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In This Issue

Hi-Tech Nursery Management in Vegetable Crops: Emerging Innovations

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Introduction

In the current scenario the production of vegetable nurseries has become a highly popularized operation, where in most of the farmers purchasing their plugs from professional growers. A vegetable nursery is a place or business where immature vegetable seedlings are grown or handled until they are ready to be transplanted permanently. Some vegetable seeds are planted in nursery beds first and the seedlings from these beds are then transplanted. Apart from onion, lettuce and asparagus, these vegetables are usually small seeded crops from the solanaceous, cruciferous and cucurbitaceous families. In the future there is a wide scope for seedling transplants, especially for those crops which having a high economic value and potentially high seed cost.

Significance of vegetable seedlings production in Hi-tech nursery

- The 'baby seedlings' can be properly cared and nurtured in the nursery bed.
- The expensive hybrid seeds can be maintained better for resulting in a more uniform crop stand.
- Quality seed germination, consistent growth, minimal seedling mortality.
- Defective seedlings can be discarded throughout the transplanting process.
- There are fewer risks of pests and diseases.

Selection of site

While choosing a location for nursery production and management, the following factors should be considered-

- The terrain should be well-drained, fertile and rich in organic matter.
- The site should be free of water logging with good drainage facilities.
- To get the desired sunlight, it should constantly be placed out of the shade.
- The nursery should be located near a water source.
- Pets and wild animals should be kept out of the area.

The components and processes of modern nursery-raising technique

Seeds, seedling tray, media, mechanization, irrigation, nutrients, protected structure, light, seed pelleting and priming biological stimulation and hardening.

Raising seedlings in nurseries is the prime factor to care

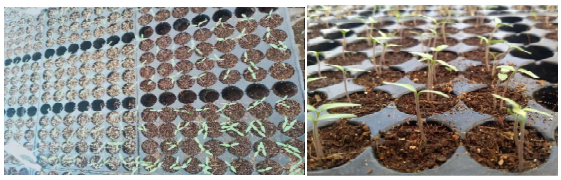
Healthy seeds or seedlings result in healthier and more productive harvests. The current state of agriculture technology necessitates the production of strong and healthy seedlings. To produce healthy seedlings, farmers and nursery managers grow seedlings in plug trays or protrays. Seeds and rooting media are frequently sown in soilless

media with coco-peat, vermiculite and microbial consortia. Sowing can be done manually or with a seed sowing machine.

Seedlings Tray and Growth media

In vegetable nurseries, seedlings are grown in various sized trays with varying numbers of cells. The size of the cell is essential since it determines the media and the water storing capacity. Seedlings grown in larger cells are taller and stronger than the smaller cells. Good chemical and physical qualities of the growing media ensure better nursery production. The physical features of the media, such as water, aeration and nutrient holding capacity have a significant role in root growth.

Sterile growth media, which may or may not be inert, having adequate cation exchange capacity (CEC) with optimum pH and nutrient absorption capacity, must be applied. Coco peat usually prepared from coconut husk is a 100% natural and biodegradable material which having a high C:N ratio and it is the most important ingredient in nursery growing media along with it has antimicrobial properties. Biological agents such as bio fertilisers and biocontrol agents (*Trichoderma viride, and Pseudomonas fluorescens*) are commonly applied into the media to provide additional benefits to the growing seedlings.



Germination

Seed germination is influenced by temperature, which varies with the crop and should be adequate with uniform moisture in the media. For improved germination, customized germination chambers are used. After seeding a black plastic sheet is used to cover the protrays to allow warmer temperatures for promoting germination. Some vegetable seeds require a specific temperature in the root zone to germinate. Like optimum temperature for Tomato and Brinjal 21°C to 24°C and Chilli and capsicum 28°C to 32°C.

Growth influencing factors

Different factors viz. light, irrigation and nutrients play a direct and crucial role on the growth of the seedlings. The structure of the nursery must be built in such a way that enough light is available for seedling production. For optimum growth and development, seedlings should be irrigated on a regular basis. To irrigate seedlings, a rose can or a flush boom can be used. Overwatering can also be harmful to emerging seedlings, since it increases the risk of acquiring foliar, collar and root diseases. Apart from the nutrients provided in the cocopeat or growing media, extra nutrition is essential for the growing young seedlings. Nutrients can be provided by foliar application. Phosphorus, along with a small amount of nitrogen, is essential for greater root growth. Nutritional imbalance can lead poor and stunted growth, resulting in poor performance.

Protected Structures

Young seedlings require specific care since they are fragile and tender, attracting sucking pests such as white flies, aphids etc., which may also act as vectors for the spread of many lethal viral diseases that can emerge later in the plant development phases. When seedlings are nurtured outside of a protected structure or in an open field, these possibilities increase. Young seedlings are additionally protected by the protective structure from severe climatic conditions such as rain, wind, heat, and a variety of infections.

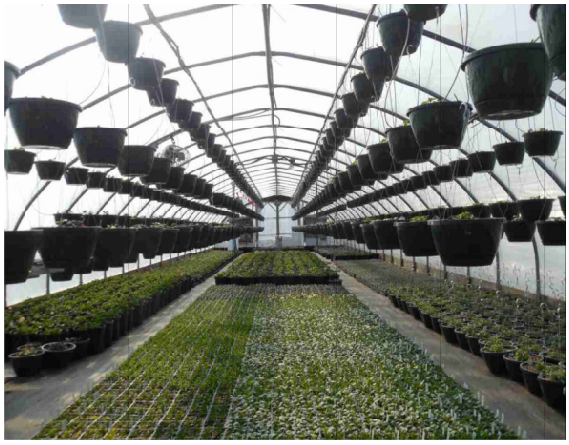
a. Polyhouse

Polyhouses employees a transparent UV stabilized polyethylene film with a thickness of 200 microns to cover the polyhouse roof. In the ploy house, retractable or moveable

shade nets of around 11 feet height are installed for managing heat and light. For better protection against rain splash the sides of the poly house usually covered with polyethylene film having 200 micron thickness. All the four sides of the side are coated wall up to 3 feet with 40 micron white coloured insect proof net.

b. Nurseries with Shade Nets

A shade net nursery is usually supported by GI pipes or stone slabs. At a height of 6.5 feet, a UV stabilized HDPE green or black shade net with 50 to 75 % shade intensity is employed to cover the nursery area. As a support for the shade net, a strong stainless wire grid is installed at the top of the construction. To keep insects out, a UV stabilised 40 percent nylon insect proof net mesh is placed on all four sides of the nursery.



Hi-tech nursery raising techniques

a. Covering with polythene sheets

Thatching can be replaced with transparent polythene covering to ensure early germination (150 micron thickness). Irrigate the nursery beds after seeding, up to the field capacity. The beds are then to be covered with a transparent polythene sheet and sealed with soil around the edges of the sheet. After completion of germination process, the polythene sheath can be removed.

b. Poly tunnels for normal weather

- Prefabricated tunnels measuring 3m long, 1.5m broad and 1.0m high in the centre are used to cover the nursery beds.
- UV-polythene sheath (200 micron) with 75% transmittance is clad around the semi-circular structure.
- The bed can be covered with tunnels once the seeding, covering, and irrigation are accomplished.
- If the nursery is grown in the winter, both apertures are often closed.

c. Sunken nurseries for extreme weather

Sunken type of nursery usually prepared during winter season. This type of nursery is created 10 to 15cm underneath the soil surface. The air blows across the soil surface, yet the

seedlings in the sunken bed are not affected by the breeze. Furthermore, covering the sunken bed with polyethylene sheets, which is essential to safeguard the seedlings from cool air, becomes easy. On bright days, the polythene cover may be removed and on wet days, it can be converted into a roof.

d. Naturally ventilated polyhouses

Naturally ventilated polyhouse can be used for commercial nursery production.

i. Poly bags for cucurbits : Seed propagation and in situ sowing are practiced in majority of cucurbits. Seeds can be sown in polybags and germinated under protected cover from low temperatures in some circumstances where an early crop is needed. At the 2-true-leaf stage, the seedlings are transplanted. This is a common practice in Punjab, particularly with muskmelon and it can be done on the hills to achieve an early crop in July. Cucurbits normally do not survive transplantation after this stage owing to tap root injury. When compared to in situ sowing, there is a significant reduction in seed quantity, saving approximately 50% to 60%.

ii. Plug tray techniques : For producing vegetable seedlings, plastic trays or protrays with various cell sizes are commonly used. In numerous European nations and Israel, two types of plastic protrays are primarily utilized to raise seedlings. Cucumber, muskmelon, tomato and brinjal require 187 cells of 3.75 cm (1.5") size plastic trays, but lettuce, cabbage, cauliflower, and capsicum require 345 cells of 2.5 cm (1.0") size plastic trays. These trays aid in correct germination, give a separate area for each seed to germinate, reduce mortality, promote uniform and healthy seedling growth and are easy to handle and store. They are also reliable and cost-effective to transport.

Hardening

Hardening is the process of gradually exposing mature seedlings to regular climatic conditions after they have been protected in order to eliminate stress and transplant shock when they are transplanted to the main field.

Pest and disease management.

- The most significant role in the control of pests and infections is cleanliness and sanitation in the nursery, particularly among the crate or protrays.
- Regular sterilization of the growing media, structures, tools, and trays is required on a regular basis.
- Proper and appropriate ventilation and air flow within the nursery space may help to prevent disease.
- Pests and diseases that may restrict the growth of healthy seedlings must be identified and appropriate countermeasures must be established ahead of schedule.

Conclusion

The emergence of various nursery growing techniques has opened up new horizons for producing vegetables in every month of the year, irrespective of the vegetable crop. Growers may now produce off-season vegetables crops in any climatology condition against several stresses and can fetch remunerative prices from its product due to innovative approaches of Hi-tech nursery production.

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Dragon Fruit-Night Blooming Cactus

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Introduction

The dragon fruit, a newly introduced super fruit in India, is regarded as a promising and remunerative fruit crop. Fruit has a highly appealing colour and mellow mouth melting pulp with black coloured edible seed embedded in the pulp, as well as excellent nutritional properties, which attracts farmers from all over India to plant this fruit crop that originated in Mexico and Central and South America (Britton and Rose, 1963; Morton, 1987 and Mizrahi *et al*., 1997). It is a long-day plant with a lovely night-blooming blossom and hence also known as "Noble Woman" or "Queen of the Night." Strawberry Pear, Kamalam, Pithaya, Night Blooming Cereus, Belle of the Night, Cinderella Plant, and Jesus in the Cradle are some of the other names for the fruit. It's a plant that only grows at night (nocturnal plant). Because of the bracts or scales on the fruit skin, the fruit is called pitaya, which literally means "scaly fruit." It has ornamental value because of the big (25 cm) flowers that bloom at night and are creamy white in colour. There are 3 different species of dragon fruit: *Hylocereus undatus*—white flesh with pink skin, *Hylocereus polyrhizus*– red flesh with pink skin and *Hylocereus (Selenicerus) megalanthus* – white flesh with yellow skin.

Taxonomical Classification

Kingdom	Plantae
Order	Caryophyllales
Family	Cactaceae
Sub family	Cactoideae
Tribe	Hylocereae
Genus	Hylocereus
Species	*H. undatus*

Origin and Distribution

The majority of *Hylocereus species* are found in Mexico, Central America and South America (*Mizrahi et al*., 1997). *Hylocereus spp*. are now found all over the world (in tropical and subtropical areas), however in India, *H. undatus* is the most widely distributed species, followed by *H. costaricensis*. Because of its hardiness, this fruit crop can withstand the harsh weather conditions of India's desert and semi-arid regions.

Nutritional Importance

Vitamin B1, vitamin B2, vitamin B3 and vitamin C, as well as protein, fat, carbohydrate, crude fibre, flavonoid, thiamin, niacin, pyridoxine, cobalamin, glucose, phenolic, betacyanins, polyphenol, carotene, phosphorus, iron and phytoalbumin are all abundant in *Hylocereus undatus*. It's rich in phytoalbumins, which are known for their antioxidant effects (Mahattanatawee *et al.*, 2006).

Pharmacological Activities

- Antioxidant activity.
- Anticancer activity.
- Antimicrobial activity.
- Prebiotic effect.
- Cardio- protective effect.
- Hypocholesterolemic Effect.

Botanical Description

Fruit - The fruit is a fleshy berry that is oblong in shape and about 4.5 inches (11 cm) thick, with a red or yellow skin/peel with scales and spines. Depending on the species, pulp might be pink, white, red or magenta in colour.

Flowers -Although the flowers are hermaphroditic, some pitaya species and cultivars are incompatible with one another. The big, fragrant, nocturnal, bell-shaped white blossoms are incredibly spectacular, tasty and can be inches long (36 cm) and 9 inches wide (23 cm). Cream stamens and stigmas with lobed stigmas. On the stem margin, 3 to 5 spherical buttons appear, with two to three of them developing into flower buds in around 13 days. After 16-17 days, when anthesis begins, the light green, cylindrical flower buds reach a height of around 11 inches (Pushpakumara *et al.*, 2006).

***Hylocereus undatus*, white-fleshed**

***Hylocereus polyrhizus*, red-fleshed**

Hylocereus megalanthus

***Hylocereus undatus* with both carpels and Stamens**

***Hylocereus undatus* flowers on plant**

Propagation

Seeds and vegetative cuttings can be used to propagate these plants. Seed propagation is not recommended due to seedling variability, and it takes 4-5 years for seedlings to blossom and fruit. Plants produced by vegetative techniques yield blooms in three years, hence commercial cultivars are propagated by vegetative means.

Irrigation Requirements

Even if dragon fruit can survive with very low rainfall, when good quality fruits are required, a consistent water supply is essential. Irrigation is vital because it allows the plant to build up enough reserves not just to flower at the best moment, but also to ensure that the fruits grow properly. Micro-irrigation on a local level is advised. Micro-irrigation, in addition to the effectiveness of the water supplied by this system, eliminates uneven and excessive watering, which can cause blooms and early fruits to fall off.

Plant Protection Measures

On *Hylocereus*, just a few pests have been identified. Ants belonging to the genera Atta and Solenopsis are well-known pests that can seriously harm plants, flowers, and fruits. *Cotinus mutabilis* perforates the stem and *Leptoglossus zonatus* sucks the sap, producing stains and some deformation. Aphids and scales of various species have also been seen on fruits and flowers. Rats and birds can wreak havoc on flowers and fruits, as well as ripe fruits. In reality, bees are incredibly efficient, and they can collect all of the pollen in just a few hours of activity. Pollen must be collected prior to the arrival of the bees and manual pollination must be performed the next morning after the bees have departed the plantation. Various fungal (*Gloeosporium agaves, Macssonina agaves, Dothiorella sp., and Botryosphaeria dothidea*), viral (Cactus virus X) and bacterial (*Xanthomonas sp. and Erwinia sp.*) infections have been reported which also infects the fruits (Barbeau, 1990).

Harvesting

The fruit skin changes colour late in the maturation period, from green to red or rosy-pink (25 or 27 days) after anthesis (depending on the species) (Nerd *et al*., 1999). Harvesting H. costaricensis will take 30 days (Anon, 2017). The fruits achieve their maximum coloration four or five days later, which causes splitting and economic loss (Anon, 2017). The first harvest occurs 14 months (*H. costaricensis*) after the cuttings were planted under West Bengal conditions; the duration between flowering and harvest is brief and varies only little depending on the environment, ranging from (27 to 33) days. The yield is roughly (10 to 30) t/ha and is dependent on planting density (Anon, 2017). Picking is difficult because to the lack of a peduncle. The current harvesting approach of just twisting and moving the fruit in a clockwise direction causes less or no damage to the fruits (Anon, 2017). Although the fruits are not very delicate, some precautions should be taken to assure a high-quality product, such as careful handling during processing and storage, especially for *H. costaricensis*, which has brittle foliated scales.

Conclusion

Dragon fruit look to have various selling factors commercially; they are appealing in shape and colour and have excellent nutraceutical properties, which attract producers from all across India. The red flesh species, *H. costaricensis*, is also high in betalains, which caters to the growing demand for antioxidant products and natural food colourants. *H. undatus* is a prospective alternative medicine source that may act as an antioxidant, anticancer, hypocholesterolemic, cardioprotective, antibacterial and prebiotic agent. Apart from that, numerous studies on this fruit have shown that it has a wide range of pharmacological actions. The crop is hardy and may thrive in any climate that is conducive to flowering and fruiting, as well as in soil with adequate drainage. This fruit crop needs research in different aspects.

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One Step Towards Taming The Soil: Temperate Orchards

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Introduction

Realizing food security and agriculture sustainability is urgently required; therefore, improving many agronomic approaches, which have drastic effects on crop growth and yield are necessary. Among various practices followed by many farmers which need thorough thought, is the use of plough. Tillage is considered an essential tool for weeding, amendment incorporation and seedbed preparation prior to planting. However, associated with it, there can be long-term negative impacts on soil health as well due to mechanical disturbance, for which balance has to be established.

Orchards are unique among crop systems in their temporal and structural complexity. During the 15 to 50 year production cycles of perennial fruit plantings, a diverse community of naturally growing "weeds" or planted groundcover species develops on the orchard floor. This groundcover vegetation can provide substantial benefits of soil conservation, nutrient cycling and habitat for desirable wildlife. However, without careful management it can also compete with trees for limiting nutrients, complicate orchard operations and harbor economic pests of fruit. Sustainable orchard floor management systems require knowledge about site-specific conditions, plant function, and consideration of trade-offs among beneficial and detrimental aspects of groundcover vegetation.

Tillage

Tilling destroys soil's natural structure, breaking-up colloids and collapsing macro pores. The short-term result is a warmer, aerated and competition-free environment suited to seed germination. Yet, the fine particles and small pores characteristic of tilled soil are ultimately unstable, leaving fields vulnerable to erosion and compaction over time. Tillage can also alter soil ecosystems. Decomposition rates often increase behind the plow, hastening the breakdown of soil organic matter and subsequent release of carbon dioxide into the atmosphere. Organic matter loss paired with the drying effect of tillage dramatically limits soil water holding capacity and moisture available for plant growth.

The structure of soil under conventional tillage (left) degrades quickly when exposed to water: Soil under conservation tillage (right) forms stable aggregates that resist erosion.

No plant on the face of earth is so weak as to germinate only in plowed soil. Man has no need to plow and turn the earth, for microorganisms and small animals act as nature's tillers. Let the grasses plow the top

soil and the trees work the deeper layers. What can be more desirable to a farmer than being able to work the fields without pulling a plow or swinging a hoe? By killing the soils with plow and chemical fertilizers and rotting the roots through prolonged summer flooding, farmers create weak, diseased plants that require the nutritive boost of chemical fertilizers and the protection of pesticides.

Man has created the preconditions that give the things we never needed its value. Flood a field with the water, stir it up with a plow and the ground will set as hard as plaster. If the soil dies and hardens, then it must be plowed each year to soften it. All we are doing is creating the conditions that make plow useful, then rejoice at the utility of our tool.

Ploughed and Flooded orchards

Soil lives of its own accord

Good soil supports plant life and poor doesn't. Good soil is absolutely teeming with life. Most of the soil life (worms, slugs, centipedes, ants, ladybird beetle larva and more) is on the surface, in the first 4 inches. Great deal of the energy that results from photosynthesis in the leaves is actually used by the plants to produce chemicals they secrete through their roots. These secretions are known as exudates. Root exudates are in the form of carbohydrates (including sugars) and proteins. Amazingly, there presence wakes up, attracts and grows specific beneficial bacteria and fungi living in the soil that subsist on these exudates. Secretions and organic matter tend to make mineral soil components clump more and increase mean ped size and stability. The rootlets, hypha and other filaments form a mesh through the peds and hold the peds together.

'Moving' not 'tilling' would work

Groundcovers provide a renewable surface layer of biomass that protects soil from weathering and compaction and influences populations of beneficial and detrimental soil microorganisms. As this biomass decomposes into the mineral soil, it replenishes organic matter—promoting microbial activity, sustaining soil nutrient reserves and increasing soil pore volume and water-holding capacity.

Groundcovers growing between or within the tree rows can also be managed to help control tree vigor, enhancing fruit quality and tree winter hardiness. Excess soil nitrogen and water availability during late summer and early autumn can prolong shoot and canopy growth, delay fruit maturation, increase the potential for winter cold injury when woody tissues fail to harden-off sufficiently. In orchards where dropped fruit are gathered for processing or fermentation, it is especially important to minimize mud splashing and soiling of fruit beneath trees and grass or clover groundcovers are often maintained over the entire orchard floor.

Deciduous fruit trees in cool-climate regions remain dormant for almost half of the year and there is little uptake of essential nutrients from soil by dormant trees. The potential for soil erosion and leaching or runoff of nitrogen, phosphorus and pesticide residues is greatest during the dormant season. Cool-season grasses such as Festuca and Lolium Species and broadleaf groundcovers such as brassicas and legumes that continue growing when fruit trees are dormant, can serve as "green manure" that fix or retain nitrogen and

other essential nutrients in biomass residues during the winter months. Mowing of these groundcovers in late spring releases nutrient reserves at a time when they are readily assimilated by fruit trees.

Flowering groundcovers that provide habitat, pollen, and nectar food sources for predatory insects, such as hover flies (*Syrphidae*) and assassin bugs (*Reduviidae*), can increase populations of these beneficial insects in orchards and help to control leaf-feeding pests such as aphids and caterpillars, reducing the need for pesticides. Moreover, clover, a year round flowering legume, can feed the pollinators when there may be no other source of pollen or nectar left.

Permanent grass and broadleaf groundcovers also facilitate access by orchard customers, workers and machinery during wet/muddy or dry/dusty conditions. Properly managed groundcovers can improve soil fertility and water-holding capacity, provide habitat for beneficial wildlife, make orchards more attractive for workers and pick your-own customers, suppress pathogenic soil fungi and nematodes and limit excess vigor of mature bearing trees—optimizing fruit quality and reducing pruning costs.

Cherry Orchard with no ploughings

One of the most important ecosystem services for sustainable crop production is the mutualistic interaction between plants and animals: pollination. The international community has acknowledged the importance of a diversity of insect pollinators to support the increased demand for food brought about by predicted population increases. Insect pollination is threatened by several environmental and anthropogenic factors, and concern has been raised over a looming potential crisis. With the ploughing most of the soil nesting pollinators, their eggs get destroyed, which could otherwise have proven beneficial at the time of adverse weather conditions, when bees cannot work.

Conclusion

Weighing the pros and con of tillage, unnecessary tillage needs to be avoided. Orchards should draw a line between temporary and long lasting benefits while choosing any practice. Why to pay for the services which could otherwise be readily and naturally available as and where needed, like pollination services by soil nesting bees, vermi composting by the native worms in the orchard itself etc. This one step can lead in extended cultivable lands rather than degrading the existing ones.

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Production Technology of Hyacinth (Hyacinthus orientalis)

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Introduction

Hyacinthus orientalis L., the common hyacinth, garden hyacinth or Dutch hyacinth, is a species of flowering plant in the Family Asparagaceae/Hyacinthaceae, Sub family Scilloidiae, the genus is native to the eastern Mediterranean region (From the north of Bulgaria, southwestern Syria, Lebanon and northern Palestine). Ornamental flower bulbs exhibit great diversity in their growth, development biology, morphology and physiology response to environmental factors (Benschop *et al*. 2010). It was introduced to Europe in the 16th century. After a long period the Dutch, or common hyacinth of house and garden culture (*H. orientalis*, native to southwest Asia) was so popular in the 18th century that over 2,000 cultivars were grown in the Netherlands, its chief commercial producer. This hyacinth has a single dense spike of fragrant flowers in shades of red, blue, white, orange, pink, violet or yellow. A form of the common hyacinth is the less hardy and smaller blue- or white-petalled Roman hyacinth of florists. These flowers need indirect sunlight and should be watered moderately. It is widely cultivated everywhere in the temperate world for its strongly fragrant flowers which appear exceptionally early in the season, and frequently forced to flower at Christmas time. They are mainly grown for aesthetic purpose in gardens and as cut flower. They are also used industries related to perfumery for obtaining essential oil extracts and also used as indoor or outdoor plants.

Varieties

Hyacinth flowers have rich history that are as colorful as their blooms. They also have numerous health benefits but use them with proper precautions. So many varieties are their but in India few are grown widely.

Blue Jacket

With dense spikes of deep blue flowers and a dark purple stripe on every petal, Blue Jacket grows up to ten inches tall and will naturalize in the right spot. It is resistant to deep and rabbits and is very easy to grow.

Gipsy Queen

These cheerful flowers include petals in soft coral with bright green, lance- shape leaves. It, too, has a lovely aroma, and is resistant to both deer and rabbits. It will naturalize in the right spot, and grows up to ten inches in height.

Hollyhock

The award-Winning Hollyhock has double flower in a reddish-pink color and a sweet, very noticeable and pleasant aroma. It

grows best in well-drained spots with medium moisture, and has won several international flower awards.

Jan Bos

With starry, dark pink flower blooms for several weeks in mid-spring and has a very pleasing aroma.

Miss Saigon

The winner of several international flower awards, this type of hyacinth is highly fragrant and has star-shaped, violet petals and bright green leaves. Miss Saigon does best in full or part shade, and blooms for several weeks in the spring.

Woodstock

Blooming for several weeks in mid-spring, this flower has reddish-purple petals and bright green leaves. Their dark plum color makes them truly unique, and because they also are very fragrant, they do well when planted along pathways and near patios and decks.

Fondant

With the lovely single, sugary-pink flowers. It is an excellent variety for forcing in pots for early color and fragrance indoors, but are equally valuable as an outdoor plant for flowering in late spring.

Top White

With a sweet and rich fragrance, Top White has bright green leaves and snow-white petals, and prefers full to partial shade. As with other types of Hyacinths, Top White is perfect for planting along walkways or near patios and decks, and it will grow up to ten inches in height.

Ecological requirements

Soil

Hyacinth can be grown in loosened, moderately fertile soil that drains well. Avoid low area where water collects; hyacinths will rot in wet soil. Before planting, loosen the soil and work in 2 to 4 inches of compost or bone meal for fertility.

Climatic conditions

Most of the hyacinths grow in zone 3 to 9. They must have cold temperatures 40 to 45º (4 to 7º) for at least 12 to 14 weeks. If temperatures in your area do not get this cold, you will need to pre-chill the bulbs in a refrigerator before planting them outdoors.

Propagation

Hyacinths are commonly propagated by vegetative means through bulb. Micro-propagation has also been successful method for large scale multiplication. Propagation through seed is used by the breeder for evolving new varieties.

Seed

Seed are not preferred for commercial multiplication; however they are used for development of new cultivars. Their natural propagation rates are very slow and take 4-6 year to develop a bulb size capable of flowering and seed set under ideal conditions [Suleyman kizil *et al* 2016].

Bulb

Hyacinths are commonly grown by bulbs. Amano and Tsutsui [1980] suggests 43°C and 38°C temperature treatment for 4 and 30 day to induce offsets on 15 cm circumference bulblets. Commercial propagation of the plant is done by scoping or cross cutting by removing apical meristems on the cut surfaces or leaf cuttings and scales [Hartmann *et al*. 1990].

Micro propagation

Plant tissue culture studies use leaves, scales, inflorescence stalk, ovaries and perianths [Hussey 1975, Pua and Chong 1984, Lu *et al.* 1988] to achieve the objectives. The breeding and commercial method of propagation should be easy independent and efficient for propagation of plants year long.

Production technology

Selection of bulb

To obtain hyacinth flowers of good quality, it is important to use the right bulb size. Bulb sizes (the circumference of the bulb in centimetres) 15-20 will provide the best results.

Dormancy of bulb

Bulb do not sprout if sown immediately after harvest even under favorable growing conditions for a minimum of 45-60 days due to the rest period of the bulbs. The dormancy can be broken by storing the bulbs in the cold storage or shady area for 8 to 12 weeks with the temperature of 2-4°C (35-45°C).

Planting time and density

In the north Indian plains, Hyacinth is planted during winter in the month of November-December [Krishna kaushik *et al*. 2021]. It can be planted in flat beds, raised beds and also in pots. In light soils such as sandy and sandy loam. It is advisable to plant them in 1m wide raised beds to excess water drained out.

Planting density

Planting of Hyacinth bulbs is done for to purpose cut flower and bulb production. Above 16-17cm circumference of hyacinth bulb should be plant at a spacing of 40×40cm row to row and bulb to bulb.

Depth of planning

The depth of planting of bulbs in soil mainly depend upon the size of bulb, type of soil and time of planning. Normally, bulbs should be done in 3-5cm depth.

Nutritional requirement

Heavy fertilization has retarding influencing on root growth and flowering. After the three weeks of planting of bulbs, Calcium Ammonium Nitrate (CAN) @ 1 kg/100m^2 should be applied. When the plants are in active vegetative growth, the second dose of CAN should be applied @ 1kg/100m^2.

Irrigation

Drip irrigation system is suitable for hyacinth. Watering of the field should be done a few days prior to planting, in such a way, that the bulbs can be planted when the soil is moist but not excessively wet. Because of hyacinth bulbs are highly sensitive to water logging condition. In condition of excess water bulbs are start wilting. So that bulbs cannot be sown in deep area and water logged area.

Diseases and pest and their management

Diseases

The production of hyacinths for cut flowers usually runs smoothly. Many problems can be prevented by the proper choice of material and the proper treatment of the bulbs before and during production. This diagram shows the most important diseases and how to deal with them. Using preventive measures reduces the risk of major damage.

Bulb rot

In this plant displaying poor and uneven rooting. This disease always begins due to excessively moist conditions during storage and is frequently associated with mechanical injury or damage of mites. Infected bulbs have a dry, punky rot and the bulb scales are often covered with the characteristic blue-green (Penicillium) or pink (Fusarium) colored growth of the fungus.

Control

Do not damage the bulbs, and be sure to plant them immediately upon arrival. Store bulbs under the ventilated and dry conditions. Control is achieved through careful digging to avoid wounding.

Soft rot

It is a bacterial disease. Infected plants fail to flower or blossoms fall off before they open. Top may appear water-soaked and collapse. Infected bulbs have a strong odor and are soft and mushy. Wet, dark green spot on leaves and flower stem that start at the base of the bulbs and extend upward. The plants have an unpleasant odour.

Control

Bulbs do not panted under wet, warm conditions. All infected bulbs should be discarded.

Bulb fly

***Merodon equestris*. Pest:**

The maggot of this fly infests the bulbs and ruins them.

Control

Destroy all infested bulbs after digging. Three hours of hot-water treatment at 110º F will be helpful in control. Small, stunted and otherwise obviously infested plants may be dug up and burned, thus preventing the spread of the infestation.

Bulb mite : *Rhizoglyphus echinopus.*

This mite injures bulbs. The mites breed continuously in greenhouses or wherever the temperature and moisture are sufficiently high. It is possible for 10 or more generations to mature in a year.

Control

Burn all soft and decayed bulbs, if allowed; store bulbs at about 35º F. Heat treat bulbs before storage (see also bulb fly, above).

Harvesting and Storage

Hyacinths produced for cutting are harvested by pulling the plants, bulb and all, from the soil. The hyacinths are ready to harvest when the flower cluster is showing definite colour and at least one of the bells has separated from the cluster. The next step is to cut the plant out of the bulb and leave the base of the bulb attached. With the base of the bulb still attached, the plant develops better flowers. This also improves keeping quality. There are

several kinds of bulb removing machines that can be used to more or less mechanisze this process. In the Netherlands, hyacinths used as cut flowers are bunched five to a bunch and held together with tape or rubber bands. Before packaging, it would be advisable to rinse off any soil residue with clean water. The bunches can then be placed either dry or in a container with a few millimeters of water for up to three days in a refrigerated storage maintained at around 2 to 5°C. Hyacinths with bulbs attached can also be placed in refrigerated storage in an upright position (to prevent crooked growth). Consumers should also be advised not to trim the stems from these hyacinths but to leave the base of the bulb attached.

Conclusion

Hyacinth has wide color ranges of flowers and also high fragrance. It is popular in International flower market or in European counties and has a high value. So that, If farmers grown hyacinth plant with better management practices then they should get high profit from it.

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Insect Pests Management in Mango

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Introduction

Mango (*Mangifera indica L.*), an evergreen and widely cultivated fruit crop of tropical and subtropical regions, is attacked by about 400 insect and mite pests. However, only a few are of major economic importance. These include leaf hoppers, fruit flies, stone weevil, mealy bugs, gall midges and others. Of them fruit flies is quarantine importance and restrict the national trade of mangoes. The pest distribution is also not uniform across the country with some species confining to specific zones. For instance, shoot gall psylla and giant mealy bug are more common in the north compared to south India.

Mango is grown in India for wide adaptability, higher nutritive value, delicious taste excellent flavour and attractive appearance. Mango plants are infested with various insects, right from nursery to old orchard and severely affected mango yield and fruit quality. 45 percent of total insects affecting mango are found in India and Mealy bug, hopper, fruit flies, shoot gall psylla, Bark eating caterpillar are main pests observed in various orchard of Pusa, Bihar. The management of Mealy bug, hopper and fruit flies are being given here (in brief) for the benefit of orchardists.

a) Mango mealy bug

b) Mango hopper

c) Shoot Gall Psylla

d) Mango fruit fly

a. Mango Mealy bug *(Drosicha mangiferae)*

A polyphagous pest feeds on wide range of fruits, vegetables and ornamental crops including Mango, guava, citrus, grape, fig, date palm, apple, avocado, banana, mulberry, coffee, coconut, soursop, peanut, bean, tomato, brinjal, okra, maize, sugarcane, soybean, cotton, rose, chrysanthemum, china Rose, croton etc. It is small oval, sort-bodied sucking insect found on new emerging leaves as well as matures stems, panicle, fruits and roots and covered with white milky wax, makes them difficult to eradicate.

Young mealy bug (Crawler) is highly mobile crawl from infected plants to non-infected plants. Small crawlers are readily transported by wind, birds, ants, clothing and vehicle and may settle in cracks and crevices, usually on new plants. The wax, which sticks to each egg, also facilitates passive transport by equipments, animals or people. Long distance movement is most probable through carrying infested planting material and fresh fruit and vegetables across the country or even from one end of a farm to the other. Ants, attracted by the honey dew, have been seen carrying mealy bugs from plant to plant.

Symptoms

- They suck cell sap from leaves and stems.
- The excess sap is excreted as honey dew which attracts ants and develops sooty mould on entire leaves surface which inhibit the photosynthetic capacity of plants.

- Interestingly, female bug and nymphs of both sexes cause damage while male adults survive only for mating. Plants become stunted and swollen (when infested) on growing tip of young plants.
- Heavy clustering of mealy bugs can be seen on fruit panicle and under leaf surface giving the appearance of a thick mat with waxy secretion.
- Severe infestation can cause defoliation with the white, waxy coating of the mealy bug. Infestation can lead to fruit drop, or fruit may remain on the plants in a dried and shriveled condition.
- Mealy bug infected fruits do not fetch good market price. Survey was conducted at Pusa site for mango diversity and almost all the mango orchards are infested with mealy bug. The principal damage associated with mealy bugs arises from sap sucking and their secretion of honeydew, led to growth of sooty mould.

Management

Cultural and mechanical Practices

- Mechanical barriers such as fences can be applied parallel to the field periphery to keep ants away from field and subsequently help in controlling mealy bug populations.
- All crop residues in orchard should be removed and dump in compost pit. Crop residues and grass left in the orchard may harbour mealy bug populations which may invade the new crop.
- Orchard should be free from weeds and crop debris as weeds also provide alternative host.
- Deep ploughing in the first fortnight of December, raking the soil around the tree trunk can prevent Nymph to climb.
- Do not move any plant material with suspected mealy bugs. Moving infested plants is the fastest way to spread the pest.
- Remove alternate host plants like Hibiscus, croton, okra, custard, guava etc., in and nearby crop.
- Equipments should be thoroughly washed before moving to new plant or orchard.
- Manual picking of mealy bugs can be done in small plants or where infestation is in early stage, apply strong jet of water to remove bugs.
- Flooding of orchards in October followed by deep ploughing kills the eggs. Additional ploughing of the orchards in November exposes the remaining eggs and other soil dwelling pests to sun's heat/birds.
- Fasten 400 gauge alkathene sheets of 25 cm width to the tree trunk besides raking the soil around the tree trunk is very effective tool for the management of mealy bug.

Chemical Control

- Chemicals are less effective against mealy bug, because of its habit to hide in crevices and the waxy covering on its body and therefore, pesticides cannot penetrate the heavy waxy layer. Most granular insecticides are ineffective; therefore, systemic insecticides are used to control heavy infestation.
- Mixing of 1.5% chlorpyriphos dust @ 250 g per tree in the middle of November reduces the newly hatched nymphs.
- If nymphs have already ascended the tree, spray imidacloprid 17.8 SL @ 0.5 ml/L or dimethoate 30 EC @ 2 ml/L of water.

Biological Control

- Biological control is regarded as

effective, long-term solution to the mealy bug infestation because parasites and predators are self-perpetuating, persists even when the mealy bug is at low population densities and they continue to attack the mealy bugs, keeping populations below economic injury levels.

- The coccinellied beetles such as *Cheilomenes sexmaculata, Rodolia fumida, Scymnus coccivora, Aulis vesttia, Coccinella septempimctata* and *Nephus regularis* are important predators of mealy bug nymphs. Biological control by release of natural enemies has proved very successful. Among the biological control agents introduction of *Cryptolaemus montrouzieri* (Australian Ladybird), *Anagyrus pseudococci, Leptomastix dactylopi, Hypo asp is spp., Verticillium lecanii* and Beauveria bassiana are effective in managing the infestation.
- *Hypoaspis* is a small mite feeds on crawlers. Soil application of the spores of the fungus, B. bassiana will ensure further reduction of the pest population.

b. Mango Hopper *(Amritodus atkinsoni)*

Mango hopper is another very serious problem in mango cultivation and found in all mango growing areas including India, Indonesia, Philippines, Taiwan, Vietnam, Srilanka, Burma, Pakistan and Malaysia. Being only mango host for this pest in favorable conditions severely hampered the fruit setting.

Symptoms

This is one of the most destructive pest of mango. Both nymphs and adults puncture and suck the cell sap from tender leaves, shoots and particularly from inflorescence results in withering and shedding of flower buds and also wilting and drying of shoots and leaves. Heavy puncturing and continuous chaining of sap causes curling and drying of infested tissues Young fruits and dried inflorescence fall to the ground as the summer wind blow. The flower stalks and leaves in infested trees become sticky due to the deposition of honey-dew secreted by the hoppers that encourages the growth of black sooty mould on foliage and other parts. Survey conducted in Bihar showed that pest can damage 30-40% crop in neglected orchards.

Management

Cultural and Mechanical Practices

- Avoid close planting as the incidence very severe in overcrowded orchards.
- Orchards must be kept clean by ploughing and removal of weeds.
- Pruning of dense overcrowded and overlapping branches to facilitate aeration and sunlight
- Avoid excess use of nitrogenous fertilizers.
- Avoid water logging or damp conditions.

Chemical Control

- Being sucking pest only systemic insecticides are effective against this pest therefore, dimethoate 30 EC @ 2ml/L or imidacloprid 17.8SL @ 0.5 ml/ L can be sprayed. Buprofezm 25 SC @ lml/L is also effective against mango hopper.
- First spray should be done in January when the blossom is about to come up and second spray after fruit set, if required.
- A rational rotational of insecticide is desirable to counteract the tendency of pest to develop field resistance.

c. Shoot Gall Psylla (*Apsylla cistelata*)

It appears occasionally serious pest in several parts of North India and observed

seriously in Bihar. Most of the mango orchards seriously affected by this pest. Likewise mango hopper this pest damage only mango crop.

Symptoms

Nymphs feed on vegetative and reproductive buds causing the formation of gall which restrict flower formation or inflorescence and reduce fruit set. Nymphs suck the cell sap inside the gall and excrete white sticky material. Nymphs are covered with white power inside the gall. About 80 nymphs reside in a gall. Effected parts start dry and very little new growth is observed in affected parts.

Management

- Collect and destroy the gall during November.
- Spray dimethoate 30 EC @ 2ml/L or methyl-demeton 25EC @ 2ml/L of water in mid-August and repeat the spray at 15 days.
- Use Resistant variety like Prabhshankar, Husnara and tolerant variety like Alphanso.

d. Mango Fruit fly *(Dacus dorsalis)*

- The adults are the size of house fly and brownish with yellow marking.
- They lay eggs on mango fruits at 50% maturity, which hatches into white maggots that feed on pulp and cause rot to the fruit, causes fruit drops and larvae pupates in soil and then adults re-emerge to attack fresh fruits. Attack can take place even during harvest.
- Fruit flies are the major problem to domestic as well as export market. Several overlapping generations are completed in a year.

Management

- Fruit fly infestation begins 45-60 days prior to harvest, Initial breeding of the fruit flies takes place on fallen fruits. So, collect and destroy by deep burying (at least 4 feet) or burning all fallen fruits at weekly interval, two months prior to harvest.
- Place fruity fly traps, @ 8-10 per acre. Before placing the traps in the field add 5 drops of malathion or dichlorvos on the plywood pieces impregnated with lure. Traps should be fastened well on lower branches, between 3-6 feet height, at least 60 days prior to harvest or earlier. Traps should be kept in shade to enhance their life and should be replaced with fresh plywood lure every 3-4 weeks. If harvest is prolonged or trap is full then empty the dead flies. In case of rain take care to remove rain water by tilting the trap and allowing water to drain off from entry holes.
- If trap monitoring shows more than 5 flies/ day, there is a need to give three bait splashes on trunk, starting at least 3 weeks prior to harvest.
- The bait splashed is prepared by mixing 100 grams of Jaggery per liter of water to get a 10% solution, add 2 ml of malathion for every liter of the jaggery solution and dip a brush or broom into this solution and splash three times on the main trunk, a foot above the ground. Repeat this every week till harvest.

Conclusion

It is concluded that appropriate management of insect pest in mango at right time of preharvest apply cultural, mechanical and chemical practices to prevent the insect pest, by the reduction of fruit yield

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Banana Pseudo Stem- An Untapped Treasure

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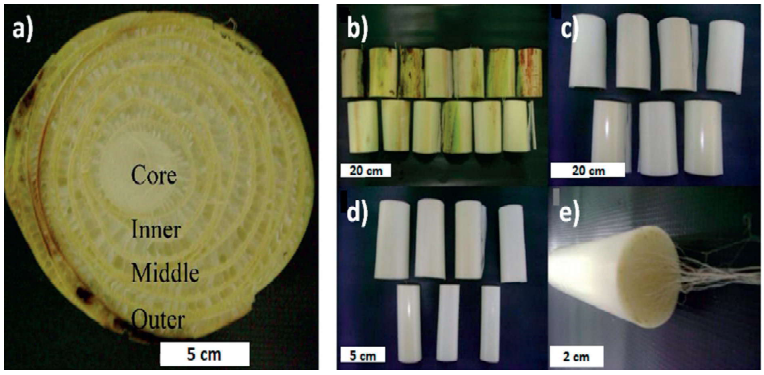
Introduction

Banana is the major fruit crop of the country. It is also known as tree of wisdom/ apple of paradise/ tree of paradise/ Adam's fig/ Kalpataru (plant of virtues) because all most all parts of the plants areuseful in one or the other way. Apart from the fruit bunches (economical part), other parts of the plant like male flower, leaves and pseudo stems are mostly discarded as waste after the harvest. Its disposal has become a major problem due to the amount of the biomass produced. It is scientifically proven that the pseudo stem and flowers are rich source of nutrients and minerals than the fruititself but the awareness about the usage, nutritional and health benefits are not wide spread. In order to the exploit the treasure of nutrients for the use and commercialization of the food products, one must know the other side of the pseudo stem i.e., its structure, nutrient composition and health benefits associated with them and preparation of some tried food products.

Parts of Banana pseudo stem

The banana plant has a shallow rooting system in which the pseudo-stems sprout vertically. As it develops, a single plant may produce about 25 of these pseudo-stems, which mature at different times. When the plants are 18–24 months old, the outer pseudo-stems are already mature and ready to be harvested. Then, about three or four pseudo-stems are stripped at a period of 6–12 months based on the rate of growth of the pseudo-stem. When the flower is out, the pseudo-stems are completely ready for harvesting. Furthermore, the shaft is cut off below the inflo¬rescence with a knife or sickle attached to a long pole and then the pseudo-stems are cut at their base. Based on the extraction methods, the pseudo-stems can be either stripped/extracted of their fibers in situ or by using a decorticating machine (Subagyo and Chafidz, 2018). The central core which is left after removing the outer fibrous layers is utilized for the food product preparation, it can be either diced as such as vegetable or can be used to extract juice to make refreshing drinks.



(Subagyo and Chafidz, 2018)

Fig 1: (a) Banana pseudo-stem trunk cross section and its parts: (b) Outer parts (c) Middle parts (d) Inner parts and (e) Core parts

Nutritional components of banana pseudo stem

Banana pseudo stem is rich source of the vitamins, minerals and dietary fiber (Ramu *et al.*, 2017).

Proximate analysis	
Moisture (%)	12.30 ±0.87
Ash (%)	4.93 ±1.42
Fat (%)	0.98±3.27
Total carbohydrates (%)	46.58±2.33
Starch (%)	21.06±0.87
Energy	64.40±1.25
Protein (%)	7.34±3.60
Total dietary fiber (%)	61.14±0.34
Phenols (mg/100 g)	188.64 ± 0.88
Vitamins (mg/100 g)	
Ascorbic acid	8.81 ± 0.20
Riboflavin	0.08 ± 0.18
Niacin	0.73 ± 0.19
Thiamine	0.15 ± 0.06
Vitamin E	0.12 ± 0.04
Macroelements (mg/g)	
Sodium (Na)	0.02 ± 0.02
Potassium (K)	10.63 ± 0.10
Calcium (Ca)	4.01 ± 0.07
Magnesium (Mg)	1.55 ± 0.18
Phosphorus (P)	2.09 ± 0.04
Microelements (ppm)	
Iron (Fe)	30.65 ± 0.16
Boron (B)	39.88 ± 0.04
Manganese (Mn)	27.86 ± 0.09
Cobalt (Co)	3.79 ± 0.01
Zinc (Zn)	16.60 ± 0.01
Copper (Cu)	0.02 ± 0.01

Health benefits of banana pseudo stem

- Banana stem is a rich source of fibre and helps in weight loss.
- Pseudo-stem has low glycemic index and high antioxidant which is good for diabetes.
- Banana stem is rich in potassium and vitamin B6. Vitamin B6 helps in production of hemoglobin and insulin. It improves the ability of the body to fight infection.
- Potassium helps in the proper functioning of muscles, including the cardiac muscles. It also helps prevent high blood pressure and maintain fluid balance within the body.
- Banana stem is said to be a diuretic and helps detoxify the body.
- It is used to prevent and treat kidney stones.
- It has been reported that a high dietary fibre intake has beneficial effects on human health.
- It also helps to eliminate waste fluids from the body.
- It helps in the treatment for the removal of stones in the kidney, gall bladder and prostate.
- The banana pseudo-stem sap can be orally taken or externally applied for stings and bites.

Pseudo stem based food products

Pseudo stem collected after the harvest of fruit bunches, outer fibrous layers are removed until the hard central core is obtained. Central core which is then utilised for the production of different processed products. Diced central core is used as vegetable, from that culinary dishes like curry, sambar and salad can be prepared. Further it can be processed to pickle, candy, toffees, food bar,canned

central core cubes, dehydrated powder- as dietary fiber supplement.Powder can be used in soup mix, curry, fortification in flours for preparation of roti or chapathis etc.

Like sugar cane, central core of the pseudo stem can be used for the extraction of juice either by using mixer or juice extractor, because of its high phenol content in juice become dark soon after extraction. So it should be treated with lime juice or water or citric acid to minimize the browning or can use immediately. Raw juice has the high amount of phenols which gives strong astringent taste, so it should be consumed after dilution with water. For the additional flavour and acceptability of the juice, one can go for the addition of preferred spices like, cumin, cardamom and pepper, can also add lime, ginger juice, salt or sugar, other juices like mango, orange, aonla, papaya, nannari root extract, mint, lemon grass or preferred fruit or vegetable juice can be added.

Conclusion

Banana pseudo stem is great reservoir of vitamins, minerals, nutrients, polyphenols, fiber etc., possessing several health benefits. Exploitation of these pseudo stem not only solves the disposable problem but also generates wealth (food, health, value added products and additional income) and substantial employment.

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Urea Molasses Multi-Nutrient Block: A Promising Supplement Feed for Improving Growth and Productivity of Livestock

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Introduction

Animal husbandry plays an important role in livelihood security and economic sustenance of farmers, especially in rainfed areas. As per 20th Livestock Census of 2019, the total livestock population in India was 535.78 million in country showing an increase of 4.6% over previous censes GOI, DAHD 2019. The increasing population and diversified food and fodder requirement of the country is expanding at faster rate, enhancing food production for future years is very challenging. Present availability of green fodder is 462 million tonnes and dry fodder is 394 million tonnes and contribution of crop residue, cultivated fodder and grasslands is 54, 28 and 18% respectively. Currently, India is deficit by 35.6% in green fodder and 10.95% in dry fodder and 44% concentrate feed. The fodder production in the country is not sufficient to meet the requirements; also, the forages offered are mostly of poor quality. Dairy animals are an important source of regular income in rain fed agro-eco-system of India. The productivity of dairy animals is greatly constrained by the lack of green fodder and good quality feed during a prolonged dry season. Reduction in milk production and weight losses of animals during the dry season are common features, which culminate in substantial economic losses to the farmers. Feeding balanced ration plays a crucial role in livestock development programme. In order to exploit the genetic potential of animals it is pre-requisite to ensure adequate and balanced supply of nutrients. Crop residues and dry grasses are the major forages used for feeding livestock in India. These crop residues are low in nitrogen, minerals, vitamins and high in fiber and lignin which restrict intake and digestibility in animals. As a result, performance of animal is often sub-optimal that is reflected in stunted growth, delayed maturity, longer inter-calving period and poor milk yield. In this scenario, strategic supplementation of nutrients is essential to improve the utilization of poor-quality roughages. Dietary supplementation of critical nutrients can improve the utilization of poor quality roughages. Considering the availability and price of concentrate mixture, resource poor farmers can hardly afford them. Animal nutritionists, all over the world, have proved that the nutritive value of crop residues can be enhanced if supplemented with deficient nutrients. The use of urea molasses mineral blocks (UMMB) through licking provides fermentable nitrogen, energy and minerals intermittently, necessary for optimum microbial growth. Microbial protein can contribute 30-40 percent of crude protein requirement of an animal. The use of (UMMB) for supplementing crop-residue-based diets for livestock has the potential to increase livestock production and net daily income. Urea molasses mineral blocks (UMMB) can be fed throughout the year but are more beneficially utilized during the dry season or when the animals are grazing

low quality fodder. Molasses based liquid supplements with added N, minerals and vitamins have recently been shown as another approach for increasing nutrient utilization to enhance growth rate and reproductive performance in cattle. Further, liquid supplements are also having advantages of supplying nutrients with fixed quantity, better availability and are easy to transport.

Why Supplement with Urea Molasses Blocks?

- UMMB can be an important source of supplement for ruminant animals to increase feed intake and productivity. This supplemental feed resource is rich in nutrients like carbohydrates, proteins and minerals.
- Ruminants in India are based on fibrous feeds like mature grass and crop residues. These feeds are deficient in protein, minerals and vitamins and are poorly digestible. Both these characteristics keep intake and productivity low.
- Supplementation with Urea Molasses Blocks (UMB) can increase digestibility of fibrous feeds by up to 20%, increase the nutrients the animal receives and can increase feed intake by 25 to 30%. If another good quality protein source such as cottonseed cake is added to the block, the animal will grow faster. Animals also benefit if other feed stuffs such as vitamins, minerals, medicines, etc., are added to the block.
- Blocks are a convenient way to make and store molasses and urea and also feed to animals. They can easily be made and used in villages. A person may make and sell blocks to farmers as a source of income.
- Several formulations are available for the production of UMMB, which allows responding to different prices and availability of potential ingredients.

How to Make Urea Molasses Mineral Block (UMMB)

- Urea Molasses Mineral Block (UMMB) is made from different ingredients where each has its own contribution in the mixture.
- It is usually made up of molasses, urea, minerals, rice bran, wheat bran, protein rich by-products, salt and water which are mixed and processed to the form a block by moulding.
- Molasses provides energy and minerals like sulphur. It increases its intake by the animal.
- Urea is a non-protein nitrogen source which is essential to improve the digestibility of the feed by providing fermentable nitrogen.
- Cereal bran is the most common fibrous feed used and provides energy and helps hold the block together. Oilseed cake is added to supply protein and it is a bypass protein source and provides immediate function for the animal.
- Salt is added to supply minerals and to control the rate of consumption.
- Cement is used to make the block. It makes the block hard and provides calcium.

Procedures for Production of Urea Multi-NutrientBlock

Urea Molasses Multi-Nutrient Block can be manufactured on the farm. UMMB manufacture is easy and simple and can be afforded by small-holder farmers and commercial producers. Different methods exist which may be used according to local conditions.

The manufacturing of UMMB can be divided into four stages as follows:

- Preparation of the Ingredients.
- Weighing and Mixing of Ingredients.
- Casting and Moulding.
- Drying.

Preparation of the Ingredients

The quantity of the different ingredients is needed to make the UMMB depends on the size of the block to be prepared and the formula to be used. UMMB with different weight and size can be prepared (1 kg, 5 kg, 10 kg and 20 kg etc). The weight of the block to be made determines the amount of each ingredient to be mixed. Using the following standard proportion, UMMB can be produced by thoroughly mixing the accurate quantities of the components viz;, molasses 40%, Rice bran 20%, wheat bran 10%, Urea 10%, cementing agent (Calcite powder) 5%, Lime 5%, mineral mixture 8%, salt 2% etc.

Casting and Moulding

- Once all the ingredients are thoroughly mixed and homogenous mixture formed, place the mixture into moulds.
- Any container, such as tin cans or small buckets can be used as a mould.
- Plastic sheets are used to line the moulds, which make easy to remove the blocks from the mould. The size of the mould to be used depends on the size of UMMB to be manufactured.
- For example to manufacture 5 kg of UMMB we can use rectangular wooden frame of 20 X 20 X 30 cm Length Width & Depth respectively. Compaction will be applied using a wooden bar and left for solidifying for 24 hours.

Drying

The block will be removed from the mold after 24 hours. The UMMB will be left to dry in a well-ventilated room under a shade for about 5-10 days depending upon the weather condition, after which it will be ready for feeding (Licking) by animals.

Characteristics of a Good Urea Molasses Multi-Nutrient Block

- A block is considered to be good when it fulfills the following characteristics are:
- Ingredients are well distributed throughout the block. It does not have lumps of urea.
- It is hard enough not to be squashed between our fingers and should be broken into pieces when it is through to ground. Our hands should feel the sticky appearance of molasses when we hold the block. It should smell a pleasant or sugary smell.

Advantages of the UMMB Technology

- Ingredients are easily available in almost all parts of the country. Methods of preparation are very easy and convenient. UMMB prepared by recommended standards has longer shelf life on storage at a dry place.
- Density of UMMB is much higher than the ingredients, which facilitates long distance transportation at a lower cost.
- UMMB blocks are suitable for supplementing dry fodder-based diets for sustainability of ruminants during lean period.
- UMMB is much cheaper than other conventional source of proteins such as oilseed cakes.

Precautions While Feeding Urea Molasses Mineral Block (UMMB)

- UMMB should be avoided for younger animals (< 6 months).
- UMMB should not be fed to animals which have not eaten fodder throughout a day.

- Consumption of excess quantity of UMMB should be prevented.
- Animals should have always been provided with clean drinking water.
- UMMB must be protected from rainwater so that it does not soften.
- UMMB should only be fed to ruminants (buffalo, cattle, goats and sheep) and never feed to monogastric species like (chicken, donkeys, horses, pigs, rabbits).
- UMMB should not be fed alone; a minimum quantity of roughage is needed to ensure that the animals do not consume excess urea, possibly leads to urea poisoning.
- UMMB should not have higher moisture (Not more than 10 %).
- UMMB should be stored at a dry place protected from insects, pest and rodents.
- UMMB should be offered to the animal in the dry manger etc.

Future prospective and Development

Although various research trial has conducted on UMMB and it has a long history, considerable additional research is still needed in order to fully exploit the benefits of incorporating various nutrients, minerals, additives and drugs in the UMMB. Formulation of blocks based on low cost and locally available feed resources that do not compete with human food should be one of the thrust areas for future work. Some regions are deficient in specific minerals. These regions should be properly mapped and blocks tailored to meet the requirements for specific minerals.

Conclusion

Urea Molasses Mineral Blocks can be an important source of supplement nutrition for sheep and goats to increase intake and increase productivity. It may be concluded that the nutritive value of crop residues which are deficient in nutrients can be enhanced by supplementation of urea, molasses and mineral block. UMMB provides easily fermentable nitrogen, energy and minerals necessary for optimum microbial growth which in turn provides host animal crude protein. Thus, supplementation of UMMB in the ration is quite beneficial. Apart from all positive responses this supplementation improves economic status of livestock owner by giving more economic returns through increased quality milk production.

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Role of Micro-Nutrients and Their Deficiency Symptoms in Rice under Intensive Cropping System

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Introduction

Nutrient is derived from latin word nutrire to 'nourish'. Nutrient is one of the most important factors for plant growth and development. Both macro and micronutrients are necessary for rice plants. Generally, sixteen nutrients are considered important for rice, where N, P and K are the primary macronutrients, Mg, Ca, and S are secondary macronutrients, and Zn, Fe, Mn, Cu, B, Mo and Cl are micronutrients. Every nutrient has its own character in different metabolic processes of plant life. Nutrients affect the disease tolerance or resistance of plants and its deficiency and toxicity conditions inhibit normal plant growth and exhibit characteristic symptoms. For optimal growth, development and production, plants need all the necessary nutrients in balance. Nutrient management both macro and micro nutrient in rice has many benefits to increase soil fertility as well as crop productivity. Micronutrient deficiencies are widespread. 50% of world cereal soils are deficient in zinc and 30% of cultivated soils globally are deficient in iron. Steady growth of crop yields during recent decades (in particular through the green revolution) compounded the problem by progressively depleting soil micronutrient pools. In general, farmers only apply micronutrients when crops show deficiency symptoms, while micronutrient deficiencies decrease yields before symptoms appear.

Rice (*Oryza sativa L.*) is one of the most important staple foods for more than half of the world's population. Its production worldwide is 510.6 million tons (FAO, 2018). Muthayya *et al.*, (2014) observed rice produces up to 50% of the dietary caloric supply for millions of people living in poverty in Asia. It contains reasonable amount of protein (6-10%), carbohydrate (70-80%), mineral (1.2-2.0%) and vitamin (Riboflavin, Thiamine, Niacin and Vitamin E). Now a days, a major factor that affects the food production is the increasing population and to meet the demand in enough quantity without damaging the soil quality, productivity and fertility is becoming biggest challenges in the present agriculture scenario. Therefore, the application of chemical fertilizer (macro and micronutrients) in huge amount are becoming mandatory to achieve the production requirements and also to meet the food demand. But this faulty method not only decreases the soil fertility, but also pollute the environment and also hamper the soil ecosystem and biodiversity. This situation is very prominent in case of rice cultivation area where huge quantity of chemical fertilizers is used. So, to overcome this problem, correct method of applying both macro and micronutrients are very important for rice production. Not only the macro nutrient but proper management of micro nutrients is also equally responsible for better production of rice.

Causes of micro nutrients deficiency in India

- Intensive cropping system through high yielding varieties.

- Lack of organic matter or low or no use of organic matter.
- Use of high analysis fertilizers having no micronutrient content.
- Not using micronutrients.
- Negative interaction of micronutrient with other macro or micro nutrients.
- Unawareness of farmers about micronutrients.
- Soil degradation.

Micro nutrients deficiencies and their Role in rice

Zinc (Zn) : Besides major nutrients, Zn is the most important micro-nutrients particularly in our country because most of Indian soil is deficient of it. Zinc is essential for several biochemical processes such as cytochrome and nucleotide synthesis, enzyme activation, chlorophyll production, maintenance of membrane activity, increase rate of seed and stalk maturation. Zinc deficiencies mainly occur when there is high organic matter in soil, calcareous soils with high bicarbonate content, intensively cropped soils. Paddy soil under prolonged submerged condition cause zinc deficiency. Deficiency symptoms causes brown to dusty brown spots on younger leaves, yellowing of leaves/midrib bleaching. Zinc deficiency in rice soil is commonly known as khaira. The main symptom of khaira in rice is usually in nursery, chlorotic/yellow patches at leaf base on both sides of the midrib; restricted root growth and usually main roots turn brown. But curative measure for correcting are application of 20 - 25 kg/ha $ZnSO_4$ in acid soil, 22 kg Zn/ha initially followed by 5 - 10 kg Zn in the later years or 50% gypsum + 10 t GM + 22 kg Zn once in 2 - 3 years in sodic soils, 1.0 - 1.5 kg/ha Zn as foliar spray at tillering stage and 2 times latter is very helpful for correct this deficiency. Plant Zn uptake from low Zn soils can be increased by Zn mobilizing chemical rhizosphere processes.

Iron (Fe) : Iron plays a vital function in rice photosynthesis. It may hamper K absorption because of its deficiency. The youngest rice leaves show the very first symptoms of its deficiency because of their immobile nature. The initiation of Fe deficiency is identified with interveinal yellowing and chlorosis of developing plants. The advancement of Fe deficiency contributes to a standardized pale yellow appearance with bleached appearances (Snyder and Jones, 1988). Though it is the most difficult and costly micronutrient deficiency to correct it can be controlled by application of $FeSO_4$ 25 kg/ha in between rows, application of iron containing fertilizers or foliar spary of $FeSO_4$ 1% - 3% solution. Iron toxicity is caused by toxic effects of excessive Fe uptake due to large concentration of Fe in soil solution

Boron : Boron is also one of the most important micro nutrient which is essential for cell wall formation, development of new cells in meristematic tissue, translocation of sugars, starches, phosphorus etc., and also concerned with precipitating excess cations, buffer action, regulatory effect on other nutrient elements etc. Boron deficiency occurs under moister stress and dry condition which cause reduced plant height (Zu *et al*., 2012). Plants fail to produce panicles if they are affected by B deficiency at the panicle formation stage. The tips of emerging leaves are white and rolled. Okuda *et al*., (1961) observed B deficient rice plant panicles certainly did not allow them to come out of the boot and eventually decreased grain production. For the corrective measure's application of B (1 - 2 kg/ha) is superior to foliar sprays. For hidden deficienct, spary 0.2% boric acid or borax at pre flowering or flower head formation stages. Excess of boron appears to inhibit the formation of starch from sugars or results in the formation of B-carbohydrate complexes, resulting in retarded grain formation (Chaudhary *et al*., 1976).

Manganese (Mn): Manganese also plays an important role in rice as it influences auxin levels in plants and high concentrations

of Mn helps in breakdown of Indole Acetic Acid (IAA), takes part in electron transport in photosystem II. Manganese also supports the movement of iron in the plant. Manganese deficiency is very common in upland rice, Pale greyish green interveinal chlorosis spreads from the tip to the leaf base. Necrotic brown spots develop later and leaf becomes dark brown. Newly emerging leaves become short, narrow and light green. Deficient plants shorter, with fewer leaves, weigh less, and smaller root system at tillering. Manganese deficiency can be corrected by application of farmyard manure, acid forming fertilizer (do not use urea), $MnSO_4$ or MnO at 2 - 5 kg/ha as multiple application (Chaudhary *et al*., 1976). Chelates should be avoided as Fe and Cu displaces Mn.

Silicon (Si): Silicon is the second most abundant element in the soil after oxygen but not yet classified as an essential nutrient. Although Si is abundant in the earth's crust, its availability in soil is very low because of its low solubility from soil source (Lindsay. 1979). Silicon also provides greater stalk strength and resistance to lodging, increased availability of phosphorus, reduced transpiration etc. Silicon tends to maintain erectness of rice leaves, increases photosynthesis because of better light interception. The major deficiency symptoms of Si in rice are soft droopy leaves and culms, lodging of plant, severe pest-disease attack (Johnson *et al*., 2005). Deficiency generally occurs due to small mineral reserves in organic soil, old paddy soils of subtropical and temperate climates. Silicon deficiency can be correct by irrigation of water rich in Si, avoid excessive application of N fertilizers, recycling rice hulls or hull ash, apply granular silicate fertilizers like Ca. Silicate: 120 - 200 kg/ha; K silicate: 40 - 60 kg/ha for rapid correction. Foliar spray of Si at 0.1% - 0.2% with sodium silicate improve Si nutrition.

Copper (Cu): Copper helps in the utilization of iron during chlorophyll synthesis. Lack of copper causes iron to accumulate in the nodes of plants. It has an unique involvement in enzyme systems of plants like oxidase enzymes, terminal oxidation by cytochrome oxidase, photosynthetic electron transport mediated by plastocyanin etc. It also acts as "electron carrier" in enzymes which bring about oxidation-reduction reactions in plants. Sandy, calcareous, lateritic soil, high in organic matter induce Cu deficiency in soil. The main important deficiency symptoms of copper are chlorotic leaves, bluish green leaves, new leaves don't unroll and leaf tips give needle like appearance, reduced tillering, less pollen viability. Excessive liming in acid soil sometimes causes Cu deficiency in soil (Rafique *et al*., 2002). It can be control by seeding root dipping in 1% $CuSO_4$ suspension, apply Cu at 5 - 10 kg/ha once in 5 years in the form of CuO or $CuSO_4$. Foliar application can be done during tillering to panicle initiation stage. Soil application can also be done with $CuSO_4$ as broadcasting or band placement.

Molybdenum (Mo): Molybdenum is an essential component of the major enzyme nitrate reductase in plants. Its requirement of plants is influenced by the form of inorganic nitrogen supplied to plants, with either nitrite (2 NO^-) or ammonium (4 NH^+) effectively lowering its need. It is also reported to have an essential role in iron absorption and translocation in plants. Deficiency symptoms of Mo in rice resembles to nitrogen deficiency (older leaves become chlorotic). Necrotic spots are seen at leaf margins because of NO_3 accumulation. Molybdenum deficiency can be correct by liming of acid soils to pH 6.5 (not preferable if pH change is not desirable for other purposes). Beside these dusting with Na/NH_4 at 100 - 500 g/ha is very much beneficial. Foliar spay of Na/NH_4 molybdate at 0.1% is also beneficial (Graham *et al*., 2002).

Conclusion

Micronutrients play an important role in crop production. They are equally importantilike macronutrients so their application is necessary.

There is very narrow difference between deficiency and toxicity levels, so, micronutrients should be applied carefully only when crop needs them and after soiltest.

There is need for application of mixed and complex frertilizers containing micronutrients.

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Imposing Maximum Residue Limit on Spices : A Key to Smoothen Export

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Introduction

Growing food demands has compelled farmers to compromise with the quality of crop. To ensure maximum crop production and storage life,farmers and traders use pesticides which potentially expose the consumers to toxic residual effects of the chemicals. The limit values of these residues are set to verify that the food is safe to consume.The Maximum Residue Limits (MRL) can be expressed as the concentration of pesticide residue predicted to occur in or on food as a result of pesticide application according to Good Agricultural Practise (GAP) and product label specifications.The MRL is not a toxicological parameter rather a trading standard established by national and international bodies (e.g., Codex Alimentarius) to ensure that residues are monitored in international food trade.

Spices are low volume high value crops which are most demanded and expensive products in the Indian market. Spices are primarily used for adding aroma and flavour into the food product as well as for medicinal purpose. India is one of the leading countries for production, consumption and exportation of spices worldwide that is why India is known as the land of Spices. Major Spices includes Black Pepper, Cardamom, Ginger, Turmeric and Chilli and minors are Cumin, Coriander, Celery, Fennel, Fenugreek, Ajwain, Dill seed, Garlic, Tamarind, Clove and Nutmeg. India exports tonnes of spices annually, which play a significant role in India's GDP. Cumin (*Cuminum cyminum L.*), often known as jeera, is a seed spice crop with high export potential among the spices crop.It is widely used in food cuisines and savouries as an organoleptic nutritious element, as well as having therapeutic properties. It is a high-value seed crop among spices that is grown extensively in Rajasthan and Gujarat's arid and semi-arid regions. As evident Cumin is more prone to insect pests and diseases an array of fungicides and insecticides are used to control these diseases which leads in the accumulation of residue in the cumin seeds. Crossing the MRL value in spices at international level is the most important reason for the cancelation of Indian export consignments which ultimately increases the risk of national and international trade.

Food safety in India is based on the Codex Alimentarius Commission's guideline of risk assessment (CAC). It is important to study the facts concerning pesticide action and persistence/dissipation under tropical Indian circumstances in order to accurately use the potential of pesticides in agriculture and health programs without harming the environment. It is also necessary to determine the status of pesticide residues in order to assure consumer safety and to overcome trade barriers on an international level. As a result, pesticides and their residues are frequently encountered, posing a serious health risk which is a matter of great concern. Many times, Internationally,

Joint Food and Agriculture Organization (FAO), World Health Organization (WHO), Codex Alimentarius Commission (CAC) member countries establish science-based food standards to ensure food safety, quality and fairness of international trade. India is a signatory to the CAC, and the National Codex Contact Point (NCCP), CAC's operations are administered by the Food Safety and Standards Authority of India (FSSAI). Since 2012, the ICAR-All India Network Project on Pesticide Residues (AINP-PR) has forged a partnership with the FAO, WHO, Joint Meetings on Pesticide Residues (JMPR) and Codex Committee on Pesticide Residues (CCPR) for the fixation of Codex MRLs in Spices, taking into consideration the challenges regarding consumer safety and export of spices from India. All India Network Project on Pesticide Residues (AINP-PR) establishes well protected system as a key success factor for the spices crops export worldwide.

Systematic Representation of Fixation of Codex MRL on Spices crops by India

ICAR-AINP on Pesticides

Residues Data Generation

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Submission of data to FAO/WHO/JMPR through FSSAI-NCCP

⇩

FAO/WHO/JMPR Data Evaluation, Risk Assessment & Proposal of MRL

⇩

Codex Committee on Pesticide Residues Adoption of Proposed MRL

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Codex Alimentarius Commission Approval of Adopted MRL and Notification by CCPR

Monitoring of pesticide residue at national level (MPRNL)

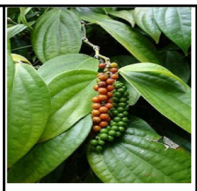
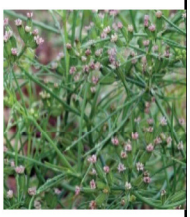
Since 2008, pesticide residue monitoring data has been compiled on various spices via central sector scheme on "Monitoring of Pesticide Residue at National Level (MPRNL)" under the ICAR-sponsored All India Network Project on Pesticide Residues (AINP-PR) and the Department of Agricultural Cooperation governed by Ministry of Agriculture and Farmers Welfare.

Significance of MPRNL

- In order to bring limelight to extension efforts for Integrated Pest Management, identify crops and locations with a rising percentage of pesticide residues (IPM).
- To promote infrastructure at quarantine stations for check the entry of items which having pesticide residues exceed the MRL.
- Pesticide residue testing and certification in export and import consignments.

In 2014-15, India submitted pesticide residue data collected on spice crops by the AINP-PR to the FAO/WHO JMPR for risk analysis and evaluation of suggested MRLs, which were addressed at the CCPR meetings. During the 49th session of the CCPR which were scheduled in 2017, the CCPR formed and approved Codex MRLs (CXLs) for 19 combinations of pesticide-spice for five different spices (cardamom, coriander, fennel, cumin, and pepper (Table 1). CCPR then made the MRLs available for international use. It also has been proved as a great achievement by India.

Table 1. Codex MRLs on different spices based on pesticide residue monitoring data generated by ICAR-AINP on Pesticide Residues (2012-17)

Commodity			Pesticide	Codex MRL (mg/kg)
Black Pepper			a. Dithiocarbamates b. Acetamiprid	0.1 0.1
Cardamom			c. Ethion d. Chlorpyrifos e. Bifenthrin f. Dithiocarbamates g. Cypermethrin h. Triazophos i. Cyhalothrin-L j. Profenophos	5 1 0.003 0.1 3 4 3 2
Coriander seed			k. Phorate l. Triazophos m. Profenophos	0.1 0.1 0.1
Cumin			n. Dithiocarbamates o. Profenophos	10 5
Fennel			p. Dithiocarbamates q. Phorate r. Triazophos s. Profenophos	0.1 0.1 0.1 0.1 0.1

Pesticides residue mitigating factor

Pre-Harvest interval

The concept of a Pre-Harvest Interval (PHI) is significant in driving healthy farming practises, healthy edible produce, residue-free goods, and improved export without pesticide residues as well as consignment rejection. Based on the dissipation rate of the sprayed pesticide molecules, a PHI of 25-38 days is often effective in resolving pesticide residues in harvested produce. Pesticides used in seed spices and their dissipation rates should be thoroughly assessed, with preference was given to those with shorter durations. Sustaining clean curing and storage facilities is also crucial in order to protect the product from extraneous pollutants that may be introduced owing to unsanitary conditions, resulting in contaminated commodities. Produce that has been graded before being sold in the market will almost surely fetch a higher price.

Good Agricultural Practices (GAP)

Another emerging concept is in the Good Agricultural Practices (GAP) field is of seed spices crops that may lead to reduction of excessive application of pesticides during crop growth.

Demonstrations Programme

Farmers usually used pesticides and chemical fertilizers to improve the performance of their crop which ultimately affect the export/ import consignments of spices crop. One of the biggest reasons is ignorance of farmers and lack of knowledge about MRL and GAP that is why there is a huge need of creating awareness among farmers and growers about these programmes through trainings and workshops.

Conclusion

Although the Codex MRL (at the global arena) for Spices has been fixed as a result of progress under the ICAR-All India Network Project on Pesticide Residues, for ensuring smooth export of spices and enhancing farmer's income.

Along with pre-harvest interval, GAP, IPM and regular training and workshop lead for the well establish system of mitigating pesticides residue from spices crops. Moreover, innovation of new and safer compounds with low residual toxicity potentially paves the path towards consumer preferences and health awareness.

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Seed Processing

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Introduction

Seed is not ready for sale immediately after harvest because it needs to undergo special technical treatment in order to meet certain quality standards. This technical treatment is composed of several stages namely: drying, cleaning and, grading, testing, treating, bagging and labeling. All these stages together are called 'processing'.

The objective of processing is therefore to give marketable seed that has been cleaned, graded, treated, packaged and tested. This means that during processing, the following types of undesirable materials are removed from seed: inert material, common weed seed, noxious weed seed, other crop seed, deteriorated seed, other cultivar seed, damaged seed and off-sized seed. The following sub-sections give brief remarks on the processing stages that a seed lot has to pass through.

Drying

Seed must be dried to an appropriate moisture level in order to facilitate processing, to prevent losses in germination and to reduce the chances of insect attack during storage. Drying generally involves the removal of moisture distributed inside the whole seed. The moisture first reaches the surface by capillary action from where it evaporates. Thus, drying of seeds is a relatively slow process. Seeds may be dried either (a) naturally or (b) artificially.

a. Natural drying : Natural drying is done by spreading the seeds on trays, floors or fields in the open sun. Air movement and heat generated by sun rays dry seeds provided weather conditions are favourable. In case of unfavourable weather conditions, drying must be done artificially.

b. Artificial drying : It involves passing of heated or unheated air through the seeds to remove moisture. In unheated drying, normal atmospheric air is passed through the seed. For effective drying, the air should have low moisture humidity; therefore, it is not effective in moist weather.

Heated air method involves passing of heated air through the seed. This method is quicker, faster and requires less drying space than the unheated air method. Drying is not affected by weather conditions as is the case with the unheated air method

Cleaning and Grading

The seed from threshing floor is mixed with seeds of other crops and of weeds, pieces of straw, gravel, soil etc. Further, the seed is not of uniform size, but it contains seeds of several sizes from some of which are undersized, shrivelled and unfit for use as seed. Separation of inert matter, weed seed and seeds of other crops from the seed is known as cleaning. Seeds from different crops differ in size, shape, weight, specific gravity, surface smoothness, colour, electrical properties, stickiness, etc. The specific gravity separators divide seeds on the basis of their weight and size; pneumatic separators separate seeds on the basis of their resistance to air flow; spiral separators separate them on the basis of seed shape; velvet-roll separators on the basis of surface smoothness; electronic separators on

the basis of electrical properties of seeds; and electronic colour separators on the basis of seed colour.

Grading is the removal of smaller and shrivelled seeds from the well filled healthy seeds. Air and screen machine uses air current for separating seeds on the basis of their resistance to air stream and uses sieves to separate seeds on the basis of their size and shape. Commonly, the air and screen machine has either two or three screens; the size of screens varies depending upon the crop.

Testing

After cleaning and grading, the seed lots are tested for percentage of pure seed, weed seeds, seeds of other crops, inert matter and germination. This is known as seed testing, and is done in a seed testing laboratory. Seed testing is an integral part of every seed certification programme and is used as a check on the quality of seed to be marketed. The seed certification agency carries out seed tests on the seed lots presented for certification.

Seed tests are done in seed testing laboratories. Almost every state has seed testing laboratory, which performs the following functions.

- Conducting research on seed testing methods.
- Training of personnel in seed testing.
- Determining the standards for seed purity and seed quality for various crops.
- Seed testing for certification and for implementation of seed laws of the country.
- Before certification, seed lots are subject to seed tests in seed testing laboratories. Generally, the following tests are conducted to determine the quality of seeds: (a) Purity test, (b) Germination or seed viability test, and (c) Moisture content test.

Sampling

Seed tests are conducted on small samples generally drawn from processed seed lots. It is essential that the samples used for seed tests are representatives of the lot.

Purity test

Purity denotes the percentage of seeds belonging to the variety under certification. The working sample is closely examined, often with the help of a magnifying glass, to classify it into the following components.

Pure seeds

Seeds of the variety under certification.

- Seed of other varieties of the same crop
- Seeds of other crops.
- Seeds of weed/objectionable weeds.
- Inert matter: Sand, straw, stones, pebbles, soil particles etc.

Defective seeds

Broken and shrunken seeds.

A broken seed that is larger than half of its original size and has intact embryo is classified as pure seed. Defective seeds are classified as inert matter. Impurity percentage is also referred as dockage.

Cultivar purity test

Determination of the amount of seeds of other varieties of the same crop in a seed lot is under certification is often more difficult than that of other impurities, e.g., other crop seed, weed seed etc. For this purpose, samples from seed lots are compared with an authentic seed sample of the cultivar in question. The seed sample is subjected to the following three types of tests as follows:

a. Examination of seed in the Laboratory: The seeds are analysed using one or more of the following tests.

- Examination of morphological features of seeds.
- KOH-Bleach Tests for Sorghum.
- NaOH Test for Wheat
- Peroxidase Test for Soybean.

- Phenol Test for Wheat.
- Poly Arylamide Gel Electrophoresis (PAGE)
- Molecular marker

b. Examination of seedling: Seedlings from the test and the authentic samples are grown under the same controlled environment and their characteristics are compared.

- Coleoptile colour
- DDT Resistance
- Size and shape of leaflets

c. Field Plot Test or Grow-out Test: These tests are much more useful in self-pollinated than in cross pollinated crops. The authentic sample is planted after every 10 test samples for a close comparison. Observations are made both on qualitative and quantitative traits of the test and the authentic sample plots during the entire growing period. A grow out test is quite comprehensive, but is rarely used in this country as it requires a much longer time, an excellent greenhouse/off-season nursery facility, and a much greater efforts and funds than the tests based on seed and seedling characteristics.

Seed Viability or Germination Test

Germination is determined as percent of seed that produce or are likely to produce seedlings under a suitable environment.

a. Germination test

Germination test determines the percentage of seeds that produce healthy root and shoot. In most of the cases, seeds are germinated on wet filter papers placed in Petri dishes. The Petri dishes are kept under controlled conditions in an incubator or in a culture room. For most species, a temperature between 18-22^{o}C is adequate. The duration of germination test varies from 7-28 days depending upon the crop species.

b. Tetrazolium Method

This method determines the percentage of viable seeds, which may be expected to germinate. The chemical 2,3,5-triphenyl tetrazolium chloride, is colourless, but it develops intense red colour when it is reduced by living cells. This phenomenon is used to determine the percentage of viable seeds in a seed sample.

Moisture content

Moisture content is determined as per cent water content of the seeds. Optimum water content reduces deterioration during storage, prevents attack by molds and insects and facilitates processing. The moisture content is determined by drying the seed samples in an oven or with the help of a moisture meter.

Moisture meters measure the resistance of seeds to an electrical current; the electrical resistance of seeds varies with the moisture content. The use of moisture meters requires calibration and a certain degree of technical skill on the part of user. But moisture meters are very efficient and extremely rapid a large number of samples can be handled in a relatively short period.

Treating

Before bagging, seeds are treated with a suitable fungicide, often in combination with an insecticide. Seed treatment is helpful in the following ways:

(a) It is helpful in controlling seed borne diseases, such as bunt in wheat, grain smut in jowar, seedling blight in maize, rice, jowar and wheat, Fusarium wilt of jowar and wheat etc.

(b) It protects seeds from seed and seedling rots caused by Pythium and Rhizoctonia commonly present in soil,

(c) It protects against damage by storage pests, and

(d) It protects from damage by soil insects in the field.

Bagging and Labelling

After seed treatment, seeds are distributed in bags of appropriate size, the process is known as bagging. Each bag is labelled with appropriate label, which carries the following information:

(a) kind of seed

(b) name of the variety

(c) purity

(d) per cent germination

(e) date of germination test

(f) per cent weed seed

(i) per cent inert matter

(j) name and address of seller

(k) period of validity of the certification

(l) any other information pertinent to the seed. Accurate labelling is important to the purchaser as it provides the necessary details about the seed. Seed laws require that accurate information be provided on the label.

Conclusion

Good quality seeds of improved varieties are the milestone for the green revolution, carrier and catalyst of agro-technologies. A successful and profitable crop production is only through quality seeds. Its production, availability and quality play a significant role in achieving the higher agricultural production. The quality seed is basically dependent the metabolic and synthetic efficiency during seed development and maturation, which in turn is reflected upon the germination and vigorous of the resultant seedling.

Harvesting is one of the agronomic management practices that require technical knowledge on maturity of the crops. This knowledge is much important in seed production than in commercial production. It is the process of removal of economic produce from the mother plant.

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Feathered Nursery Plants: A New Perspective for Raising High Density Plants

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Introduction

Feather is a branch that is produced in the same year as the leader. Feathers are sometimes produced in strong growing first year budded trees (although usually not enough feathers) or by a Knip-boom tree technique (where the one-year nursery tree is cut at the 60 cm (24") height and re-grown a 2nd year, producing feathers on a strong-growing leader. For a high quality tree, the presence of a good number of feathers is desirable because they form flower buds in the second year of nursery production and enable the tree to bear fruit in the first year. Also feathered trees enable an earlier formation of a canopy structure. Feathering: It is a technique for developing lateral branches in nursery plants by making use of either practice or plant growth regulators or both. Feathers are sometimes first year budded trees. Many temperate fruit crop growers are looking hard at making the investment in new orchards. With the large investment of money and management required to be successful, it is important to plan well & consider all details. Any mistake made at the beginning about: Site selection, Choice of rootstock or cultivars, Pollination, Soil preparation, Training system etc., have long term detrimental effects on the orchards performance & profitability.

Important factors in feathering are:

- Apical dominance.
- Nutrient availability.
- Ecological conditions.

1. Apical dominance : Apical dominance is a term referring to the control that the terminal bud exerts over the development of lateral buds. This dominance establishes certain branching patterns characteristic of each woody plant species. There are several hypotheses which try to explain the mechanism of apical dominance. The hormonal hypothesis, the photosynthetic hypothesis, the hypothesis of water and mineral nutrient transport. The hormonal hypothesis stresses the growth importance of auxins in the apical growth dominance & importance of cytokinins in overcoming apical dominance. With apples, Benzyl Adenine (BA) and the combination of BA and Gibberellins play an important role in overcoming apical dominance and in the production of well-feathered apple nursery trees.

2. Nutrient availability: If adequate nutrients are provided to plants at early stage then plants grow healthy and they produced more feathers at early stage, they give high yield and early economic returns.

3. Ecological conditions: This factor also helped in producing enhanced feathering. If ecological conditions are best then they produced more feathers at early stage. Sometimes due to ecological conditions, feathers are less produced and then that year yield becomes less. So, that we also manage ecological conditions for feathering.

Why we need feathering?

Now-a-days intensive orchards/HDP are in a wave and feathered trees are preferred

because non-feathers are non-precocious bearing i.e., bearing starts in 3-4 years after planting and maximum production occurs after 5years (late economic returns). But feathered plants show precocious bearing and start to give yield from second year of planting resulting in early economic returns. It is more profitable at early stage. Feathered plants are acknowledged as a building block/key factor for an early crop in the orchard. Well-feathered nursery plants greatly contribute to plant architectural engineering and shorten the investment period. Future pruning is consequently simple and management costs are reduced.

Type of branches using in feathering

- **Vertical branches :** These branches are inhibiting flower bud formation. These branches are lean and weak.
- **Horizontal branches :** These branches stimulate flower bud formation and are thick and strong.

In feathering, we prefer horizontal branches because they accumulate more carbohydrates and they produce more spur, it gives early yield and early economic returns.

Propagation techniques in feathering

Budding: Budding is the form of grafting in which only one bud is inserted in the rootstock. This method is generally employed during spring and rainy season.

Grafting : It is a method of vegetative propagation where two plants parts are joined together in such a manner that they unite and continue their growth as one plant. In this method scion twigs have more than two buds on it.

Feather formation is superior and vigorous on budded plants than on grafted plants. In budding, chip-budding has been found to be more effective. The use of chip-budding produced larger and more uniform feathers on one year old trees with more and longer lateral branches compared with T-budding. The superior growth of trees budded by chip-budding was associated with the formation of a better union between scion and rootstock. We prefer budding plants in feathering because they are more desirable as compared to grafted plants for developing feathers.

Advantages

- Feathering is governed by apical dominance.
- Feathering leads to early flower bud formation.
- Plant architecture is easy.
- Early economic returns.
- Thick & strong crotch angles.

Disadvantages

- More costly
- Due to dense feathering, fruit quality is reduced because interception of light does not occur at lower branches.

Nursery trees for the new orchard

Starting an orchard with high quality nursery trees is the first key to a successful planting. High qualities trees will quickly establish to the desired height & fill their space. The right trees will be ready to produce fruit in the 2nd year & will reach full production a few years later. Planting the right trees means early cropping which is the profitability of new orchard. Trees of lesser quality can eventually fill their space & produce good yields but the early returns are lost, so profitability over the life of planting will be less.

Characteristics of an ideal apple plant nursery

At least 1.7 m (5 ft) tall, preferably 2-2 m (6-7 ft). An abundance of healthy roots. Consider 6-10 “feathers” that are 12-25 cm (6-12”) long. The bottom feather no lower than 24” (60 cm) above the soil when the tree is in place in the orchard. Remove crisis cross and

diseases branches. Nursery plant should be diseases free for well feathers. Feathers are sometimes produced in strong growing first year budded trees (although usually not enough feathers) or by a Knip-boom tree technique (where the one-year nursery tree is cut at the 60 cm (24") height and re-grown a 2nd year, producing feathers on a strong-growing leader).

Sailent features of feathered plant

- A well feathered tree should have at least four to five branches in all the directions.
- It should be more than 12cm.
- A crotch angle of more than 45 degree.

Components of feathering plants

- Feathers / spreading branch.
- Crotch angle.
- Propagation technique.

Spreading branch

In any tree training system, the aim is to fill the trees space as quickly as possible. When you bend a branch or shoot below the horizontal position so that the tip is at the lowest point-the dominant bud. Before you spread branches with narrow crotch angles. Effect of branch spreading – the way that shoots or branches are spread and positioned and the time of year when this is done, affect growth and cropping. When you bend a branch or shoot below the horizontal position- so that the tip is at the lowest point – dominant bud. Encourages and increases flower bud formation Allows light penetration onto all portions of a limb.Increases fruit-setting.

Crotch angle

The angle made by scaffold limbs to the trunk or the secondary branch to scaffold limb is called crotch. The crotch should be broad and not narrow. The crotch angle measures the distance between the trunk and the base of the branch. An upright branch has a narrow crotch angle of less than 45 degrees. A sturdy, wide-angled branch has a 45 to 60 degree crotch angle. The crotch angle plays a role in light interception within the canopy. The crotch angle is particularly important for red skinned varieties because anthocyanin development is influenced by light intensity and duration. The best production comes from branches trained to grow at about 45 degree angle from the vertical position.

Feather Development

- Physiological Concept
- Hormonal Concept

Physiological Concept

- Feathering of nursery trees is controlled by apical dominance.
- Due to apical dominance plant exerts control over the development of the lateral buds.
- In order to produce a well-branched, highly marketable tree, apical dominance must be interrupted.

It has been a common observation in many vascular plants especially the tall and sparsely branched ones that if the terminal bud is intact and growing, the growth of the lateral buds just below it remained suppressed. Removal of the apical bud results in the rapid growth of the lateral buds. This phenomenon in which the apical bud dominates over the lateral buds and does not allow the later to grow is called as apical dominance. The apical dominance might be under the control of auxin produced at the terminal bud and which is transported downward through the stem to the lateral buds and hinders their growth.

Auxin induces vascular differentiation in plants. This has also been confirmed in tissue culture experiments and form studies with transgenic plants. Cytokinins are also known to participate in differentiation of vascular tissue and it is believed that vascular

differentiation in plants is probably under the control of both auxin and cytokinins.

Hormonal concept

Auxins play a role in apical growth dominance, which can be overcome by various growth regulators like cytokinins.

The application of 6-benzylaminopurine (BA) affects the fow of auxins and temporarily impedes the main shoot growth which helps overcome apical dominance and creates favourable conditions for feather formation.

Technique

How to develop feathering

PGRs

- Benzyl adenine
- Gibberellins
- BA+GA

Benzyl adenine

- Benzyl adenine are hormones that stimulate cell division, or cytokinesis.
- These hormones may also be involved in controlling leaf senescence and the growth of lateral branches.
- The most active, naturally-occurring cytokinin is zeatin.
- Benzyl adenine occurs in most plants including mosses, ferns, conifers, algae and diatoms.
- Benzyl adenine is the one of the chemical form of cytokinin.

Site of synthesis

- Synthesized primarily in the meristematic region of the roots.
- This is known in part because roots can be cultured (grown in artificial medium in a flask) without added cytokinin, but stem cells cannot.
- Cytokinins are also produced in developing embryos.

Transport

- Via xylem (transpiration stream).
- Zeatin ribosides are the main transport form; converted to the free base or glycosides in the leaves.
- Some cytokinin also moves in the phloem.

Benzyl adenine Actions

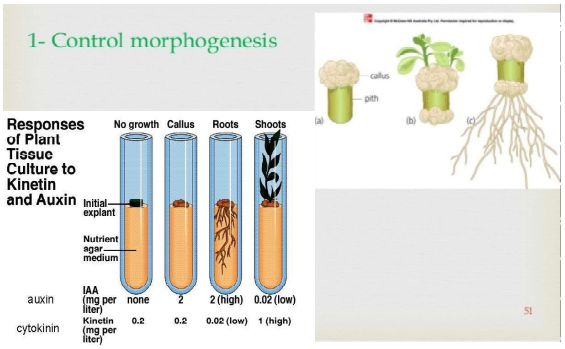
a. Control morphogenesis

- In plant tissue cultures, cytokinin is required for the growth of a callus (an undifferentiated, tumor-like mass of cells):

The medium	The callus differentiation
Callus + auxin + no cytokinin	Little growth of callus
Callus + auxin + cytokinin	Callus grows well, undifferentiated

- Ration of cytokinin and auxin are important in determining the callus

The concentration	The callus differentiation
Callus+low (cytokin-inauxin)	Callus grows well, / forms roots
Callus + high (cytokinin/auxin)	Callus grows well, forms meristem & shoots



b. Regulates the cell cycle/cell division

- (Hence, the name "cytokinins) -

especially by controlling the transition from G2 mitosis.

- This effect is moderated by cyclin-dependent protein kinases (CDK's) and their subunits, cyclins.

c. Bud development

- Direct application of cytokinin promotes the growth of axillary buds.
- Exogenous cytokinin and auxin are thus antagonistic in their effects on axillary bud growth

d. Delay senescence

- Senescence is the programmed aging process that occurs in plants.
- Loss of chlorophyll, RNA, protein and lipids.
- Cytokinin application to an intact leaf markedly reduces the extent and rate of chlorophyll and protein degradation and leaf drop.

e. Greening

- Cytokines promotes the light-induced formation of chlorophyll and conversion of etioplasts to chloroplasts (greening process).

f. Promote cell expansion

- Cytokinins stimulate the expansion of cotyledons.
- The mechanism is associated with increased plasticity of the cell wall, not associated with acidification.

Gibberellins

Site of synthesis

Young leaves, roots, and developing seeds (developing endosperm) and fruits.

Transport

I. Made in the tissue in which it is used.

II. Transport occurs through xylem, phloem, or cell-to- cell.

III. Phloem seems to be most important transport route.

IV. Transport is not polar, as it is for auxin.

Gibberellins Actions

Promotes stem elongation

- When applied to intact plants, GA usually causes an increase, unlike auxin.
- It overcomes dwarfism in mutants that have a mutation in the GA synthesis pathway.

Dwarf = short

Wild type = tall

Dwarf + GA = tall.

Thus, GA application.

- stimulates elongation.
- Acts on intact plants.
- Promotes stem elongation.

Dwarf Mutant gas

Dwarf Mutant plus Gibbnerellin

The Model plant Arabiodopsis has been used to understand gibberellin biosynthesis

- Root growth
- Elongation of the internodes
- Dormancy of buds

Root growth

Gibberellins have little or no effect on root growth. At higher concentration in some plants, however, some inhibition of root growth may occur. The initiation of roots is markedly inhibited by gibberellins in isolated cuttings.

Elongation of the internodes : Most pronounced effect of gibberellins on the plant growth is the elongation of the internodes, so much so that in many plants such as dwarf varieties of apple, pear , cherry etc.They overcome the genetic dwarfism.

Dormancy of buds

In temperate regions the buds formed in autumn remain dormant until next spring due to severe colds. This dormancy of buds can be broken by gibberellins treatment.

Mechanism of Gibberellin

- Of the 136 different known gibberellins only GA3, GA4, GA7 are important
- Promote cell expansion or cell division or both of plant.
- Extensibility changes in GA treated tissues: height reduced the extensibility of hypocotyls tissues while darkness and GA overcome this inhibition.
- GA 3 Synthesis of RNA Proteins: An increase in level of RNA and protein cause an
- Increase in total metabolites in plant cell.

Method of PGR Application

- Spray PGR 10 to 14 days after bud break to green tissue on the un-branched leader from the tip down to the existing branches or to 24 inches above the soil line on 1-year-old trees.
- Apply the PGR in white latex paint with a roller to the leader at bud swell, before any green tissue is showing.
- Notch the leader at bud swell before bud break with a hack saw or double-edged clippers.

Recommendations for Nurseries

First leaf apple trees where the leader has no buds broken but just prior to bud swell. For example, newly planted nursery tree whips. Second-leaf apple trees where leaders have vegetative blind wood with no visible buds or branches. Existing young, tall-spindle or vertical-axis apple orchards with limited branching in the tops of the trees. The key to branching trees is to start early and make multiple applications (3 to 5) of a PGR, depending on location. When the whip reaches 36 inches in height, treat the growing tip with a PGR. Repeat this application every 5 to 7 inches of new growth (7 to 14 days) for 4 to 5 applications. The use of feathered trees combined with high planting densities and minimal pruning has resulted in a significant improvement in yield of new orchards over the first 5 years. The larger the initial calliper of the tree at planting, the greater the growth and yield in the first 4-5 years. The greater the number of feathers at planting, the greater the yield especially in the second and third years. Feathered nursery trees are a critical component of most high-density apple planting systems including the Tall Spindle

Role of plant growth regulators in feathering on apple

In apple, BA and the combination of BA and GA play an important role in overcoming Apical dominance and in the production of well feathered apple nursery tree. The total no. of feathers increased with an increase in the concentration of BA and BA + GA. The highest no. of feathers was obtained with BA + GA 400 microlitr/liter treatments while in 2012 it was obtained with BA and GA 450 and 400 treatments. Increase in the concentration of BA and BA+ GA to a certain limit leads to an increase in the number of feathers.

The main factor responsible for tree branching potential is apical dominance is thought to be controlled by the interaction of endogenous growth hormones especially auxins & gibberellins. Additionally feathering may be influenced by other factors such as plant density, cultural practice & climate. For a high quality tree, the presence of a good no.

Table 1. : Effects of BA and BA + GA4+7 applications on feather length and tree height in Golden Delicious one-year-old trees (year 2011)

Treatment	Total feather length (cm)	Average feather length (cm)	Tree height (cm)
BA+GA_{4+7} 450[1]	172.6a[2]	25.8bcd	143.2d
BA+GA_{4+7} 400	164.3a	22.2cd	151.0cd
BA+GA_{4+7} 350	99.0c	25.8bcd	158.5abc
BA+GA_{4+7} 300	40.8e	20.4cd	155.0abc
BA+GA_{4+7} 250	23.4e	17.9de	159.6ab
BA+GA_{4+7} 200	32.5e	32.5ab	155.8abc
BA 450	137.3b	23.6cd	159.4ab
BA 400	105.8c	26.0bcd	157.0abc
BA 350	99.2c	27.1bc	153.3bc
BA 300	41.2e	18.8cde	159.0ab
BA 250	71.5d	35.0a	153.8abc
BA 200	18.0e	11.2e	154.7abc
Control	25.0e	19.9cd	161.4a

of feathers is desirable because they form flower buds in the 2nd year of nursery production & enable the tree bear fruit in the first year. Also feathered trees enable the tree bear fruit in the first year. Also feathered trees enable an earlier formation of a canopy structure. The application of BA phytohormones in higher concentration can negatively affect the tree height.

Neutralizing their negative effect on tree height is intensive irrigation accompanied with the provision of nutrients during the period of intensive growth of the main shoot, which should maintain an adequate growth rate.

One-year-old Golden Delicious apple trees untreated with phytohormones formed a small number of feathers at 62-64cm above ground in a standard nursery production method for one-year-old unbranches trees. Phytohormones BA and BA+GA_{4+7} significantly affected the formation of feathers. Increasing concentrations of BA and BA+GA to a certain limit leads to an increase in the number and the total length of feathers. In agro ecological conditions prevalent in Serbia, and with standard planting technologies, it is necessary to use BA and GA in concentrations of 400 micro litre/litre. BA so that a sufficient number of feathers is formed. If used in higher concentrations, the result may be trees shorter than 150cm due to negative effect of BA. A possible method of obtaining an adequate number of feathers with the application of BA and BA+GA while neutralizing their negative effect on the tree height is intensive irrigation accompanied with the provision of nutrients during the period of intensive growth of the main shoot, which should maintain an adequate growth rate

Role of PGRs in feathering of pear

Table 2. Total number of feathers, length of feathers and percentage of feathers in Maiden trees as influenced by different bioregulators.

Treatments	Number of feathers	Total length of feathers	Percentage of feathers
Control	4.13abc	71.5ab	48a
Arbolin 036SL-7.5 (ml/l) (2x)	5.26bc	79.4ab	90d
Arbolin 036SL-12.0(ml/l)	5.24bc	72.7ab	84cd
Arbolin 036SL – 25.0ml/l	5.00bc	71.8ab	90d
Arbolin 038SL-25.0 (ml/l) + amin	7.90de	119.2bc	90d
Arbolin 038 SL-12.0 (ml/l) + amin	5.95e	89.19ab	72b
Arbolin 038 SL-12(ml/l)	10.13e	143.4c	100e

The investigated pear cultivars differ in the degree of apical dominance. The use of BA and GA mixtures is an effective measure for promoting lateral branching of conference pear. Further investigation is needed to improve branching.

Role of PGRs in feathering of cherry

Table 3.The effect of Perlan treatment on the number, length, percentage and crotch angle

Treatments	Mean lateral number (no./tree)	Mean lateral length (cm/tree)	Crotch angle	Perc-entage (%)
Control	2.0ab	31.1 c	43.0c	58.3c
100ppm	2.8ab	34.4 bc	44.0c	83.3b
250ppm	2.3ab	48.6a	54.0ab	100.0a
500ppm	3.2a	47.6a	44.0c	91.6b
750ppm	3.0a	44.7a b	55.0a	100.0a
1000ppm	1.7b	45.0a b	46.0bc	50.0c

Most cultivated fruit species and cultivars do not produce enough lateral branches in the nursery because of strong apical dominance. However early high yields in intensive plantings are possible with branched trees having wide-angled lateral. Based on the first year data of our trials, 500 and 750ppm seem to be the most successful. Perlan treatments for sweet cherry, taking into account chemical cost, 300ppm could be suggested for inducing lateral branching on 0900 'Ziraat' nursery trees. Generally, Perlan also increased tree height and diameter. Application did not cause any phototoxic symptom on leaves or any damage on the tree. Additional trials with more cultivars under different conditions should be continued to ultimately establish a reliable and practical method to propagate branched trees in the nursery.

Pinching

Pinching is a form of pruning that encourages lateral branching on the plant.

Mechanism of Pinching

- Pinch-back the shoot two inches using your thumb and finger or pruners.
- Pinching will do two things: weaken the growth of the developing shoot so it is not likely to compete with the leader, and promote the development of a fruit bud in the vicinity of the pinch.
- Pinching should be done in the month of early July.

Table 4. Effect of different plant growth regulators and pinching on the number of feathers in Apple

	Treatments	No. of the feathers
T1	BA@45 0ppm(2x)	3.02
T2	BA@450 ppm (3x)	3.17
T3	BA+GA @450ppm(2x)	3.18
T4	BA+ GA @450ppm (3x)	4.01
T5	Pinching (2x)	1.18
T6	Pinching (3x)	1.42
T7	BA@450ppm(2x) + pinching	3.52
T8	BA @450 (3x) + pinching	3.83
T9	BA + GA @450oppm (3x)+ pinching	4.82
T10	BA + GA @450ppm (3x) + pinching	6.52
T11	Control	0.64

The results presented in this Table show that incremental height was significantly affected by both branching chemicals and

pinching. The untreated plants (control) resulted in maximum incremental height (26.16 cm), while as, the minimum increment in height (12.99 cm) were recorded under the treatment BA @ 450 ppm (three times) + pinching. The treatments BA+GA_3 @ 450 ppm (two times) + pinching (17.42 cm) and BA+GA_3 @ 450 ppm (three times) + pinching (17.15 cm) and BA @ 450 ppm (two times) + pinching (19.18 cm) were at par to each other in final plant height.The results presented in Table also further show that the percent increase in height was significantly affected by both branching chemicals and pinching. The untreated plants (control) resulted in maximum percent increase in height (54.13%), while as, the minimum percent increase in height (25.47%) was recorded under the treatment BA @ 450 ppm (three times) + pinching. The percent increase in height was at par under BA+GA_3 @ 450 ppm (three times) + pinching (33.75%) and BA +GA_3 @ 450 ppm (two times + pinching (33.62%) with each other.

Conclusion

The use of strong, well-branched nursery trees is a prerequisite of early and high yields because they are precious bearing i.e., bearing starts in 3-4th year.High quality nursery trees is the first key to a successful planting. High quality trees will quickly establish grow to the desire height and fill their space. The right trees will be ready to produce fruit in the second year and will reach full production a few years later. Planting the right trees means early cropping which is the profitability of new orchard. The quality of nursery tree can be enhanced by mechanical method or PGRs.The mechanical methods like heading, top twisting or removal of apical leaves are not so effective as plant growth regulators: PGRs are most effective when applied at the appropriate times to regulate plant growth or development. PGRs used in fruit crops are those that enhance branching, including Benzyl adenine, Gibberellins and benzyl adenine + Gibberellins. These PGRs are frequently called chemical pinchers because they generally inhibit the growth of the terminal shoots or enhance the growth of the lateral buds, thereby increasing the development of lateral buds, thereby increasing the development of lateral branches. Plant growth regulators can be used to enhance flowering. The use of PGR like BA and GA alone or in combination is an effective measure for promoting lateral branching to meet the growing demand of feathered plants.

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The Phenomenon of Parthenocarpy in Cucurbitaceous Vegetables: A Overview

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Introduction

The word parthenocarpy is originated from two Greek words "parthenos" meaning virgin and "karpos" which means fruit. The term "parthenokarpie" was introduced by Noll in 1902. Later parthenocarpy is defined by Winkler in 1908.

In botany and horticulture, parthenocarpy (literally meaning virgin fruit) is the natural or artificially induced production of fruit without fertilization of ovules. These fruits are either non-viable or seedless. In other words, the process which limits female fertility and allows growth of seedless fruits without fertilization is known as parthenocarpy (Schwabe and Mills, 1981) as reported in banana (*Musa paradisiaca*) (Joldersma, 2018), tomato (Lycopersicum esculentum L.) (Rotino *et al,* 1997), watermelon (*Citrullus lanatus*) (Kihara, 1951;), grapes (*Vitis vinifera*) (Gustafson, 1942;) and cucumber (*Cucumis sativus L.*) (Pike and Peterson, 1969; Li, J *et al*, 2017).

Another physiological phenomena similar to parthenocarpy known as, stenospermocarpy majorly observed in grape (Vitis vinifera) (Royo *et al* ,2018), is a process where fertilization of gametes happen yet the seed becomes rudimentary that is why it may also produce apparently seedless fruit, but the seeds are actually aborted while still small.

Classification

Parthenocarpy is classified primarily into 2 types as suggested by Varoquaux *et al.* (2002),

- Natural / Genetic parthenocarpy
- Induced or artificial parthenocarpy

Natural/ Genetic parthenocarpy

Natural parthenocarpy is when seedless fruits are produced without any special treatment. Seedless fruits are produced from the ovaries in the absence of pollination and fertilization without any special treatment. Since this is the natural process by which seedless fruits are produced so, that the process is called natural parthenocarpy.

Induced Parthenocarpy

Induced parthenocarpy is when seedless fruits are produced from the ovary by giving with special treatment to the flower. In this case, special treatments are given to flower to produce seedless fruits. The special treatment used to induce parthenocarpy is either water extract of pollen grains or growth-promoting hormones. As the name suggests induced (Artificial) + Parthenocarpy (Production of Seedless Fruit). So an Artificial Process to produce seedless fruits so this is called induced parthenocarpy.

- Irradiated pollen.
- Plant growth regulator (i.e. Auxin, Gibberellins) application.
- Polyploidy breeding.

Importance

- Seedless fruits like watermelon has better consumer acceptance. (Baker *et al.*, 1973).

- Parthenocarpy improves quality of fruits like in brinjal. We can get high-quality fruits with the help of parthenocarpy which is not possible by nature. (Dalal *et al*., 2006).
- Increases economical profit in postharvest industry. (Lukyanenko, 1991).
- Parthenocarpy improves stability in crop production as there is no need for pollinator insects and as well as pollinator plants thus yield of the crop also improves.(Rao *et. al*. , 2018)
- Parthenocarpy keeps the insects and pests away because there is no need for pollination. Insects are required for pollination. So parthenocarpy protects the plant from being attacked by pesticides.

Parthenocarpy in cucurbits

Cucurbitaceae family also known as cucurbits is one of the largest and economically important families, which consists of 95 genera and 965 species. Genus like *Cucurbita, Lagenaria, Citrullus* is included in this vast family. Which is equally important considering India's climatic and socio-economic factors this family is very important. So, producing seedless or parthenocarpic cucurbits also is favourable and profitabl for the following reasons: Seedlessness in fruits, more flesh content and more nutritious, parthenocarpic gynoecious varieties of cucumber are generally early in nature, yields more than other seeded varieties, due to the seedless nature parthenocarpic fruits don't need pollinators unlike other cucurbits, and for this reason parthenocarpic fruits are well suited for protected cultivation, year round propagation and production.

Parthenocarpy exploited in production of Cucurbits

Watermelon (*Citrullus lanatus*)

In watermelon parthenocarpy is not natural is induced by applying plant growth regulators, using soft X-ray irradiation, producing polyploidy fruits and sometimes by distant inter-specific hybridization.

But seedless fruit is more nutritious and economically profitable.

Plant growth regulator

CCPU @ 200 ppm induces parthenocarpy in non pollinated ovaries of watermelon (up to 89.5 %) as reported by Hayata *et al* in 1995, again when CPPU @ 200 ppm and NAA @ 150 ppm is applied parthenocarpy also induced significantly.2,4-D @ 25ppm minimizes number of empty seeds or papery seeds.

Polyploidy breeding

Kihara (1951) produced seedless polyploid (4n) watermelon using colchicine.

Irradiation

Diploid seedless watermelon was produced when pollination is done with soft X-irradiated pollen @ 800 and 1000 Gy in 'Fujihikari TR' resulted small empty seeds whereas for 'Benikodama' 400, 800 and 1000 Gy doses gave the best result (Sugiyama and Morishita, 2000) and gamma ray irradiated partially functional pollen @ 600 and 800 Gy. Results indicated that seedless watermelon cultivars had a significant increase in total sugar and carotenoid contents thus, providing an important source of phyto-nutrients in the diet. (Moussa and Salem 2009)

Interspecific hybridization

Parthenocarpic watermelon fruit obtained by pollinating with bottle gourd pollen. Female flowers of watermelon were pollinated with bottle gourd pollen (*Lagenaria siceraria* Standl.) produced seedless watermelon with

fruit set of 57.1 % (Sugiyama *et al*., 2014). There were no normal seeds except for some small, white empty seeds. Seedless fruits from bottle gourd pollen tended to be oblong or triangular and is considered to be a common tendency of seedless watermelon (Wong, 1938; Gustafson, 1941). The triangular shape was presumed to result from the inability of pollen tubes to reach the lower part of the ovary. That is, it was hypothesized that the secretion of hormones was insufficient in the lower part of ovary since deformation of fruit was related to hormone secretion (Yamane *et al.*, 2010).

Parthenocarpic Varities:

Arka Madhura from IIHR, Bangaluru, Happy family from Syngenta, Pusa Bedana [Developed from IARI by crossing Tetra-2(4n) x Pusa Rasal(2n)], Yellow Seedless (KAU-CL-TETRA 1 x CL-1), Red Seedless (KAU-CL-TETRA 1 x CL-4), Farrukhabadi, Asahi Yamato

Cucumber (*Cucumis sativus L.*)

Cucumber (Cucumis sativus L.), the fourth most cultivated vegetable around the world (Plader *et al*. 2007, Innark *et al*. 2013), is one of the most economically important cucurbit vegetable plants (Robinson & Walters 1997). Cucumber is a cucurbit crop which naturally produces parthenocarpic fruit, along with gynoecy parthenocarpic cucumbers produce early fruits with very high yield. But in some cases parthenocarpy can be induced by applying plant growth regulators and inducing transgene.

Natural / Genetic parthenocarpy

Pike (Pike, L. M., & Peterson, C. E., 1969) report that a single incompletely dominant gene (P) controlled parthenocarpy. The inheritance of parthenocarpy in cucumber is conditioned by an incomplete dominant gene *P*. In the homozygous condition *PP* produces parthenocarpic fruits early, with the first developing generally by the fifth node. Heterozygous *Pp* plants produce parthenocarpic fruits later than homozygous plants and fewer in number. The homozygous recessive *pp* produces no parthenocarpic fruits.

Artificialy induced parthenocarpy

Using plant growth regulators: Cantliffe (1972) found that Morphactin IT 3456 (methyl-2chloro-9-hydroxyfluorene-(9)-carboxylate), and TIBA (2,3,5-tiiodobenzoic acid) induced parthenocarpic fruit to develop at a concentration of 50 ppm; also the node for the formation of the first fruit was significantly lowered. Again at 100 ppm Morphactin IT 3456, CCDP (3-carboxy-1-(p-chlorophenyl)-4,6-dimethyl-2-pridone) and TIBA produced both morphactin and TIBA again lowered the node number at which the first fruit developed.

Transgenic induction

Zhimin Y *et al.*, (2006) induced parthenocarpy in cucumber by introducing DefH9-iaaM chimeric transgene into cucumber genome with *Agrobacterium tumefaciens* mediated method.

Irradication

Deunff and Sauton (1994) induced abortive embryogenesis by pollinating female flowers with irradiated pollen by at 400 Gy dose of gamma rays in the non-parthenocarpic cucumber 'Bellafem' was during spring and autumn.

Maintenance of genetic parthenocarpy in cucumber

The only way to maintain a parthenocarpic line is to inbred or selfing, but most of the parthenocarpic varieties are gynoecious in nature that's why induction of male flower is the only way to maintain parthenocarpic plants.

Pointed Gourd (*Trichosanthes dioica Roxb.*)

Pointed gourd (*Trichosanthes dioica Roxb.*) is a dioecious cucurbit vegetable and

green fruits are only edible after cooking. Seedless or less-seeded fruit is preferred because; seeds are unpalatable due to their hard coats. Parthenocarpy is also induced in pointed gourd;

Polyploidy breeding

Hassan *et al.* (2020) conducted a study by immersing diploid seeds in 0.05%, 0.1%, and 0.5% colchicine for 24, 48 and 72 h to induce tetraploid. These tetraploides are used in inter- ploidy and intra-ploidy crossings as parents. Crossing between compatible tetraploid (maternal parent) and diploid (paternal parent) (4x × 2x) resulted in a similar fruit set rate and shape as those of the diploid; but the number of seeds in 4x × 2x offspring is drastically less than it's diploid parent. This tetraploid female can be easily maintained by vine cutting.

Plant growth regulators

Jahidul Hassan and Ikuo Miyajima,(2019) reported that application of plant growth regulators to unpollinated flowers of pointed gourd successfully induced parthenocarpic fruits compared to corresponding hand pollinated fruits which produced several numbers of well-developed normal-sized and hard seeds. However, some parthenocarpic fruits induced by NAA and GA3 at 200ppm contained less than 5 seeds which were morphologically seemed abnormal and shorter in size compared to normal seed. The other plant growth regulators i.e. TIBA, CPPU, 2,4-D etc., treated parthenocarpic fruits have seed like cavity structure that were empty and covered by thin edible soft layer.

Problems with parthenocarpic fruits

- Seed production is a tough job in parthenocarpic plants hence it needs expert knowledge and sometimes not economically profitable.
- Seeds are quite expensive comparing to seeded varieties.
- Fruits are sometimes malformed and not ideal for market.
- Taste or texture of fruit is also undesirable sometimes as example parthenocarpic cucumber has soft watery texture which is not preferred by Indian customers.

Future scope of parthenocarpy

- Combine several genes with parthenocarpic gene
- Improve character and quality of fruit.
- Developing parthenocarpy in high value crops to get more and early yield.
- Combine male sterility gene with parthenocarpy gene to improve yield and promote crossing.
- Maintain and produce crops with stable level of parthenocarpy.

Conclusion

- As these parthenocarpy plants don't need pollination this factor may play a major role to develop many diverse cucurbits as most of them are cross pollinated
- In spite of some serious problems mentioned there's lot to exploit in cucurbits through parthenocarpy fruits.

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Cultivation Practices of Milky Mushroom

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Introduction

The first report on wild occurrence of Calocybe indica, commonly called "Dudh Chatta" means ("Milky white mushroom") originated from India. Its milky white color and robust nature are appealing to consumers (Fig. 1). In nature, milky white mushrooms are seen grown on humus rich soil in agricultural fields or along the roadside in tropical and subtropical parts of India, especially in the plains of Tamil Nadu (South Indian State) and in Rajasthan (located in the western edge of India). These mushrooms can be grown between the months of May and August, which normally coincides with sufficient showers after a prolonged dry spell. Since this mushrooms is morphologically similar to Agaricus bisporus (Button mushroom), it has been quite popular in southern Indian states and slowly getting popular in other countries (China, Malaysia, and Singapore). Cultivation of milky mushroom has become popular in Tamil Nadu, A.P. and Karnataka where the temperature prevails more than 25-30°C. This is tropical mushroom next to paddy straw.

Small scale mushroom growers prefer to grow this tropical mushroom due to the following reasons: (1) Ideally suited to warm humid climate (30-38°C and 80 to 85% humidity), (2) Its longer shelf life without any refrigeration (can be stored up to 7 days at room temperature), (3) Retains fresh look and does not turn brown or dark black like that of button mushrooms, (4) Lesser contamination due to competitor molds and insects during crop production under controlled conditions, (5) Infrastructure needed to grow this mushroom is very much affordable and cost of production is comparatively low, which means industrial production could be attractive and (6) Has a short crop cycle (7-8 weeks) and good biological efficiency of 140% (140 kg fresh mushroom/100 kg dry substrate).

Milky mushroom (*Calocybe indica*) can be grown on wide range of substrates as in case of oyster mushroom. It can be grown on substrates containing lignin, cellulose and hemicelluloses. Substrate should be fresh and dry. Substrates exposed to rain or harvested premature (green color) are prone to various weed molds which may result in failure of the crop.

Substrate and substrate preparation

It can be grown on any agricultural waste which have good amount of lignin, cellulose and hemicelluloses like straw of paddy, wheat, ragi, maize/bajra/cotton stalks and leaves, sugarcane leaves and bagasse, cotton and jute wastes, dehulled maize cobs, tea/coffee waste etc. However cereal straw (paddy/wheat) easily available in abundance, is being widely

used. Straw is chopped in small pieces (2-4 cm size) and soaked in fresh water for 8-16 hours. This period can be reduced when pasteurization is to be done by steam. Main purpose of soaking is to saturate the substrate with water. It is easier to soak if straw is filled in gunny bag and dipped in water. The substrate can be treated in various ways as follows:

Steam pasteurization

Wet straw is filled inside insulated room either in perforated shelves or in wooden trays. Steam is released under pressure from a boiler and temperature inside the room substrate is raised to 65°C and maintained for 5-6 hours. Air inside the room should be circulated to have uniform temperature in the substrate.

Hot water treatment

Water is boiled in wide mouth container and chopped wet straw filled in gunny bag is submersed in hot water for 40 minutes at 80-90°C to achieve pasteurization. Drain excess water and cooled the substrate to room temp. for spawning. This is very popular method particularly with small growers.

Chemical sterilization

Ninety liters of water is taken in a rust proof drum (preferably of galvanized sheet) or G.I. tub of 200 liters capacity. Ten to twelve kg of wheat straw is slowly steeped in water. In another plastic bucket, carbendazim 7.5 g and 125 ml formaldehyde (40%) is dissolved in 10 liters of water and slowly poured on the already soaked wheat straw. Straw is pressed and covered with a polythene sheet. After 15 to 18 hour the straw is taken out and excess water drained. One can use a larger container or cemented tank of 1000-2000 liters for soaking more straw. The chemicals to be added can be calculated accordingly. The remaining solution can be used once again for chemical sterilization of straw without any further addition of chemicals. Some of the farmers fill the pre wetted substrate in nylon net bags and press these bags in to the cemented tank containing chemical solution. This makes the process of taking out of substrate easier.

Sterilization/Autoclaving

Substrate is filled in polypropylene bags (35x45cm, holding 2-3 kg wet substrate) and sterilized in an autoclave at 15 lb psi for 1 hour. Once pasteurization/sterilization is over, straw bags should be shifted to spawning room for cooling and spawning.

Spawn and Spawning

Sorghum or wheat grains were found to be the best substrates for *C. indica* spawn production. During preparation of the spawn culture, these substrates are half cooked in water for about 30 min and the excess water is usually drained before the grains are slightly air-dried and mixed thoroughly with 2 % calcium carbonate. This wet substrate is then transferred to autoclavable polypropylene bags (usually 30 × 12 cm), which should filled up to 75% volume and sterilized at 20±2 lb psi for 90 minutes. After cooling to ambient temperature, the bags should be aseptically inoculated with the mushroom mycelia, closed and incubated at 30°C temperature. After 15 to 20 days of incubation, complete colonization of the substrate by the mushroom mycelia will be observed, meaning that they can be used for culture bed inoculation. The age of spawn is an important factor that influences the flushing pattern and yield of milky white mushroom. An interesting study developed by Pani who prepared spawns with wheat grains and stored for different periods (14-60 days), revealed that the best milky white mushroom yields were obtained using 21 day old spawn. Prolonged storage of spawn reduced the productivity and total yield.

The rate of mixing spawn to the prepared substrate should be 4 - 5 % of weight of wet straw, means 40-50 kg. Spawn is sufficient for

spawning 1000 kg compost. If lower rate of spawning is done then lower spawn run will be observed i.e., the duration of spawn run period will be increased while higher rate of spawning will lead to rise in temperature of the substrate which adversely affect the spawn run. Therefore the rate of spawning must be accurate.

Colonization of the substrate by mushroom mycelium is known as spawn run. In case of milky mushroom, complete spawn run may takes about 20 days. After that the bags are ready for casing.

Method of Spawning

Spawning is the inoculation of the culture into the substrate or compost. It is the actual planting of the spawn and requires much care depending on the species of mushroom and the technology being applied. However, there are several techniques of introduction of mushroom to substrate. It can be done by any of the following two methods:

Thorough method: Mixing of whole quantity of substrate with required amount of spawn thoroughly and then filled in the polythene bags or trays.

Layer method of spawning: It is the method of filling bags making layers of substrate and spawn i.e., fill some quantity of prepared substrate and then sprinkle spawn over it and then fill some quantity of substrate and then sprinkle some spawn. Thus fill the bag or tray with prepared substrate and spawn making different layers.

Spawned substrate is filled in polythene bags (35x45 cm size) of 125-150 gauze thickness. After filling cover the filled bags with polythene by tying the mouth of bag with rubber band or sutali. Then these bags are shifted to crop room for spawn run and 25-30^{o}C temperature with 80% RH and darkness in the crop room is maintained for the faster spawn run.

Casing

Casing is an important agronomic practice in the cultivation of any humicolous mushroom (that grows on soil) and milky white mushroom is not an exception. Casing was found to be an absolute requirement for proper fructification in *C. Indica* because it triggers off the change of mycelium from vegetative to reproductive phase. Compact casing interfaces impede the diffusion of harmful metabolic gases on mushroom bed surface. Thus accumulation of high concentrations of carbon dioxide in the soil during fructification usually results in yield depression. The qualities of casing soil are – (1) It should have a high water holding capacity, (2) It should retain a good air space ratio to facilitate gaseous exchange i.e., good porosity, (3) Ihe pH of such soil must be neutral to alkaline, and (4) It should be nutritionally poor.

Casing mixtures: Different formulations of casing mixtures can be used for the cultivation of milky mushroom e.g.

- Mixture of 2 years old FYM and 2 years old spent compost (1:1by volume).
- Garden soil and sand mixture (4:1 by volume).
- Decomposed FYM and loam soil (1:1 by volume).
- Peat soil, sand, biogas slurry, farm yard manure and coir pith compost.
- Partially steamed clay loam soil.

It is considered that casing prepared using clay loam soil generate maximum yields and a higher number of buttons than other media. In sandy soil and farm yard manure, the fungus took more than 10 days for the production of pinheads and attained harvesting maturity. In clay loam soil and peat, the buttons appeared almost 2 days earlier when compared to all other casing media tried. Interestingly, the clay loam soil had the quality to absorb moisture

quickly and release it slowly. In this soil, less water was needed to maintain the required moisture level and a delay in spraying did not lead to the total drying of bed surface. Using vermi-compost as casing substrate was also reported with limited success. In addition to its composition, pH, EC, water holding capacity, porosity and bulk density of casing mixture are some of the important factors to be considered while selecting substrates for casing.

Sterilization/Pasteurization of Casing mixtures

Casing soil is treated either by steam at 65-70oC for 6-8 hours or by drenching with formaldehyde or formalin (40%) @ 3 liters in 40 liters of water per m3 casing soil. The pH of casing soil can be adjusted between 7-8 (with the addition of chalk powder, calcium carbonate) about a week in advance of casing. Solution should be enough to saturate the soil. It is covered with polythene sheet to avoid escape of chemicals and at an interval of 2 days soil is turned so that at the time of casing soil is free from formalin fumes. Steam sterilized casing soil produced better yield than the chemically treated with formalin or using heat sterilization.

Casing application

Unfold the bags and its top is made uniform by ruffling the top surface of the substrate. Casing material is spread in uniform layer of 4-5cm thickness. Water spraying should be done immediately after casing application to make the casing wet. Temperatures 32-35°C and RH 80-90% are maintained in the crop room. Case run take about 9-10 days.

Crop Management, Harvesting and Packing

It takes about 10 days for mycelium to reach on top of the casing layer when fresh air is introduced while maintaining temperature and R.H. as above. Light should be provided for long time (10-12 hours daily). The changes thus made in the environment, result in the initiation of fruiting bodies within 3-5 days in the form of needle shaped pin heads which will mature in about a week.

Crop management

A. During substrate preparation

Substrate is a major source of weed molds and disease causing organisms. Hence substrate should be chopped and soaked at a distance from bag filling/spawn running and cropping areas. The worker chopping straw should not be involved in bag filling and spawning without taking a bath and change of cloth.

B. During the bag filing, spawning and Spawn running stage

(i) Bag filling and spawning room should be sprayed with formaldehyde (1%) twice in a week. Persons doing the process should take a bath and change the cloth before the job. There should not be much air movement in the room. For large scale production it is advisable to have Hepa filtered air circulation. Spawn running rooms should be sprayed as given below:

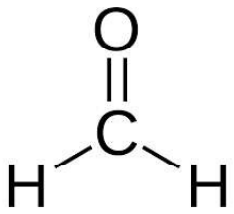
(ii) Formaldehyde 0.5% (5ml/litre of water) once a week.

(iii) Malathion 0.1% (1 ml/litre of water) once in a week. Rooms should be protected from the rates and flies by providing iron frames and nylon net on windows.

C. During casing and cropping:

At the time of casing bags open the top surface spray carbendazim (1 gm) + formaldehyde (5ml) in 1 liter of water, do casing and repeat it on casing soil and inside the room and again after a week. It should not be sprayed on mushrooms. Malathion (0.1%) should be sprayed in the evening or next day to protect from flies. It should not be sprayed on mushrooms. If any patch of mold (it may be green/blue/brown) is noticed do spot

treatment with formaldehyde (4%, 40 ml/liter) soaked cotton by touching it on and around the spot. This will kill the mould. Before removal of bags spray formaldehyde (2%) to dispose off spent substrate away from the farm.



D. Water management :

This is very important for a good and healthy crop. During rainy season controlled watering is required and watering once may be enough. During summer watering twice may be sufficient to maintain the required RH and moisture of the substrate. During such period one can use mist sprayer 3-4 times and frequently check the moisture of the casing by touching. Watering should also be adjusted to maintain RH inside the cropping room.

Harvesting and Packing

After 9-10 days of casing, pinheads start emerging out which will be ready to harvest within 3-5 days. Mushrooms 7-8 cm diam. are harvested with the help of Thumb and first two fingers by holding the fruit body, twisting it and pulling out from the bag. It should be done before watering the bags. After harvesting, cut the lower most portion of the stipe with the help of sharp knife to remove the soil adhered on it and then packing should be done. Packing can be done as per the market demand in packets of either 200 gm, 250 gm, 500 gm or one kg bags. However, if growers have to send the product to any processing unit for the making of value added products then bulk packing can also be done. Packing should be done in perforated polythene/polypropylene bags for marketing.

Spent Mushroom Substrate

The SMS of milky mushrooms has not been studied much as the cultivation of this mushroom has remained confined to only a few pockets of Southern peninsular regions of India only. As the substrate and the methodology used for substrate production are similar to that of *Pleurotus spp*. so it can be presumed that the physical properties of this SMS will be similar to that of SMS from oyster mushroom. The biochemical properties, which more depend upon the species used for cultivation, are bound to vary from specie to specie. Even with respect to its utility for cultivation of other mushrooms, for vermi composting, bioremediation, bio control of diseases and insect pests of crop plants, bio fuel production and composting for manure preparation has not been studied much. Considering the physical structure and bulk of SMS from milky mushrooms there are possibilities that it can found uses in bio fuel production that includes extraction of enzymes for their use in bio-ethanol production and their use in heat generation and composting for manure preparation.

Conclusion

Cultivated mushrooms have now become popular all over the world. There are over 200 genera of macro-fungi which contain species of use to people. Twelve species are commonly grown for food or medicinal purposes, across tropical and temperate zones, including the Common mushroom (*Agaricus*), Shiitake (*Lentinus*), Oyster (*Pleurotus*), Straw (*Volvariella*), Lion's Head or PomPom (*Hericium*), Ear (*Auricularis*), *Ganoderma* (Reishi), Maitake (*Grifolafrondosa*), Winter (*Flammulina*), White jelly (*Tremella*), Nameko (*Pholiota*), and Shaggy Mane mushrooms (*Coprinus*). Commercial markets are dominated by *Agaricusbisporus, Lentinulaedodes* and *Pleurotus*sp., which represent three quarters of mushrooms

cultivated globally. Mushrooms provide a high protein and low caloric diet and can thus be recommended to heart patients. They also contain all the essential amino-acid required by an adult. Small scale mushroom growers prefer to grow this tropical mushroom due to the following reasons: (1) ideally suited to warm humid climate (30-38ºC and 80 to 85% humidity), (2) its longer shelf life without any refrigeration (can be stored up to 7 days at room temperature), (3) retains fresh look and does not turn brown or dark black like that of button mushrooms, (4) lesser contamination due to competitor molds and insects during crop production under controlled conditions, (5) infrastructure needed to grow this mushroom is very much affordable and cost of production is comparatively low, which means industrial production could be attractive, and (6) has a short crop cycle (7-8 weeks) and good biological efficiency of 140% (140 kg fresh mushroom/100 kg dry substrate).

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Hydroponics – A New Horizon to Green Fodder Cultivation

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Introduction

Green fodder feeding to livestock ensures optimization of productivity. Though India is the top producer of milk in the world insufficient livestock feed, fodder is one of the constraints affecting growth, health, production and reproduction potential of livestock. Green fodder is essential to feed livestock but the reduced availability of land, lack of water and more labour requirement. It is become difficult to produce required quantity green fodder throughout the year also the lack of quality fodder hampers the growth production and reproduction of livestock. Green fodder plays major role in feed of milch animals, there by providing required nutrients for milk production and health of the dairy animal. Rapid urbanisation and mining areas has caused shrinkage of grazing and fodder producing lands. Due to non-availability of quality green fodder throughout the year, milk producers are forced to utilize extra concentrates for optimum milk production. Non availability of irrigated lands for fodder production, higher labour cost, and small land holdings has left dairy farmer with many challenges for milk production in the Country. It is quite evident that with decreasing cultivable land and depleting natural resources, sustainable technology would be the key driver of the dairy industry in the years to come.

Production of the natural diet for livestock, Green Fodder, to meet the current demand has become a greatest challenge among livestock farmers. India statistically utilizes only 4.9% of gross cropped land for cultivating green fodders and facing a deficit of 35.6% green fodder, 26% of dry fodder and 41% of concentrate feed ingredients. Realizing the need and gap between demand and supply of the green fodder, Hydroponic fodder production technology has revolutionized the green fodder production in the 21st Century.

The Reasons of Scarcity of green Fodder

- Rapid urbanization has caused decrease of land available for grazing and fodder cultivation.
- Fragmentation of land reduces land holdings.
- The farmer prefers to cultivate commercial and food crops.
- There is a scarcity of water for irrigation, due to water label depletion.
- Most farmers are poor and not able to fence their land which leads to free grazing cattle and wild animals enter the fields and causes menaces in the fodder field.
- Labour shortage is an acute problem in agriculture and animal husbandry allied activities.eg cultivation of green fodder, cutting, chaffing it and feeding the same to the cattle.
- In forest areas/coastal areas adequate land are not available for forage cultivation.
- In diversified climate of India, the climate is not suitable for fodder production.

What is hydroponics?

The word hydroponics has been derived from the Greek word 'water working'. Hydro means water' and ponic means 'working' and it is a technology of growing plants without soil, but in water or nutrient rich solution for a short duration in an environmentally controlled houses or machine.

The concepts of hydroponic fodder are date back to the 1800's or earlier, from the 'Hanging Gardens of Babylon' era, when European dairy farmers fed sprouted grains to their cows during winter to maintain milk production and improve fertility . It is a viable friendly alternative technology for landless farmers for fodder production without soil. It is also called fresh fodder biscuits, sprouted fodder or sprouted grain or alfa-culture . Fodders including maize, barley, oats, sorghum, rye, alfalfa, horse gram, ragi, bajra, jowar and triticale can be produced by hydroponic technology.

Importance hydroponic fodder production

Conservation of water

Hydroponic system minimizes water wastage since it is applied directly to the roots and is often recycled and used several times. The research findings concluded that hydroponic system equates to only 2-5% of water used in traditional fodder production system . It has been reported that only 1.5 – 2 litre of water is enough for 1 kg hydroponic fodder production compared to 73, 85, and 160 litres of water to produce 1 kg green fodder of barley, alfalfa, and Rhode's grass under conventional field conditions respectively .

Precise use of Space

Hydroponic systems require much less space and makes ideal for urban dwellers with limited yard space. Using hydroponics technology, up to 1000 kg maize fodder can be produced daily from 45-50 m^2 area which is equivalent to conventional fodder produced in 25 acres of cultivable land. It is also easy to start a hydroponic system indoors where number of racks with multiple tiers thereby resulting in land preservation. Practically, one square meter area can produce ample fodder for two cows per day and the milk yield was increased by 13% .

Reduces growth time

Hydroponic technology takes only 8 days to develop from seed to fodder where it took at least 45 days for a conventional fodder to grow.

Fodder yield

Fodder production is accelerated by as much as 25% by bringing the nutrients directly to the plants without developing large root systems to seek out food. One kg of un-

sprouted seed yields 8-10 kg green forage in 7-8 days .The hydroponics maize fodder yield on fresh basis is 5-6 times higher than that obtained in a traditional farm production and is more nutritious.

Source of essential nutrients

Compared to the un-sprouted seed, the content (DM basis) of Crude Protein (CP), Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF) and Calcium increased but organic matter and Non-Fibrous Carbohydrates (NFC) decreased in the hydroponic green forage. Hydroponic fodder is a rich source of vitamin A, vitamin E, vitamin C, thiamin, riboflavin, niacin, biotin, free folic acid, anti-oxidants like β-carotene and minerals. The biomass conversion ratio is as high as 6-7 times that of the conventional green fodder grown for 65-80 days. Besides, hydroponic fodder is a good source of bioactive enzymes, essential fatty acids, chlorophyll and minerals which directly responds fodder growth and improves the performance of livestock .

Persistent flow of green fodder

Fodder can be produced round the year irrespective of the failure of the monsoon, land availability, natural calamities and labour shortage that leads to sustainable agriculture and livestock production.

Reduced carbon footprints

Hydroponic is more environment friendly compared to traditional agriculture in relation to use of inorganic chemicals. This condenses GHGs emissions and lessens considerable global warming. Hydroponic systems help in reducing the fuel consumption for transportation of product from distant agricultural farms and carbon emissions in turn.

Limits of pesticides, insecticides and herbicides

Traditional outdoor farming must rely on herbicides, fungicides and/or insecticides for optimum production. Hydroponic fodder is grown in a controlled environment without soil and therefore no soil borne disease resulting minimizing use of pesticides, insecticides and herbicides. The susceptibility of any infection can easily be ruled out with specific compound in hydroponically grown fodder.

How to grow hydroponic fodder ?

One of the most important considerations for starting a fodder hydroponically is the kind and availability of the seeds. Choose the seed based on animal dietary needs, availability and weather condition. In summer maize (corn) and barley is best suitable crop but in winter oats and wheat.

The process of growing Hydroponic fodder

- Dry the seeds under direct sunlight one day prior to seed washing. Remove broken seeds and dirt's from the seeds. Store seeds in a dry and safe place.
- Weigh the seeds accordingly for each tray. As our fodder tray, 2 ft x 1.5 ft x 3 inches can take 1 kg of seeds, weigh it and then add to a plastic bucket. The seeds should be submerged in water, all the seeds which are floating would not germinate, remove them. Wash the seeds till the dirt is gone.
- Leave the seeds in the bucket for 12 hours. To prevent any contaminates add 50 gm of salt or dilute bleach or a horticultural-grade hydrogen peroxide solution.
- After soaking in water for 12 hours, drain all the water in the bucket. Next process is germination, you can do it in two ways. One way is clear all the water in the buckets, add the soaked seeds and allow the bucket to open air. The second way is to add these soaked seeds into a gunny bag. Both processes require 12 hours. If the germination doesn't happen, due to weather leave it for 24 hours. If the seeds are sprinkled some water over the seeds.

- After a total of 24 hours (1 day) transfer the seeds to the clean plastic tray as measured(1 kg of seeds). The plastic trays should not have any blockage for the drain holes and also clean from fungal infection. Its good practice to clean the plastic tray once used with any bleaching agent.
- The partially germinated seed is regularly sprinkled with water. For effective & uniform water application, sprinklers & timer assembly is used. The timer is useful for periodically switching on fogger. You can manually sprinkle the water 3 to 4 times a day.
- All seeds should come in contact with water, as the extra water is drained out through holes in the tray.
- Within a period of 7 to 8 days, there is profuse growth of fodder which is ready for feeding to the animals.
- The technique has its utility because of the high ratio of seed to fodder. One kg of seed can yield 6 to 8 kg of green fodder within a limited time span of 7 days. Harvest on the appropriate day: day 4 for poultry, day 6 for pigs and day 8 for cow.
- The cost of production of maize fodder works out to be Rs 2 per kg.
- Do not keep the fodder for more than 9 days, the nutrient contents will be low.

Conclusions

For sustainable dairy farming, quality green fodder should be fed regularly to dairy animals. Hydroponic fodder is a good option in front of the farmer because it grows fast, it contains a high nutrient value, and the most important thing is animals like to eat. Fodder obtained from hydroponics consists of grass with grains, roots, stem, and leaves as compared to the only stem and leaves the part in conventionally grown fodder.

Traditional fodder production requires a major investment for the purchase of land in addition to the investment of agricultural machinery, equipment, infrastructure for harvesting including handling, transportation and conservation of fodder. It also requires labour, fuel, lubricants, fertilizers, insecticides, pesticides and weedicides. On the other hand, hydroponic fodder production requires only seed and water as production inputs with modest labour inputs. Further, it minimizes post-harvest losses without requirement of fuel. Likewise, this novel technology takes only 7-8 days to converts seeds into fodder compared to fodder production by traditional system.

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Importance of Nutrients in Onion Production

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Introduction

Onions represent the Second largest area and production among vegetable crops after Potato in India. The per capita consumption of onions is around 741 gram in the rural area and 854 gram in urban area per 30 days. They are a high-value crop, where both high yield and quality are important economic considerations. Successful onion production depends on careful nutrient management, as well as other management techniques, pest issues and climatic factors. An onion bulb is different from other root crops (such as sugar beets) or a stem-produced potato. Each onion layer is called a "scale" in botanical terminology and comprises of the foundation of an individual leaf. Hence, the number of leaves is important in determining bulb size. A premium price is paid for a large onion, so they are sorted and marketed according to size. The market place for smaller onions is limited and less valuable. Important quality factors for onions include bulb shape, scale, color, scale thickness, scale retention, number of scales, bulb firmness, number of growing points, paper quality and neck thickness.

Nitrogen Application

Nitrogen is the most major nutrients for high returns and bigger bulb size. High application rates of Nitrogen for Kharif onion 75 kg/ha and for Rabi Onion 110 kg/ ha a bare normally needed (It applied in 3 splits first at basal, second at 30 DAT and third At 45 DAT). Placement is more effective than broadcasting. Because the crop is shallow rooted with poor root branching, it is common practice to use split N-applications to maximize uptake efficiency. It is likewise significant to apply nitrogen in the right form to maximize uptake during specific periods of crop.

Deficiency symptoms

- Deficient crops are slow growing.
- Pale yellowish-green colored leaves.
- New leaves are thin, erect and smaller in diameter.
- They are also more prone to breaking.

Phosphorus application

Phosphorus is a constituent of nucleic acids (DNA and RNA) and essential for energy transfer inside the plant. Therefore, it causes a direct effect on production and quality. Phosphorus is rarely required in large quantities. However, where crops are grown on soils with very low natural P levels, higher rates are required to boost yield and bulb size. It is important that phosphorus is available early season in order to encourage growth, particularly of the root system. Placement of phosphorus within the root zone has been shown to work better than when P-fertilizer is broadcast.

Deficiency symptoms

- Plant growth and establishment slows and rooting is adversely affected and stunted.
- Leaves are mottled green/yellow, brown.

- Maturity can also be delayed and crops tend to have a thicker neck at harvest.

Potassium application

Potassium is required in the production and transfer of sugars and carbohydrates to the bulb, enzyme activation and synthesis of proteins. It also maintains the ionic balance and water status within the plant, thereby improving resistance to cold injury and drought. Onions have a relatively high K-requirement. Maximum uptake is later than that of nitrogen and peaks during bulb formation and enlargement. However, over-application can lead to yield reductions.

Deficiencies symptoms

- Leaf tips turn brown and there is some slight yellowing of older leaves.
- Growth slows and leaves become erect.
- The entire leaf may also droop and appear thin and papery.
- Bulbs are soft with thin skins.

Boron application

Boron is involved with carbohydrate metabolism and protein synthesis. It also plays a key role in calcium movement within the plant. Boron is one of the essential micronutrients for onion production and should not be confined. While is quickly carried up from the soil, it is relatively immobile in the plant, so foliar sprays are much more efficient. It is important to sustain the right balance of calcium, nitrogen and boron in the soil. High calcium and high nitrogen levels can reduce boron uptake.

Deficiencies symptoms

- Young leaves develop yellow and green mottling.
- Older leaves yellow and die back.
- Light yellow lines appear and develop into ladder-like transverse cracks on the upper surfaces of older leaves.
- They become brittle and deep green in color.

Table1. Effects of Micro Nutrients at Growth Stages

Macro nutrients			
Stage	**Nitrogen**	**Phosphorus**	**Potassium**
Pre-Planting	Promote strong early growth	Maximize root development and to supply reserves for season long growth and good building	Promote strong early growth
Vegetative Growth	Ensure continued growth and development	–	Ensure continued growth and development
Bulb Formation	In nitrate forms to maintain bulb development and early growth		Peak requirements are during bulbing – for yield and quality
Bulb Fill	In reduced amounts so as to maintain dry matter production, but not compromise bulb quality	Encourage ripening, early maturity and a big bulb size	Maximize dry matter & sugar accumulation as well as quality

- Plants can be stunted or distorted.
- Deficiencies are most common on low pH and sandy soils as it is readily leached.

Zinc application

Zinc is important for the development and function of growth regulators (e.g. Auxins) that influence Internode elongation. It is also involved in chloroplast development and thus important for photosynthesis. Zinc uptake can be limited by heavy application of Phosphorus. Therefore, it is important that zinc and phosphorus are balanced, particularly during the early phases of growth.

Deficiencies symptoms

- Deficient plants are stunted and have twisted, outward bending leaves.
- Older leaves take on an orange mottled appearance.
- Younger leaves have a faint chlorosis and yellow striping.
- Building can be delayed and crops may not store well.
- Problems are more common on high pH or calcareous soils or during cold, wet weather.

Calcium application

Calcium is a key component of cells, maintaining the structure of cell walls and stabilizing cell membranes. It likewise delivers a direct influence on the salt balance within plant cells and activates potassium to regulate the opening and closing of stomata to allow water movement from the plant. Calcium enhances pollen germination regulates some enzyme systems and acts upon the maturation and health of cells and conductive tissues. Calcium is probably the third most important nutrient needed by onions and has a central character to play in maintaining crop quality. Calcium nitrate is particularly useful applied early to improve establishment, ensuring crops are ready to make a desired height before transplanting. Although relatively low levels of calcium in the bulbs are critical for storage and quality, improving the strength of the cells.

Deficiency symptoms

- Leaf tips or short lengths of the leaf - die back, without any previous yellowing of the leaf, causing the top of the leaf to fall over and die.
- Onion bulbs are of low density and reduced quality and have softer skins.

Magnesium application

Magnesium is required for many processes including transfer of energy and protein synthesis. With 20-25% of the plant's total magnesium localized in the chloroplasts, it is especially important for chlorophyll production. Onion crops use relatively low levels of magnesium. However, a regular supply needs throughout the life of the crop. Special caution is needed in fertization systems to ensure that magnesium, potassium and calcium are balanced.

Deficiency symptoms

Older leaves turn a uniform yellow along with their entire length due to lack of chlorophyll.

Leaves can exhibit pale lesions on leaf tips.

Sulfur application

Sulfur is an important component of enzymes and other proteins and is required for chlorophyll formation. It has a marked effect on the pungency of the onion through increasing the pyruvic acid content of the bulb a key quality characteristic. Most sulfur uptake occurs in late season during bulb growth. Sulfur helps to improve the crop's utilization of nitrogen. Plants with high sulfur content have greater tolerance to pest and disease attack. Sulfur has also been linked to increased skin

strength and color.

Deficiency symptoms

- Leaf production is affected and the plant produces fewer leaves.
- Younger leaves are uniformly yellow in color.

Molybdenum application

Molybdenum is an important component of nitrate reductase and thus involved in nitrogen metabolism as well as the synthesis of pigments and chlorophyll. As all other micronutrients, molybdenum plays a role in seedling and leaf growth.

Deficiency symptoms

- Deficiency in new crops results in poor crop emergence and seedling death.
- In established crops, lack of molybdenum leads to leaf tip dieback with wilted tissue between the necrotic and healthy areas.
- Problems are most common on acidic or sandy soils with low organic matters.

Copper application

Copper has a key role to play in lightning formation. It is also linked to chlorophyll performance. Adequate supplies of copper are important for bulb skin and onion scale development, as a result of the element's role in learning production.

Deficiency symptoms

- Tips of young leave turn white and twist into a corkscrew or bend at right angles.
- Bulbs have thin, yellow outer scales are less solid and are often earlier maturing.
- Deficiencies are more common on organic or sandy soils and where excessive nitrogen rates have been applied.

Table 2. Effects of some Micronutrients in Onion

Stage	Boron	Zinc	Calcium
Pre-Planting	Ensure good shoot growth	Ensure good shoot growth	
Vegetative Growth	Ensure photosynthetic growth is not limited	Ensure photosynthetic growth is not limited	Maintain vigorous, healthy leaf growth and to build plant supplies prior to building
Bulb Formation	To maintain leaf growth	To maintain leaf growth	Ensure good supply to the bulb to maximize eventual storage quality
Bulb Fill	To improve storage quality and calcium uptake	Less critical, but to maintain growth and prolong bulking	Maintain good bulb firmness and quality with reduced storage problems

Table3. Effects of Micronutrients in Onion

Stage	Magnesium	Copper	Molybdenum	Sulfur
Pre-Planting				Encourage plant growth

Stage	Magnesium	Copper	Molybdenum	Sulfur
Vegetative Growth	Maintain vigorous, healthy leaf growth and to build plant supplies prior to building	Ensure photosynthetic growth is not limited	Ensure photosynthetic growth is not limited	
Bulb Formation		To maintain leaf growth	To maintain leaf growth	
Bulb Fill		For good skin quality	Less critical, but to maintain growth and prolong bulking	Depending upon the desired pungency of the onion

Conclusion

Nutrients is very important for quality production and it is also responsible to increase the storage life of product. Major and minor nutrients are important in physiological and biochemical reactions, they are useful for the manufacture of sugars and carbohydrates. Minor nutrients are essential for pollen germination, amino acid, enzyme, chlorophyll, anthocyanin, etc. A good nutrient management in onion ensure bumper quality production.

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Hi- Tech Horticulture-A Concept to make Farming Economical

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Introduction

'Hi-tech Horticulture' may be defined as the deployment of any technology, which is modern, less environment dependent, capital intensive and has the capacity to improve the productivity and quality of horticultural crops. In recent years, with the increase in population, there is also increase in the demand for food and nutritional security. The conventional method of farming cannot cope with the increased demand, thus it is required to upgrade the technologies in the agriculture field. Also, the effect of climate change is likely to increase in terms of high temperatures, weather instability, the emergence of new pests and diseases, in addition to the danger of increasing sea levels and water decline from glacier sources, therefore to feed the increasing population we have to work smartly and also it is our moral responsibility to preserve the natural resources for future generations. The Food and Agriculture Organization (FAO) forecasts a 15-20 percent decline in global agricultural production by 2080. Consequently, designing appropriate solutions to reduce the effects of climate change is one of the greatest challenges for plant scientists today. To meet the needs of agriculture, strong research and development support is required to provide science-based solutions to improve the quality of life of people including farmers who also consume food and produce food for their livelihoods. Horticultural sector provide great scope for the use of hi technology in this area since by cultivating in small area of land the productivity is higher (especially vegetable, flowers crops and medicinal crops) as compared to other agronomic crops. Hi-Technology horticulture provides a tremendous potential for producing high quantity and quality of produce.

Potential areas in Hi tech Horticulture

a. Protected /greenhouse cultivation

Protected cultivation practice is outlined as a cropping technique where controlled micro-climate influences the growth and development of a plant. With the advancement in agriculture, several protected cultivation practices has been adopted massively in commercial farming. Among these protecting cultivation practices, green house, Plastic house, arte fact house, internet house and shade house etc., is useful. A greenhouse could be a framed or inflated structure lined with a clear or semi-transparent material that during which within crops may be full-grown underneath the conditions of a minimum of partly controlled setting.

b. Hi-tech propagation

Availability of quality planting material in required quantities in time is the basic need for horticulture industry (*Bhattacharyya et al.*, 2017). In recent time micro propagation has come out as one of the important tool for easy and quick production of large quantity of plant material and has been used in crops like banana, chilli, tomato and many high value ornamental plants like gerbera, orchid etc. There is a high scope in our country for micro propagation of crops especially in ornamental crop. Protray growing of seedling (tomato, chilli etc.,) can be practised where the large number of high quantity and quality of seedling can be grown in less area and time without much labour required. Growing of grafted seedlings and propagation of cutting can be done by use of poly bags.

c. Hydroponics

Hydroponics is a technology which in recent days gaining importance in High-tech Horticulture where subset of hydro culture adopted for growing most of the high value horticultural crops without using field based substrates i.e., soil. In this technology plants are cultivated by using different growing media with proper minerals in the nutrient solutions and a subset of hydro culture which involves growing plants (usually crops) without soil, by using mineral nutrient solutions in an aqueous solvent. Terrestrial plants may grow with their roots exposed to the nutritious liquid, or, in addition, the roots may be physically supported by an inert medium such as perlite, gravel, or other substrates. Despite inert media, roots can cause changes of the rhizosphere pH and root exudates can affect rhizosphere biology. Plants commonly grown hydroponically, on inert media, include tomatoes, peppers, cucumbers, strawberries, lettuces, cannabis and model plants like Arabidopsis thaliana. Hydroponics offers many advantages, notably a decrease in water usage in agriculture. Since hydroponics takes much less water to grow produce, it could be possible in the future for people in harsh environments with little accessible water to grow their own food.

d. Aeroponics

Aeroponics is the process of growing plants in an air or mist environment without the use of soil or an aggregate medium. The word "Aeroponic" is derived from the Greek meanings of *aer* ("air") and *ponos* ("labour"). Aeroponic culture differs from both conventional hydroponics, aquaponics and in-vitro (plant tissue culture) growing. Unlike hydroponics, which uses a liquid nutrient solution as growing medium and essential minerals to sustain plant growth, or aquaponics, which uses water and fish waste, aeroponics is conducted without a growing medium. It is sometimes considered a type of hydroponics, since water is used in aeroponics to transmit nutrients. The basic principle of aeroponic growing is to grow plants suspended in a closed or semi-closed environment by spraying the plant's dangling roots and lower stem with an atomized or sprayed, nutrient-rich water solution. The leaves and crown, often called the canopy, extend above. The roots of the plant are separated by the plant support structure. Often, closed-cell foam is compressed around the lower stem and inserted into an opening in the aeroponic chamber, which decreases labor and expense, for larger plants, trellising is used to suspend the weight of vegetation and fruit.

e. Vertical Farming

As urban populations continue to rise, innovators are looking beyond traditional farming as a way to feed everyone while having less impact on our land and water resources. Vertical farming is one such solution that's been implemented around the world. By vertical farming, horticultural crops can be cultivated easily in urban areas by planting in vertically stacked layers in order to save space and use minimal energy and water for irrigation. In India, vertical farming is at nascent stages; however, there are few start-ups & agri-tech companies revolution in the field. Vertical Farming has several advantages, which makes it promising for the future of agriculture. The land requirement is quite low, water consumption is 80 percent less, the water is recycled and saved, it is pesticide-free and in cases of high-tech farms there is no real dependency on the weather.

f. Integrated Pest Management (IPM) and Integrated Nutrient Management (INM)

Integrated Pest Management (IPM) has become a widely practiced Hi-tech horticulture practice now. Integrated Pest Management in horticultural production is one of the key requirements for promoting sustainable agriculture. Integrated Pest Management aims at a judicious use of cultural, biological and chemical control of pests and diseases. Integrated Nutrient Management (INM) Integrated Nutrient Management (INM) also has become a widely practiced Hi-tech horticulture practice now. Integrated Nutrient Management (INM) refers to maintenance of soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of the benefits from all possible sources of plant nutrients in an integrated manner. Another important aspect of INM is the enhancing of the Fertilizer Use Efficiency (FUE) by proper placement of fertilizer in close proximity to the rhizosphere of the highest root activity. Integrated Nutrient Management has become one of the common practices among progressive horticulture producers today.

g. Plasticulture

Plasticulture has become a popular hi-tech horticulture technology today. Plastics have various applications in commercial horticultural production. The practice of using plastics for commercial horticultural production is termed as 'Plasticulture'. Various applications of plastics in horticulture include Protected Cultivation (greenhouse structures; high and low tunnels etc), Plastic Mulching and Plastic Lining. Plasticulture improves the economic efficiency of production systems and helps in efficient water and energy management. Plasticulture reduces temperature fluctuations and moisture fluctuations and also helps in controlling pest and disease infestations. Plasticulture plays a dominant role in precise irrigation and nutrient applications by reducing wastage of water and nutrients and by reducing soil erosion. Use of plastics has proved beneficial to promote the judicious utilization of natural resources like soil, water, sunlight and temperature.

h. New technologies like Global Positioning System (GPS) and geographic information systems (GIS)

GPS receivers collect location information for mapping the boundaries of the fields,

irrigation systems, roads and the problematic areas in crops like weeds or diseases. GPS accuracy helps farmers to build farm maps with correct acreage for field areas, positions on the road and distances between points of interest. In farm preparation, field mapping, soil sampling, crop scouting and yield mapping, such technologies are used. These advanced systems allow the farmers to produce their crops accurately by applying the accurate quantities of pesticides, herbicides and fertilizers.

i. Use of Drones

Drones are the wireless and sensor-equipped devices used for surveying in the fields. They easily capture the whole data at lower altitudes and also capture high-quality images. These are also used for spraying insecticides and pesticides in the fields.

j. Food processing and value addition

As most of the crops in horticulture are perishable in nature, it is necessary to process them so they can be used for longer periods. Moreover, horticulture food processing forms a major percent of the entire food processing industry. For long term use, horticultural foods such as fruits and vegetables are processed into various value-added products such as pickles, preserves, squashes, marmalade, concentrate, fruit mixes, jam, jelly, canned vegetables and canned fruits. Talking about flowers, they not only excel for their aesthetic value, but they are also rich sources of Nutraceutical goods. Hi-tech horticulture has scope for many new avenues in the future.

Advantages of Hi-tech

- Yield increases up to 5 to 8 times – high productivity per unit area.
- Better quality growth and uniformity is there.
- Big savings in key inputs such as water (up to 50 percent), fertilizers (up to 25 percent) and pesticides.
- Possibilities of off season production.
- Round the year production of crops.
- Impact on natural ecosystems will be reduced.
- Less runoff of chemicals into rivers and ground waters.
- In the regions of extreme climatic condition hi tech structures are only option available option for crop production.

Disadvantage of hi tech

- Initial expenses are very high means requires high capital investment.
- Skilled labour is required to operate the farms.
- Need for research and development.
- Requires time and commitment.
- Experience and technical knowledge is very necessary.
- Water and electricity risks are always there.
- System failure threats.
- Diseases and pests may spread quickly.

Conclusion

Hi-tech horticulture is being commercially used for production of exotic (non-native) and off-season vegetables, export-quality cut flowers and also for raising quality seedlings. Economic returns from the high value agricultural produce can be increased substantially when grown under Hi-tech horticulture hence, it is a powerful tool for doubling productivity of horticultural crops and be used for doubling farmers' income also prosper our country by providing food as well as nutritional security.

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Socio-Economic Impact and Adoption of High Yielding Varieties in Small Millets for Productivity and Net Profit Enhancement of Tribal Farmers of Eastern Ghats of Tamil Nadu under Tribal Sub-Plan

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Introduction

Balanced growth and economic development in an eco-friendly manner is the ultimate aim of every country and the strategic plans for developing countries like India. During the five year plan, it was realized by policy makers that the Scheduled Tribes are still way behind the mainstream development process. Apart from this, it was also been realized that the general plan schemes and programmes designed for the overall development of the economy hardly improved their socio-economic status. Similarly, the benefit of such general welfare schemes did not percolate down towards the development of Scheduled Tribes (STs) Population of the country in any significant manner. In order to address these issues, the Tribal Sub-Plan was initiated during Fifth Five Year Plan for socio-economic amelioration of the tribal communities. Scheduled Tribes are the disadvantaged section of the society due to socio-economic exploitation and isolation for a long time. Since long, they have been relegated to low income generating occupations, inferior trades, unhygienic environment and menial occupations. The population of Scheduled Tribes (STs) is 104.3 million (2011 Census) constituting 8.6% of the total population of the country. Among them 90 % of STs live in rural area and only 10% live in urban area.

Improved-technologies generated during the past in agriculture especially high yielding short duration varieties are still out of reach of the tribal farmers. Major cause for this is illiteracy, ignorance about the technology, poor socio-economic status and very poor connectivity of the farmers. In spite of spectacular significant strides made in agriculture, development is yet to take place in remote areas, which have not received any assistance for their upliftment and the farmers of these areas are still dependent upon the old varieties and landraces in different crops, which are available with them since ages. However, these landraces were adapted to limited resources and due to poor maintenance still remain exceedingly poor yielder and with deteriorated seed quality. Hence, these farmers are forced to earn their livelihood in the neighbouring urban areas to fulfill their daily requirements. Limited availability of seeds of the improved varieties in spite of large quantity of breeder and foundation seeds being produced by the government agencies in public and private sectors seem to be major constraint in agricultural development. Looking into these facts mentioned, it is necessary to educate the tribal communities regarding their upliftment through adoption of modern agricultural technologies developed and these would also help in monetary gains mainly in small millets as their traditional crops. In this aspect, Centre

of Excellence in Millets, Tamil Nadu Agricultural University, Athiyandal, is implementing Tribal Sub-Plan in Eastern Ghats such as Kalrayan hills, Yelagiri, Servarayan, Kolli hills, Chitheri and Jawadhu hills of Tamil Nadu since 2016 under AICRP on Small Millets.

Case study

Goal of this project is to enhance the productivity in Little millet/Samai and net profit uplifting of Jawadhu hills tribal farmers. Objectives are to demonstrate the high yielding and short duration varieties in tribal farmer's field also net profit uplifting by primary processing of little millet. For the past five years (2016-17 to 2020-21) a total of 590 farmers were benefited under this scheme with an area courage of 125 ha with the project cost of Rs. 16.50 lakh. The main component of the scheme is input distribution for demonstrations and trainings about technologies. The critical inputs like, seeds, bio-fertililzers, bio-control agents, MN mixture, chemical fertilizers and small farm tools were distributed to the tribal farmers.

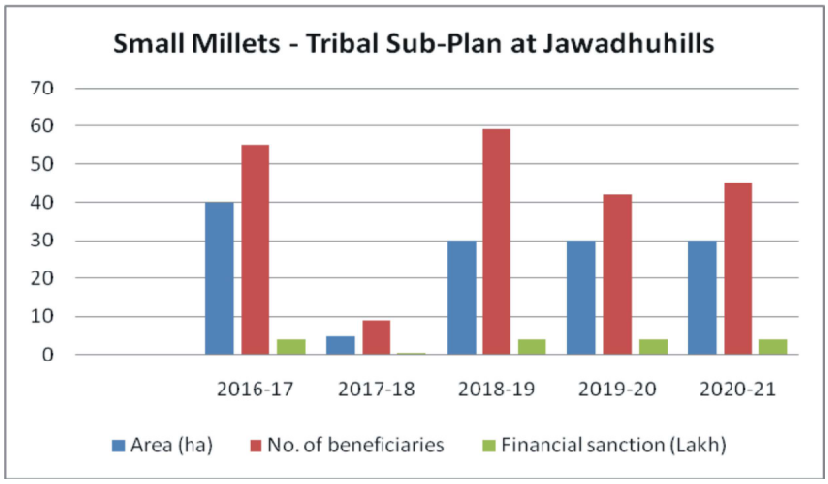
The average grain yield of the demonstrations is 1200 kg/ha whereas the average yield under local practice is 900 kg/ha which is 33 percent increase over their local practice in the Jawadu Hills. Through this scheme, the net income of the beneficiary farmers had increased by Rs.9000/ha with the B:C ratio of 1.5 to 1.95. By dehusking the grains using the millet mill, the farmers are able to sell the samai rice at a cost of Rs.80/kg whereas the grains as such are procured for Rs.25 to Rs.30/kg. Hence, through processing, the farmers are able to get an additional income of Rs.10/kg of grain.

One of the beneficiary, Mr. D. Vijayasarathi S/o Devarajan, Chinnakuttai village of Palamarathur panchayat has become an Agri-preneur at Jamunamathur to sell rice of Small Millets and biscuits made from small millets. Motivated by the success of this innovative farmer, a group of young farmers including a few farm-women have requested intensive training for value addition in small millets in coming years as their feed-back.

Table 1. Small Milets Demonstrations details under Tribal Sub-Plan

S.no.	Year	District	Crop & variety Area	Financial	Area (ha)	No of benefi-ciaries	Training	
							Nos.	Beneficia ries
1.	2016-17	Tiruvannamalai, Salem, Vellore, Dharmapuri	Little millet, Foxtail millet, Finger millet, Proso millet	4.00	40	55	-	-
2.	2017-18	Tiruvannamalai	Little millet	0.50	05	9	-	-
3.	2018-19	Tiruvannamalai, Vellore	Little millet, Foxtail millet, Finger millet	4.00	30	59	6	240
4.	2019-20	Tiruvannamalai, Salem, Vellore, Dharmapuri	Little millet, Foxtail millet, Finger millet, Proso millet	4.00	30	42	3	88
5.	2020-21	Tiruvannamalai, Tirupatturi, Dharmapuri	Little millet, Foxtail millet, Finger millet, Proso millet	4.00	30	45	3	120

Fig. 1. Year-wise (2016-17 to 2020-21) demonstration area and number of beneficiaries in TSP



Tribal-Sub-Plan Scheme under ICAR (Small Millets) has brought out success in yield maximization of small millets and increase the net income of tribal farmers through adoption of high yielding varieties, integrated weed, pest and disease management, milling and value addition. According to the proverb, 'seeing is believing', the tribal farmers have been motivated to become agri-preneurs after noticing the success of the farmer cum entrepreneur Th.D. Vijayasarathi. His self confidence and living status have improved and now he is capable of putting his mini stall in the exhibitions and explains the qualities of his products made of small millets.

Small farm tools distributed to farmers

Primary processing unit for little millet processing

Tribal Farmers training at Nilavoor

Conclusion

The high yielding and short duration small millet varieties were slowly replaced the traditional varieties in tribal areas for higher the production of small millet crops and availability of improved varieties as one of the witness is our cause study. Also the ultimate net profit uplifted by primary processing machineries as one of the joint hand for uplifted. Now the tribal farmers with small millets are joint together for a long way towards the traditional journey along with economic gain.

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A High Density and Ultra High Density Planting of Fruit Crops: A Novel Concept for Increasing Productivity

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Introduction

High Density and Ultra High Density planting is one of the novel concepts for increasing fruit productivity without affecting the quality of fruits. HDP is defined as planting at a density in excess of that which gives maximum crop yield at maturity if the individual tree grows to its full natural size. In other words, it is the method of planting of more plants than optimum through manipulation of tree size. India is the largest producer of fruits. India ranks second in fruits production in the world after China. The average productivity and per capita production of fruit crops is very low in India other than the developed countries. The main reasons behind low productivity are old and senile orchards, wider spacing, low yielding varieties, poor orchard management and inadequate technological up-gradation and adoption by the Subedi *et.al.*(2020). High density planting gives earlier production and return per unit area, shortens juvenility, eco-friendly, provides efficient land use and better use of resources like light, water and fertilizers, efficient pesticides application, besides, in this system the harvesting becomes easy (Peter *et.al.*(1975). High yield of fruit trees can achieved by adopting improved cultivar, good rootstock , quality planting materials and better cultivation practices, the important factors for maximum fruit production may depends on the number of trees per unit area. Hence using of HDP and UHDP is the best option to increase productivity and quality without affecting the plant and soil fertility (Robinson, 2007). HDP is one of the efficient production technologies to achieve the objective of enhanced productivity of fruit crops. Yield and quality of the produce are two essential components of the productivity. HDP aims to achieve the twin requisites of productivity by maintaining a balance between vegetative and reproductive load without impairing the plant health.

Principle of high density planting

- To make the best use of vertical and horizontal space per unit time.
- To harness maximum possible returns per unit of inputs and resources.
- Increased capture sunlight per unit area.
- Land use efficiency

Advantages of high density planting

- Best utilization of land and resources.
- Higher yield per unit area with quality fruits.
- Facilitate better utilization of solar radiation and increase the photosynthetic efficiency of the plant.
- Early economic returns.
- Induces precocity, increases yield and improves fruit quality.
- Reduces labour cost resulting in low cost of production.

Disadvantages of high density planting

- High initial establishment cost compare

to conventional system.

- Economic life span of the orchard becomes lower.
- Chance of reduction in fruit size and weight.
- Intercultural operation becomes difficult.
- Maintenance of plant architecture becomes a tedious job.
- Overcrowded growth of canopy results in build-up of high humidity, reduced cross ventilation in the orchard, which are conducive for more incidence of pests and diseases. e.g., Sigatoka leaf spot & fingertip in banana causes hindering effect in HDP.

Approaches for establishing high density orchards

- HDP can be achieved with the suitable use of following components:
  - **a.** Dwarf scion varieties
  - **b.** Dwarfing rootstocks and inter-stocks
  - **c.** Training and pruning
  - **d.** Use of growth regulators
  - **e.** Suitable crop management practices

Traditional planting system Vs. HDP

Sr. No.	Attributes	Traditional System	HDP/Meadow System
1	Tree numbers	Few large tree / ha	Many small tree / ha
2	Bearing	Start after two year	Start from 1st year
3	Production	Less	High
4	Labour requirement	More labour	Less labour
5	Management	Due to large tree size, difficult to manage	Due to small size of tree, easy to manage
6	Quality	Poor quality due to large canopy so less sunlight penetration	Good quality and colour development due to small canopy so more sunlight is penetrate and minimum insect damage
7	Production Cost	High	Low
8	Intercropping	Possible in early years when canopy is not dense	Not possible due to less spacing

Use of Genetically Dwarf Scion Cultivars

Sr. No.	Genetically dwarf cultivar	Desirable Features
Mango	Amrapalli	Precocious and regular bearing cultivar
Papaya	Pusa Nanha	Dwarf cultivar
Sapota	PKM 1 and PKM 3	Dwarf columnar tree shape
Apple	Spur variety like Red Chief and Orange spur	Bear on short stem, spur; bear more spurs and yield high
Cherry	Compact and Lambert	High yielding, Self fruitful and Dwarf
Peach	Red Heaven	Dwarfing and high yielding

Source: (Singh, 2018)

Use of Dwarfing Rootstock

Crop	Dwarfing rootstock
Apple	M9, M26, M27 (Ultra dwarf)
Ber	*Zizyphus rotundifolia*
Citrus	Trifoliate orange, Sour orange, Citranges
Guava	*Psidium friedrichsthalianum, P. pumilum,* Aneuploid - 82
Mango	Vellaikolumban for Alphonso, Olour for Himsagar and Langra
Cherry	Colt, Charger
Peach	Siberian C, St Julien X
Pear	Quince C
Plum	Pixy

Source: (Goswami, Jai & Singh, 2014; Singh, 2018)

Use of growth regulators

- Use of Bio-regulators can prolong dormancy, reduce vegetative growth, delay flowering, reduce fruit drop etc.
- Commercially adopted Growth retardants are CCC, Ancymidal, Paclobutrazol, B-9 (Phosphon D) and Chloramquat. Paclobutrazol have gained commercial application in crop regulation in mango.
- Tree size can be reduced by inducing viral infection e.g. Citrus, apple, but not adopted commercially. In apple, virus free rootstock series East Mailing Long Ashton (EMLA) are vigorous than their infected counterparts.

Plant Architecture in HDP

- Plants for high density should have more number of Fruiting branches and minimum number of structural branches.
- These branches should be so Arranged and sized that each branch cast minimum shade on other branches.
- Plant architecture is influenced by the method of propagation, rootstock and spacing.

Methods of HDP

- High density can be achieved by close planting which in turn is made possible through Control of tree size or planting in a system which accommodates more number of plants.
- Manipulation of tree vigour is an important prerequisite for success of high density planting in any fruit crop.
- High density of fruit orchards is generally achieved by controlling the size of tree or through improved planting system.

Impact of HDP

- In India the concept of High density orcharding in Mango took practical shape after the development of the dwarf and regular mango hybrid Amrapali at IARI, New Delhi and dehorning technique developed at the GBPAUT, Pantnagar.
- In mango, Amrapali at 2.5 X 2.5 m in triangular system accommodation of 1600 plants and Dashehari at 3.0 X 2.5 m in square system 1333 plants per hectare.
- Increase in yield per hectare was 2.5 times in Amrapali than that of the low density orchards of vigorous cultivar. In Dashehari mango, the average yield in high density is reportedly 9.6 tonnes compared to 0.2 tonnes in low density planting. This yield can further be improved in alternate bearing cultivars like Dashehari, Chausa and Bombay Green through the application of growth retardant like Paclobutrazol.

Spacing at different planting system of fruit crops

Sr. No.	Crops	Traditional Spacing (m)	HDP Spacing (m)
1	Mango	7.5 × 7.5 - 12.5 x 12.5	3.0 x 2.5 – 5.0 x 5.0
2	Banana	2 × 2 – 2 × 3	1.5 × 1.5 – 1.8 × 1.8
3	Papaya	2 × 2 – 3 × 3	1.8 × 1.8
4	Sapota	10 × 10	5 × 5
5	Guava	6 × 6 – 8 × 8	3 × 3 – 3 × 1.5
6	Aonla	10 × 10	5 × 5
7	Citrus	6 × 6 – 8 × 8	3 – 6 × 3 – 4.5
8	Apple	10 × 10	3 × 0.75

Source: (Singh, 2018)

Conclusion

Though HDP and UHDP have various advantages in much crop production but commercial adoption at farmer's orchard is still lacking. HDP and UHDP give maximum production per unit of area due to maximum number of tree. Hence, it is essential to maintain HDP and UHDP orchard by using various techniques like pruning of trees to develop proper plant architecture and annual canopy management for proper light interception. Use modern training system especially in temperate fruit crops for maintains shape and size of canopy for quality fruit production.

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Application of Nanotechnology: Prospects and Challenges

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Introduction

In the 1950's, physicist Richard Feynman, considered "the father of nanotechnology", launched the idea of the power of manipulating molecules and atoms, resulting in components so small they are invisible to the naked eye. However, Nano science is the study of particles on an atomic or molecular scale, whose size is measured in nanometres. A nanometre is a billionth of a meter. Thus, nano technology can be described as a collection of methods and techniques for processing materials at an atomic and molecular scale to create products with special physicochemical properties about conventional products (Antonio *et al.*, 2014).

It is emerging as a rapidly growing field with its wide application in science and technology to manufacture new materials at the nano-scale level, where unique phenomenon enables novel applications. The resulting materials and systems can be designed to exhibit novel and significantly improved optical, chemical, biological and electrical properties such as nano tubes, nano materials, nano wire, etc.

Therefore, it is clear that the new nano-scale products replace the old ones because of their efficient functions. Nanotechnology has the potential to revolutionize agriculture and food systems. The nano-scale level of foods can affect the safety, efficiency, bioavailability and nutritional value properties and the molecular synthesis of new products and ingredients (Aguilera, 2005). The nano-scale food additives are used to influence texture, flavour, provide functionality and even detect pathogens, detect food spoilage and release nano-antimicrobials to extend the shelf life.

Impact of Nanotechnology

Nanotechnology is a fascinating field of science dealing with the manipulation of an atom by atom. Thus, processes and products evolved from Nano science are the most precise ones that are impossible to achieve by the conventional system. Nano technology applications are expected to revolutionize the food sector in the future.

The potential applications include

- Superior processing techniques.
- Improved food contact materials.
- Better quality.
- Shelf-life of food products.
- Novel packaging materials with better mechanical barriers.

By manipulating matter on an atomic, molecular and supramolecular scale, antimicrobial properties can improve the properties of bioactive compounds like delivery properties, solubility and absorption through cells.

Nanotubes are utilized in partial hydrolysis of the milk protein a-lactalbumin by a protease from *Bacillus licheniformis* can be made to self-assemble into similar nanotubes under appropriate environmental conditions.

Nanosensors detect gases, pathogens, or toxins in packaged foods and electrochemical glucose biosensors are nanofabricated by layer-by-layer self-assembly of polyelectrolyte for the detection and quantification of glucose and a risk assessment report has been published about Magic. So, a list of factors potentially affecting human health and ecological risks of nanoparticles. Recently, there is considerable interest in exploring the potential of nanotechnology in encapsulation of bioactive materials such as compounds with poor water solubility, peptide, protein, drugs and large hydrophilic molecules and delivery of biologically active substances, also enhancing the flavor and other sensory characteristics of foods and introduce antibacterial nanostructures into packaging.

Clay nanocomposites are being used to provide an impermeable barrier to gasses such as oxygen or carbon dioxide in lightweight bottles, cartons and packaging biodegradable films. Storage bins are being produced with silver nanoparticles embedded in the plastic. The silver nanoparticles kill bacteria from any material previously stored in the containers, minimizing health risks from harmful bacteria. Nano-coatings and films are currently used on various foods, including fruits, vegetables, meats, chocolate, cheese, candies, bakery products and French fries. Now a day's Nanoemulsions are also used in food industries. And the application of nanotechnology in the food industry focuses specifically on applications that are most likely to be commercialized in the immediate future.

Application of Nano technology in Food Industry

a. **Nano-tubes:** Nano tubes are essentially buckyballs that have been on two sides with other atom groups added in the characteristic hexagon shape to form a hollow carbon tube. In comparison, partial hydrolysis of the milk protein α-lactalbumin by a protease from *Bacillus licheniformis* results in building blocks that self-assemble into nanometer-sized tubular structures at appropriate conditions and increase stability can be controlled. These nano structures promise various applications in food, nanomedicine and nanotechnology. Single walled-carbon nanotube field-effect transistors (SWNT-FETs) functionalized with olfactory receptor-derived peptides (ORPs) which can recognize trimethylamine, so it helps determine the quality of three kinds of seafood (oyster, shrimp and lobster), but were also able to distinguish spoiled seafood from other types of spoiled foods without any pre-treatment processes. And also, Carbon nanotube composites dendrimer can be used as an effective adsorbent for removing dyes from coloured effluents from aqueous solutions in a batch system and avoiding pollutants produced in many industries and have different adverse effects on water resources.

b. **Nano-sensors :** The development of novel sensors and biosensors with interest for the food industry is one of the key fields for recent days nano biotechnology and nano material science. The functionalized nano materials are used as catalytic tools, immobilization platforms, or optical or electroactive labels to improve biosensing performance, exhibiting higher sensitivity, stability and selectivity. Nanomaterials are playing an increasing role in the design of sensing and biosensing systems with interest for applications in food analysis. Nanosensors for detections of gasses in the package, small molecules and pathogens in food. And also, specific detection of sucrose and fructose in

several commercial fruit juice samples and the results were compared with those obtained with a commercial spectrophotometric enzymatic kit (Antiochia, 2014).

c. **Nano-composite :** Fish protein isolates FPI/ fish skin gelatin FSG-ZnO nano-composite films, especially those prepared at pH3, exhibited strong antibacterial activity and thus could be used as an active food packaging material (Arfat, 2016). Nanosilicon dioxide particles effectively hydrolyzed olive oil with modified stability, adaptability and reusability. Antimicrobial activity by silver nanoparticles on the above-mentioned microorganisms proposes the possibility of a more cost-effective solution antibacterial agent against dysentery-causing microbes.

d. **Nano-coatings:** Active food coating plays a role of a barrier to the outside environment to protect food products. Whereas gold was coated (Nanolayers of 40-nanometer thickness) on one side of apple, cucumber, lettuce and tomato, by Physical Vapor Deposition (PVD) method, in high vacuum condition at room temperature. The deposition angle of gold nanoparticles were vertical to all species. After coating, we kept them in normal room temperature and it leads to increases in the shelf-life products in average room temperature (Kangarlou and Shirvaliloo, 2012).

e. **Nano-emulsions :** Nano-emulsions are colloidal dispersions that contain small oil droplets (r<100 nm) that may be able to overcome many of the challenges of fortifying foods and beverages with omega-3 fatty acids. The composition and fabrication of nano-emulsions can be optimized to increase the chemical and physical stability of oil droplets and increase the bioavailability of omega-3 fatty acids. And also, in food products can facilitate the use of less fat without compromising creaminess, thus offering the consumer a healthier option. Products of this type include low-fat nanostructured mayonnaise, spreads and ice creams.

Challenges

The nanoparticles are more reactive, more mobile and likely to be more toxic. Toxicity is the most important issue that must be addressed before the commercial exploitation of nano particles. Whereas to determine the effects of these materials on the normal micro flora of the alimentary canal of the consumers. Currently, no regulations exist for specific control or limit for nano-sized particles production. Particle size, mass, chemical composition, surface properties, and aggregation of individual particles are the properties of nano materials that determine the impact on the body.

Conclusion

Nano materials used as food additives or food packaging materials must not cause any health risks for consumers or to the environment. Further, research studies are required to investigate the hazards of nano materials, taking the size as the main factor even though some of the chemical materials in the form of large particles are safer than when they are in the nano state. Hence, commercial application of nanotechnology-derived products can be made only after the safety issues are resolved. There is also an immediate need for regulation of nano materials before their incorporation into food and dairy processing, including packaging. In addition, nanotechnology-derived products need to demonstrate their economic competitiveness before commercialization. Until now, information related to the economic competitiveness of nano technology-derived products is almost lacking.

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Importance of Balance Diet and its Effects on Human Health

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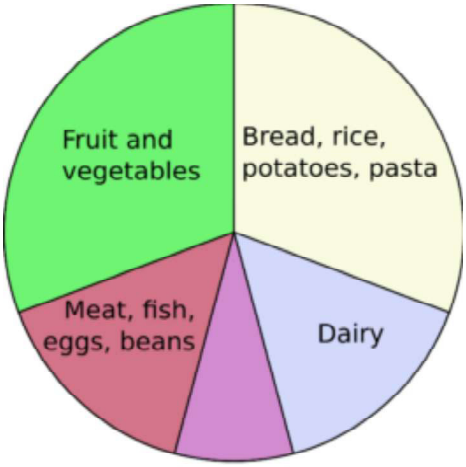
Introduction

A balanced diet is one that fulfills all of a person's nutritional needs. Humans need a certain amount of calories and nutrients to stay healthy. A balanced diet provides all the nutrients a person requires, without going over the recommended daily calorie intake. And a balanced diet is a diet that contains an adequate quantity of the nutrients that we require in a day. A balanced diet includes six main nutrients, Fats, Protein, Carbohydrates, Fibre, Vitamins and Minerals. All these nutrients are present in the foods that we eat. Different food items have different proportions of nutrients present in them. The requirements of the nutrients depend on the age, gender and health of a person.



Importance of a Balanced Diet

The following are the importance of a balanced diet:

Balanced Diet leads to a good physical and a good mental health.

It helps in proper growth of the body.

Also, it increases the capacity to work

Balanced diet increases the ability to fight or resist diseases.

Components of a balanced diet

Some components of a balanced diet are as follows:

Fats

Some part of our energy requirement is fulfilled by fats. Fats can be found in fatty foods such as butter, ghee, oil, cheese, etc.

Proteins

We need proteins for growth purposes and to repair the wear and tear of the body. Protein also helps in building muscle. It is found in dairy products, sprouts, meat, eggs, chicken, etc.

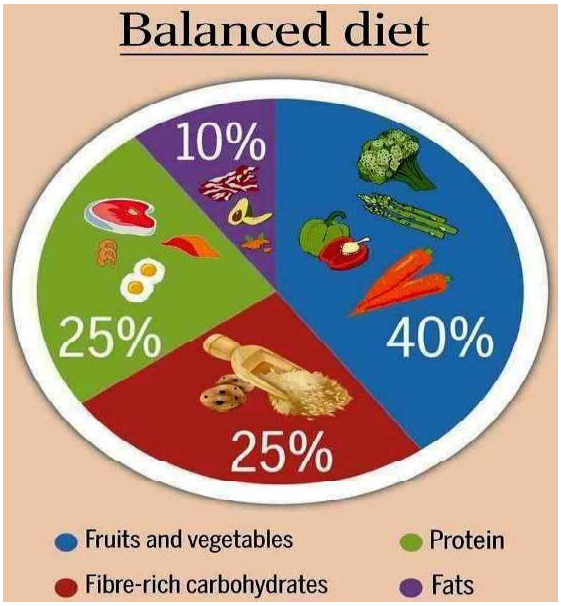
Carbohydrates

We need the energy to process and it is fulfilled by carbohydrates. Carbohydrates provide us energy. Carbohydrates can be found in rice, wheat, chapatti, bread, etc. Cereals are our staple food.

Minerals and Vitamins

Vitamins, Minerals and Fiber improve the body's resistance to disease. We mainly obtain it from vegetables and fruits. Deficiency diseases like Anemia, Goitre, etc., can be caused due to lack of mineral in the body.

Balance food materials and meals are important social events. But other than for pleasure, we need food to get nutrients, vitamins, minerals and energy. Very few foods are either all good or all bad. By having an idea of the balance in your diet, it should be easier to enjoy food and be healthy. The present investigate the perceptions of worldwide researcher about nutritional balance diet and its effects on human health body main Focusing on nutritional proper balance diet and its effects on health, in case if improper nutritional balance diet intake in both form under nutrition and over-nutrition have adverse effects on health. Your body requires variety and specific amounts of nutrients to function properly and perform the activities of daily life. If your body does not get those nutrients, which is common when eating an unbalanced diet, it can develop health problems. A common-sense approach, including eating from a variety of food groups and maintaining proper portion control, may help avoid any potential problems, as well as keep you healthy and vibrant in the process.



Nutritional balance diet is the quantitative analysis of food material that the human health body absorber. The body breaks down the food to get the body that it necessary: proteins, fats, carbohydrates, vitamins and minerals are the essential in human body. Nutritional to sum of all processes involved in how organisms obtain nutrients, metabolize them and use them to support all of life's processes. If body does not have these things, than the body will unable to work properly. Balance diet has been one of the basic needs of every individual living on the earth. And is that process which provides energy to the human body to perform various tasks in human body. Different kinds of disease, weakness and disabilities are closely related with the intake of insufficient amount to food nutrients and proper balancing diet. This study main focus upon nutritional balance diet and its effects on human health.

At least forty percent of your nutritional intake every day has to be through fruits and vegetables. It is ideal to ensure that every meal includes a colorful assortment of veggies and fruits, but if this is difficult to implement you could cover it over the span of a week. By doing this each day, you get an adequate supply of vitamins, minerals, potassium, folate, antioxidants and so on, without compromising on quantity or quality.

Eating a healthy diet is all about feeling great, having more energy, improving your health, and boosting your mood. Good nutrition, physical activity and healthy body weight are essential parts of a person's overall health and well-being. There's no questioning the importance of healthy food in your life. Unless you maintain a proper diet for a healthy body, you may be prone to diseases, infection, or even exhaustion. The importance of nutritious food for children especially needs to be highlighted since otherwise they may end up being prone

to several growth and developmental problems. Some of the most common health problems that arise from lack of a balanced diet are heart disease, cancer, stroke, and diabetes. Being physically active manages many health problems and improves mental health by reducing stress, depression, and pain. Regular exercise helps to prevent metabolic syndrome, stroke, high blood pressure, arthritis, and anxiety

Conclusion

Opting for a balanced, adequate and varied diet is an important step towards a happy and healthy lifestyle.

Vitamins and minerals in the diet are vital to boost immunity and healthy development,

A healthy diet can protect the human body against certain types of diseases, in particular no communicable diseases such as obesity, diabetes, cardiovascular diseases, some types of cancer and skeletal conditions.

Healthy diets can also contribute to an adequate body weight.

Healthy eating is a good opportunity to enrich life by experimenting with different foods from different cultures, origins and with different ways to prepare food.

The benefits of eating a wide variety of foods are also emotional, as variety and colour are important ingredients of a balance diet.

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Genetic Engineering Techniques in Fruit Crops

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Introduction

Genetic engineering is a powerful method for plant development that has the potential to allow desirable features to be integrated into existing genomes. Transformation technology has paved the way for crucial genes to be transferred into plant genomes for improving resistance to fungal, viral and other pests, drought and salinity, as well as silencing undesired genes and improving nutrient acquisition (Mallikarjuna *et al*., 2016).

Advantages

- GM Technology reduces the number of backcross generations.
- The ideal scenario being targeted gene editing with no alteration of the genetic background (no off-target effects). Thus GM breeding has the potential to be extremely fast.

Disadvantages

- One of the most significant drawbacks of GM breeding is that the target gene must be identified and sequenced.
- It necessitates specialist laboratories and is costly, while less expensive, simpler alternatives are being developed (Forster *et al*., 2015).

Methods of genetic transformation are usually divided into two categories:

- Indirect transformation.
- Direct transformation methods.

Direct Gene Transformation Methods

The methods by which foreign DNA is directly inserted into the plant genome then it is known as direct gene transformation methods. The introduction of naked DNA into plant cells is used in direct DNA transfer procedures. The majority of direct DNA transfer procedures are recognized to be simple and efficient. These methods have resulted in the development of several transgenic plants.

a. Particle bombardment

In biolistics technology, DNA is coated onto gold or tungsten micro-particles and bombarded at high velocity in a stream of helium into intact cells or tissues. The biolistic procedure is divided into two stages: 1. Coating metal particles (microprojectiles) with nucleic acid, and 2. Accelerating the coated microprojectiles to velocities suitable for penetrating target cells or tissues without causing severe biological disturbance. Because it does not require the manipulation of genetically engineered organisms like *Agrobacterium*, biolistic transformation is simple and safe. It also enables for the co-transformation of numerous constructs (Agrawal *et al*., 2005 and Naqvi *et al*., 2009) and the integration of larger transgenes (Alpeter *et al*., 2005). The co - transfer of large portions of the vector backbone DNA, which can severely affect transgenic expression, is one negative aspect of biolistics (Hammond *et al*., 2001 and Tassy *et al*., 2014).

b. Electroporation

The treatment of plant cells with short high-voltage electric pulses is known as electroporation. For high molecular particles like DNA, the electric pulse shock generates a temporary permeability of the plasmalemma (Bates *et al.*, 1989). The transport of DNA occurs through pores generated in the cytoplasmic membrane as a result of electric pulses (Sowers *et al.*, 1992). The pores have a temporal nature and are linked to the enhanced dipole moment of hydrophilic heads that make up cell membrane lipids. Phospholipid dipole heads dislocate in the direction of the electric field, causing breaches in the cell membrane's integrity. The specific effect of the electric field on tissues cultured in vitro was determined by analyzing the growth of isolated protoplasts as well as with protoplast-derived calli of Colt cherry (*Prunus avium* × *P. pseudocerasus*). Analyzing the growth of isolated protoplasts as well as protoplast-derived calli of Colt cherry (*Prunus avium* × *P. pseudocerasus*) was used to evaluate the specific influence of the electric field on tissues cultivated in vitro. The ability of electroporated tissues to regenerate plants was also examined. The callus made from protoplasts and exposed to three exponential pulses at 250 V or 500 V demonstrated the greatest fresh weight gains between subcultures (Ochatt *et al.*, 1988). Plant regeneration was achieved through secondary somatic embryogenesis when embryo and somatic embryos at the torpedo stage of coffee were electroporated with DNA containing the *gus* and *bar* genes.

A. PEG (Poly Ethylene Glycol)

Rearrangement of transgene sequences has been seen during protoplast transformation employing PEG transgenes, which can be integrated in single copies as well as multiple copies linked together or at independent loci. Protoplasts are advantageous as a starting material because they are totipotent, allowing transgenic plants to be regenerated from single cells without chimaeras. The protoplast's' cell cycle stage appears to play a role in the integration pattern, with protoplasts in M phase (mitotic phase) producing transgenic plants with more copies of the transforming plasmid, frequently at different loci. High copy numbers and frequent plasmid sequence rearrangement occur in protoplasts during the S phase (DNA synthesis phase) (Kartzke *et al*., 1990). PEG has often resulted in low transformation frequencies (less than 1 per cent of treated cells). Using effective selection techniques, however, a high number of transgenic plants can be created due to the availability of a large number of cells in such systems.

B. Sonication

The temporary permeability of the plasma membrane can be altered by sonication (ultrasound) to enhance uptake (Tachibana *et al.*, 1999). The ultrasound treatment may be easier to perform than other direct DNA delivery methods such as particle gun bombardment, electroporation and microinjection. Sonication, however, could cause cell damage or ever rupture. Regardless of the nature of the plant material to be transformed, gene transfer by ultrasonication follows the same simple procedure (Liu *et al.*, 2006).

Indirect Gene Transformation Methods

The bacteria of the genus *Agrobacterium* are mostly soil-dwelling and plant-associated. Crown gall disease is caused by phytopathogenic strains that have a tumor-inducing (Ti) plasmid in their genome, whereas hairy root disease is caused by strains that have a root-inducing (RI plasmid in their genome. The T-DNA region, which is flanked by left and right repetitions on the TI (tumor-inducing) plasmid, enables the transfer of DNA encompassed by these border sections. On their Ti plasmids, some *Agro bacterium species* contain more than one T-

DNA, resulting in more than two T-DNA boundaries from which T-DNA can be processed.

a. Agrolistics/ Agrolytics

The agrolistics strategy combines the benefits of efficient biolistic delivery with the precision of the *Agrobacterium* T-DNA insertion mechanism, reducing homologous areas that cause genetic and/or epigenetic instability. For some plant species, biolistic transformation is the preferred strategy, although many of the integration events that arise from these changes are undesirable. It is possible to achieve relatively predictable inserts in plants that are not ordinarily transformable using *Agrobacterium* by combining aspects of *Agrobacterium*-mediated transformation (Sharma *et al*., 2005).

b. Sonication-Assisted Agrobacterium-Mediated Transformation (SAAT)

In the presence of *Agrobacterium*, plant tissue is subjected to brief periods of ultrasound, which is an important modification in *Agrobacterium*-mediated transformation. SAAT treatment causes a large number of small and uniform wounds throughout the tissue, allowing easy access to the *Agrobacterium* and improving transformation efficiency in a variety of plant tissues, including immature cotyledons, leaf tissue, suspension cultures, somatic and zygotic embryos (Sharma *et al*., 2005).Many experiments have recently shown that SAAT significantly increased the efficiency of *Agrobacterium* infection by introducing a large number of micro-wounds into the target plant cells or tissues. In the *Agrobacterium*-mediated transformation of various fruit crops, SAAT improved transformation efficiency. For example, *Prunus mume* and *Vitis vinifera*.

Modern Genetic Engineering Techniques

Several innovative strategies have been created and are being used to enhance the breeding of superior crop varieties over the last 15 years. These procedures, when compared to traditional breeding, increase the precision with which changes in the genomes are made, reducing the time and effort required to develop varieties that meet new requirements. The employment of a GM phase is a common denominator throughout these approaches, but the end result is products with no foreign genes (i.e., genes not from the species itself or from cross-compatible species).GM is typically defined as a change in genotype caused by the insertion or alteration of a specific DNA sequence using artificial delivery systems and recombinant DNA technology. Earlier, GM technology centered on inserting DNA from a foreign species, but there has been a shift away from transgenics (foreign DNA insertion) to cisgenics (same species DNA insertion) and, more recently, targeted mutagenesis (genome editing) of a preferred genotype. These innovative methods includes TALENs, CRISPR/Cas9, Zinc Finger Nucleases (ZFNs) and RNAi and micro RNA technology.

Conclusion

Many fruit and vegetable crops, such as strawberry (*Fragaria* × *ananassa*), apple (*Malus* × *domestica*) and sweet orange (*Citrus sinensis*), are developed through hybridization and selection. The development of seedless horticultural crops such as watermelon using diploid and tetraploid parents is another application of hybridization breeding. Crop hybridization breeding, on the other hand, has some constraints that are quite difficult to overcome. Although fast track breeding techniques and genetic engineering approaches may speed up breeding and selection procedures, this takes tremendous amount of manpower and land resources. Recently, in addition to classical gene transfer technology, modern genetic engineering methods also have been started to apply for many plant species. It seems that the techniques illustrated in the present literature will be more important with combination of classical plant breeding.

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Fungal Leaf Spots in Banana

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Introduction

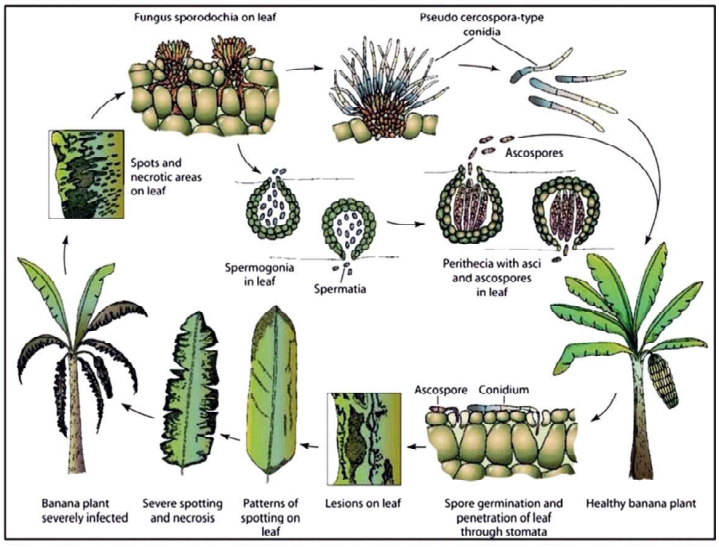
Bananas (*Musa spp*.) are the world's leading fruit crop with 140 million tons of bananas produced annually in subtropical and tropical regions. The fruits are a key staple food in many developing countries and as a source of income for subsistence farmers. It is originated from Indochina and South East Asia (Price, N.S., 1995).

Bananas and plantains are susceptible to several diseases that have been of serious concern to the industry, namely *Fusarium* wilt (Panama disease) caused by *Fusarium oxysporum* f.sp. *cubense* (Maryani *et al.*, 2019), Banana bunchy top virus (*Stainton et al.* 2015) and the Sigatoka leaf spot disease complex (Churchill 2011), which include the most serious leaf spot diseases of banana.

The sigatoka leaf spot disease complex is very destructive to the foliage of banana plants and reduces the photosynthetic area to the plants and causes a yield loss upto 80 percent. Among various *Mycosphaerella* spp., which cause leaf spot disease in banana, *Mycosphaerella fijiensis* (black sigatoka), *M. musicola* (yellow Sigatoka) and *M. eumusae* (septoria leaf spot) are considered as major leaf spot pathogens worldwide. In India, Eumusae leaf spot disease (*Pseudocercospora eumusae anamorph.*) is considered as the most important leaf spot pathogen of commercially grown cultivars of banana (*Thangavelu et al.* 2014).

Epideomology

With black Sigatoka, ascospores and to a certain extent conidia are the propagules by which the fungus is dispersed. Conidia form readily in high humidity, especially if a film of free water is present on leaves. These asexual spores disperse during rain-wash and splashing, causing local spread of the disease. Pseudothecia mature when dead leaf tissues are saturated with water for approximately 48 hours. Ascospores are the primary means of long distance dispersal and are the main means of spreading during extended periods of wet weather. *Mycosphaerella fijiensis* forms relatively few conidia, so ascospores are thought to be more important in



Disease cycle (Agrios, G. N., 2005)

the disease cycle. Sigatoka leaf spot on bananas decreases somewhat during the dry season but otherwise produces more or less continuously repeated cycles of infection. The disease severity is seen more during rainy and winter season, which coincides with advanced vegetative and shooting stages of the crop. It is more prevalent in the states like Tamil Nadu, Kerala, Maharashtra and Karnataka having maximum disease severity of 90-100 percent in cultivars like Grand Naine, Robusta, Nendran (AAB) and Rajapuri (AAB).

Symptomatology

Sigatoka symptoms are characterized by oval to round necrotic lesions, which first appear pale yellow on the lower surface of the leaf (Meredith and Lawrence, 1970). This differentiates it from black Sigatoka at early stages of lesion development. The fungal infection also causes large necrotic lesions on the leaves of banana resulting in loss of photosynthetic capacity, slower filling of fingers, reduced finger size and premature ripening of fruits and finally leading to remarkable yield loss in quantity, reduced quality and marketability of the crop.

Diagnostic symptoms on leaf

Uneven ripening of bananas

Cultural management

Cultural management techniques such as wider plant spacing, better drainage of both water and air, better weed management and removal of severely diseased leaves or portions of them from plants can also be used to obtain some measure of control. Simply removing infected leaves (deleafing) and placing them on the ground can significantly reduce the efficacy of ascospore discharge. The application of urea Phosphorus and Potassium in to infested plant debris on the ground can accelerate decomposition and thus reduce further the available spore inoculum.

Deleafing (a)

Deleafing (b)

Spray schedule

ICAR-NRCB, Trichy, Tamil Nadu recommendations

Days after planting	Qty of chemicals/ liter of water
150 days	Carbendazim 1 g + mineral oil 10 ml
175 days	Propiconazole 1 ml + mineral oil 10 ml
200 days	Carbendazim + Mancozeb combination 1 g + mineral oil 10 ml
225 days	1.4 g of Nativo (Trifloxystrobinn+ tebuconazole)/liter + mineral oil 10 ml
250 days	Propiconazole 1 ml + mineral oil 10 ml
275 days	Carbendazim + Mancozeb combination 1 g + mineral oil 10 ml
300 days	Carbendazim 1 g + mineral oil 10 ml

(R. Thangavelu and N. Marimuthu., 2014)

Conclusion

The symptoms of sigatoka disease complex varied with the cultivar, altitude and season of occurrence. Further investigations on pathogen diversity through intensive survey and identification of resistance sources among Musa spp., to the different pathogens are necessary. Crop losses due to these diseases are very conspicuous and small and marginal farmers cannot afford to control those using pesticides.

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Supply of Green Fodder Round The Year

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Introduction

Green fodder serves as an important cost-effective source of providing required nutrients for dairy animals. It is characterized by high digestibility and palatable nature. Under mixed feeding system, the micro-organisms present in green fodder aids in enhancing the digestibility of crop residues. Further, it also helps in maintaining good health of livestock and enhancing their breeding efficiency and besides these advantages, fodder production is mostly neglected in our country, particularly in urban dairy farms due to the excessive fragmentation of land and several other constraints.

The major feed resources for livestock in our country are grasses, community grazing on common lands, harvested fields, crop residues and agricultural by-products, cultivated fodder, edible weeds, tree leaves from cultivated and uncultivated lands and agro-industrial by-products. Residues of crop include sugarcane tops, fine straws, leguminous straws, coarse straws, etc. (*Rathod et al.*, 2019). Fodder crops are the plant species that are cultivated and harvested for feeding the animals in the form of green forage, silage, hay or other forms (Roy *et al.*, 2019).

The total livestock population in India is 535.78 million as per the 20th Livestock Census released in 2019. It has shown an increase of 4.6 percent compared to the previous Census in 2012 (Livestock Census, 2019). The total area under fodder crops in India is nearly 8.6 million had which is less than 5 percent of the area under cultivation in country. According to the Ministry of Agriculture assessment, there is a huge gap between demand and supply of feed and fodder for the livestock in the country. The green fodder supply in twenties was estimated to be 406 MT whereas the demand would be 1134 MT. It can be inferred that the supply of green fodder would be deficit by 65 percent of the demand (Kumar *et al.*, 2012).If this severe shortage in fodder supply is not addressed soon India could possibly face a huge crisis in enhancing milk production.

Definitions

Forage

Forage may be defined as the vegetative matter, fresh or preserved, utilized as feed for animals. Forage crops include a variety of grasses, crucifers and other field crops cultivated and used in the form of fodder, pasture, hay, and silage. Fodder crops are the cultivated plant species that are used as feed for livestock.

Green fodder

Any feed that is made from green crops like legumes, cereal crops or tree based crops is called green fodder.

Types of green fodder

Based on the season of cultivation, green fodders are classified into three types.

Kharif fodder (June – September): Sorghum, field bean, cowpea, bajra, maize, etc.

Rabi fodder (October – Dec/Jan): Lucerne, oats, barley, berseem, etc.

Summer fodder (April–June): Maize, sorghum, field bean, cowpea, bajra, etc.

Status of green fodder availability and future forecast

It can be observed from **Fig.1** that, over the years, the demand for green fodder is increasing approximately by 36 per cent but the supply is increasing only by 5 percent. Similarly, **Fig.2** indicates a positive trend (increasing trend) of the percentage deficit of green fodder with respect to the actual demand over the years (1995-2025). The projected percentage deficiency of green fodder with respect to its actual demand for the year 2025 was estimated to be 65%. On the other hand, the livestock population is also increasing over the years (Livestock Census, 2019). Under these circumstances, it is important to formulate suitable cropping plans to ensure year-round supply of green fodder.

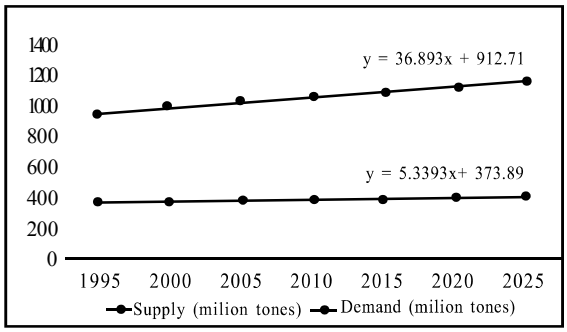

Fig 1. Supply and demand scenario of green fodder over the years

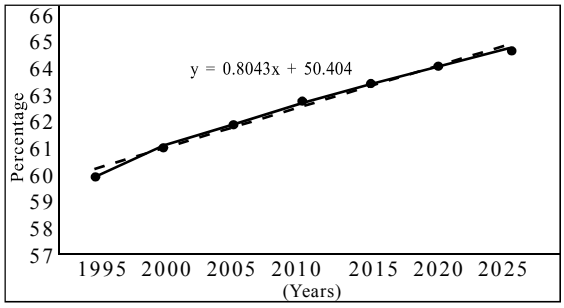

Fig 2. Percentage deficit of green fodder with respect to actual demand

Forage production systems in various regions of India

The fodder production mainly depends on cropping pattern, climate & Soil type. Various cropping patterns suitable to the climate and soil types of different regions of India are presented below which could ensure supply of green fodder round the year (IGFRI, 2012).

Hill and Northern Region

Hill and Northern Region	Green fodder yield (t/ha/year)	Climate & Soil type
Maize + Cowpea - Lucerne + Oats – Mustard NB Hybrid + Velvet bean - Berseem + Mustard	85 123	Sub-temperate, Moist, Red soil
Maize+Cowpea-Toria-Oats NB Hybrid + Berseem - Cowpea	177 121	Low land, Red & yellow soil
NB hybrid + Berseem NB hybrid + Lucerne	212 176	Semi-arid, Sandy loam soil

Central and Western Region

Central and Werstern Region Year	Green fodder yield (t/ha/year)	Climate & Soil type
NB hybrid + Cowpea - Berseem + Mustard Sorghum + Cowpea - Berseem + Mustard-Maize + Cowpea	255 176	Semi-arid, Red soil
NB hybrid + Cowpea - Berseem Sorghum + Cowpea - Berseem + Mustard - Sorghum + Cowpea	176 169	Sub-humid, Black soil
NB hybrid + Cowpea - Lucerne	253	Semi-arid, Black soil

Eastern Region

Central and Werstern Region Year	Green fodder yield (t/ha/year)	Climate & Soil type
Pearl millet + Cowpea - Maize + Cowpea - Oats Maize + Cowpea - Sorghum + Cowpea - Berseem + Mustard	103 96	Sub-humid, Red acidic soil
Maize + Cowpea - Dinanath grass - Oats Maize + Rice bean - Berseem + Mustard	131 112	Sub-humid, Alluvial soil

Werstern Region Year	Green fodder yield (t/ha/year)	Climate & Soil type
NB hybrid (perennial) Maize + Cowpea - Maize + Cowpea - Maize + Cowpea	106 85	Humid, Acidic soil

Southern Region

Southern Region Year	Green fodder yield (t/ha/year)	Climate & Soil type
NB hybrid + Lucerne Sorghum + Cowpea - Maize + Cowpea - Maize + Cowpea	225 111	Sub-humid, Black soil
Guinea grass in Coconut plantation 135 Congo signal gram in Coconut plantation 75	106 85	Humid, Acidic soil

Conclusion

Green fodder is the vital feed supplement for the livestock growth and milk production. Addressing the deficiency of green fodder by following suitable cropping patterns is the need of the hour. Additionally, strategies such as growing hydroponics green fodder as an alternate to conventional fodder cultivation, use of quality seeds of high yielding varieties, use of chaff cutter to minimize wastage, planting perennial grasses like hybrid Napier bajra/guinea grass in about 15 to 20 percent of the cultivated area, etc., could ensure supply of green fodder around the year.

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Probiotics and its Use in Modern Poultry for Growth and Development

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Introduction

In modern intensive poultry production, normal flora is slow in colonizing the intestine of newly hatched chicks.Therefore, antibiotics are usedto prevent diseases and improve growth performance. The use of antibiotics in poultry industry led to development of drug-resistant bacteria, drug residues in the body of the birds and imbalance of normal flora. All of the above led to banning of antibiotic use in poultry diets. One alternative of antibiotics is the use of probiotics. Probiotics are live microorganisms which, when administered in adequate amount, confer a health benefit on the host (FAO/WHO, 2002) and have beneficial effects on growth performance.

Probiotics should not be confused with *prebiotics,* which are typically complex carbohydrates (such as inulin and other fructo-oligosaccharides) that microorganisms in the gastrointestinal tract use as metabolic fuel. Commercial products containing both prebiotic sugars and probiotic organisms are often called "synbiotics." Probiotics are live microbial food/feed ingredients that have a beneficial effect on health that stimulates the growth of beneficial microorganisms and reduces the amount of pathogens, thus improving the intestinal microbial balance of the host and lowering the risk of gastro-intestinal diseases. When supplemented to chicken probiotics improve feed-intake, growth performance, meat quality, egg production, egg quality and have cholesterol lowering potential in poultry products.

Features of good probiotics

- They should be a strain capable of exerting beneficial effects on the host animal.
- They should be non-pathogenic and non-toxic.
- They should be present as viable cells.
- They should be capable of surviving and metabolizing in the gut environment.
- They should be stable and capable of remaining viable for periods under storage and field conditions.

Importance of probiotics

- Probiotics are live microorganisms that exhibit several beneficial effects on animal health.
- These probiotics are usually incorporated in animal feed supplements or drinking water to prevent the growth of harmful bacteria in animals.
- Taking into account the growing awareness regarding animal nutrition and health.
- The global poultry probiotics market is slated to witness massive growth over the coming years.
- Poultry probiotics market size from Poultry & chick applications may witness gains at above 6 to 7 %.

- Chick & Poultry need these products to improve gut health and microflora which would improve their immune systems.
- Prolong exposure towards contaminated environment may cause infections in new born chickens.
- Global poultry probiotics market share is competitive and moderately consolidated.

Genera mostly used in probiotics

The seven core genera of microbial organisms most often used in probiotic products are *Lactobacillus, Bifidobacterium, Saccharomyces, Streptococcus, Enterococcus, Escherichia and Bacillus*. Multiple strains may be beneficial than single strain as they act on different sites and provide different modes of action that create synergistic effects.

Mode of action

The mode of action of probiotics in poultry is followings

- Maintaining normal intestinal micro flora by competitive exclusion and antagonism.
- Altering metabolism by increasing digestive enzyme activity and decreasing bacterial enzyme activity and ammonia production.
- Improving feed intake and digestion.
- Neutralizing enterotoxins and stimulating the immune system.

The most common mechanism of probiotics to work is Competitive Exclusion (CE), which was originated on the finding that the newly hatched chicken could be protected against Salmonella colonization of the gut by providing it with a suspension of gut content prepared from healthy adult chickens. By competing for the common niche in the gut, probiotics exclude the sites for pathogen replication. CE refers to the physical blocking of opportunistic pathogen colonization and altering the environmental niches within the intestinal tract like intestinal villus and crypts leading to better immune system. CE due to probiotics includes competition for physical attachment sites, enhancement of host immune system and production of antimicrobial compound from metabolic reactions. Enhancement of the epithelial barrier, increased adhesion to intestinal mucosa, production of antimicrobial substances and modulation of immune system are other mechanisms of action by probiotics. A front line of defense against the adverse effect of pathogens is provided by probiotics showing its antimicrobial effect. It is also modulate the immune system mostly depend on the strains of bacteria or microorganisms used, probiotic preparation method, routes of administration and environment where birds are raised.

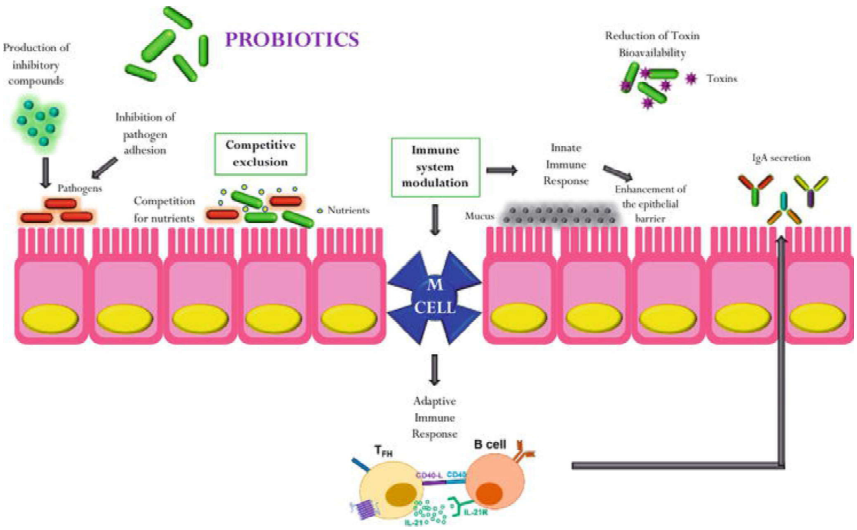

Figure No: 1- Mode of action of probiotics

Application of probiotic in modern poultry

Although probiotics are considered Potential alternatives to antibiotic use in poultry because they leave no residue in meat and eggs, their mode of action, the diversity of microorganisms in terms of species and even between strains of the same species, as well as metabolism. They may differ inactivity. Affect their effectiveness. In addition, other factors that affect the effectiveness of probiotics in poultry are the species of origin, method of probiotic preparation, the existence of colonizing microorganisms in the gastrointestinal tract conditions, the environment where the birds are raised, the use of probiotics Time of application and route of administration, immunological state, poultry lineage, as well as age and concomitant use of antibiotics.

Selection of probiotics

The desirable traits for selection of functional probiotics are must fulfill the following conditions, it must be a normal inhabitant of the gut, and it must be able to adhere to the intestinal epithelium to overcome potential hurdles, such as the low pH of the stomach, the presence of bile acids in the intestines, and the competition against other micro-organisms in the gastro-intestinal tract. The tentative ways for selection of probiotics as biocontrol agents in the poultry industry are illustrated in **Figure No: 2**. Many *in vitro* assays have been developed for the pre-selection of probiotic strains. The competitiveness of the most promising strains selected by *in vitro* assays was evaluated *in vivo* for monitoring of their persistence in chickens. In addition, potential probiotics must exert its beneficial effects (e.g., enhanced nutrition and increased immune response) in the host.

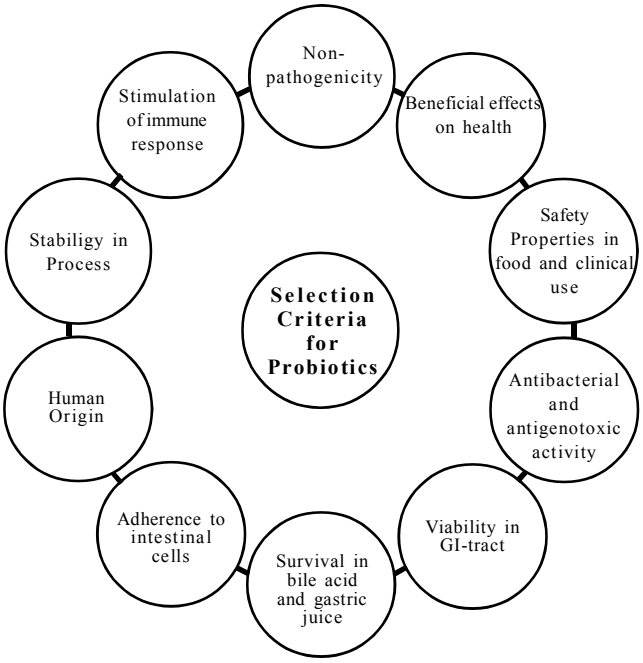

Figure No: 2 Selection of probiotics in modern poultry

Effect of Probiotics on growth and immune response

The major effects observed in poultry due to probiotics including yeast cultures supplementation are in growth performance, meat quality, immune response, intestinal morphology, and intestinal microbiota. In poultry, the feeding of probiotics to maintain normal flora mainly improve feed consumption/digestion and gut health and stimulate the immune system. Probiotics may potentially stimulate growth through increased short-chain fatty acids (SCFA) production in poultry and through selective regulation of insulin signaling in different tissues Short chain fatty acids like acetate, propionate and butyrate are used as energy source in tissues. Another mechanism by which probiotics may stimulate

growth is by regulating the immune system. When immune system is regulated, it suppresses the negative effects of chronic immune activation. When immune system is activated, there is diversion of nutrients from production process towards immune response.

Improved health and production performance

Many beneficial effects of probiotics were suggested, such as improved immune system, modification of gut microbiota, reduced inflammatory reactions, decreased ammonia and urea excretion, lower serum cholesterol and improved mineral adsorption; on the other hand probiotics may have an indirect positive impact on performance parameters and production profitability.

Conclusions

Probiotics have a number of beneficial effects in poultry production. Probiotics improves feed intake, feed conversation ratio, stimulates growth rate, increases egg production and have hypocholesteronemic effects on poultry products. It is also improve the gut health, immune system.The probiotics have a wide range of mechanism of action that eventually improve growth performance or eliminate the pathogens like *Salmonella* and *E. coli* in chicken. The growth performance due to probiotics feeding directly relates to the immune functions and healthy guts. Despite the wide use of probiotics in poultry production, an accurate dosage of administration has yet to be established. It can be mixed into water and feed with different dosages.

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Triacontanol : A Promising Plant Growth Regulator

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Introduction

Demand for agricultural crops continues to rise as a result of rising population and damage to fertile cropland. Plant growth regulators (PGRs) are commonly used in crop production to maximize plant growth and productivity by increasing fruit set, fruit number, and weight. It is involved in flowering, fruit set, ripening, and physiochemical changes that occur during storage. Plant growth inhibitors are used to reduce the length of a plant's shoots without altering developmental patterns or causing phototoxicity. In fact, the use of growth regulators had improved the production of vegetables in terms of growth and quality, which sparked interest among scientists and farmers for the commercial application of growth regulators. This was accomplished not only by limiting cell elongation, but also by slowing the rate of cell division and physiologically regulating plant height.

Triacontanol (TRIA) is a natural novel plant growth regulator found in plant cuticular waxes and bee wax. It is a straight chain 30 carbon fatty alcohol i.e., primary alcohol is an endogenous hormone which is active at very low concentration on the cell membranes. The chemical name is triacontanol-1 or n-triacontanol, referred to as triacontanol or TA or TRIA, also known as benzyl alcohol. Triacontanol (TA) is a non-toxic, pollution-free, low - cost, high - efficiency, broad - spectrum plant growth regulator that plays an important role in plant growth and development. TRAI can significantly increase the amount of chlorophyll in leaves, improving photosynthesis and also overcome various stress in plants.

Triacontanol (TRIA), an endogenous plant growth regulator, promotes a variety of metabolic activities in plants, resulting in improved growth and development. TRIA also plays an important role in reducing stress-induced changes in crop plants by modulating the activation of stress tolerance mechanisms. The role of exogenously applied TRIA in plant morpho-physiology and biochemistry, for example, in terms of growth, photosynthesis, enzymatic activity, biofuel synthesis, yield and quality under normal and stressful conditions, is discussed in this paper.

The TRAI and GA_3 can stimulate the formation of a bud, flowers and plant branching, increase photosynthesis and plant metabolism, stimulate cell growth, build a healthy root system, thicken plant foliage and flowers make stem and root stronger and help new cuttings grow a fast root, all of which can increase plant yields and quality.

Mode of Tria Action

Many investigators have explored the effects of TRIA on several basic metabolic processes including photosynthesis, nutrient uptake, and enzyme activities. Several efforts have been made to elucidate the mechanism of TRIA action (Ries *et al*. 1993). Assumption of a cascade effect led to the identification of 9-ß-L (+)-adenosine as a second messenger of TRIA (Ries *et al*. 1993). TRIA rapidly elicits the second messenger (TRIM) in rice (Oryza sativa L.), which at nanomolar concentrations

causes the plants to respond in a manner similar to TRIA (Ries 1991). TRIM has been identified as 9-ß-l (+)-adenosine (9H-purin-6-amine, 9-ß-L-ribofuranosyl). TRIA enhanced the formation or release of L(+)-adenosine in the root tissue of rice seedlings within one min of TRIA application to the shoots, which might have elucidated the first step in the mode of TRIA action. It is already reported that TRIA rapidly increases the ratio of l (+)-adenosine to d(–)-adenosine, probably at the tonoplast (Ries 1991). There remains the problem of how TRIA elicits l(+)-adenosine and what is the source of l(+)-adenosine in plants. Based on known metabolic processes, de novo synthesis of l(+)-adenosine is unlikely, because of the rapidity of the response. The most probable source of adenosine is AMP derived from ADP and ATP (Olsson and Pearson 1990). In TRIA treated plants, the nonracemic L(–)-adenosine (–11%) is released to affect plant processes (Ries 1993). Salt stress causes decrease in plant growth and productivity by disrupting physiological processes, especially photosynthesis. The accumulation of intracellular sodium ions at salt stress changes the ratio of K : Na, which seems to affect the bioenergetic processes of photosynthesis. Iyengar and Reddy (1996) noted that decreases in photosynthetic rate in saline condition resulted from a number of factors including:

productivity of vegetables and cereal crops. (Ries *et al*. 1993). TRIA has been proven to propel the growth and/or yield of a broad array of annual vegetables, agronomic and horticultural crops, and forest species. The increase in yield is due to the rapid increase in the net assimilation rate as observed in tomato after TRIA spray. In greenhouse studies, foliar applications of 1.0-100 mg L-1 of L(+)-adenosine increased the growth of tomato (*Lycopersicon esculentum* Mill.), maize (*Zea mays L.*), cucumber (*Cucumis sativus L.*), and carrot (*Daucus carota L.*) (Ries *et al*. 1990). Furthermore, Eriksen *et al*. (1982) observed a TRIA-mediated increase in the dry weight of tomato seedlings in controlled environment

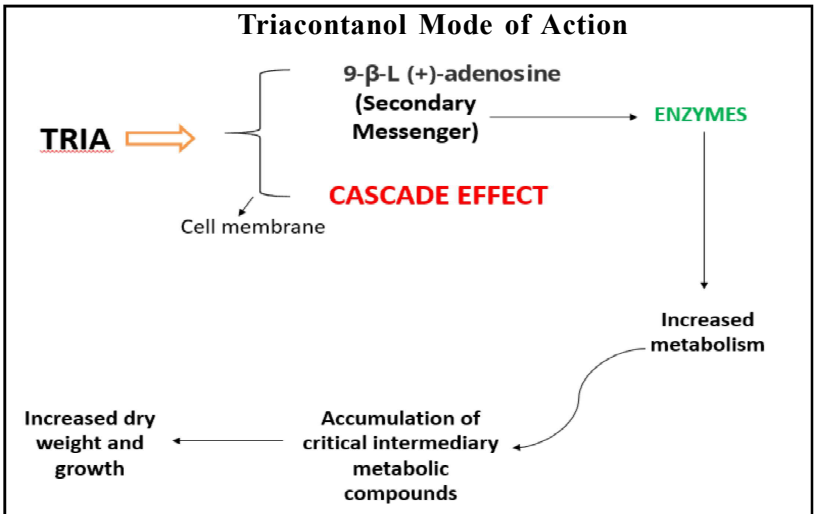

Figure 2. Mode of action of triacontanol (TRIA)[Source-Naeem *et al*. 2012]

Response of Plants to TRIA

a.Growth attributes : According to several research, TRIA applied to the root medium or the leaves improved the growth and research; however, no similar dry weight increase was detected in maize seedlings. When seeds were treated with TRIA, it had no effect on seed germination or early growth in several species, but it did have a substantial effect on improving the rate of cotton germination (*Gossypium hirsutum*).TRIA foliar spray boosted the dry weight of rice seedlings in nutritional medium, as well as corn, barley, and tomato plants (Ries *et al*. 1993).TRIA's growth-promoting effects on a

variety of plant attributes, including plant height, fresh and dry weights, leaf area, and root nodulation, have been studied by a number of researchers in a variety of medicinal crops (Chaudhary *et al.* 2006). TRIA alone and in combination with potassium increased tomato plant height, fresh and dried weights, and leaf area per leaf (Khan *et al.* 2009).

b. Physiological and biochemical attributes : When applied exogenously, TRIA has been found to regulate a variety of physiological and biochemical processes directly or indirectly. (Naeem *et al.* 2012). The initial step toward understanding TRIA function was isolating and profiling TRIA-regulated genes, which provided clues to the biochemical pathways and physiological processes that control, as well as expose the components involved in TRIA signalling (Chen *et al.*2002). Photosynthesis was linked to an increased number of TRIA sensitive genes. TRIA improved the state of photosystems and increased the level and activity of ribulose-1,5-bisphosphate carboxylase oxygenase (RuBisCO) (Chen *et al.* 2002). Photosynthesis has been identified as a key plant response to TRIA, with improved photosynthesis and greater photosynthate accumulation being ascribed to increased plant growth and dryweight. TRIA also enhanced the activity of malate dehydrogenase, a crucial respiratory enzyme. In a study, Borowski *et al.* (2009) revealed that the maximum efficiencyof PS-II in the dark (Fv/Fm) was clearly increased by the applied TRIA and the efficiencyof excitation-capture by PS-II reaction centers were even much increased. In fact, a number of studies have demonstrated an increased rate of CO_2 fixation and photosynthesis in a variety of plant species as a result of TRIA application in nanomolar concentrations. Similarly, TRIA alone or in combination with gibberellic acid significantly increased the net photosynthetic rate, stomatal conductance and internal CO_2 concentration in Artemisia annua. Moreover, also found the significant effect of TRIA on photosynthetic parameters regarding hyacinth bean (*Lablab Purpureus L.*), coffee senna (*Senna occidentalis L.*), and Japanese mint (*Mentha arvensis L*). In addition, the contents of photosynthetic pigments were significantly influenced by exogenous application of TRIA. The content of the pigments in TRIA-treated leaves could presumably be attributed to the increase in the number and size of chloroplasts as revealed by Chen *et al.* (2003). As a result of foliar sprayof TRIA at early vegetative stages, Naeem *et al.* (2012) reported an increase in the nodule-nitrogen and leghemoglobin contents of hyacinth bean at 60 days after sowing (DAS) followed by that at 90 DAS. The TRIA alone or in combination with gibberellic acid significantly enhanced the activities of NR and CA in artemisia (Aftab *et al.* 2010). Sharma *et al.* (2002) suggested that a higher content of leaf-nutrients in TRIA treated plants could be attributed to the higher metabolic activity and increased drymatter production that might result in enhanced water and nutrient uptake from soil subsequently.

c. Yield and quality attributes : TRIA has been used to increase the productivity of food crops and vegetables in the past few decades with great success. TRIA exhibited a substantial increase in production on various crops, including dry beans, sweet corn and cucumbers, in the early studies. Improvement in yields of several important food crops have been recorded by several researchers as a result of TRIA application. Borowski *et al.* (2000) reported significant increase in tomato yield as result of TRIA application at 0.3 and 3.0 mg L-1. Another study found that when TRIA was sprayed as foliar sprays, there was a significant increase in total and per-plant tomato yield; but, when TRIA was added to the growth medium, there was only a transitory increase in yield and number of fruits. When the TRIA was used in combination with GA3 on the coriander crop, the maximum numbers

of umbels, fruits per umbel, 100 seed weight, and seed yield were reported (Idrees *et al*. 2010). Foliar application of TRIA, at a concentration of 0.5 mg , significantly promoted the contents of saccharides, starch, soluble proteins, amino acids and phenols in green gram (Kumaravelu *et al*. 2000). TRIA application also improved the contents of soluble protein, starch, sugars, and free amino acids in the leaves of Oryza sativa and Zea mays. Moreover, Naeem *et al*. (2010) reported a significant positive effect of TRIA on the seed-content of protein and carbohydrate in hyacinth bean. Similarly, carbohydrate and protein contents in turmeric (*Curcuma longa L.*) and ginger (*Zingiber officinale Rosc*.) were significantlyimproved bythe foliar sprayof TRIA (Singh *et al*. 2011).

Conclusion

TRIA administered at nanomolar concentrations promotes plant growth and physiological activity in a variety of plant species, according to compelling data. TRIA has been shown to boost the growth, yield and quality of a variety of crops, including vegetables, horticultural crops and medicinal and aromatic plants, when applied foliarly. Increased production of secondary plant products, such as essential oil and active components of medicinal and aromatic plants, is also facilitated by TRIA-mediated increases in dry matter. However, more research is needed to determine the significance of TRIA in the regulation of plant development and metabolism in terms of gene expression regulation.

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The Growing Threat of Global Warming in India

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Introduction

Global warming is the long-term heating of Earth's climate system observed since the pre-industrial period (between 1850 and 1900) due to human activities, primarily fossil fuel burning, which increases heat-trapping greenhouse gas levels in Earth's atmosphere. Global warming is a gradual increase in the earth's temperature generally due to the greenhouse effect caused by increased levels of carbon dioxide, CFCs and other pollutants. Global warming has emerged as one of the most important environmental issues ever to confront humanity. This concern arises from the fact that our everyday activities may be leading to changes in the earth's atmosphere that have the potential to significantly alter the planet's heat and radiation balance. It could lead to a warmer climate in the next century and thereafter, portending a potpourri of possible effects – mostly adverse. International efforts to address this problem have been ongoing for the last decade with the Earth Summit at Rio in 1992 as an important launching point and the Conference of Parties in Buenos Aires in 1998 as the most recent step. Although India as a developing country does not have any commitments or responsibilities at present for reducing the emissions of greenhouse gases such as CO_2 that lead to global warming, pressure is increasing on India and other large, rapidly developing countries such as China and Brazil to adopt a more pro-active role. At the same time, the developed countries of the North are trying to limit the extent of their commitments for emission reduction. In this situation, the public and policy makers need to be aware of the ramifications and implications of the global warming problem, even if it is a problem that may manifest itself only sometime in the next century. What is climate change? Climate change is a newcomer to the international political and environmental agenda, having emerged as a major policy issue only in the late 1980s and thereafter. But scientists have been working on the subject for decades. They have known since the 19th century that carbon dioxide (CO_2) in the atmosphere is a 'greenhouse gases', that is, its presence in the atmosphere helps to retain the incoming heat energy from the sun, thereby increasing the earth's surface temperature. Of course, CO_2 is only one of several such greenhouse gases in the atmosphere. Others include methane, nitrous oxide and water vapor. However, CO_2 is the most important greenhouse gas that is being affected by human activities.

CO_2 is generated by a multitude of processes ranging from animal and plant respiration to the burning of any kind of fuel containing carbon, including coal, oil, wood and cow dung. For a long time, human activities that generated CO_2 caused only a small perturbation in the natural cycle of the gas. However, since the Industrial Revolution when our usage of fossil fuels increased dramatically, the contribution of CO_2 from human activities has grown large enough to constitute a significant perturbation of the natural carbon cycle. Since the early 50's, as regular measurements of the atmospheric

concentrations of CO_2 were started, it has been conclusively established that these concentrations are increasing rapidly, driven by human activities. The concentration of CO_2 in the earth's atmosphere was about 280 parts per million by volume (ppmv) in 1750, before the Industrial Revolution began. By 1994 it was 358 ppmv and rising by about 1.5 ppmv per year. If emissions continue at the 1994 rate, the concentration will be around 500 ppmv, nearly double the preindustrial level, by the end of the 21st century. The concentrations of other greenhouse gases such as methane and nitrous oxide have also been rising at a fairly rapid rate. The effect is that the atmosphere retains more of the sun's heat, warming the earth's surface. Of course, not all man-made additions to the atmosphere increase warming. For example, aerosols, tiny particles of solid or liquid suspended in the air, which result from the emissions of soot and sulphur dioxide from power plants tend to reflect heat and diminish warming. But aerosols are mostly short lived while the CO_2 released into the atmosphere will stay there for decades. At the same time, concern about local air quality is driving many countries to impose stringent controls on emissions of substances such as sulphur dioxide. As a result, many scientists feel that even as these emissions decrease in the future, the full effect of the greenhouse gases will be unmasked, leading to an even more rapid warming pattern. While the pattern of future warming is open to debate, it is indisputable that the surface of the earth has warmed, on average, 0.3 to 0.6 degrees celsius since the late 19th century when reliable temperature measurements began. Recent decades appear to be the warmest since at least 1400, according to the fragmentary information available. It is against this backdrop of knowledge that the Intergovernmental Panel on Climate Change (IPCC) concluded in its second assessment report in 1995 that the current state of knowledge 'now points towards a discernible human influence on global climate.' In this assessment report, the IPCC also concluded that under the existing scenarios of economic growth and development leading to greenhouse gas emissions, on a worldwide average, temperature would rise by 1 to 3.5 degrees celsius by the year 2100 and global mean sea level by about 15 to 95 centimeters. It is likely that changes of this magnitude and rapidity could pose severe problems for many natural and managed ecosystems, as well as important economic sectors such as agriculture and water resources. Indeed, for many low-lying and deltaic areas and small islands, a sea level rise of one meter could threaten complete loss of land and extinction of habitation.

Scenarios of future climate change are usually developed using complex 3-dimensional models of the earth's atmosphere and oceans. However, while we have some degree of confidence in the gross or aggregate estimates for climate parameters (such as globally averaged surface temperature) from these models, there is a great deal of uncertainty with regard to regional details. In addition, most of the ill effects of climate change are linked to extreme weather events, such as hot or cold spells of temperature, or wet or dry spells of rainfall, or cyclones and floods. Predictions of the nature and distribution of such events in a changed climate are even more uncertain, to the extent that virtually no authoritative predictions exist at all. Despite these uncertainties, it is clear that even the possibility of changes in such extreme events is quite alarming. Global warming has often been described as one of the most serious environmental problems ever to confront humanity, as this problem is inextricably linked to the process of development and economic growth itself. Since greenhouse gases are generated by burning fossil fuels as in power plants, factories and automobiles, it is not easy to reduce emissions, since virtually every facet

of our lives is intimately tied to the consumption of energy. Climate change is an unusually difficult issue for the people who make the decisions in democratic governments. First of all, the science is uncertain while governments have to make firm policy decisions, if only the decision to do nothing, long before these uncertainties can be resolved. Political leaders are already beginning to overstate the clarity of the science in order to attract public support. A lot of money is now going into climate research and new findings with varying political implications will continue to appear. Any serious attempt to cut emissions will have clear and immediate costs, but the benefits may not appear for a long time. To the extent that the benefits may be disasters that didn't happen, they may never be obvious. But the costs will be. As the debate develops, much of it is being cast in terms of the restraint that the present generation owes to future generations.

Unlike many other environmental issues, such as local air or water pollution, or even stratospheric ozone depletion caused by chlorofluorocarbons (CFCs), global warming poses special challenges due to the spatial and temporal extent of the problem – covering the globe and with decades to centuries time scales. Again, in this particular issue, science has played and continues to play, a critical role in defining the structure and basis of the debate. The following three dimensions of the issue illustrate the vexing features of the science underlying the problem:

i) Cumulative effect of the historical emissions. The climate system acts as a large integrator, that is the response of the system is a result of the entire history of the forcing being applied.

ii) Lags in the system. The response of the ocean-atmosphere system occurs several decades to centuries after the changes in the atmospheric greenhouse gas concentrations. As a result, even if emissions of greenhouse gases were stabilized immediately, it would take many years for the climate system to reach a new quasi steady state and some changes (such as sea level rise) would continue to happen.

iii) The actual consequences of climate change are likely to exhibit considerable spatial and temporal variability – thus some regions may actually experience a transition to a milder, warmer, wetter and overall better climate regime. As a result, there are costs as well as benefits associated with climate change, although the scientific consensus is clearly that the overall effects are likely to pose a significant burden. How have we tried to respond to climate change? Negotiations began in 1991 under United Nations auspices to formulate an international treaty on global climate protection. Those negotiations resulted in the completion by May 1992 of a Framework Convention on Climate Change (FCCC). The Convention was opened for signature at the Earth Summit in Rio de Janeiro in June 1992 and it entered into force in March 1994. The Convention has few binding requirements. It calls for nations to limit carbon dioxide and other greenhouse emissions, by 'addressing anthropogenic emissions by sources and removals through sinks of greenhouse gases'. It does not set out specific targets or timetables for reducing emissions. It only requires the developed country signatories to formulate and adopt policies that aim at stabilishing greenhouse gas emissions at 1990 emission levels, recognizing that the return by the end of the present decade to earlier levels of anthropogenic emissions would contribute to modifying longer term trends in anthropogenic emissions consistent with the objective of the Convention to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The Convention adopted the

notion of common but differentiated responsibility, recognizing that the global climate was a common resource and responsibility, but that there were clear asymmetries between the developed and the developing countries in terms of both the past and present contributions to the problem as well as the resources to respond to it. That is, the developed countries are, by far the largest emitters of CO_2 and other greenhouse gases. At the same time, they also have the technical and financial resources to try and reduce their emissions. Two broad groupings of countries emerged after the Convention, the countries of the Convention or the developed countries and the others. Countries such as Russia or Ukraine (parts of the former Soviet Union) although a part of the countries are placed in a special category as Economies in Transition. At the time of the Rio Summit, proponents of more specific, legally binding targets and timetables for reducing greenhouse gas emissions successfully urged follow-on talks leading to future negotiation of a protocol or other legal instrument in order to strengthen the Framework Convention. In 1995, the Parties to the Framework Convention at their first meeting in Berlin, Germany, declared that commitments made in 1992 to reduce greenhouse gas emissions were inadequate to meet the objective of the Convention. So-called 'next steps' were needed to confront the potential of global warming in the post-2000 time frame. Consequently, the Parties agreed to a process, set forth in their 'Berlin Mandate', of analysis and assessment of just what next steps might be taken to limit greenhouse gas emissions. This process resulted in the negotiation of a protocol, the final details of which were completed at the third meeting of the Conference of the Parties to the Framework Convention held 1-12 December 1997, in Kyoto, Japan. The Kyoto Protocol to the United Nations Framework Convention on Climate Change commits industrialized nations to specific, legally binding emission reduction targets for six greenhouse gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorinated compounds and sulfur hexafluoride. The protocol was opened for signatures on 16 March 1998. International political implications have proven significant. By far the majority of greenhouse gases are emitted by sources in industrial and transportation sectors (especially automobiles) that are concentrated in developed countries. These countries have shown concern not only about their own emissions, but about increased emissions from poorer countries as they expand their economies. Friction has been evident in the debates over which actions, by developed and developing countries should be undertaken, on what schedules and which parties should pay incremental costs for mitigation measures. Developing countries generally have argued that the financial burden of change should be borne by developed countries, which are mainly responsible for current atmospheric change due to human activity. As the Framework Convention (FCCC) states, the basic goal of the negotiation process is to return the concentrations of greenhouse gases to a level that prevents dangerous anthropogenic interference with the climate system. The simplest way of conceptualizing this goal is to consider a target or limit for the atmospheric concentrations of the greenhouse gases set at a level that does not lead to unacceptable climate change. Of course, since our ability to predict future climate change is very limited, the notion of what is 'unacceptable' is itself quite imprecise and fuzzy. In this conceptualization, the economic activities in different countries that lead to greenhouse gas emissions correspond to this limit or resource being used up. The entire negotiation process then may be

regarded as an effort to address the following three questions:

(i) What exactly is the limit and how should it be defined?

(ii) What is the basis that ought to be used for the manner in which different countries can use up this resource?

(iii) What are the instruments that could be used to divide up and actually distribute this resource to the different countries once the allocation basis has been determined?

The first question centres around the level of atmospheric concentrations that would be considered acceptable in view of the possible consequences of climate change. A related issue is whether the limit would be specified individually for each greenhouse gas, or whether some sort of a 'basket' approach could be used where countries could trade-off amongst the different gases. This issue depends critically on whether the effects of the different gases could be made commensurate with each other through a set of equivalences and if greater flexibility or economy would be obtained. It has also been suggested that rather than concentrate on the greenhouse gas concentrations, it may be better to focus on the sinks for these gases – which is primarily the terrestrial biosphere and the oceans. The second question centres around the basis for the allocation and is currently the subject of much debate. Large, populous developing countries like India and China would clearly favor a per capita basis, as it gives them the greatest scope for increasing emissions further in their development processes. The final question deals with the approach to be followed once the allocations have been determined. A large variety of market based instruments such as taxes and tradable permits have been deployed for conventional pollutants such as sulphur dioxide and there is much research on their applicability in the climate context. However, the key issue to recognize here is that any instrument will necessarily have to address large scale technology and monetary transfers since developing countries could, in principle, 'sell' their allocations to the developed countries. For India, the climate change issue has several ramifications: First, although India does not currently have any obligations under the Convention to reduce its greenhouse gas emissions, international pressure will keep increasing in this regard. It is therefore important for us to develop a clear understanding of our emission inventory. We also need to document and analyse our efforts in areas such as renewable energy, wasteland development and afforestation all of which contribute towards either reducing CO_2 emissions or increasing CO_2 removal from the atmosphere. Considering that these efforts may often be undertaken for a variety of reasons not directly related to global warming, but yet have benefits as far as climate change is concerned, we may be able to leverage such efforts in the international context. Second, we need to develop a clear and well articulated position on each of the three basic questions indicated earlier. This position needs to be supported by appropriate analysis. The Indian research community could contribute substantially in this regard. Finally, we need to recognize that even if countries do undertake immediate and rapid action to reduce their emissions, some degree of climate change is inevitable. If we consider the fact that we have very limited abilities to deal with weather extremes in the present day, the situation may get worse in the future. Therefore, we need to significantly improve our ability to plan and adapt to extreme events such as floods, droughts, cyclones and other meteorological hazards. Any robustness that we build into the system in this regard will always stand us in good stead, no matter what climate change actually transpires.

Conclusion

Global warming is the major challenge for our global society. There is very little doubt that global warming will change our climate in the next century. So what are the solutions to global warming? First, there must be an international political solution. Second, funding for developing cheap and clean energy production must be increased, as all economic development is based on increasing energy usage. We must not pin all our hopes on global politics and clean energy technology, so we must prepare for the worst and adapt. If implemented now, a lot of the costs and damage that could be caused by changing climate can be mitigated.

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Microorganisms in Combating Plant Diseases

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Introduction

Tropical with warm and humid climate in India provides ideal conditions for development and spread of diseases of crops cultivated under intensive crop cultivation. The losses are going to increase with change in agricultural practices and the agriculture production is often derailed from the target due to losses caused by biotic and a biotic stresses. The losses caused by biotic stresses and the archaic nature of plant production measures were recognized in recent years. The losses due to weeds, diseases and insects have been estimated to be around 40% in the developing or under developed countries. Out of these losses, 18% is produced by disease producing microorganism. Management of crop disease by using chemicals is regular practice and yielded considerable amount of reduction of diseases. Although several methods are followed for this purpose, disease control by chemicals is the promising one especially under intensive cropping programmes. Chemicals, on the other hand, may cause problems with residues left on crops, and chemical fungicides and bactericides used in plant disease management are growing more expensive, as well as leaving non-biodegradable toxic compounds. Plant diseases can acquire resistance to fungicides and bactericides in some circumstances.

Due to consideration of above ill effects, it becomes inevitable to develop a bio-based, eco-friendly, biodegradable plant derived pesticides or microbial pesticides in order to control plant pathogens. Now, the researchers are forced to look for the alternate strategy, which counter the problems created by chemicals is biological way of control of the diseases. A replacement of chemicals for disease control is not at all anticipated in the near future, but considerable progress has been made in reducing the negative effect of pesticides on the environment by using biological method of disease control.

In biological control, use of beneficial microorganisms against the pathogenic microorganisms, the beneficial microorganisms are called as biocontrol agents / antagonistic organisms. Biological control of pathogen is achieved by artificial introduction of antagonistic microorganisms into the environment. Several species of fungi, bacteria and actinomycetes are used as biological agent against the plant pathogen. Fungi antagonistic includes *Trichoderma viride, T. harzianum, T. hamatum, T. lignorum, T.koningii, T. pseudokoningii, Chaetomium globosum, Pencillium citrinum, Myrothecium roridum, Epicoccum purpurescens* are reported to be antagonistic against different pathogens. The bacteria *Pseudomonas fluorescens* and Bacillus *subtilis* are used as biocontrol agents against many soil borne as well as foliar pathogens in plants. Beside this uses of bacteriophages, bedllovibrio and a virulent microbial strains (induced resistance) have also shown to be antagonism.

Mode of action of antagonists

The antagonists may act in different ways to control the pathogens.

a. Competition

The microorganisms compete for space and nutrients for their survival in their natural habitats. It occurs when two or more organisms require the same thing and the use of this and use of this by one reduces the amount available to the other. This mode of action is possible when antagonist is introduced in the soil to control the root rot disease. The highly virulent, stable antagonists can possess the high competitive ability in the soil ecosystem. Competition for substrates is the most important factor for heterotrophic soil fungi. Plant growth promoting rhizobacteria have competitive ability in rhizosphere. Generally the bacterial have the capacity to colonize in root region as rapidly. So this leads to suppression of growth of pathogen in the soil as well as in leaf surface (Kohl *et al*., 2019). *Pseudomonas fluorescens and Bacillus subtilis* have this mechanism in the rhizosphere region of plants.

b. Antibiosis

Antibiosis is a condition where the metabolites are secreted by underground parts of plants, soil microorganism, plant residues etc. Antibiosis plays an important role in biological control of plant diseases. It occurs when the pathogen is inhibited or killed by metabolic products of the antagonists (Raaijmakers and Mazzola, 2012). Antagonists are shown to produce antibiotics, which affect the growth of the pathogen. The fungal antagonist such as *Gliocladium virens* produces glioviridin and gliotoxin and *Penicillium citrinum* is known produce an antibiotic citrinin. The antibiotic production was determined in most of the antagonistic organism when it was interact with the pathogens. There are reports of antibacterial antibiotic produced by antagonistic bacteria. There are termed as bacteriocins and these are proteinaceous substances produced by some strains of bacteria which are antagonistic to closely related species or some other strains of same bacteria. *B.subtilis* produce Bulliform and bacteriocin isolated from Corynebacterium michiganense control the tomato canker disease.

c. Lysis

It implies disintegration or destroying of pathogenic propagules during the action by releasing cell wall degrading enzymes by biocontrol agents. It is the complete or partial destruction of a cell by enzymes. Lysis may be differentiated into two types, endolysis and exolysis. Endolysis (autolysis) is due to nutrient starvation or antibiosis and death of a cell by the cell's own enzymes or toxins or other factors. Endolysis does not usually involve the destruction of the cell wall. Exolysis (heterolysis) is the destruction of cell of an organism by the enzymes of another organism. The chitinases or cellulases produced by an organism will destroy of cell wall of other organism.

d. Mycoparasitism / Hyperparasitism

Mycoparasitism is the phenomenon of one fungus being parasitic on another fungus. Mycoparasitism or hyperparasitism occurs when the antagonist invades the pathogens by secreting enzymes such as chitinases, celluloses, glucanases and other lytic enzymes. The parasiting fungus is called hyperparasite and the parasitized fungus as hypoparasite. In mycoparasitism, two mechanisms operate among involved species of fungi. The events like coiling, penetration, branching and sporulation, resting body production, barrier formation and lyses are takes place during fungus and fungus interaction (Jeffries, 1995). *Trichoderma viride* will express mycoparasitism mechanism on root rot and wilt fungus.

e. Hydrogen cyanide

Many rhizobacteria are able produce hydrogen cyanide and this has been shown to

play a role in biological control of plant diseases and increasing the yields. Pseudomonas *spp*., produce hydrogen cyanide in rhizosphere and which inhibit the growth of plant pathogens.

f. Induced Systemic Resistance (ISR)

ISR is the activation of defense mechanisms of a plant by an agent likely a fungus, bacteria, virus, chemical etc., and the plant become resistant to a number of plant pathogens. Sometimes, the plants inoculated with avirulent strain of pathogens or non-pathogens leads to induced systemic plant resistance against subsequent challenge by pathogens. The biocontrol agents bring about induced systemic resistance (ISR) through the physical and mechanical strength of cell wall as well as changes in physiological and biochemical reaction of host leading to the synthesis of defense chemicals against challenge inoculation of pathogens (Wiesel *et al.*, 2014). Accumulation of pathogensis related proteins (chitinase, B-1, 3 glucanase), chalcone synthase, phenylalanine ammonia lyase, peroxidase, phenolics, callose, lignin and phytoalexins are takes place following interaction with biocontrol agents.

Not only activation of defense mechanisms, bio control agents also secretes plant growth hormones like Auxins, Cytokinin, Gibberellins etc. These hormones suppress the deleterious pathogens and promote the growth of plants and simultaneously increase the yield. This was found in rice when seeds treated with *Bacillus subtilis* or dipped in *Pseudomonas fluorescens*.

g. Production of siderophore

They are extra cellular small compounds, which selectively binds iron (Fe3+) siderophores are generally produced both by aerobic and facultative anaerobic bacteria under low iron stress condition. Several reports conformed that *P. fluorescens* produced siderophore (pyroveridin) and this compound is useful in improving seedling health in crop like cotton and tomato (*Pieterse et al.*, 2014). Plant growth promoting rhizobacteria produce siderophore compound which will uptake Ferric ion and condition leads to starvation of pathogens for the want of ferric ion in soil.

Use of fungal antagonists

Among the fungal antagonists, *Trichoderma* is the most widely used fungal organism to control a variety of plant diseases especially in crops like pulses and oil seeds. Nowadays, for the management of root rot diseases, *Trichoderma* antagonists have been recommended particularly in areas of Tamil Nadu, Andhra Pradesh and Karnataka. Commercial formulation of the fungal antagonists is developed in other countries and used as seed or soil treatment in the disease management programme.

Use of bacterial antagonists

The bacteria viz., *Bacillus subtilis, Agrobacterium radiobacter K – 84, Pseudomonas fluorescencs, Serratia sp, Azotobacter* and *Streptomyces* have been proved as effective against foliar as well as root diseases. A few biocontrol agents which are registered or available in the market. The following tables have the information on bacterial agents used against various diseases.

S. no.	Biocontrol Agent (s)	Against the disease (s)
1	*Agrobacterium radiobacter* K–84	Crown gall of coriander (*Agrobacterium tumifaciens*)
2	*Bacillus subtilis*	Wilt of red gram
3	*Pseudomonas fluorescens*	Rice sheath blight (*Rhizoctonia solani*), pythium damping off in cotton, cowpea root rot and fusarial wilt of banana.

Use of bacteriophages

They are viruses that attack bacteria and usually destroy them. A number of phages have now been discovered for many phytopathogenic bacteria such as pseudomonas glycinea, *Xanthomonas campestris pv. citri* in citrus, *Xanthomonas campestris pv. malvaceraum* in cotton etc., (van Lenteren *et al*., 2018). This can be applied as spray are lost in the host when inoculated alone but when the receptor are present, phages not only multiply and reach higher population and also survive for a much longer period in the host. Best control was achieved when phages were applied first. Repeated application of phage lysate was considered necessary for successful biological control, however much work is needed before bacteriophages can be used in management of bacterial diseases.

Application of biocontrol agents

Biocontrol agents are applied as seed, soil and foliar application in the crop protection programme, but the application prior to pathogen attacks will provide protection to the crops. Normally fungal antagonist (commercial formulation) are recommended @ 4g/kg of seed application and fungal bacterial antagonist formulation of biocontrol agents have been developed in other countries, they are listed in the following table.

Sl.No	Product name	Biocontrol agent	Target *pathogen*	Source
1	Tricodermin	*Trichoderma spp*	*Pythium* spp	Bulgaria and Russia
2	Gliogard	*Glicladium virens*	*Rhizoctonia solani*	USA
3	Dagger G	*Pseudomonas fluorescens*	*R.solani*	USA
4	Conqueror	P*seudomonas fluorescens*	*R.solani*	Australia
5	Quantum 4000	*Bacillus subtilis*	*Fusarium* spp	USA
6	Mycostop	*Streptomyces griseoviridis*	*Alternaria brassicola*	

Advantages of biocontrol agents

- Persistence nature of biocontrol agents
- When biocontrol agents applied in the soil, they will exist in the environment for many years. They will provide long lasting and permanent control against the diseases.
- Environmentally safe.
- They did not leave any toxic residues in the ecosystem.
- They can be easily amenable for mass multiplication packing, distribution and successfully applied in crop protection
- Effective as prophylactic treatment.
- Cost effective.

Constraints in using biocontrol agents

- It requires a through understanding of the biology and ecology of the pathogen as well as biocontrol agents.
- Most known biocontrol agents are generally specific to a single pathogen species but the ideal biocontrol agents should be able to control more than one pathogen.
- Normally biocontrol agents have slow or delayed action on the pathogens.

Future thrust in biological control

People are more conscious and concerned about pesticide residues in food and water and

they are aware that these biocontrol agents are environmentally safe. This is providing the impeities for suitable biocontrol agents as a substitute to chemicals. Generally, biocontrol agents have narrow host (pathogen) range. So, using biotechnological methods. Scientist can improve the agents with wide host range, high virulence and long storage effect. In recent year's effort have been made to increase the efficacy of biocontrol agents through biotechnology. The challenges of biocontrol are, however, not only to create genetically engineered superior agents but also to develop in expensive easily applied preparations that remain viable under less than optimum conditions. On the other hand, genetically engineered biocontrol agents should passed through a number of experiment on and human health. Because, sometimes they yield negative impact in the ecosystem.

Conclusion

In view of the loss due to plant diseases, the farmers can explore all available possible ways to reduce the usage of chemicals including beneficial microorganisms. The ecofriendly management of disease in agriculture to boost production without deteriorating the environmental health is the need of the day and so to keep the ecosystem for a long time the future generation.

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ABOUT THE SOCIETY

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

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

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

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

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

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