, there are also potential risks associated with using AI in agribusiness management. First, there is the risk of AI systems being hacked or manipulated by malicious actors. Additionally, there is the risk of errors due to incorrect data or programming mistakes. Finally, there is the risk of AI systems being used for unethical purposes such as manipulation or exploitation.

## SOLUTIONS

Businesses can ensure that their AI systems are compliant with regulations by implementing measures such as data privacy and security protocols, ethical guidelines, and audit processes. Additionally, businesses should ensure that their AI systems are regularly tested and monitored to ensure they are functioning properly. Finally, businesses should ensure that their AI systems are regularly updated to keep up with changing regulations.

## CONCLUSION

In conclusion, AI has the potential to revolutionize agribusiness management by improving efficiency and productivity, enhancing quality control and assurance processes, and automating mundane tasks. However, there are some challenges associated with using AI such as high costs of implementation and lack of skilled personnel that must be overcome in order for AI to be successfully implemented in agribusiness management.

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# ROLE OF DIFFERENT PLANTS IN MANAGEMENT OF PROBLEMATIC SOILS

Krishi Vigyan Kendra, Kalikiri, Chittoor

In India approximately 6.73 mha of soils are problematic. Most of the area is in Gujarat, Uttar Pradesh, Maharashtra, West Bengal, Rajasthan, Tamil Nadu and Andhra Pradesh. Crops can tolerate salinity, acidity or alkalinity in soils only upto some extent. If the soils have high salinity crop plants cannot tolerate and there are high chances of crop growth retardation and reduced crop yields. Adverse effects of high salinity on type of the crop, family of the crop, crop growth stage depends on salinity at the root zone. Correcting the problematic soils is very costly so instead of using costly inputs growing the plants that tolerates the salinity may gives better results. Before sowing analysis should be done on extent of salinity, crops that can tolerate the level of salinity. For example in soils with high salt content Crespa critica, Cyperus rotundis etc can be grown.

**Indicator plants:**

Indicator plants can be used to identify the level of salinity in soils. But precautions should be taken as this plants can be grown both in problematic and no-problematic soils. Soil sample collection should be done in proper time. Crop growth should be observed carefully when grown in problematic soils to assess the level of salinity.

**Identification of problematic soils based on crop growth:**

Depending on the level or extent of salinity differences in crop growth and development may be observed which include

- Uneven growth of crop
- Retarded growth, poor stature
- Dark bluish colour leaves
- Yellowing of leaves.

**Table. Crops and their pH levels, soil EC where it can grow**

| Crop | pH | EC |
|---|---|---|
| Rice | 9.2-10.2 | 4.0-10.0 |
| Wheat | 8.8-9.3 | 6.5-11.0 |
| Mustard | 8.9-9.2 | 4.0-11.0 |
| Safflower | 8.7-8.8 | 4.0-6.0 |

| | | |
|---|---|---|
| Sugarcane | 8.8-9.0 | - |
| Cowpea | 8.6-8.8 | 4.0-5.0 |
| Greengram | 8.6-8.8 | - |
| Redgram | 8.3-8.6 | - |
| Chickpea | 8.6-8.8 | 4.0-5.0 |
| Bajra | 8.7-8.9 | 4.0-8.0 |
| Groundnut | - | 3.2 |
| Cotton | - | 7.7 |
| Sorghum | - | 6.8 |

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# PHYTOTOXIC EFFECTS OF EXCESSIVE USAGE OF PESTICIDES ON CROP

Krishi Vigyan Kendra, Kalikiri, Chittoor

Phytotoxicity means toxic effect of chemical inputs on crops when sprayed in higher doses. Compared to insecticides and fungicides; herbicides should be sprayed carefully as alike other pesticides herbicides are prepared in a way that they kill the target weeds. So spraying higher doses of herbicides may kill crop plants. Herbicides can reach crop plants by water or soil or vapour form. So immediately after spraying herbicides, crop plants cannot be sown as they may cause harm to the seeds. Phytotoxicity depends on herbicide dose and pollution. For ex: In cotton spraying of 2,4 D herbicide will cause venation mosaic virus. Small and marginal farmers are using same sprayer for all pesticides including herbicides. After spraying of herbicides residues may stay in the nozzle when sprayed is not cleaned properly. Herbicide residue which is left in the nozzle will fall on the crop plants and kills sensitive crops like cotton, grapes and other sensitive crops. Not only herbicides, but also insecticide, fungicides and nematicides also cause harmful effect on plants if used in higher than required dose. Phytotoxicity caused by insecticides depends on formulation of insecticides like water soluble powder, emulsifiable concentrate, granules etc. Plants may show symptoms like drying, burning, wiliting and even death of the plants may occur when sprayed in higher dose. In some cases leaves, stem, flower buds and fruits may be distorted in shape and size. Plants when subjected to water stress are more vulnerable and have high chances of damage compared to other plants. Temperature, relative humidity and sunlight are some of the factors that influence the phytotoxicity level. Spraying insecticides during high temperatures cause more damage to crop plants compared to lower temperature. High ultraviolet rays, soil moisture, soil structure,soil microorganisms also influence level of phytotoxicity. Higher dose of pesticides should not be sprayed whenplants are subjected to water stress. Pesticides should not be sprayed when temperature is more than 32 degrees. Spraying in the morning and evening should be avoided during cool climate. Compared to emulsifiable concentrates, water soluble powders are more safer.

- Dichlorovas, Fenitrothian, quinolfos, monocrotophos, copper oxychloride, methyl demetan and dimethoate causes harm to sorghum when sprayed in higher doses.
- In cotton herbicides should be avoided to maximum extent
- Chemical inputs like sulphur when used in higher doses may affect cucmber
- Onion and chrysanthemum plants can be affected if profenophos is used in higher doses
- Chilli may face phytotoxic effect if propiconazole is sprayed in higher doses
- Profenophos if sprayed in higher doses may cause phytotoxic effect on maize
- Leaf fall can be seen in curry leaf plant if sulphur is sprayed in more than required dose.

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# CLIMATE- SMART AGRICULTURE TO SEQUESTER CARBON AND TO MITIGATE GREENHOUSE GAS EMISSIONS

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## CLIMATE CHANGE IMPACT ASSESSMENT

Global temperature rise and climate change have a significant impact on agriculture, affecting ecosystems and their benefits to society. Agriculture and animal husbandry, agricultural land and water resources, and food security are increasingly affected. Methods are essential for assessing the impact of climate change.

The impact of climate change is expected to worsen, leading to an increase in extreme weather events such as droughts, floods, heat waves and unpredictable rainfall patterns that threaten food security and hinder (if not impossible) agricultural production. The emission of greenhouse gases below the surface is accelerated into the atmosphere, leading to global warming. This will affect already fragile ecosystems, cause severe land degradation, and further threaten food security


Fig.1: Impact of climate change on agriculture

## AGRICULTURAL ACTIVITIES (PRODUCTION OF FOOD CROPS AND LIVESTOCK) CONTRIBUTE TO EMISSIONS OF GHG IN SEVERAL WAYS.

Various agricultural land management practices can increase nitrogen and nitrogen oxides ($N_2O$) emissions into soil

- A few activities that lead to N2O emission from agricultural land include using herbal and artificial fertilizers, growing nitrogen-fixing crops, draining organic soils, and irrigation practices.
- Livestock, specifically ruminants consisting of cattle, produce methane (CH4) in the course of their everyday digestion process
- The management of animal manure also affects the emissions of $CH_4$ and $N_2O$.
- Minor sources of agricultural emissions include $CO_2$ from lime and urea use, $CH_4$ from rice cultivation, and residues from burning crops, which produce $CH_4$ and $N_2O$.

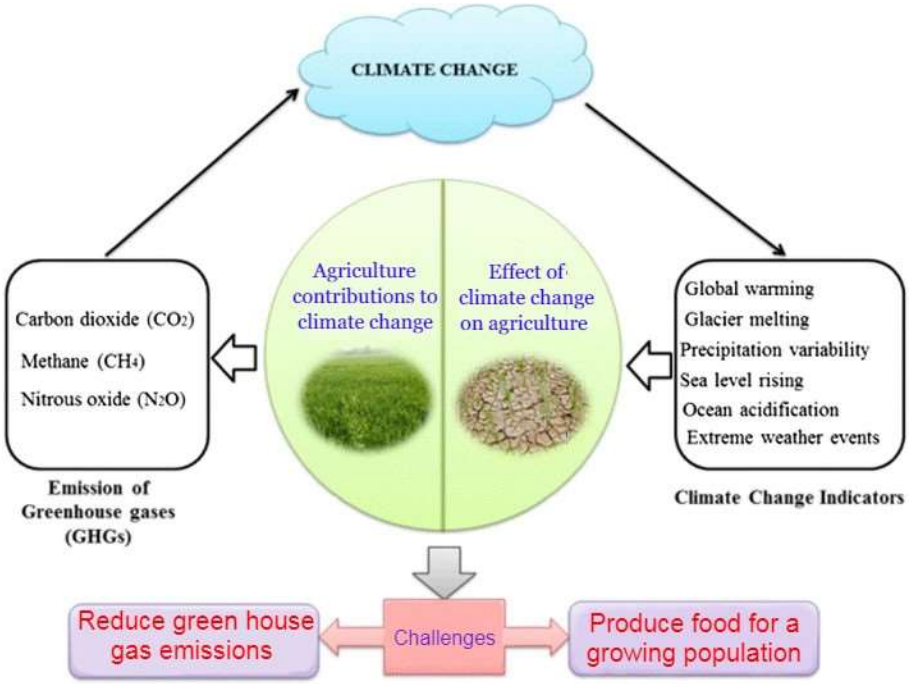



Fig. 4: Relationship between agriculture and climate change

**THE MECHANISMS FOR REDUCING AGRICULTURAL EMISSIONS ARE:**

**REDUCING FUEL CONSUMPTION**

When gasoline or diesel is burned in vehicles and machines, farms and other agricultural enterprises emit carbon dioxide. Farms and other agricultural businesses emit carbon dioxide when cars and machinery burn gasoline or diesel. As farmers improve operational efficiency or use less economical farming methods such as no - till, they will reduce greenhouse gas emissions from fossil fuels.

**IMPROVING NITROGEN-USE EFFICIENCY (NUE)**

Farmers can modify their nutrient management practices to cut back the emissions of nitrogen fertilizers and manure applied to farmland.

**CROPPING SYSTEM**

Sequencing of rice - green gram- wheat showed a higher SOC recovery rate than rice - wheat, followed by green gram - rice and mustard - rice, which may be due to the inclusion of beans in the grain system. Continuous application of 100% NPK with lime, FYM spreads soil organic carbon regeneration, maintains soil fertility and crop sustainability in Alfisol soybean-wheat cropping system (Geeta *et* al., 2019)

**INCREASE CARBON SEQUESTRATION ON FARMLAND:**

Farmers can employ techniques to increase the amount of crop debris in the field and the amount of organic matter stored in the soil in order to increase carbon sequestration.

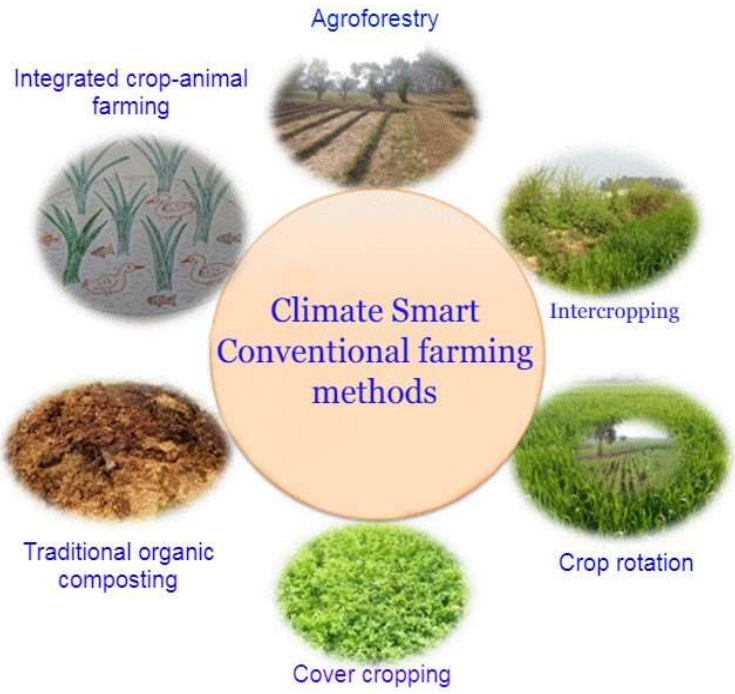



Fig. 5: Climate Smart Conventional farming methods

**CONSERVATION TILLAGE**

Conservation farming refers to many strategies and methods that reincorporate crops into the residues of previous crops that are deliberately left at the soil surface. Less tillage reduces soil turbulence and reduces soil carbon emissions into the atmosphere

**COVER CROPS**

Covered Crops are tools to keep soil in place, promote soil health, and improve water quality and reduce pollution caused by agricultural activities. The quantity of carbon sequestered through cover crops plants relies upon on soil type, management, altitude and climate (Poeplau and Don, 2014 ). In previous studies, the percentage of cover crops that could sequester carbon on farmland was 0.22 tons/acre/year (Ruis and Blanco-Canqui, 2017).

**WASTE MANAGEMENT**

It is a common practice for Indian farmers to remove waste from the field or burn it in the field, which makes it difficult to maintain SOC. Careful use of crop residues and mulch cultivation techniques are effective for carbon sequestration (Tomar *et* al., 1992, Lal *et* al.; 1980).

**CROP ROTATION**

Crop rotation has many environmental benefits and is widely used in agriculture. Changes in the use of arable land can help to increase the level of organic carbon in the soil.

**AGROFORESTRY**

Forests and forestry systems play a dominant role in the long-term flux and storage of carbon (C) in the Earth's biosphere, increasing global interest in these land-use options for stabilizing greenhouse gas (GHG) emissions.

**CONSERVATION RESERVE PROGRAM (CRP)**

The CRP provides compensation for farmers to voluntarily remove severely eroded or environmentally sensitive agricultural land from use for 10-15 years.

**INCENTIVES TO REDUCE GREENHOUSE GAS EMISSIONS:**

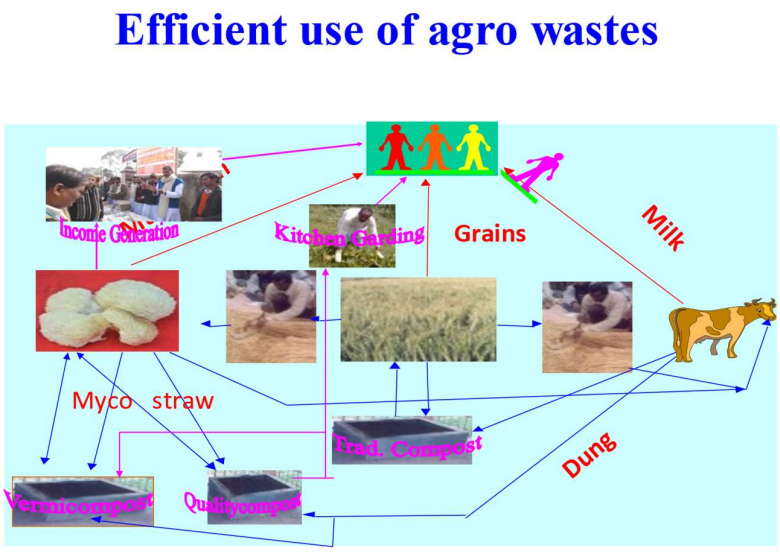
Another policy option is to provide direct incentives for the agricultural slowdown, which is similar to current federal protection programs, such as the Conservation Reserve Program (CRP).

**RENEWABLE ENERGY PRODUCTION ON FARMLAND:**

Farmers can also help to reduce greenhouse gas emissions by increasing the raw materials used for biofuels or by installing wind turbines and solar panels on their land.

**EFFICIENT USE OF AGRO WASTES**

All agricultural waste has incredible potential benefits, so the effective conversion, recycling and utilization of these wastes are essential to control pollution and greenhouse gas emissions. Foods such as mushrooms, grains, milk, and vegetables can increase crop yields, save energy, improve environmental quality, and increase independence through income generation. Thus, there is an urgent need to strengthen the most suitable methods for converting such agricultural waste into cheap and valuable materials.




**CONCLUSIONS**

Agricultural carbon sequestration refers to the ability of agricultural land and forests to remove carbon dioxide from the atmosphere. Agricultural carbon sequestration Carbon sequestration refers back to the switch of carbon from the surroundings to some other long-time period carbon pool. Many agricultural methods and technologies will scale back gas emissions and stop global climate change by improving soil carbon storage. Introducing climate-friendly agricultural practices, such as conservation agriculture, intercropping, crop rotation, crop improvement, INM, water and soil conservation agriculture, can increase the amount of carbon sequestration in the soil above the threshold limits. Soil carbon sequestration may be a vital tool to improve soil fertility and reduce the greenhouse effect. Therefore, carbon sequestration in the soil is a natural, useful and environmentally friendly process.

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# MICRONUTRIENTS, THEIR IMPORTANCE AND THE FACTORS AFFECTING THEIR AVAILABILITY IN SOIL

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Micronutrients, also known as trace elements, are required in small quantities, but their deficiency in soil could cause a decrease in crop yield, further affecting animal and human health. Micronutrients are present as cations and anion form in the soil out of the main micronutrient, Fe, Mn, Zn, Cu and Ni behave as cations, while B, Mo and Cl occur as an anion in the soil. Due to this ion form, their chemistry varies from each other. Micronutrients as a cation exist in the five pools according to Viets (1962)-

1) Water soluble
2) Exchangeable form
3) As a complex, adsorbed or chelated form
4) Bound form in carbonates, sesquioxides and secondary minerals
5) Primary minerals

[Note: These five forms decide the availability and deficiency of micronutrients in the soil.]

Micronutrient deficiency is commonly observed in soils with very high pH. Sodic soil has Zn, Fe, Mn, and Cu deficiency. While in acidic soil Mo deficiency is most commonly observed.

**Important functions and deficiency symptoms of micronutrient**

1. **Iron:** Helps in the synthesis and maintenance of chlorophyll, and absorption of other nutrients. Play essential in nucleic acid metabolism

   **Deficiency-** Causes chlorosis between the veins of leaves, the veins remaining green i.e. responsible for interveinal chlorosis.

Normal leave

Fe deficient leave

Mn deficient leaves of oat

Zn deficiency- khaira disease

2. **Manganese:** Acts as a catalyst in oxidation and reduction reactions in plants, protects from the harmful effect of free radicals, is involved in nitrogen assimilation in plants, Helps in chlorophyll formation, and play role in oxidative and non-oxidative decarboxylation reactions.

   **Deficiency-** Its deficiency is generally seen in middle leaves. In monocotyledons it forms a grey streak. For example: Grey speak in oats, marsh spots in peas etc. In dicotyledons, it shows interveinal chlorosis symptoms.

3. **Zinc:** Constitute of several enzymes like carbonic anhydrase, dehydrogenase etc. it helps in P translocation in plants. Associated with water uptake and water relation in the plant.

   **Deficiency**- Deficiency symptoms first appear in younger leaves, beginning with interveinal chlorosis and progressing to a reduction in shoot growth and internode shortening. Causes khaira disease of rice, little leaf in cotton, white bud in maize etc.

Cu deficiency symptom

Mo deficiency symptom

Cl deficiency symptom

4. **Copper:** Acts in enzyme systems like plastocyanin for oxidation-reduction reactions. It is essential for atmospheric nitrogen fixation in plants. It imparts disease resistance to plants.

   **Deficiency**- It affects the symbiotic and non-symbiotic nitrogen-fixing micro-organisms. Produces whiptail in cauliflower, dieback in citrus, empty glumes in wheat

5. **Molybdenum:** It is the structural component of the nitrogenase enzyme. Required for nodule formation, pollen formation and anther etc.

   **Deficiency**- Chlorotic mottling and cupping in cauliflower

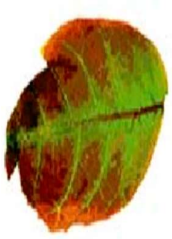
6. **Chlorine:** Play an important role in osmoregulation in plants. It is involved in oxygen evolution in photosynthesis. Act as a cofactor in water splitting enzyme in PSP II.

   **Deficiency**- Plants exhibit wilting, twisting, chlorosis, necrosis and curling symptoms.

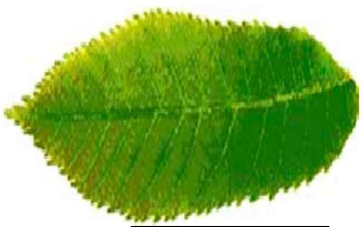
7. **Boron:** It is for cell division in plants. Responsible for drought tolerance, pollen germination and carbohydrate metabolism. Acts as a regulator of potassium/calcium ratio in the plant and facilitates sugar translocation in the plant.

   **Deficiency**- Dieback and corking in fruits, fruit cracking, the hardiness of fruits, corking and pitting in tomatoes, internal cork of apple, hollow stem and bronzing of curd Cauliflower, brown heart disease in, turnips etc.

B deficiency symptom in citrus



Ni deficient leave



Normal leaves

8. **Nickel:** It plays role in the transport of nutrients, associated with nitrogen metabolism.

   **Deficiency**- leaf tip necrosis in cowpea

**FACTORS AFFECTING THE AVAILABILITY OF MICRONUTRIENTS**

**Effect on Cations**- Fe, Mn, Zn, Cu and Ni occur as a cation in the soil. Factors affecting their availability are

**1) Soil pH**- At lower pH i.e. acidic soil favours the availability of micronutrient cation in the soil solution. But generally, they become toxic under such conditions and may hinder the adsorption of other cations in the soil. At higher pH than 7, they get precipitated as insoluble hydroxides.

**2) Oxidation number of cations-** Cations with lower oxidation number is more soluble than higher oxidation state. A higher oxidation state is favoured under the aerobic condition of the soil where the nutrient gets oxidised and their availability becomes very low.

**3) Presence of other soil constituents -** Soil constituents like organic matter, oxides and hydroxides of Al and Fe, inorganic ions, and fertilizer added affect the availability of micronutrients in the soil. Micronutrients may get fixed on the clay colloids if their concentration increases in the soil solution. Organic matter has acids which form organometallic complexes and become unavailable to plants. Some ligands keep these cations in soluble form and become in available form. Microorganisms assimilate these micronutrients in their body, which are later released through the death of microorganisms through mineralisation. These microorganisms also produce chelating agents which transform cations into soluble complexes. These chelates increase the availability of micronutrients in the soil.

**Effect on anions**- B, Mo and Cl occur as an anion in the soil. Factors affecting the availability of anions are-

**Chlorine-** Plants adsorb it as chloride ions, which are water soluble, so easily subjected to leaching loss. As it has a negative charge and does not adsorb over the soil colloid. Saline soil has a high concentration of chloride ions. Rainwater also contains a substantial amount of chloride. A deficiency of chloride is observed as rare in the soil.

**Boron-** The availability of boron in the soil is affected by its pH. At low pH, it occurs in soluble form and from boric acid which is available for plants. In general, higher pH favours boron availability. Boron is also made available from the mineralisation of organic soil. Liming soil could reduce boron availability as it temporarily causes Lime induced B fixation in the soil.

**Molybdenum-** The availability of molybdenum in acidic soils is less as it gets fixed in iron and aluminium compounds and also on silicate. This could be removed by anion exchange by phosphorous. Liming the soil could increase its availability. The chemistry of Mo is the same as that of P in soil.

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# SADABAHAR: AN AMAZING MEDICINAL PLANT OF PRESENT ERA

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Sadabahar, also referred as "ever-blooming blossom," is a well-known flower that has established itself in both herbal treatment and modern medicine. The names "Madagascar Periwinkle" in English, "Nayantara" in Bengali, "Ushamalari" in Malayalam and "Sadapushpa" in Hindi are all local names for this plant. *Catharanthus*, often known as *Vinca rosea*, is a genus meaning "pure flower." The plant is believed to be a native of the West Indies. It is a perennial plant that is primarily cultivated in tropical regions, particularly the Southern United States. The *Catharanthus* plant has a woody base and attains a height of two feet and plant spread of one feet. It bears extensive branches with alternate or opposite petiolated leaves with oblong shape and thick and leathery texture. The petals of the majority of modern cultivars overlap, the blooms come in a variety of colours, including pink, white, or a combination of the two, or they can even be pale pink with a dark violet dot in the centre.

Periwinkle is a well-known medicinal plant that may be found almost anywhere in the world. It is a flowering plant with a brief lifespan that is mostly planted as an ornamental. Vincas are trailing types plants with chromosomal number of 2n=16, whereas tetraploid plants grow more faster and have larger blooms. It belongs to family Apocynaceae bearing several species like *Catharanthus roseus, Catharanthus lanceus, Catharanthus trichophyllus, Catharanthus longifolius, Catharanthus pusillu, Catharanthus scitulus, Catharanthus coriaceous* and *Catharanthus ovalis*. These species are distributed in India, China and Madagascar. The evergreen vine ground plants with supple variegated green leaves are *Vinca minor* and *Vinca major*, which are closely related.

Periwinkle plants thrive on nutrient-depleted, well-drained soils as fertile soil do not promote flowering and generate flower drop. Periwinkle prefers a hot climate, full sun to moderate shade and flowering lasts overall summer. Although it is a drought-tolerant plant, slight irrigation is necessary. It is susceptible to frost. *Catharanthus* plants can be multiplied from mature cuttings that can form roots as well as from seeds which germinate in complete darkness.

Over 120 terpenoidindole alkaloids (TIAs) are present in this plant and several of them have strong pharmacological characteristics. The plant also contains vincristine, vinblastine, an antihypertensive alkaloid called ajmalacine, as well as antihypertensive and antispasmodic properties. Ayurvedic treatments derived from the plant's stem, leaves and roots are used to cure conditions like diabetes, hypertension, asthma, gastro-intestinal problems and female sexuality concerns. Smoking dried leaves, however, can have adverse effects, including skin prickling, hallucinations, uncoordination, renal and nervous system issues.

Since the beginning of time, periwinkle has been used as traditional medicine to treat a number of diseases. In India, wasp stings were treated using the plant's leaf juice. In Hawaii, the herb is boiled to stop bleeding. In China, it is employed as a diuretic, an astringent and a cough remedy. In Central and South America, it was used to alleviate sore throats, inflammation, and lung congestion. In the Caribbean, flower

extract is used to cure infections and discomfort of the eyes. Since Europeans believed that *Catharanthus* could ward off evil spirits and because the French called it "sorcerer's violet," it was also considered to be a magical plant.

In modern medical science, it alkaloids bears significant anticancer efficacy and the strongest effect is observed against tumours that are resistant to many drugs, suggesting that *Catharanthus* contains chemicals that cooperate with antineoplastic substances to limit resistance to them. Numerous alkaloids are produced by *C. roseus* and many of them build up in various areas of the plant. These terpenoidindole alkaloids are produced by secondary metabolic processes (TIAs). Numerous studies have linked the enhanced production of metabolites, or alkaloids, via boost transcription genes to signal components such as receptors, Ca2+ influx and medium alkalinization.

Important *Catharanthus* alkaloids used in medicine Vinblastine and Vincristine were among the first naturally occurring substances whose structures were determined by X-ray and were also among the first heavy atom derivatives whose absolute configuration was determined by X-ray. Periwinkle contains Vinblastine, Vincristine and their related compounds. If swallowed, the milky sap that the *Catharanthus roseus* stem produces is poisonous. Alkaloids make up 0.86, 0.67 and 0.31 percent of the roots, leaves and stems, respectively. The chemotherapy drugs Vincristine and Vinblastine are used to treat Hodgkin's lymphoma and paediatric leukaemia, respectively. Although the plant generates more Vinblastine, Vincristine is utilised more frequently. Vinblastine can, however, be chemically or biologically changed into Vincristine.

Hence, this amazing flower has been used for its numerous health advantages since the dawn of humanity. In addition to being used as an ornament, it is now widely used in modern medical and ayurveda applications for controlling diabetes, promoting skin health, treating respiratory conditions and controlling hypertension. This plant has helped countless cancer patients in the past and will help even more in the future.

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# PHARMACEUTICAL PROPERTIES OF *ROSA* SP.

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**ABSTRACT**

More than 10,000 cultivars and 300 species make up the *Rosa* genus. *R. arkansana* root has hemostatic, stimulant, and tonic properties. The primary ingredient in *R. canina* hips is vitispirane (isomer). The roots of *R. centifolia* have astringent properties and are helpful for intestinal ulcers, rickets, haemorrhages, and diarrhoea. According to studies, *R. damascene* has hypnotic, analgesic, neuritic atrophy-preventive, and anticonvulsant effects. The roots of *R. laevigata* were frequently used to treat seminal weakness, uterine prolapse, urinary incontinence, menstrual problems, diarrhoea, joints pain, external injuries, burn injuries, toothaches, and stomach pain in traditional Chinese folk medicine (Gao Y., Cheng W.M. and Li G.Y., 1993; Zhou *et al.*,2009 and Gao *et al*.,2010). To improve the nutritional value and health-promoting effects of food, rose petals from the *R. multiflora* extract may be used as a functional ingredient (Sudeep et al., 2021). *Rosa rugosa* is a significant product for the cosmetic industry because of its strong anti-inflammatory effects. Phenolics, phenolic acids, flavonoids, and tannins are quite diverse (Lu J. and Wang C., 2018).

**INTRODUCTION**

The *Rosa* genus includes woody, perennial blooming plants like roses. More than 10,000 cultivars and 300 species make up the *Rosa* genus. It's a member of the Rosaceae family (Baydar, 2006). Its leaves have some sort of therapeutic quality that makes them usable as a form of medication. Numerous different sorts of medicines are made using it. This rose bloom is loaded in vitamin C. *Rosa canina* is used to make rose hip oil. Vitamins A, B1, B2, B3, B6, C, E, and K, folic acid, potassium, calcium, iron, tannin, and a variety of enzymes are all present in rose petals and rose hips. Rose flowers have antidepressant, spasmolytic properties, astringent, bile production-inducing, cleansing, antibacterial, and antiseptic. Diarrhoea can also be treated with rose hip tea. The antibacterial, anti-inflammatory, anti-parasitic, and somewhat sedative properties of rose petals. Additionally, they have mild laxative properties, are beneficial as a heart tonic, and can help decrease cholesterol (Chahar, 2016).

**PHARMACEUTICAL PROPERTIES OF DIFFERENT SPECIES**

1. ***Rosa arkansana-*** The root is tonic, stimulating, and hemostatic. The root's compound decoction has been used to cure fits and convulsions as well as bleeding wounds. The fruit of many members of this genus is a very rich source of vitamins and minerals, especially in vitamins A, C, and E, flavanoids, and other bio-active compounds. The root has been used in the treatment of eye complaints. It is being researched as a food that can lower the incidence of cancer as well as a way to halt or reverse the growth of cancers. It is also a fairly good source of essential fatty acids, which is somewhat unusual for a fruit (Porter).
2. ***Rosa canina-*** Vitispirane is the primary component in rose hip essential oil (isomer). *Rosa canina* L. is high in vitamins, particularly vitamin C, and phenolic compounds, which have antioxidant properties. Another study looked at the antimicrobial properties of ethanolic and methanolic extracts of *R. canina* dry petals. Rose hip has historically been utilised in Iran to treat diabetes due to its anti-diabetic qualities. It has been discovered that regular consumption of rose hip powder can dramatically reduce

the risk of cardiovascular diseases in obese individuals without having any harmful side effects (Selahvarzian et al., 2018).

3. ***Rosa centifolia-*** The roots are effective for treating intestinal ulcers, The leaves are used to treat wounds, ophthalmia, hepatopathy, and haemorrhoids. They are also used to treat rickets, haemorrhages, and diarrhoea. The flowers have aphrodisiac, depurative, febrifuge, styptic, digestive, carminative, rejuvenating, cooling, emollient, fragrant, cardio tonic, anti-inflammatory, expectorant, rejuvenating, and tonic qualities. Tea brewed from flower petals is helpful for headaches, vertigo, and blood purification. Mild sedative, anaesthetics local to the area, laxatives, liver protectors, antidepressants, and cardio-active. Rose petals are revitalising and act as a tonic (Jitendra et al.,2012).

4. ***Rosa* damascene-** Research indicates that *R. damascene* has hypnotic, analgesic, anticonvulsant, and protective effects on neuritic atrophy. Bronchiodilator impact of ethanol extract and essential oil fraction (n-butanol, ethyl acetate) from flowers on the respiratory system. Extracts from ethanol and water have an antitussive action. The effects of aqueous-ethanolic extract can increase heart rate and contractility. The methanol extract's pure compounds show anti-HIV properties (Hongratanaworakit, 2009).

5. ***Rosa gallica-*** It is claimed that this rose type can treat a wide range of illnesses (Ueno et al., 2019). *Rosa gallica* has been shown to have antibacterial, anti-inflammatory, and antioxidant properties (Jo et al., 2021). Hydromethanol 80% extract had the highest total phenolic content and extraction yield of the five leaf extracts. It also had very high antioxidant and antimicrobial activity against the tested microbial strains (Abdelbaky et al., 2021)**.** Gallic acid is used to prevent skin ageing is primarily which is an ingredient in *Rosa gallica*. So, *Rosa gallica* could be exploited as a functional ingredient in the creation of nutraceuticals against skin ageing (Jo et al., 2021).

6. ***Rosa laevigata***- Due to its medicinal qualities, this species is very valuable (Jian et al., 2014 and Feng et al., 2014). The roots of *R. laevigata* were frequently used to treat seminal weakness, uterine prolapse, urinary incontinence, menstrual problems, diarrhoea, joints pain, external injuries, burn injuries, toothaches, and stomach pain in traditional Chinese folk medicine (Gao, Y., Cheng, W.M. and Li, G.Y., 1993; Zhou *et al.,*2009 and Gao *et al.,*2010). Plants are endowed with novel secondary metabolites, including polysaccharides, flavonoids, steroids, tannins, laevigatins E, F, and G, etc. (Mehboob et al., 2017).

7. ***Rosa multiflora-*** Ethanol extract can be utilised in cosmetics as a natural preservative and antioxidant (Kim *et al.*, 2018). RoseFit is a bioactive extract of *R. multiflora* with a standardised isoquercetin content of 2% to 3%. It has a potent anti-obesity effect due to its high phenolic content. It reduces dietary fat absorption by inhibiting lipase (Sudeep *et al*., 2021).

8. ***Rosa rugosa***- *Rosa rugosa* has significant anti-inflammatory qualities, which make it a beneficial component for the cosmetics business. *R. rugosa* is a common food in China and a crucial drug source listed in the China Pharmacopeia. In Eastern Asia, *R. rugosa* roots are frequently used to treat chronic inflammatory diseases. It's antioxidant and cytotoxic properties were the subject of studies on its anti-tumor properties (J. Lu and C. Wang, 2018).

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# NURSERY MANAGEMENT IN FLOWER CROPS

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## INTRODUCTION

A nursery is a location where planting material, such as seedlings, saplings, cuttings, and so on, is raised, propagated, and multiplied in preparation for transplanting into prepared beds. The availability of high-quality, true-to-type planting material is a requirement for profitable ornamental crop production. Establishing a nursery is a long-term endeavour that requires planning and expertise. Plants are nurtured in a nursery by providing optimal growing conditions to ensure germination. Nursery saves a lot of time when it comes to raising the next crop. The majority of flower crops are propagated by seeds and require a nursery to raise the seedlings. Nurseries are required for the sowing of seeds and the planting of cuttings for rooting and establishment of herbaceous perennials. Woody perennials are grown from seeds for multiplying the rootstocks from cuttings, layers and through grafts to perpetuate the same genetic properties.

## IMPORTANCE OF NURSERY

- Large number of flower plant can be grown and maintained per unit area.
- When seeds are sown in seedbeds, their germination percentage increases, as does the vigour of the seedlings.
- Small and expensive hybrid seeds can be raised more effectively due to better care and management.
- Management of insect-pests, diseases and weeds is easy in a nursery.
- Manipulation of growing conditions for plants becomes easy.
- seeds become possible, which ultimately results in fetching more returns.
- The seed requirement of nursery raised crops is less as compared to direct seed sowing of the same crop due to better management.
- The management of seedlings can be done in a better way with minimum care, cost and maintenance as the nursery area is small.
- Better and uniform crop growth can be obtained in the main field by selecting vigorous and healthy seedlings.
- Off-season sowing of Sowing seeds in a nursery allows additional time for doing preparatory tillage in the main plot. Harvesting of the previous crop can also be prolonged, if needed.

## WHAT IS NURSERY?

A nursery is a managed site, designed to produce seedlings grown under favourable conditions until they are ready for planting. The primary goal of all nurseries is to produce enough high-quality seedlings to meet the needs of users.

**ORNAMENTAL NURSERY**

Nursery for ornamental plants in such a nursery, seedlings, rootstock, and scion material of ornamental plants are raised and preserved for future use. It includes ornamental plant mother blocks that are used in layering as well as producing scion material for budding and grafting. The nursery's raised and flat beds are filled with seedlings of various annuals, perennials, and ornamental rootstocks. The vegetative and reproductive phases of bulb and tuber crops are housed in a separate nursery block. Cuttings of various climbers and creepers are also planted for rooting here. Many indoor and outdoor potted plants can be found in an ornamental nursery. Individual seedling blocks of cut and loose flowers, seasonal, bonsai, climbers, and creepers are managed here.

**NURSERY MEDIA**

The growth medium must be firm enough to hold the seedling or propagules during rooting and provide food and water for young seedlings to grow successfully. Soil is a very common, easily accessible, and relatively inexpensive medium used in nurseries. Sand is commonly used in mother block beds as well as vegetative plant propagation media. Peat soil, sphagnum mass, vermiculite, perlite, leaf mould, saw dust, grain husk, and coco peat are some of the other media used in nurseries. In general, the pH of the growing medium influences the availability of all mineral nutrients. Maximum availability occurs in growing media such as organic soils between pH 5.5 and 6.5.

**SEED TREATMENT**

Fungicides such as Captan, Thiram, or Carbandazim are applied at 2.0 g/kg seed and thoroughly mixed in the seeds to disinfect the surface of the entire seed lot to keep pathogens at bay.

**METHODS OF SEED SOWING**

- **Broadcasting**
- In this technique, seeds are broadcast on nursery beds before the beds are covered with decomposed compost or sieved farmyard manure (FYM). However, this method has drawbacks as well. For example, the seeds cannot be placed in the desired location, and comparatively more seeds are needed.
- **Line sowing**

  It is an appropriate method for sowing seeds in a nursery. Sowing in lines results in better seedling quality and germination. By using this technique, each seed is given its own space and develops robustly and healthily. Here, weeds and unhealthy seedlings are easily managed.

**PRECAUTIONS TAKEN DURING SEED SOWING AND PLANTING**

- **During seed sowing**

  The seeds must be pristine and free of contamination. After being mixed with sand, small seeds must be sown at the correct depth and distributed evenly. The seeds must be sown with enough room between them to avoid crowding. It also ensures that the seedlings get enough nutrients, sunlight, air, and water. To avoid the seeds or seedlings drying out or going bad, the soil should not be too wet or dry.

- **During planting**

  After selecting and watering uniform, healthy seedlings, they must be planted at the recommended spacing late in the afternoon.

**COMMON DISEASES IN NURSERY AREA**

- **Damping-off**

  Nursery plants are frequently affected by this severe pathogens, which has the potential to be fatal. Fungi like Pythium, Phytopthora, Rhizoctonia, and Fusarium cause pre-emergence and seedling diseases like damping-off. These fungi attacks on seeds just as they start to sprout. Infected seedlings collapse from rotting in the collar region, and the girdling of the seedlings occurs close to the bases of the stems. High humidity, moist soil surfaces, hot, cloudy weather all favour damping-off, which is the opposite of dense

planting. One of the best preventative measures is to keep the soil surface dry because it thins out seedlings and reduces sowing density, which enhances aeration. Other methods include treating the nursery bed either by soil solarisation or soil sterilisation with formalin @ 2 per cent, drenching with Copper oxychloride @ 2g/l or seed treatment with thiram or carbendazim @ 3g/kg.

- **Wilt**

  Plants frequently appear discoloured and wilted. The leaves turn yellow. The disease is controlled by soaking the soil in copper oxychloride at a rate of 2g/l or carbendazim at a rate of 2g/l, or by applying *Trichoderma harzianum*..

- **Leaf spot**

  One can often notice small to big black or brown spots on leaves. The disease is controlled by spraying mancozeb @ 3g/l.

**CONCLUSION**

Over the time, there has been an increase in demand for floricultural and vegetables seedlings. There is burden on the nurserymen to provide healthy and good quality seedlings. This can be overcome by adoption of modern technology of nursery seedling production. In Haryana, there is good initiative taken by Govt. by inauguration of Hi-tech polyhouses for production of healthy and disease-free seedlings by the aid of Indo-Israel projects in different districts.

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# BIOCHAR: A SUSTAINABLE APPROACH FOR CLIMATE-RESILIENT AGRICULTURE

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Agriculture in the modern era faces the issue of balancing the twin goals of achieving food, fodder, fiber, and fuel security with the restoration of soil resources for long-term usage. Improve soil fertility by making effective use of crop residues and other farm wastes by turning them into a viable source of soil amendment. The use of biochar enhances several soil properties, including nutrient retention, aggregate stability, pH, cation exchangeable capacity (CEC), microbial development, and enzymatic activity. Numerous studies have shown that adding biochar to agricultural lands boosts crop yields by enhancing soil fertility. Therefore, using biochar made from various organic residues is a successful strategy for enhancing soil fertility and crop yield over the long term.

## BIOCHAR

Biochar is a solid, dark product made from biomass that has high carbon content. The special qualities of biochar have the power to increase agricultural productivity and soil fertility. "Biochar" is a combination of the Greek words "bios," which implies life, and "char" (product of pyrolysis of biomass, as charcoal). According to archaeological data, humanity first produced and used biochar more than 2500 years ago. There has been a lot of interest in biochar in recent years for use in a variety of environmental applications, including the eradication of pollutants, the storage of carbon, and soil improvement. In ancient times,"biochar" is generated via the "slash-and-char" method, which involved cutting up plant material or crop remnants, lighting them on fire, and then burying them to smolder. Biochar is a carbon-rich substance that is burned and used as a soil additive to absorb carbon and enhance soil condition. During the pyrolysis process, which produces biochar, also known as agrichar, organic material is burned to a temperature between 250 and 700 degrees Celsius. It is known as the "black gold" of agriculture. Sustainable biochar can be produced from waste biomass by pyrolysis and other cutting-edge thermochemical methods. The process of pyrolysis involves heating organic material in the absence of oxygen to produce a variety of byproducts, including charcoal and bio-oil. Biochar is a fine-grained, porous substance that resembles charcoal produced by spontaneous burning.To increase soil fertility and restore degraded land, the use of biochar and biochar-compost blends from several alternative organic sources has been suggested. In India, agricultural crop waste is a significant source of biomass. Utilizing biomass, which is found in crop residues and other farm wastes, as a practical source of soil application is an efficient way to improve soil fertility. As a result, biochar application is becoming more and more popular.

## BIOCHAR PRODUCTION

Pyrolysis is a type of energy conversion that involves heating biomass in the absence or almost absence of oxygen to produce charcoal. Biomass is pyrolyzed to create char, oils, and gases. The feedstock and the pyrolysis conditions are the primary factors of the properties of the biochar generated.Firstly, the chemical and structural composition of the biomass feedstock, which is connected to the chemical and structural composition of the generating biochar, has an impact on the behavior, function, and fate of the biochar in soils. Second, the processing variables, such as temperature and residence durations, control how much biomass is physically and chemically altered during pyrolysis.

**IMPORTANT FEEDSTOCK FOR BIOCHAR**

The term "feedstock" refers to the kind of biomass that is pyrolyzed and converted into biochar. Many diverse substances, such as wood, grain husks, nut shells, manure, and crop wastes, have been suggested as biomass feedstock for biochar. Others potential feedstock for biochar production includes sewage sludge and municipal trash, although using these materials carries risk due to the presence of toxic elements such as heavy metals. Thermal degradation of cellulose and lignin occurs at temperatures between 240 and 350°C and 280 and 500°C, respectively. Ash-rich biochar is typically produced by biomass with high mineral concentrations, such as grass, grain husks, and straw leftovers.

**METHODS OF BIOCHAR PREPARATION:**

Thermal decomposition is usually achieved from pyrolysis or gasification. The various methodsfor biochar preparation:

a) **Traditional method**

It is commonly known as heap method. It is an ancient method of biochar production and in this method, crop remains are cut, ignited and buried to smolder, which eventually produces “biochar”.

**b) Slow pyrolysis**

This process operates at atmospheric pressure and at comparatively low temperatures (300-5000°C). Low heating rates exist, varying from 0.01-2.0 $Cs^{-1}$. Typically, biochar preparation takes 5 to 30 minutes, and the output rate is about 35%.

**c) Fast pyrolysis**

This technique operates at a high pressure and a temperature between 501 and 8000°C. High heating rates exist, varying from 10 to 50 $Cs^{-1}$. The typical time needed to prepare biochar is 2 seconds, and the percentage of biochar produced is between 10-15%.

**d) Intermediate pyrolysis**

It has a temperature of 500°C and is a hybrid of slow and quick pyrolysis. The typical preparation time for biochar is 10 to 20 seconds, and the production rate is about 25%.

**e) Gasification**

In the gasification chamber, the biomass feedstock is partially oxidised at a temperature of >800°C and increased pressure. The typical preparation time for biochar is 10 to 20 seconds, and the output rate is 1 to 10 percent.

**CHARACTERISTICS OF BIOCHAR:**

- Different forms of biochar can be classified based on their physicochemical characteristics, which can then be used as a guide to choose where and how to apply them to soil.
- Depending on the biochar feedstock and pyrolysis conditions, the characteristics of biochar materials will change.
- The idea of "designer biochar," in which the properties of biochar are matched to the particular requirements of soil, is based on variations in pH, ash content, surface area, and other properties of biochar.
- While biochar produced at 400°C preserves volatile and readily labile chemicals, biochar produced at 600°C results in a significant degree of recalcitrance.
- Additionally, high-temperature pyrolysis created biochar with a high carbon content, a wide surface area, and strong adsorption properties, while low-temperature pyrolysis produced biochar with high yields.
- Biochar has a porous structure with many pores of all sizes, which makes it a great place for bacteria, actinomycetes, and arbuscular mycorrhizal fungus to colonize, grow, and reproduce.

- The biochar pores may serve as a micro-habitat for colonizing bacteria, shielding them from being nibbled upon by their natural predators, according to several investigators.

**COMPOSITION OF BIOCHAR:**

The composition of biochar is quite diverse and includes both stable and labile components. Due to the relative increase in volatile matter loss and the conversion of alkyl and O-alkyl carbon to aryl carbon, the proportion of aromatic carbon in biochar also rises as the pyrolysis temperature rises. The two primary structural fractions that make up each biochar particle are generally acknowledged to be stacked crystalline graphene sheets and randomly organized amorphous aromatic structures. Their primary elements are typically thought to be carbon, volatile matter, mineral matter (ash), and moisture.By pyrolyzing wood-based feedstocks,biochars that are coarser and more durable are produced. The ash content of the biomass feedstock affects the ash content of biochar. In contrast to biochar made from woody feedstocks, vegetation such as grass, grain husks, straw leftovers, and manures typically create biochar with high ash levels.

**EFFECTS OF BIOCHAR ON SOIL FERTILITY:**

1) Used as a soil amendment
2) Incorporating biochar into soil reduces nitrous oxide ($N_2O$) emissions
3) Influence of biochar on soil physical properties such as wettability of soil, water infiltration, water retention, macro-aggregation and soil stability are of critical importance in tropical environments in combating erosion, mitigating drought and nutrient loss and in general enhancing groundwater quality.
4) Influence of biochar on soil chemical properties including pH, organic carbon and exchangeable cations
5) Influence on nutrient use efficiency
6) Longer-term benefits of biochar application on nutrient availability mainly due to a greater stabilization of organic matter, concurrent slower nutrient release from added organic matter and better retention of all cations due to a greater cation exchange capacity.
7) Influence of biochar on soil microbial activity
8) Biochar provides a suitable habitat for a large and diverse group of soil microorganisms.
9) Symbiosis between effective microbes and plant roots through the medium of charcoal, that promotes the growth of plants

**CONCLUSION**

It can be concluded that biochar is produced from the waste biomass, which not only resolves the management crisis of agricultural waste but also enhances the soil properties and stimulation of beneficial microbial diversity in the soil. Studies have proved that biochar application to the soil has a great potential to enhance soil fertility and crop yield by improving soil properties, increasing plant nutrient availability etc. Hence, the use of biochar from organic residues is an effective approach for the improvement of soil fertility and crop productivity.

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# LEAF COLOR CHART INSTANT TOOL FORREAL-TIME NITROGEN MANAGEMENT AND IMPROVING NITROGEN USE EFIICIENCY

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**ABSTRACT**

Inadequate and excessive use of nitrogen fertilizers causes environmental pollution, lodging of plants and increased pest stress, in addition to increased cost of farming due to excessively applied fertilizers and pesticides in the field. Nitrogen application at the proper time and in adequatequantity is critical for a healthy plants and the environment. Rice leaf color intensity hasa close connection withleaf nitrogen status and leaf chlorophyll content. The concept for the use of leaf color as an indicator to apply nitrogen in rice was crystallized during the 1990s. Leaf color chart (LCC) was developed by the International Rice Research Institute and the Philippine Rice Research Institute that helps guide farmers for real-time nitrogen management in rice farming. The technology is inexpensive, and easily affordable by most resource poor rice farmers.

**INTRODUCTION**

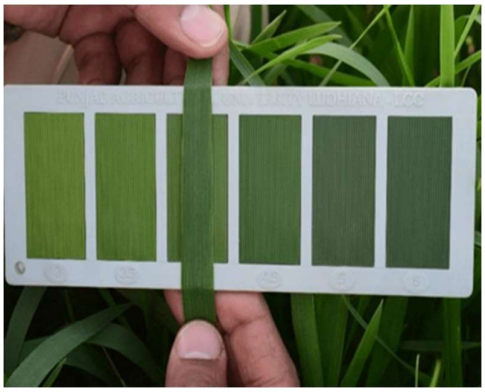
Nitrogen management plays a vital role in achieving the potential yields of rice cultivars. Increased fertilizer nutrient input, particularly nitrogen fertilizer, contributes greatly to global agricultural production enhancement.Blanket fertilizer recommendations are inefficient because they do not account for soil N supply variability or variations in crop demand. It would be preferable if nitrogen inputs could be tailored to real crop conditions and nutritional requirements. Farmers generally apply too much nitrogen (and little P and K and other nutrients) which results in high pest and disease incidence and serious lodging. The consequence of high nitrogen application is associated with high pesticide use to control pests, more expenditure on pesticides and reduced yield and poor grain quality due to lodging. Nitrogen recovery by rice is low, ranging from 20 to 40% because of nitrogen losses via ammonia volatilization, denitrification, and runoff and leaching. The proper time of nitrogen application is critical to minimize nitrogen loss and increase recovery. Site-specific nitrogen management has the potential to increase fertilizer use efficiency as well as grain yield in the farmers' fields. The need for precise and responsive management of nitrogen fertilizer in rice is compelling for both economic and environmental reasons.

The leaf color intensity of rice is directly related to leaf chlorophyll content and leaf nitrogen status. Japanese scientists developed a nitrogen management tool called leaf color chart (LCC) which was subsequently modified by Chinese scientists.

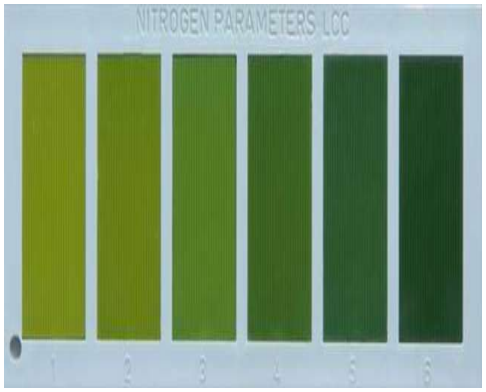
**LEAF COLOR CHART**

A leaf color chart is a simple and inexpensive diagnostic tool used to measure the green color intensity of rice leaves to assess the nitrogen requirements by a non-destructive method. It is an important tool that enables farmers to adjust the nitrogen fertilizer application based on crop demand. It was jointly developed by the International Rice Research Institute (IRRI) and the Philippine Rice Research Institute (PhilRice) from a Japanese prototype in late 1990s. It is made of high-quality plastic material (8×3 inches). It consists of six color

shades ranging from light yellowish green (No. 1) to dark green (No. 6) color strips fabricated with veins resembling those of rice leaves. The LCC used in Asia is typically a durable plastic strip about 7 cm wide and 13 to 20 cm long, containing four to six panels that range in color from yellowish green to dark green as in Fig.



Six panel LCC developed by PAU




Six panel LCC developed by IRRI and PhilRice

The leaf color chart is an innovative cost-effective tool for real-time or crop-need-based nitrogen management in rice. A leaf color chart is a visual and subjective indicator of plant nitrogen deficiency and is an inexpensive, easy-to-use and simple alternative to the chlorophyll meter/SPAD meter (soil plant analysis development). A leaf color chart is an ideal tool to optimize nitrogen use in rice at high yield levels, irrespective of the source of nitrogen applied, viz., organic manure, biologically fixed nitrogen, or chemical fertilizers and the precise application of nutrients through the use of the such tool can raise the profitability of the production system and may reduce environmental pollution. Thus, it is an eco-friendly tool in the hands of farmers.

**GUIDELINES FOR USING THE LEAF COLOR CHART**

1. Take LCC readings once every 7 to 10 days, starting from 14 days after transplanting for transplanted rice and from 21 days after sowing to flowering for direct seeded rice.
2. Choose the topmost fully expanded leaf color measurement because it reflects the nitrogen status of rice plants. The leaf color is measured by placing the middle part of the leaf on LCC and comparing the leaf's color with its color.
3. During measurement, provide shade with your body, because leaf color reading is affected by Sun's angle and sunlight intensity. If possible, the same person should take LCC readings at the same time of the day.
4. Take readings of ten leaves randomly chosen in a plot. Alternately, if more than five leaves show a reading below the set critical value, top dress nitrogen fertilizer to correct N deficiency.
5. Generally, the critical value for sfffffffff high yielding varieties 4.0. If the average value fall below 4.0, top dress N fertilizer (20-30 Kg $ha^{-1}$) to correct nitrogen deficiency.

**MERITS OF LCC**

1. LCC is anuncomplicated and effortless tool for the farmers to measure the nitrogen status of the leaf and to identify the instance for top dressing of N to paddy.
2. LCC is cheap and portable thus, making it easy to carry to the field for estimating the N status of the leaf.
3. It is a non-destructive method and doesn't involve any laboratory analysis.
4. Any specific knowledge or skill is not required for using LCC because it depends only in comparing the color and computing the scale of the leaf with the standard chart.

**DEMERITS OF LCC**

LCC fail to specify minor variations in leaf greenness as the colour shades lie in between two shades.

1. The comparative accurateness of LCC to measure the leaf nitrogen status can be estimated only when it is equated and interrelated with chlorophyll meter readings and adjusted accurately with the plant groups.
2. LCC resorted only to adjusting the top dressed nitrogen but fail to adopt the basal N appliance by LCC.
3. LCC can be better suited in site-specific nutrient management approach wherein to realise optimal reaction to nitrogen fertilizer, other nutrients need not be restricted.
4. Hence, sufficient levels of other nutrients need to apply on basis of soil test results.
5. P or K deficits make dimmer leaf colour leading to inaccurate LCC interpretations.

**PRECAUTIONS AT THE TIME OF READING**

1. Nitrogen fertilizer is applied when the reading is less than the critical value.
2. Only one person takes a reading from first to last.
3. Measuring time 8:00-10:00 or 2:00-4:00 is effective.
4. At the time of measuring make shade on LCC on a leaf.
5. Left border 15 meters at 1-hectare area.
6. Do not pick the leaf.
7. Do not select disease and pest affected leaf.

**CONCLUSION**

It is can be inferred that leafLCC is a stress free, user friendly and economical tool for assessing chlorophyll content of rice leaf. Leaf color chart centric nitrogen supervision aids farmers to assess the actual time N requirement of the crop and guarantees nitrogen saving without conceding their production.

The LCC is an easy-to use and inexpensive diagnostic tool for monitoring the relative greenness of a rice leaf as an indicator of the plant nitrogen status. The LCC can be used to guide the application of nitrogen fertilizer to maintain optimal leaf nitrogen content for achieving high rice yield with effective nitrogen management. Farmers generally use leaf colour as a visual and subjective indicator of the rice crops nitrogen status and need for nitrogen fertilizer application. The LCC used at critical growth stages helps to decide whether the recommended standard nitrogen rate needs to be adjusted up or down based on the leaf colour. Consequently, improved nitrogen management can help produce greater yields and reduce the environmental pollution.

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# IMPACT OF COVID-19 PANDEMIC ON AGRICULTURAL YOUTHS

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The COVID-19 pandemic has had a profound impact on agricultural youths in India and around the world. The virus and the measures taken to contain it have affected the entire agricultural value chain, from production to distribution and consumption, with severe consequences for the livelihoods and well-being of young people involved in agriculture.

In India, the nationwide lockdown, imposed in March 2020 to curb the spread of the virus, resulted in the disruption of supply chains and a decline in demand for agricultural products. This led to a decline in prices and a loss of income for farmers and agricultural workers.

The pandemic also affected the education and livelihood opportunities for agricultural youths in India. Many schools and vocational training centres were closed, hindering the education and skill development of young people in rural areas. The economic downturn also reduced job opportunities for agricultural youths, making it difficult for them to find employment or start their own businesses.

The situation is similar around the world, as the pandemic has led to a decline in demand for agricultural products due to the closure of restaurants, hotels, and other food service establishments. This has resulted in a decline in prices and a loss of income for farmers and agricultural workers, particularly for those producing perishable goods such as fruits, vegetables and milk. The pandemic has also affected the availability of labour for agricultural activities, as many migrant workers were unable to return to their workplaces due to the restrictions on travel. This has led to a shortage of labour for planting and harvesting crops, resulting in a loss of productivity and income for farmers.

The pandemic has also disrupted the global food supply chains, which has led to a lack of access to food for the most vulnerable populations. This has had a particularly adverse effect on smallholder farmers and agricultural youths, who often lack the resources to adapt to the changes caused by the pandemic.

In conclusion, the COVID-19 pandemic has had a significant impact on agricultural youths in India and around the world, affecting their livelihoods, education, and job opportunities. Several policies can be implemented to overcome the impact of COVID-19 on agricultural youths. Some of these include:

1. Financial assistance: Governments can provide financial assistance to farmers and agricultural workers who have been affected by the pandemic. This can include direct cash transfers, subsidies, and low-interest loans to help them cope with the loss of income.
2. Support for smallholder farmers: Small and marginal farmers and agricultural youths are particularly vulnerable to the impact of the pandemic. Governments can provide support for smallholder farmers by increasing the procurement price of crops, providing technical assistance, and creating market linkages to help them sell their products.

3. Investment in technology: Governments can invest in technology to help farmers and agricultural youths adapt to the challenges of the pandemic. This can include providing training on digital platforms for e-commerce, precision agriculture, and other technologies that can improve productivity and reduce costs.
4. Education and training: The pandemic has affected the education and skill development of agricultural youths. Governments can invest in education and training programs to provide young people with the skills they need to succeed in the agricultural sector.
5. Job creation: The economic downturn has reduced job opportunities for agricultural youths. Governments can create jobs by investing in rural development projects and promoting agro-industries, which can create new employment opportunities for young people.
6. Food security: The pandemic has disrupted global food supply chains and increased the risk of food insecurity. Governments can ensure food security by investing in local food production and distribution systems and supporting smallholder farmers.

Encouraging sustainable practices: Encouraging sustainable agricultural practices can help farmers to adapt to the changes caused by the pandemic and to build resilience for future challenges.

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# LATE BLIGHT – A DEVASTATING DISEASE OF TOMATO

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## INTRODUCTION

Late blight disease has historical significance as the cause of the Irish potato famine during 1840s. This famine resulted in the death of more than one million people. The disease is caused by the oomycete pathogen *Phytophthora infestans* (Mont.) de Bary, and it is the best known, longest studied and still among the most destructive of all plant diseases. The pathogen has a wider host range mainly includes solanaceous family crops mainly on Tomato and potato. More problematic during winter season. Low temperature and high humidity prevailed from November to January favours late blight incidence (Muhammad Yussouf Saleem *et al* 2016). It is the best known, longest studied and still among the most destructive of all plant diseases. More than 180 years have elapsed since *Phytophthora infestans* caused the Irish famine, but management strategies of late blight disease often remain unsustainable and costly. The pathogen continues to cost billions of dollars annually through yield losses in potato and tomato and increased plant protection measures (Ristaino 2002).

## SYMPTOMS

- Late blight appears on the leaves, stems, and fruits (Robin & Choen, 2004). On the leaves, symptoms appear as pale green, water-soaked spots, often begins at the leaf tip or edge. These lesions are often surrounded by a pale yellowish-green border that merges with healthy tissues.
- Under favourable conditions, lesions enlarge rapidly and turn dark brown to purplish-black, killing the leaves instantly. High humidity and leaf wetness, favors the growth of a cottony, white mould on the lower side at the edges of lesions.
- However, in dry weather, infected leaf tissues quickly dry and the white mould growth disappears. On stem, brown to black lesions which enlarge rapidly under moist conditions and the entire stem may be killed soon. (NICRA team of Tomato Pest Surveillance 2012). Transmission is accompanied by the dispersion of airborne asexual sporangia during the growing season (Shattock, 2002). During wet, cool weather, crop loss due to late blight can be rapid and nearly impossible to control if preventative measures are not used (Stone, 2014).

**MANAGEMENT**

- Growing of resistant hybrids like Arka Abhed developed by IIHR, Bangalore.
- Proper water management should be followed. Heavy irrigation must be avoided. Removal of basal leaves touching ground will be helpful to reduce spread of the disease.
- Spray need based fungicides like chlorothalonil 2g or carbendazim + mancozeb 2g or dimethomarph 1g + mancozeb 3g or pyraclostrobin-metiram 3g per litre of water at 7-10 days interval.

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# COVID-19 PANDEMIC AND ITS IMPACT ON NUTRIENT INTAKE OF CONSUMERS

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The COVID-19 pandemic has had a significant impact on the nutrient intake of consumers. The pandemic has led to changes in consumer behaviour, food access and food security, which have in turn affected nutrient intake.

One of the major impacts of the pandemic on nutrient intake has been the change in consumer behaviour. With the closure of restaurants and other food service establishments, many people have been purchasing more food for home consumption. This has led to an increase in the purchase of non-perishable and shelf-stable foods, such as canned goods, pasta, and rice, as well as an increase in online grocery sales. However, these types of foods tend to be less nutrient-dense than fresh fruits and vegetables, lean proteins, and dairy products, which can lead to a decrease in nutrient intake.

Various studies also observed that there is a significant socioeconomic gradient in the effect of the COVID-19 pandemic on calories consumed. Specifically, the study found that among working age households, those from higher socioeconomic status (SES) groups exhibited considerably larger increases in calories than households in lower groups. People from lower socioeconomic groups are more likely to be disproportionately affected by the economic and social disruptions caused by the pandemic. On the other hand, people from higher socioeconomic groups may be more likely to have access to healthy food options, and may have the resources to purchase and intake, which allows them to maintain their dietary habits.

Another impact of the pandemic on nutrient intake has been food access and food security. Many people have lost their jobs or seen their income decrease due to the pandemic, which has led to an increase in food insecurity. This has caused many people to consume less nutrient-rich foods, such as fruits and vegetables, lean proteins, and dairy products, and more inexpensive and less nutritious foods, such as processed foods and fast foods.

The pandemic has also affected the supply chain and distribution of food. Due to disruptions in the supply chain, there have been shortages of certain foods, including fresh fruits and vegetables, which can make it difficult for people to access nutrient-rich foods. Additionally, the closure of schools and other food service establishments, such as universities and hospitals, has led to a decrease in the consumption of nutrient-rich foods in these settings. This can be particularly concerning for children and vulnerable populations such as older adults, as they may not be getting enough of the essential nutrients they need.

In terms of specific nutrients, the pandemic has led to a decrease in the consumption of dairy products, particularly in food service settings such as schools and universities. This may lead to a decrease in the intake of important nutrients such as calcium and vitamin D, which are found in dairy products. Additionally, with the decrease in consumption of fresh fruits and vegetables, there is a risk of nutrient deficiencies, particularly in vitamins C and A, which are essential for a healthy immune system.

Overall, the COVID-19 pandemic has had a significant impact on the nutrient intake of consumers. The changes in consumer behaviour, food access, and food security have led to a decrease in the consumption of nutrient-rich foods and an increase in the consumption of less nutritious foods. It is important to continue to support the food industry and ensure that people have access to a variety of nutrient-rich foods, in order to maintain a healthy diet and prevent nutrient deficiencies. This can be done by providing support to farmers and food producers, increasing access to food assistance programs, and promoting education and awareness about the importance of a healthy diet during the pandemic.