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# Krishi Udyan Darpan

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# Krishi Udyan Darpan

(Innovative Sustainable Farming)

## In This Issue

# A Natural Tool for Protection of Environment: Organic Farming

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## INTRODUCTION

The agriculture sector is experiencing a renovation motivated by new machineries, which seems very encouraging as it will facilitate this primary division to travel to the next level of farm yield and productivity (Himesh, 2018). A more suitable definition of organic agriculture is provided by the National Organic Standards Board (NOSB) — the federal advisory panel created to advise the USDA on developing organic legislation.

***"An ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off farm inputs and on management practices that restore, maintain and enhance ecological harmony (NOSB, 1995)."***

Intensive conventional farming can add contamination to the food chain. For these reasons, consumers are quested for safer and better foods that are produced through more ecologically and authentically by local systems. Organically grown food and food products are believed to meet these demands (Rembialkowska, 2007). Though in the past green revolution technologies have amplified crop yields and produced food to meet caloric requirements of the global population (Smil, 2000), there are also increasing concerns about the environmental costs, such as increased soil erosion, surface and groundwater contamination, greenhouse gas emissions, increased pest resistance and reduced biodiversity and so (Smil, 2000) forth, with use of such technologies (Pimentel, 1996 and Tilman *et al*., 2002). In recent years, organic farming as a cultivation process is gaining increasing popularity (Dangour *et al*., 2010). Organically grown foods have become one of the best choices for both consumers and farmers (Chopra *et al*., 2013).

**Principals for Organic Farming:** Organic manure, Crop rotation, Vermicomposting, Nitrogen fixing microorganisms, organic residue, crop residue, bio fertilizers, bio pesticides, kitchen waste, sludge and biogas are some of the main elements. These are proved to be very useful in maintaining soil health and texture. Their use is eco-friendly and helps in developing sustainable agriculture. In organic farming, more emphasis is given to the environmental health. Due to its nature friendly approach, it helps in reducing soil, water and air pollution. Therefore, acts as natural tool for environmental protection and sustainable development (Skoufogianni, 2016). Some principles are the core of organic agriculture that ensures sustainable development (Luttikholt, 2007).

**Status of Organic Farming in India:** Organic food and farming have sustained to grow across the world. Since 1985, the total area of farmland under organic production has been increased securely over the last three decades (Willer and Lernoud, 2019). By 2017, there was a total of 69.8 million hectares of organically succeeded land recorded globally which represents a 20% growth or 11.7 million hectares of land in comparison to the year 2016. This is the largest growth ever recorded in organic farming (Willer and Lernoud, 2019). The growth of organic farming in India was quite dawdling with only 41,000 hectares of organic land comprising merely 0.03% of the total cultivated area. In India during 2002, the production of organic farming was about 14, 000 tonnes of which 85% of it was exported (Chopra *et al*., 2013). The most important barrier considered in the progress of organic agriculture in India was the lacunae in the

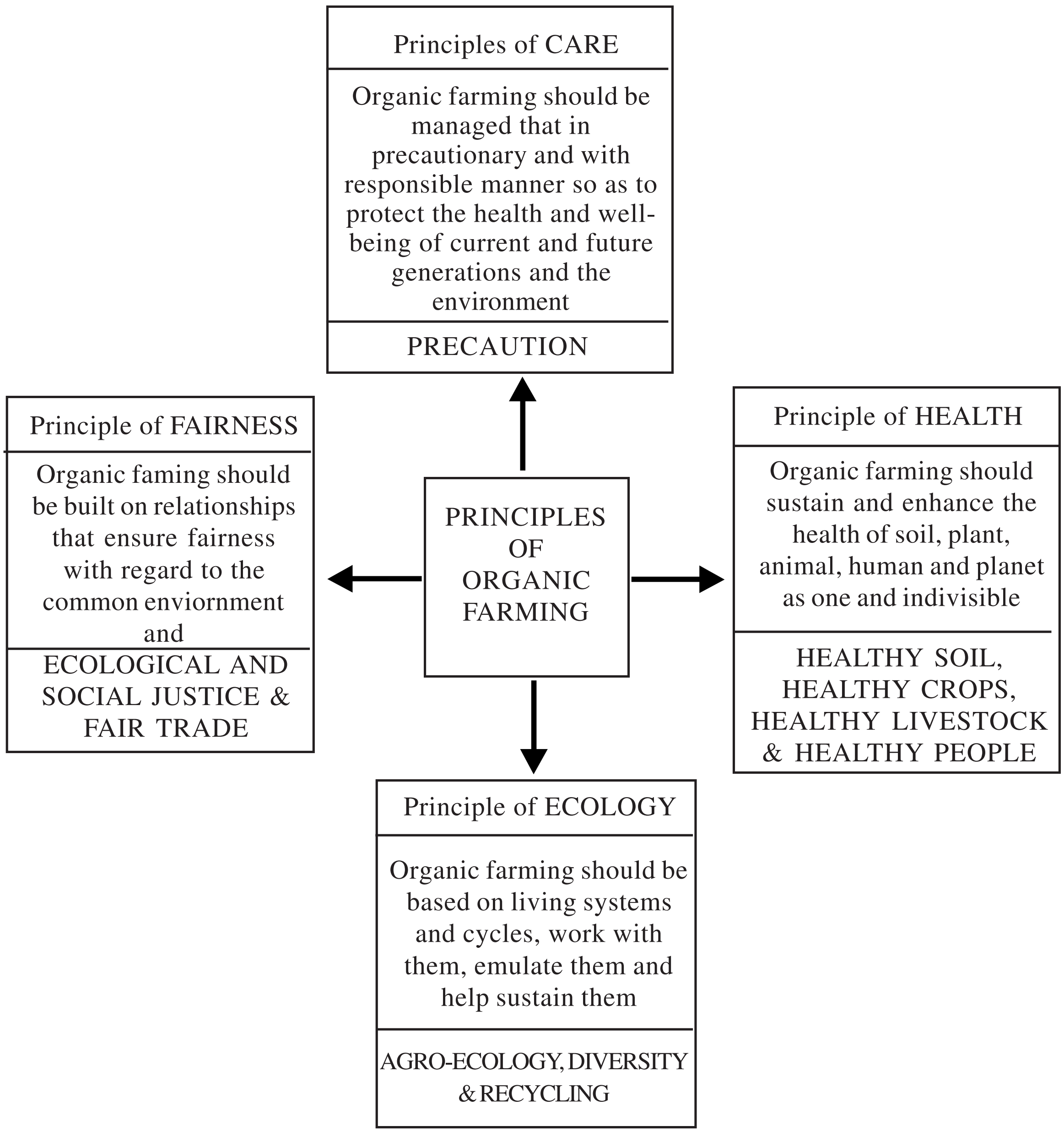


**Figure:1.** Principles of organic farming (adapted from IFOAM, 1998).

government policies of making a firm decision to promote organic agriculture. Moreover, there were several major drawbacks in the growth of organic farming in India which include lack of awareness, lack of good marketing policies, shortage of biomass, inadequate farming infrastructure, high input cost of farming, inappropriate marketing of organic input, inefficient agricultural policies, lack of financial support, incapability of meeting export demand, lack of quality manure, and low yield (Bhardwaj and Dhiman, 2019). India ranked 8th with respect to the land of organic agriculture and 88th in the ratio of organic crops to agricultural land as per Agricultural and Processed Food Products Export Development Authority and report of Research Institute of Organic Agriculture (Chopra *et al*., 2013; Willer and Lernoud, 2017). But a significant growth in the organic sector in India has been observed (Willer and Lernoud, 2017) in the last decades. In the union budget 2020–21, Rs 687.5 crore has been allocated for the organic and natural farming sector which was Rs 461.36 crore in the previous year. (Kumar 2020),

**Future Prospects of Organic Farming in India:** Indian traditional farmers possess a deep insight based on their knowledge, extensive observation, perseverance and practices for maintaining soil fertility, and pest management which are found effective in strengthening organic production and subsequent economic growth in India. The progress in organic agriculture is quite commendable. Currently, India has become the largest organic producer in the globe (Willer and Lernoud, 2017, 2019) and ranked eighth having 1.78 million ha of organic agriculture land in the world in 2017 (Sharma and Goyal, 2000; Adolph and Butterworth, 2002; Willer and Lernoud, 2019). Various newer technologies have been invented in the field of organic farming such as integration of mycorrhizal fungi and nanobiostimulants (to increase the agricultural productivity in an environmentally friendly manner), mapping cultivation areas more consciously through sensor technology and spatial geodata, 3D printers (to help the country's smallholder), production from side streams and waste along with main commodities, promotion and improvement of sustainable agriculture through innovation in drip irrigation, precision agriculture, and agro-ecological practices. Another advancement in the development of organic farming is BeeScanning App, through which beekeepers can fight the *Varroa destructor* parasite mite and also forms a basis for population modeling and breeding programs (Nova-Institut GmbH, 2018).

**Conclusions:** Organic farming yields more nutritious and safe food. The popularity of organic food is growing dramatically as consumer seeks the organic foods that are thought to be healthier and safer. India, at present, is the world's largest organic produce (Willer and Lernoud, 2019). With this vision, we can conclude that encouraging organic farming in India can build a nutritionally, ecologically, and economically healthy nation in near future.

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# A New Rootstock for Temperate Stone Fruits

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## INTRODUCTION

The choice of rootstocks depends mostly on climatic and soil conditions, which are usually more unsatisfactory in north-western Himalayan region. The length of the vegetation period, sum of temperatures and rain precipitations have significant effects on the rootstock performance. Over the last so many years many Prunus species and hybrids have been tested as potential dwarfing and semi dwarfing rootstocks for stone fruits particularly. The most promising selections so far tested at IARI Research Farm, Dhanda, Shimla have been *Prunus persica* Japan (ornamental peach). This rootstock has shown high yield efficiency, precocity, graft compatibility and smaller in size than the standard rootstock. Based on the performance of this rootstock on plant architecture (dwarfing), graft / budding compatibility, precocity, productivity, fruit size, fruit colour and quality, abiotic stress resistance (cold), it has been recommended to use this promising dwarfing rootstock for stone fruits cultivation in high density orcharding and low chilling areas. Even it can be grown in pots, kitchen garden where little space is available for any kind of cultivation.

Economic viability of a fruit production enterprise is linked directly to orchard productivity and management efficiency. To increase productivity and efficiency requires tree survival, managed vigor and increased marketable yields over the expected life span of the orchard. Several surveys have been undertaken to determine the relative importance of the various "problems" facing stone fruit industries around the world. The different problems associated with the rootstocks of stone fruits are soils having high bulk density, parasitic nematodes, root rot fungal pathogens, other edaphic or replant but the major being incompatibility of the rootstock with the scion. In India, the restrictions for the cultivation of stone fruits are mainly due to lack of compatible rootstocks. The major production of stone fruits in India is in the North-Western Indian States of Jammu and Kashmir (J&K), Himachal Pradesh (H.P.), Uttrakhand hills and to some extent in the North-Eastern Hills region.

Different rootstocks have been reported for different problems in stone fruits. Additionally, many "problem" sites have more than one limitation and require that a new rootstock incorporate resistance to multiple problems for successful adaptation. In many cases, new rootstocks are probably best suited for regional or prescription/niche planting rather than broad use over a large industry. Regional testing is the only way to determine each rootstock's best adaptation. Priorities vary from one stone fruit crop to another. Several studies have shown that the rootstock requirement for apricots (*P. armeniaca*) and plum (*P. domestica, P. salicina)* are similar to the rootstock requirement of peach. For sweet cherry (*P. avium*), the first and foremost need in rootstocks is for size reduction followed by increased scion precocity and compatibility so sour cherry (*P. cerasus*), which has low inherent vigor (compared to sweet cherry) can be used as a rootstock for sweet cheery. Fortunately, many stone fruit species can be budded onto other Prunus species. As a result peaches, plums, apricots and almonds (*P. amygdalus*) often can be budded onto rootstocks developed for each other. Not all stone fruit scions are compatible with available *Prunus* rootstocks namely: *P. cerasifera*, *P. cerasifera* x *P. munsoniana*, *P. domestica*, *P. insititia*, *P. americana*, *P. pumila*, *P. besseyi*, *P. spinosa*, *P. dulcis*, *P. amygdalus* x *P. persica*, *P. insititia* x *P. domestica*, *P. armeniaca*, *P. salicina*, *P. persica* x *P. davidiana* and *P. amygdalus* x *P. nemared* (*P. persica* x *P. davidiana*) used as rootstocks for peach, plum, apricot and almond in different countries.

Major portion of the total stone fruits production in Himachal Pradesh is confined mainly to the mid hill region falling in the altitude range of 1000 – 1700 meters above mean sea level where the summer is moderately hot (31.8$^{o}$C to 34.8$^{0}$C) during May-June and winters are cold (2.4$^{o}$C to 3.7$^{o}$C) during December–January. The average annual rainfall ranges from 100-130 cm, 90% of which is limited to two months of the monsoon (July–August) and during the rest of the year plants remain under water stress. Most of the orchards are on sloppy land where irrigation is difficult to practice and due to scarcity of water and uneven distribution of rainfall throughout the growing season drought conditions are commonly prevalent, which results in poor fruit set, heavy fruit drop and sometimes even cause the death of the plants. Like majority of fruit crops, stone fruits are also multiplied clonally by grafting the scion cultivar on the desired rootstock and beneficial effects of rootstock on the grafted plant. Wild relatives of the stone fruits e.g., wild peach (Kateru), wild apricot (Chulli) and Behmi have remained the first choice as rootstock in case of stone fruits on commercial level and have adapted in this region for ages.

Thus, in India the productivity of peach, plum and apricot is 8.10 tonnes/hac, 5.7 tonnes/hac and 4.17 tonnes/hac respectively which is considerably low as compared to other countries where these fruits are grown commercially. Non-availability of good rootstocks suitable for the local climatic conditions for mid hills of Himachal Pradesh is one of the major reasons for the low productivity of these crops. Since there are huge variations available in form of wild peach (kateru), wild apricot (Chulli) and Behmi from which suitable clonal rootstock could be evolved which are suitable for the local climatic conditions and benefit the orcharding enterprise to a larger extent.

### The new prospective

A new rootstock from ornamental peach, *Prunus persica* Japan (syn. *Prunus japonica*) which is compatible with all the stone fruits have been studied at the IARI, Regional station, Shimla and successful results have been recorded. It is mainly cultivated for ornamental use (figure 1). It is a shrub species in the genus *Prunus*. The shrub reaches 1.5 m by 1.5 m. Its flowers are hermaphrodite and are pollinated by insects. The plant blossoms in May. Its fruit reaches about 14 mm in size and has an agreeably sweet flavor.

All the stone fruits like Peach, Plum, Apricot, Prune, Almond, Nectarine, and Cherry of genus *Prunus* have been successfully grafted on *Prunus persica* Japan (ornamental peach). These have shown complete graft compatibility, precocity and fruit set. The rootstock is very dwarfing in nature thus can be successfully used for high density plantation. Based on the performance of this rootstock on plant architecture (dwarfing), graft/budding compatibility, productivity, fruit size, fruit colour and quality, abiotic stress resistance (cold), it has been recommended to use this promising rootstock for stone fruit cultivation in high density orcharding and low chilling areas. Even it can be grown in pots, kitchen garden where little space is available for any kind of cultivation.

**Conclusion:**

All the temperate stone fruits like Peach, Plum, Apricot, Prune, Almond, Nectarine, and Cherry of genus *Prunus* have been successfully grafted on *Prunus persica* Japan (ornamental peach). These have shown complete graft compatibility, precocity and fruit set. The rootstock is very dwarfing in nature thus can be successfully used for high density plantation. Based on the performance of this rootstock on plant architecture (dwarfing), graft/budding compatibility, productivity, fruit size, fruit colour and quality, abiotic stress resistance (cold), it has been recommended to use this promising rootstock for stone fruit cultivation in high density orcharding and low chilling areas. Even it can be grown in pots, kitchen garden where little space is available for any kind of cultivation.

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# Agricultural Waste to Organic Compost: New Trends for Sustainable Agriculture

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## INTRODUCTION

Annually, a huge quantity of agricultural wastes are generated in India is estimated to be approximately 620 million tones that must be degraded in terms of organic compost through the bioconversion process. Recently, pollution caused by burning of parali (rabi and kharif crop residues) are red-hot problem in India. Thus, the accumulation of these agricultural wastes causes severe disposal problems concerned with the fertility and microbial ecology of soil, environmental pollution and harmful effect on plant and animal health. Several researchers reported that the disposal of untreated agricultural waste is either performed by dumping, burning or unplanned landfilling. This has led to a serious deleterious contaminating impact on fertility of soil, shifting of beneficial microbial communities, emission of greenhouse gases, air pollution, progressive soil erosion and climate change.

The bioconversion is a sequential process that involves conversion of agricultural waste into raw compost, further humus rich compost fortified with beneficial decomposer microorganisms to produce high quality organic compost that resolve multidimensional problems like soil fertility, environmental pollutions, reduction in use of excessive chemical fertilizers and emission of greenhouse gases. The wide range of bacterial and fungal species has immense importance as decomposer microorganisms that produce fortified organic compost through bioconversion process. The potential decomposer microorganisms comprises either single or combination (consortia/formulation) of beneficial microorganisms like N-fixers, P-solubilizers or K-mobilizers and biocontrol agents that degrade agrowaste through biochemical process and enriches compost to produce bioorganic products. The metabolic activity and biosynthetic capability of specific microorganisms to amend, transform and exploit agrowaste in order to obtain vigor and biomass production give new insight towards microbes based natural bioconversion. Similarly, organic compost is also enriched with amino acids, botanicals, humic acid, mineral nutrients, phytohormones etc., that may add valuable growth in plants.

In concern of sustainable agriculture, organic compost is an alternative natural resource for minimizing the application of chemical fertilizers, management of crop residues and high yield production in the farmer’s fields. In this order, controlled composting conducted by potential decomposer microbial communities to degrade agricultural residues properly and provide high-value low-cost bioorganic compost for farmer’s. This emerging technique of composting processes can benefit farmers to attract towards organic compost rather than chemical fertilizers and simultaneously it enhanced the production of high-value profitable crops like vegetables, fruits, flowers, and organic crops. The application of biofortified compost with bioagents, controlled the soil, seed or seedling borne fungal pathogens in the field that reduces the application of biopesticide. Similarly, farmers also applied consortium of microorganisms that are capable of fixing nitrogen, solubilizing phosphorus, zinc and mobilizing potassium that can be fortified with compost. The scientific approaches that targeted farmer-friendly microbe-mediated agricultural waste bioconversion for composting among the grass-root stakeholders are a matter of perception and preference. Several factors that hamper the awareness of technologies among the farmers are lack of knowledge about soil and plant characters, less awareness about effect of chemicals on agricultural foods on human health, dilemma to adopt new technologies, and short-sightedness towards long-term benefits of organic and fortified compost in agriculture. To overcome these problems Indian government started awareness programs using ICT tools or by videos, learning materials or by technical demonstration kits, television/ media adds, new government programs regarding sustainable agriculture are connected farmers to adopt these technologies.

Presently, elevated pollution through burning parali (crop residues) in North India is one of the best examples. Indian government lead and aware farmers for safe and useful decomposition practices of parali (crop residues) rather than burning that destroy microbial ecology, beneficial microbes, soil fertility and elevated air pollution. In this context, bio-decomposers liquid formulation technique has been developed by Indian Agriculture Research Institute (IARI), Dehli, PUSA institute which ensures speedy biodecomposition of crop residues within 8-10 days in fields and after 15 days fields will be ready for next harvest. These efforts can yield desirable impacts on crop yield production, minimizes the application of high-cost chemical fertilizers, integrated farm management practices, limiting hazard of pollutants due to enduring effects of pesticides, dropping production cost of the crops, converting agriculture residue into useful compost and enhancing soil fertility level that lost due to countable changes among farming communities. Therefore, the Indian government has publicized profound interest in promoting adaptation of such environment- and agriculture-friendly practices in farmers through innumerable progressive organizations and funding schemes.

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# Artificial Ripening in Fruit Crops – A Boon or Bane

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## INTRODUCTION

Ripening is physiological maturity of an inedible plant organ into a visually attractive olfactory and taste sensation. Ripening makes the completion of development of a fruit and the commencement of senescence. It is normally an invisible event. Ripening is a result of complex changes, many of them probably occurring independently of one another. Ripening is associated with both the anabolic and catabolic processes. During ripening processes complex, multi structured compounds are broken into simple compounds.

Fruit ripening is a natural phenomenon that makes the fruit soft and sweeter. During ripening the fruits achieve desirable quality, flavour, colour, palatable nature and improvement in overall textural properties. Usually there is a decline in acid content and an increase in soluble sugar content with ripening. During the process of ripening starch is converted to simple sugars.

Artificial ripening would ensure a uniformly ripened fruit with excellent cosmetic/ visual characteristics but there is compromise with nutrition value, organoleptic qualities and shelf life when compared with the naturally ripened ones.

**Understanding the need for artificial ripening**

Artificial ripening is the process of triggering the ripening process of an almost matured or fully matured fruit. Artificial ripening agents is known to hasten the ripening process. Artificial ripening concept emerged when man understood the need of transporting firm matured fruit at some distant place and initiate the ripening process after it has reached the destination. This is because transportation of firm fruits is not only economically beneficial but also renders minimum damage to the fruits. Another need for artificial ripening is to accelerate the ripening process during any particular event when the market price or requirement is high. For example, during Ganesh Utsav in Maharashtra or Durga Puja in West Bengal the demand for fresh ripened bananas is at its peak. The demand is such enormous that even supplies from adjacent districts and states are not enough. Then there comes the need for artificial ripening agents which can ripen the fruit during the peak requirement time. Hence, we can conclude from the above paragraph that artificial ripening is not the need of nature but the need for commercial horticulture where the seller usually applies ripening agent to trigger the ripening process. It also helps in synchronized harvesting of the fruits.

| Parameters | Value |
|---|---|
| Temperature | 18 - 25 OC |
| RH | 90-95 % |
| Duration of treatment | 24-72 hrs |
| Ethylene concentration | 10 to 100 ppm |
| Carbon dioxide | < 1% |
| Air circulation | Sufficient enough for aeration but not too much to cause anaerobic damage to fruits |

**Optimum condition for artificial ripening.**

**Some common artificial ripening agents**

For artificial ripening of fruits, the application of ripening agents and chemicals are usually applied during pre-harvest stage, just after harvesting, transportation and storage. The stage of application ripening agents depends on the need of the seller. Discussed below are some artificial ripening agents seldom employed in artificial ripening.

### A. Ethephon/Ethrel

Ethephon is one of the most commonly used ripening hormones in India. It is a very common ethylene-generating chemical that is used in post-harvest treatments. Ethephon is chemically known as 2 – chloroethyl phosphonic acid with chemical formula $C_2H_6ClO_3P$. In India it is known by the trade names Floral and Cepa. The resultant ethylene produced is similar to that produced during ripening process. Ethephon is known to penetrate into the fruit tissues and decomposes to liberate ethylene gas. Government of India has allowed the use of ethephon for ripening of fruits as it is less harmful as compared to the other commonly used ripening agents. Ethephon is widely used for ripening banana, mango and other berries. Ethrel is the liquid form of ethephon where the fruits are needed to be dipped in ethylene solution.

Even though ethrel/ethephon application is safer as compared to other ripening processes but is known to produce organophosphate signs of toxicity. This includes lacrimation, muscle twitching, salivation and incoordination. Inhibition of red blood cells and cholinesterase are also observed in case of excess application. Excess exposure might lead to chest tightness, respiratory troubles, lung disorders and even loss of consciousness.

### B. Ethylene glycol

Ethylene glycol is another low-cost ripening agent with chemical formula $C_2H_6O_2$. It is widely used as an artificial ripening agent. Ethylene glycol is cheaper as compared to gaseous ethylene. Ethylene reacts with hydrogen peroxide to form ethylene glycol

$$C_2H_4 + H_20_2 \rightarrow C_2H_6O_2$$

Ethylene glycol is not only cheap but it can be diluted with water and it can be used as a dipping treatment for fruit ripening. It shows efficacy of ripening even where temperature is low. The major drawback of Ethylene glycol is that it should be kept away from children as it is poisonous and might lead to kidney failure.

### C. Ethylene ($C_2H_4$)

Ethylene is a gaseous ripening hormone of chemical formula $C_2H_4$. It is applied in fruits to trigger the ripening process. The gaseous hormone is very expensive is not commercially feasible for sellers. Ethylene in the range 0.1

to 1 ppm can trigger the ripening process. It is a safe ripening agent according to FDA and government of India as well. For artificial ripening, ethylene is blowout using catalytic generators in a closed chamber under controlled temperature and relative humidity. Ethylene generators can also be used. Ethylene is known to trigger rate of respiration thus causing denaturation of chlorophyll, synthesis of anthocyanin and carotene, increase in sugar content, decline in titratable acidity and cell wall softening. Ministry of Agriculture, GOI have suggested an application of 10-100 ppm exogenous application of ethylene to be sufficient to trigger the ripening process.

**D. Calcium carbide ($CaC_2$)**

Calcium carbide is a chemical compound of chemical formula $CaC_2$ which is known to produce acetylene and calcium cyanamide at controlled conditions. In particular temperature and in presence of sufficient moisture produces acetylene gas which acts as a ripening agent. Acetylene is another ripening gas which (that) is produced during the process. The intensity of colour development in $CaC_2$ ripened fruits depends on concentration of $CaC_2$ used. The fruits ripened using calcium carbide is of good colour but is poor in terms of flavour, taste and palatability.

$$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca\ (OH)_2$$

10 tonnes of fruit can be ripened using 1 kg of Calcium carbide which costs near about Rs. 25-30. The use of Calcium carbide ($CaC_2$) as a ripening agent is banned in many countries including India. Till then it is used extensively by local sellers. Fruits ripened by Calcium carbide ($CaC_2$) can be extremely hazardous as it is known to have traces of phosphorous and arsenic. Acetylene gas is also known to affect the neurological system due to prolonged hypoxia. Excess exposure might cause immediate adverse effects like diarrhea, vomiting, burning sensation of chest, weakness, trouble in swallowing, irritation in eyes, shortness of breath. This is the reason why it is banned according to the rule 44AA of the Prevention of Food Adulteration Rules 1955.

**Quality comparison between naturally ripened and calcium carbide ripened fruits**

| Parameters | Naturally ripened fruit | Using Calcium carbide |
|---|---|---|
| Weight per fruit | Good | Fair |
| Aroma Excellent | Good | |
| Taste Sweet | Slightly less sweetUsually starchy | |
| Firmness | Optimum | Fair |
| Texture | Less attractive but somewhat uniformly coloured | Uniformly coloured |
| Shelf-Life | Longer | Short – Initiation of blackening in 2-3 days |

**Regulations to prevent hazardous artificial ripening**

Not all artificially ripened fruits are not hazardous. But the consumption of fruits ripened by using artificial ripening agents like Calcium carbide can be catastrophic. Government has banned the use of Calcium carbide as a ripening agent. But till then at local level the user is not yet stopped. Most of the sellers are using the harmful chemical due to lack of awareness but some of the sellers

**Comparison between ethylene and calcium carbide based artificial ripening**

| Aspects | Ethylene-based | Calcium carbide |
|---|---|---|
| Legal | It is approved by WHO and FDA and is unanimously accepted | Totally illegal and banned in many countries. In India its application is punishable under law |
| Quality of produce | Excellent taste and aroma | Dry texture, poor aroma and poor taste |
| Health | Safe and Natural | Highly carcinogenic and can cause multiple organ failure |
| Shelf-Life | More | Less |
| Market demand | Increasing due to public awareness | Low (with increasing awareness) |
| Weight Loss | Low (<7%) | High (>13%) |
| Transport losses | Takes longer period to soften | Softens in 2-3 days |
| Ripening costs | Rs.5 per 10 Kg (approx) | Very cheap |

are applying Calcium carbide quite intentionally due to its cheap price. There should be restriction in selling and buying of Calcium carbide at grass root level can stop the use of Calcium carbide. Awareness and training at wholesaler, retailer and local shopkeeper level should also be organized. The use of Calcium carbide is banned in our nation but awareness at consumer level is also important. Consumers should avert buying homogeneously ripened glossy attractive fruits as they might be ripened by Calcium carbide. Naturally ripened fruit have patches, spots and green spots as well. For second time precautions consumers should wash the fruits with cold water or baking soda solution before the consumption of any fruits purchased from the market.

## Conclusion

Artificial ripening technology of fruits is a boom for our society as it has several positive aspects. But along with numerous positive aspects there are also some dark sides of artificial fruit ripening. The use of hazardous chemicals like Calcium carbide can be dangerous for our society. Hence it can be concluded that ripening of fruits using safe chemicals that are non-hazardous to human health can boost commercial horticulture. But the use of carcinogenic chemicals should be totally avoided for safety of future generations.

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# Effectiveness of Herbicides and Their Combinations in Direct Seeded Hybrid Rice (*Oryza sativa* L.) in Coastal Belt of West Bengal

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## INTRODUCTION

Most rice growers in coastal belt of West Bengal have no other option but to go for rice cultivation in *kharif* season under lowland situations, representing about 17% of total rice area of this state (Banerjee *et al.* 2018). Weeds are the predominant barrier to direct seeded rice production in rainy season (Biswas *et al.* 2020). Bengal farmers traditionally practice hand weeding which is labour and cost intensive. On contrary, the herbicidal application saves time as well as cost. But continuous application of single herbicide facilitates shifting of dominant weed flora and the development of resistant biotypes against the particular herbicides (Kundu *et al.* 2020 a, b). Therefore, sequential or tank-mix application of various post-emergence herbicide would be a good option to control the heavily diversified weed flora in direct seeded rice (Ghosh *et al.* 2016). This study was undertaken to compare the performance of different post-emergence herbicides, mechanical and cultural weeding on weed control efficiency and hybrid rice (cv. PAN 2423) productivity in coastal belt of West Bengal.

### Materials and Methods

The Field experiment was conducted at Regional Research Station (coastal saline zone), Bidhan Chandra Krishi Viswavidyalaya, Kakdwip, South 24 Parganas, West Bengal during rainy season of 2017-18 and 2018-19. The farm is situated at 22°40´ N latitude, 88°18´ E longitude and 7 m above mean sea level. The soil was clayey in nature, neutral pH, having medium N, P and rich in K. The trials were laid out in a randomized block design with eight weed control treatments [T1, glyphosate 41 EC at 0.75 kg/ha at 10 days before sowing, T2, butachlor 50 EC at 1.5 kg/ha at 3 days after sowing (DAS), T3, bensulfuron-methyl + pretilachlor 66.60 GR at 0.06 + 0.06 kg/ha at 15 DAS; T4, T1 *fb* T2; T5, T1 *fb* T3; T6, hand weeding at 20 and 40 DAS; T7, cono weeder and T8, control or weedy check] with three replications. The individual plot size was 5 × 4 m. Herbicides were applied with knapsack sprayer fitted with flat fan nozzle by dissolving in 500 liters water per hectare. Other management practices were applied on hybrid rice (cv. PAN 2423) followed standard package and practices. Bio-efficacy was recorded by accounting numbers and dry weights of weed flora by random placing of quadrate 0.5×0.5 m. Rice yield was determined from the net plot area (12 $m^2$ excluding the border area).

As wide variation existed in data on weed density were transformed through square-root (method before analysis of variance. All the collected data were analyzed statistically by the analysis of variance (ANOVA) technique using the STAR Software version 2.0.1 of International Rice Research Institute, Philippines, 2013. The differences between treatments means were tested on the significance level of *p* d"0.05.

**Result and Discussion**

The experimental field was infested with the following weed flora, namely *Echinochloa colona* (30%), *Cyperus iria* (20%), *Marsilea quadrifoliata* (25%) and *Ludwigia parviflora* (25%) during both the years of study, before and after herbicide application. Maximum and minimum weed population and dry weight were recorded in weedy check and hand-weeded plot respectively. Among the herbicidal treatments, application of glyphosate 41 EC at 0.75 kg/ha at 10 days before sowing followed by bensulfuron-methyl + pretilachlor 66.60 GR at 0.06 + 0.06 kg/ha at 15 DAS resulted in minimum weed count at 60 DAT, irrespective of weed species (Table 1). Similar findings were also reported by Ghosh *et al.* (2016) who opined that the collective impact of herbicides inhibits the initial weed seed germination and subsequent weed growth at later stage in rice field. Least weed density irrespective of grass, sedge and broadleaf with herbicide mixture at different crop growth stages was also reported by Banerjee *et al.* (2017). In the present study, however, least weed dry weight (13.10 g/m$^2$) was recorded in the plot treated with butachlor 50 EC at 1.5 kg/ha at 3 DAS, which had no significant difference with weed dry weight obtained by combined application of glyphosate 41 EC at 0.75 kg/ha at 10 days before sowing followed by bensulfuron-methyl + pretilachlor 66.60 GR at 0.06 + 0.06 kg/ha at 15 DAS (Table 1). Sequential or mixed application of herbicides is the most prominent and effective option than the use of single herbicide, most particularly in complex grass and broadleaf weed infestation in rice fields (Singh *et al.* 2006). Application of glyphosate effectively control the weeds including *Cyperus* spp. before puddling resulted in lesser weed density, dry weight and ultimately higher weed control efficiency in transplanted paddy (Manisankar *et al.* 2019). As compared to control plots (weedy), the maximum reduction in weed dry matter was recorded in hand-weeded plots, closely followed by the plots receiving butachlor 50 EC at 1.5 kg/ha at 3 DAS, as estimated by weed control efficiency of herbicidal treatments. Previously, Singh *et al.* (2016) showed better performance with the application of butachlor at 2 kg/ha in respect to minimum weed dry matter accumulation and maximum dry matter reduction.

Amongst the tested herbicides, the plots receiving glyphosate 41 EC at 0.75 kg/ha at 10 days before sowing followed by bensulfuron-methyl + pretilachlor 66.60 GR at 0.06 + 0.06 kg/ha at 15 DAS produced hybrid rice with higher yield components (300 panicle/m$^2$ and 2.25g panicle weight, respectively) (Table 1). The same treatment combination registered the significantly highest grain yield (4.58 t/ha), comparatively lower than grain yield obtained in hand-weeded plot. However, the highest B:C ratio was obtained with same treatment combination which might be due to the low cost involvement in weed control practice (Table 1). On other hand, the lowest grain yield with poor economic return was recorded from control plots (weedy check), as there was huge competition between hybrid rice and predominant weeds for essential growth factors (moisture, nutrients, sunlight etc.). Our results are in good conformity with Singh *et al.* (2008) who reported maximum rice productivity along with good economic viability from the plot treated with sequential application of non-selective and selective herbicide at proper time rather than single application.

**Table 1. Effect of weed control measures on diverse weed-flora, yield components, yield and economics of direct seeded hybrid rice (pooled data of two years)**

| ents | Weed density (nos./$m^2$) at 60 DAS | | | Total weed dry weight at 60 DAS (g/$m^2$) | Weed control efficiency (%) | Panicle number / $m^2$ | Panicle weight (g) | Grain yield (t/ha) | Weed index (%) | B:C ratio |
|---|---|---|---|---|---|---|---|---|---|---|
| | Grass | Sedge | BLW | | | | | | | |
| | 2.75 (7.67*) | 2.82 (7.99) | 3.15 (9.97) | 13.67 | 77.09 | 259 | 2.00 | 3.03 | 34.97 | 1.04 |
| | 2.47 (6.11) | 2.46 (6.07) | 3.02 (9.17) | 13.10 | 78.04 | 269 | 2.08 | 3.46 | 25.75 | 1.13 |
| | 2.57 (6.65) | 2.42 (5.87) | 3.03 (9.17) | 14.17 | 76.25 | 273 | 2.16 | 3.77 | 14.09 | 1.25 |
| | 2.65 (7.09) | 2.50 (6.29) | 3.19 (10.21) | 14.67 | 75.41 | 288 | 2.07 | 4.17 | 10.51 | 1.39 |
| | 2.21 (4.89) | 2.42 (5.87) | 2.41 (6.03) | 13.90 | 76.70 | 300 | 2.25 | 4.58 | 1.71 | 1.68 |
| | 1.57 (2.50) | 2.09 (4.43) | 2.55 (6.52) | 5.30 | 91.11 | 342 | 2.39 | 4.66 | 0 | 1.47 |
| | 2.36 (5.58) | 2.33 (5.46) | 2.89 (8.37) | 17.27 | 71.05 | 307 | 2.41 | 4.10 | 12.01 | 1.12 |
| | 5.55 (31.07) | 4.29 (18.40) | 4.34 (18.80) | 59.67 | 0 | 164 | 1.63 | 1.73 | 62.87 | 0.48 |
| | 0.57 | 0.29 | 0.48 | 8.05 | - | 32 | 0.07 | 0.27 | - | - |

*Figures in parenthesis represent the original value

DAS, Days after sowing; BLW, Broad leaved weed; B:C , Benefit : cost; LSD: Least significant difference

## Concluision

The diverse weed-flora in direct seeded hybrid rice was effectively controlled by the combined application of glyphosate 41 EC at 0.75 kg/ha at 10 days before sowing followed by bensulfuron-methyl + pretilachlor 66.60 GR at 0.06 + 0.06 kg/ha at 15 DAS. This superior treatment may be recommended as it recorded maximum yield and profitability than any other tested chemical or cultural or mechanical weed control measures in direct seeded hybrid rice cultivation in coastal Bengal.

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# Leaf Colour Chart – Eco-Friendly Tool for Farmer


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## INTRODUCTION

Leaf colour chart (LCC) is a low cost and easy to handle diagnostic tool for real-time or crop-need-based nitrogen (N) management in rice, wheat, maize and cotton crops. LCC used as quick and reliable intelligent tool and helps rice, wheat, maize and cotton farmers to visually assess the leaf N status and to apply the nitrogenous fertilizers for these crops at different growth stages. LCC is usually a plastic, ruler-shaped strip containing 4 to 6 panels that range in colour from yellowish green to dark green.

The colour panels of the LCC are designed to indicate whether rice, wheat and maize crop plants are hungry or over-fed by nitrogenous fertilizer. By matching the colour of the rice, wheat and maize leaf to the colour on the LCC, farmers can decide proper time and amount of N fertilizer for application. LCC ensures only need-based optimum application of chemical fertilizer (urea) and reduces pesticide use in agriculture and enhances farmers' income as well as food quality.

LCC never aims reduction in fertilizer nitrogen application at the cost of reduction in yield. In fact, purpose of using LCC is to apply adequate amount of nitrogen and avoid application of fertilizer more than required. Use of LCC helps to determine nitrogen demand of the crop and guide right time of fertilizer nitrogen application so as to prevent unwanted nitrogen losses and their serious impact on the ecosystem. Generally it reduces fertilizer nitrogen requirement because farmers often apply nitrogen fertilizers in excess. But, if under certain circumstances farmers are using nitrogenous fertilizers less than the crop requirement, LCC based technology will guide to apply more fertilizer nitrogen and would certainly improve yield.

A case study in West Bengal, India indicated that, in all three rice seasons, LCC adopter farmers used significant-ly less N fertilizer than nonadopt-ers. Reduced N use by LCC adopters did not affect grain yield in any of the seasons. Rather, the adopters produced slightly higher yields than did nonadopters—about 19, 43, and 95 kg/ha higher in the *pre-kharif*, *kharif,* and *boro* season, respec-tively. N fertilizer savings by LCC adopters were on average 25 kg N/ha (54 kg urea/ha), a 19% sav-ing over the farmers' practice. The rates of N savings in the different rice seasons were similar—this was highest at 31 kg N/ha (67 kg urea/ha) in the *boro* season, followed by 23 kg N/ha (50 kg urea/ha) in the *pre-kharif* season, and 20 kg N/ha (44 kg urea/ha) during *kharif.*

Adopter farmers also reported low insect-pest incidence in fields where N fertilizers were used ac-cording to LCC readings. Farmers reduced the number of insecticide sprays from an average of 2.55 per season to 1.28 (n=148). The LCC adopters reduced insecticide sprays by 50%, which was significantly lower than what they used to apply before LCC adoption. The aver-age number of sprays made by nonadopter farmers was similar to that by adopter farmers before the introduction of the LCC (2.56 sprays per season).

The Consultative Group on International Agricultural Research (CGIAR) Research Program on Climate Change, Agriculture and Food Security (CCAFS) introduced the model of "Climate Smart Villages (CSVs)" in Bihar, India. The idea was to raise awareness among farming communities in South Asia about LCC and various technological, institutional and policy-oriented options that have the potential to increase their climatic resilience, adaptation, agricultural productivity and income, while reducing emissions of greenhouse gases.

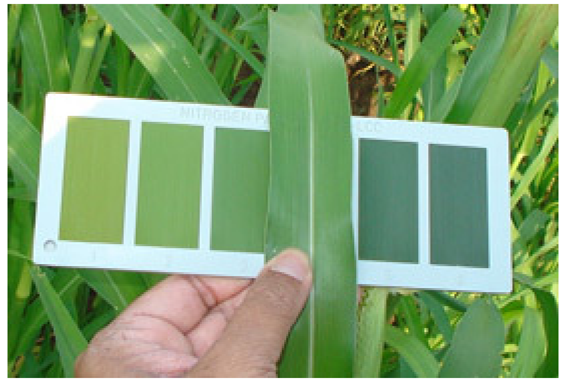
According to the Punjab Agricultural University the use of LCC in Punjab for rice, wheat, maize and cotton crops, can result in saving of around rupees 170 crore annually as well as the environment.

By using LCC in irrigated rice, let us assume a potential saving of 23 kg N or 50 kg urea/ha/season. The estimated annual saving of urea is 834,000 tons for India if 50% of farmers use LCC in the irrigated rice area of 22.3 million ha.

Leaf color chart has been successfully evaluated and recommended for need based nitrogen application in rice, wheat and maize crops. It has also been observed that the principles of using LCC for monitoring crop nitrogen demand can work in sugarcane, potato, cotton, cassava, vegetables, mustard, oilpalm etc., as well. The research is in progress and appropriate technology may emerge for these crops in the near future. If it happens then we are going to have more nutritious and good quality food and food products

**CONCLUSION**

Leaf color chart has been successfully evaluated and recommended for need based nitrogen application in rice, wheat maize and cotton crops. It has also been observed that the principles of using LCC for monitoring crop nitrogen demand can work in sugarcane, potato, cassava, vegetables, mustard, oilpalm etc. as well. The research is in progress and appropriate technology may emerge for these crops in the near future. If it happens then we are going to have more nutritious and good quality food and food products.



**LEAF COLOUR CHART (LCC)**

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# Local and Global Enviromental Problems

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## INTRODUCTION

An environmental problem occurs when there comes a change in quality or the quantity of the environmental factor that directly or indirectly affects everything on earth. There are several environmental problems that could be local or global.

***Factors which cause these problems are*:**

- Population Explosion
- Rapid Industrialization
- Urbanization
- Modern Lifestyle

**Local Environmental Problems**

- Pollution
- Deforestation
- Waste Disposal problem
- Over-Exploitation of natural resources

**Pollution:**

Introduction of contaminants into the natural environment that causes adverse change is called pollution and the components of pollution are known as pollutants.

**Types of pollution:**

- Air Pollution
- Water Pollution
- Light Pollution
- Soil Pollution
- Noise Pollution

**Waste Disposal Problem:**

Removing, storing or destroying damaged, used or other unwanted domestic, agriculture or industrial products is known as waste disposal.

**Solid wastes:**

Garbage, rubbish, sewage treatment, dead animals

**Pollution Deforestation**

**Harms:**

Waste disposal in lands creates problems such as ground water contamination, methane gas formation and disease vector hazards.

**Over Exploitation of Natural Resources:**

The act of using resources unfairly for the own advantage is known as over exploitation of resources.

Following consequences can arise from the careless and excessive consumption of these resources:

- Deforestation
- Extinction of species
- Soil erosion
- Natural Disasters

**Global Environmental Problems:**

- Global Warming
- Green House Effect
- Ozone Layer Depletion
- Acid Rain

**Global Warming :**

The gradual rise in the overall temperature of the atmosphere of the Earth is known as global warming. Temperature increase is caused by an increased concentration of greenhouse gases.

**Major Gases :**

- Water Vapour
- Carbon dioxide
- Methane
- Ozone

**Causes of Global Warming:**

Some causes of global warming are following:

- The emission of Greenhouse gases like Carbon dioxide, methane, nitrous oxide etc., into the atmosphere.
- Burning of Fossil Fuels
- Deforestation
- Agriculture

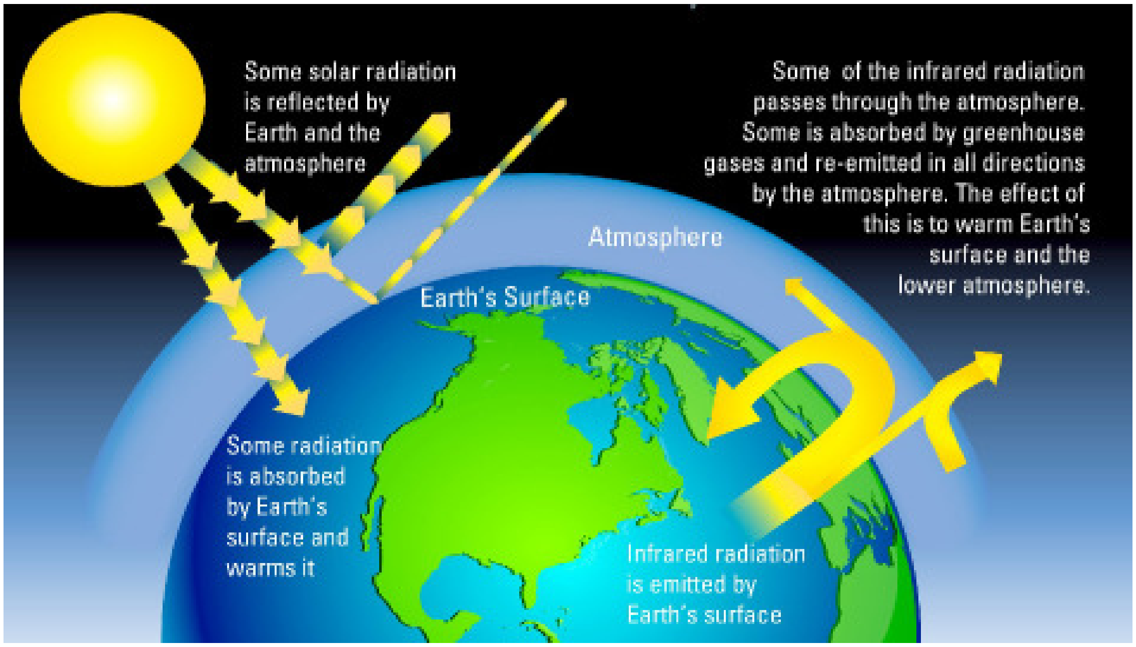
The results of global warming are melting of glaciers, effects on marine life, sinking of coastal regions etc.

**Green House Effect**

It is a process that occurs when gases in Earth's atmosphere traps the Sun's heat. It is due to the blanketing effect of man-made $CO_2$ in the atmosphere.

**Green House Gases:**

- Carbon dioxide
- Methane
- CFCs
- Ozone




**Sources:**

Sources of greenhouse gases are following:-

- Burning of coal and natural gas
- Forest fire
- Burning of fossil fuels
- Automobiles fumes


**Automobile Fumes**

***Forest Fires***

**Ozone LayerDepletion:**

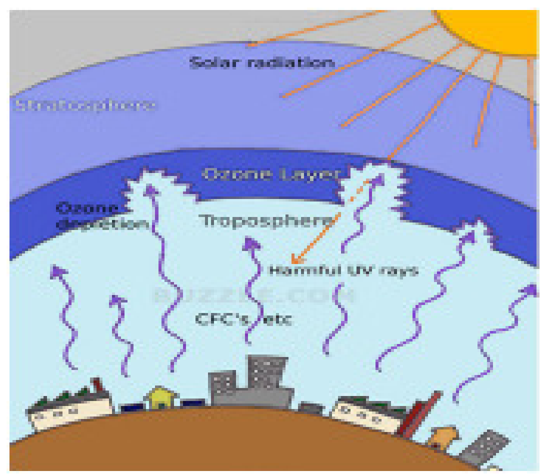
The gradual thinning of earth's ozone in the upper atmosphere is known as Ozone layer depletion. It is mainly caused due to Chlorofluorocarbons (CFCs).

Ozone layer prevents the harmful UV rays of the sun to enter the earth.UV radiation breaks the CFCs and chlorine atoms released.Each chlorine atom can break as much as 100000 ozone molecules. The chlorine from CFCs depletes the amount of Ozone

Pesticides such as Methyl bromide, halons used in fire extinguishers, methyl chloroform etc.

Below are some effects of Ozone layer depletion:

- Skin cancer
- Damage to plants and animal
- Cataracts
- Premature Ageing of skin
- Mutation




**Diagrammatic view of ozone layer depletion**

**Cataract**

## How to Minimize Environment Issue?

Now we know the major issues which are causing damage to the environment. So, now we can discuss the ways by which we can save our environment. For doing so we have to take some measures that will help us in fighting environmental issues. Moreover, these issues will not only save the environment but also save the life and ecosystem of the planet. Some of the ways of minimizing environmental threat are discussed below:

**Reforestation –** It will not only help in maintaining the balance of the ecosystem but also help in restoring the natural cycles that work with it. Also, it will help in recharge of groundwater, maintaining the monsoon cycle, decreasing the number of carbons from the air, and many more.

**The 3 R's principle –** For contributing to the environment one should have to use the 3 R's principle that is **Reduce**, **Reuse**, and **Recycle**. Moreover, it helps the environment in a lot of ways.

To conclude, we can say that humans are a major source of environmental issues. Likewise, our activities are the major reason that the level of harmful gases and pollutants have increased in the environment. But now humans have taken this problem seriously and now working to eradicate it. Above all, if all humans contribute equally to the environment then this issue can be fight backed. The natural balance can once again be restored.

## Conclusion :

The environment plays a significant role to support life on earth. But there are some issues that are causing damages to life and the ecosystem of the earth. It is related to the not only environment but to everyone that lives on the planet. Besides, its main source is pollution, global warming, greenhouse gas, and many others. The everyday activities of humans are constantly degrading the quality of the environment which ultimately results in the loss of survival conditions from the earth.. To tackle these environmental issues, protecting the environment is very vital. This not only helps in preventing the detrimental effects but also helps us to conserve the natural resources and natural environment for future generations. Protection of the environment is not only a social movement but is also backed by various laws that have been passed to ensure that humans do not misuse the resources any longer.

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# Nanotechnology: A Promising Technology for Agriculture Oriented Research

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## INTRODUCTION

For the last few decades, major population pressure had led to food scarcity and consequence decline in global agriculture and forestry due to urbanization. Plants, the indispensable component of our planet are always bare to different environmental variations and numerous stress factors throughout their life. Unlike animals, plants are deprived of mobility to a better place on arrival of any kind of stress (biotic/abiotic). To overcome such stresses, nature has provided them certain mechanisms that helps these sessile organisms to endure these stresses. Though, plants develop various mechanisms (avoid, escape and tolerate) to counter against adverse conditions but their responses could vary considerably even in the same plant species. As a result, identification of tolerant plant species is always the major concern towards sustainable agriculture and crop production. Foremost abiotic stresses which affect plants include heat, salinity, cold drought, flooding/submergence (anoxia), chemical toxicities, and excess light. So, there is a major concern among scientific communities to raise world food crop production by 70% (FAO, 2009). In such varying environmental scenarios, it is needful to recognize a new area of research to conquer the technological challenges in addressing the yield barrier, resource use efficiency, and development of environmentally accepted technology (Jalil and Ansari, 2019).

Nanotechnology, a recently multi-disciplinary area and emerging field of science which offers immense and wide use in various discipline and its allied field e.g., medicine, agriculture, industrial, environment, electronics with application in numerous preparations e.g., Medicine and Drugs, Nano devices, Optical Engineering, Bio-engineering, tissue engineering etc. The trends of development in the field of nanotechnology and its based industries are increasing tremendously. In the current scenario and recent estimation report of Consumer Products Inventory (CPI) of upto August 2015, the nanotechnology-based consumer products inventory has grown to 1,814 products, representing thirty-fold increase in comparison to 54 products as listed in 2005 (CPI, 2015).

Nanotechnology has emerged out broadly into the 'agri-food sector' which includes the nano sensors, tracking devices, targeted delivery of required components, food safety, new product developments, precision processing, smart packaging and others.

Nanotechnology offers wide research area and provides opportunities for a large scope of diverse applications and advantages in fields of biotechnology and agriculture-based research such as disease prevention, nutrient management by nano-fertilizers, nano-pesticides or nano-herbicides, mitigating abiotic stress. Recently, nanotechnology has emerged out to be a probable promising technology for solving the problem associated with abiotic stress to obtain sustainability in the field of agriculture. Increasing crop production is the need of hour to deal with the increasing population. It has been estimated that various factors like climate change, habitat loss, global warming have decreased the yield of major crops like wheat, maize, barley by ~40 million metric tons per year (1981-2002; http://environmentalresearchweb.org/cws/article/news/27343).

**Conclusion**

Nanotechnology, a multi-disciplinary approach, has emerged out as a powerful discipline in the last few years and is revolutionizing various field like medicine, agriculture, industrial, environment, electronics etc. Nanotechnology is emerging as a tool for agriculture by empowering it with tools to conquer nutritional poverty and food scarcity. The applicability of nanotechnology needs to be commercialized from laboratory to agricultural fields.

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# Nanotechnology in Agriculture: Opportunities, Potential & Constrains

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## INTRODUCTION

Currently, nanotechnology in India has achieved a prime position and attracted tremendous attention. Moreover, the consequences of innovative approaches of nanotechnology are framing infrastructure of 21st century as the 'nano-century'. Therefore, Government of India is also playing fundamental role since 2001 by funding and developing scientific centers dedicated towards nanotechnological researches with aim of exploiting nanotechnology for benefit of mankind. The first step towards achieving the goal was launching of Nanoscience and Technology Initiative (NSTI) in the Tenth Five Year Plan (2002-2007) with budget of roughly 60 million rupees. Further, the Department of Science and Technology (DST) took lead in expanding the descendent of the NSTI by creating nano-mission with budget of 10 billion rupees for five years. Moreover, in the Eleventh Five Year Plan (2007-2012), the DST alone has granted 193 billion rupees. Afterward many other government agencies got involved in funding and initiating nanotechnology R&D that include Department of Biotechnology, Department of Atomic Energy, Council for Scientific and Industrial Research, Indian Council for Medical Research, the Defense Research and Development Organisation etc. Most importantly, in 2004 National Centre for Nanomaterials was also constructed in collaboration with the USA, Russia, Japan, Germany and Ukraine.

Presently, the achievements of nanotechnology based research in India could be estimated by the fact that, India gained global rank 6th in 2009 in terms of publication whereas earlier in 2000 global rank 17th was attained. Various Indian research institutes contributed tremendously in achieving this position at global level and due to this India has been labeled as '(an)emerging nano-power'. However, besides publication, the patenting activity earlier was not up to the mark and was quite low as out of 1,356 patents filed in the IPO, only 46 patents had been granted to Indian institutions till late 2015. It is interesting to note that the major areas for patenting worldwide include pharmaceuticals, electronics and nano-polymers.

### Nanotechnology in agriculture

Though, in past decade the concept of nanotechnology in India has gained noteworthy attention due to its multidimensional applications in the field of pharmaceuticals, electronics, cosmetics etc. But, implications of nanotechnology in agricultural field are still mostly unexplored. The planning commission of India has also recommended nanotechnology for enhancing agricultural productivity. Afterwards several states viz. Andhra Pradesh, Gujarat, Haryana, Himachal Pradesh, Karnataka and Tamil Nadu have initiated research programme for linking nanotechnology to agricultural sector. Nowadays, when agricultural sector is getting modernized day by day, the integration of nanotechnology has provided novel and advanced solutions to many challenges coping with agriculture. The major threat to agricultural production is imposed by various kinds of phytopathogens causing serious diseases leading to huge economic losses. Earlier the idea of green revolution witnessed indiscriminate use of chemical pesticides for plant disease management making the agro-ecosystems unsustainable. Globally, around 2 million metric tons of chemical pesticides are used annually for controlling pathogens and pests with an expected rise to 3.5 million metric tons in next 2 years. Obviously, this application makes successful control over plant diseases but on the other hand it also gave birth to many environmental and health hazards followed by reduced soil fertility, development of pesticide resistant pathogens and high accumulation of pesticide residue in food chains. Subsequently, the more sustainable approach of using biopesticides emerged where agriculturally important microbes are being used as biocontrol agents for plant disease management. But most recently, nanoparticles based strategy is gaining considerable attention, agriculture owing to its unique properties, as compared to biopesticides.

**Biopesticides versus Nanoparticles based formulations**

In the last few decades, there was upsurge in demand for biopesticides due to rising awareness of the ill effects of chemical pesticides. Biopesticides comprise of beneficial microbes and provide environment friendly means of controlling plant diseases and hence, currently 9.9% of the global market is shared by biopesticides as compared to 1.1% share of chemical pesticides. However, there are some major concerns associated with their usage and to tackle them. Recently innovative approach of harnessing nanotechnology in agriculture is gaining noteworthy consideration. As compared to biopesticides, nanoparticles based formulation carries major advantages in terms of their high on-field stability, high environmental compatibility, high surface area and maximum coverage at very low dose.

**Employing nanoparticles based formulation for enhancing agricultural production**

Nanoparticles (NPs) generated through nanotechnology in the size range of 100 nm or less, hold promising applications in agriculture due to their exclusive physical, chemical and biological characteristics. These nanoparticles are highly stable with large surface area and provide size dependent qualities. Till now, many physical and chemical methods ate known for synthesis of nanoparticles, for example, high energy ball milling, are-discharge, laser pyrolysis or abalation, electrochemical, chemical vapor deposition, microemulsion sol-gel and reverse precipitation. These methods involve a myriad of inorganic and organic materials and are expensive, unstable and not environment friendly. Therefore, presently biological means of synthesizing nanoparticles using biomolecules of either plant or microbial origin are getting more successful as these biomolecules are of low cost, non toxic and environment friendly.

Moreover, it provides new opportunities to utilize agriculturally important microbes for developing nanoparticles based formulation pointing towards exciting possibilities of nanofarming. Such biofabricated nanoparticles could be of great potential exhibiting excellent antifungal activity against a broad range of phytopathogens. On the other hand, concept of nano-fertilizer has also received tremendous attention for their balanced crop nutrition. The application of innovative technology of nano-fertilizer in agriculture has resulted into significant increase in crop yield.

The beneficial use of nanoparticles for enhancing crop productivity has become the latest topic of research in many developing countries. Most importantly, nanotechnology has opened a new avenue for precision agriculture by serving as operational means of disease control and enhanced crop production.

**Table 1. Beneficial role of Nanoformulations over Biopesticides**

| Parameters | Biopesticides | Nanoparticles based formulations |
|---|---|---|
| On-field stability | Low | High |
| Shelf-life | Major issue & determine efficiency | Not required |
| Environmental compatibility | Low (efficiency of biopesticide affected due to fluctuating environment | High (unaffected by the external environment) |
| Size-dependent qualities | No | Yes |
| Surface area | Low | High |
| Coverage | Moderate | Maximum |
| Required dose | High (area dependent dose) | Very low (cover large area at low volume) |

The multifarious applications of NPs in agriculture have been documented in Table 2.

**Table 2. Various applications of Nanoparticles based formulation in Agriculture.**

| Nanoparticles | Applications |
|---|---|
| Nano-encapsulated agrochemicals | Control of phytopathogens |
| Nano capsulated agrochemicals | Control of parasitic weeds |
| Silver Nanoparticles (AgNPs) | Control of phytopathogens |
| Titanium di-oxide (TiO2) NPs | Broad spectrum of antimicrobial activity & can reduce various plant diseases by serving as an antifungal & antibacterial agents |
| Chitosan polymer NPs | Used for controlled release of NPK |
| Polymer NPs | Insecticidal activity against adult *Tribolium castaneum* |
| Silica NPs | Insecticidal activity |

**Multifarious applications of nanotechnology in agriculture**

The multifarious application of nanotechnology as shown in Figure 1 is mentioned below.

i. Use of metal oxide NPs and carbon nanotube for improving seed germination of rainfed crops.

ii. Formulation of nano-fertilizers for enhanced crop productivity.

iii. Development of nanoformulations for plant disease management.

iv. Effective weed control by nano-herbicide.

v. Managing post harvest diseases using nanoparticles base strategy.

vi. Development of nano-sensors and diagnostic devices for monitoring agroecosystem.

vii. Improving soil structure and remediation of toxic metals.

**Major constraints associated with nanotechnology usage in agriculture**

Besides providing excellent applications in agriculture there are some biosafety issues which need to be addressed in future research endeavor. Most importantly we cannot ignore the unseen impacts of nanoparticles and hence scientific community should perform detail studies to ensure safety and risks of such nanoformulations. The various associated issues are as follows:

i. Biosafety issues
ii. Impact on environment and soil microbiota
iii. Impact on crops
iv. Interaction of nanoparticles with plant physiology
v. Nanotoxicity towards human, animals.

**Futuristic approach**

Future studies should deal with biosafety issues related to nanotechnology highlighting their impact on plants, environment and soil. Moreover, various kinds of biotic interactions taking place after application of nanoparticles should not be ignored. What is the fate of applied nanoparticles in environment should be the key point of future research. After dealing with all these issues, nanotechnological applications could be recommended for development of nano-formulations.

**Conclusion**

Nanotechnology, the rapidly emerging scientific field has achieved a prime position and attracted tremendous attention, nationally and globally. Recognising the lucrative benefits and outcomes, government is supporting and funding research in nanotechnology and developing speciality centres and also framing international collaborations. Though various known risks and hazards are associated with the application of nanotechnology in agriculture and pest control, still, it assures with a new ray of hope for the mankind that, if managed adequately, we may soon have a nano-formulation based healthier, economic and environment friendly- zero chemical pesticide farming across the globe. Thus, a drift in nanotechnology research is the demand of time to address the biosafety issues and curb the risks and hazards associated with nanotechnology products.

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# Organic Farming: Evolution of Chemical free Agriculture

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## INTRODUCTION

Agriculture is the most important part of our country. where different types of crops are cultivated and by doing agriculture with modern technology. Farmer uses different techniques and methods to make the crop more effective and grow well. But for more production, the farmer uses inorganic and synthetic materials. They are very harmful to crops as well as soil also. They can be lost soil fertility and nutritional value also.

Organic agriculture is an exclusive practice that promotes and enhances agro-ecosystem health, biodiversity, biological cycles, soil nutrition and diversity. This is accomplished by handling on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs. By increasing the amount of organic matter in the soil, organic farmers enhance the soil's ability to absorb water, reducing the impacts of drought and flooding. Improving soil organic matter also helps it to absorb and store carbon and other nutrients need to grow healthy crops, which, in turn, are better able to resist insects and diseases. Organic farming uses a variety of methods to improve soil fertility, including crop rotation, cover cropping, reduced tillage, and application of compost.

The organic farming system is not new in India, it's following from ancient time. It is the part of a farming system which primarily aimed at propagating the land and Elevate crops in such a way, as to keep the soil alive and in good health by use of organic wastes like crop, animal and farm wastes, aquatic wastes and other biological materials along with beneficial microbes like *Azotobacteria* sp., PGPR, *Bacillus* sp., *Rhizobium* sp. mycorrhiza etc to release nutrients to crops for increased sustainable production in an eco-friendly pollution-free environment.

Biological research into soil and soil organisms has proven beneficial to organic farming. Varieties of bacteria and fungi break down chemicals, plant matter and animal waste into productive soil nutrients. In turn, they produce benefits of healthier yields and more productive soil for future crops. Fields with less or no manure display significantly lower yields, due to decreased soil microbe community. Increased manure improves biological activity, providing a healthier, more arable soil system and higher yields.

Organic biological fertilizer sources release their nutrients slowly over time, providing more opportunity for the nitrogen to be digested by soil organisms and taken up by crops before leaching below the root zone. Increased soil organic matter in the soil leads to tighter nutrient cycling and greater water holding capability in organically managed soils, with the result that nitrate leaching from groundwater is about half that of conventionally farmed soils.

Crop rotation and green manure help to provide nitrogen through legumes, which fix nitrogen from the atmosphere through symbiosis with rhizobial bacteria. Intercropping, which is sometimes used for insect and disease control, can also increase soil nutrients, but the competition between the legume and the crop can be problematic and wider spacing between crop rows is required. These encourage soil fauna and flora, improving soil formation and structure and creating more stable systems. In turn, nutrient and energy cycling is increased and the retentive abilities of the soil for nutrients and water are enhanced, compensating for the non-use of mineral fertilizers.

Using biological forms of fertilizer such as compost, animal manures, and legume cover crops, builds soil organic matter, even when routine tillage is used for weed control. Building soil organic matter increases soil water retention and nurtures more active soil microbial communities that retain nitrogen in the soil longer and transform it into non-leachable gaseous forms. There is a small but telling body of research in the US that suggests that improved soil quality influences the ability of crops to withstand or repel insect attacks and plant disease.

Organic farming methods combine scientific knowledge of Agriculture and some modern technology with traditional farming practices based on naturally occurring biological processes. Today, It is developed by various organizations. They are defined by the use of fertilizers of organic origin such as compost manure, green manure, and bone meal and place emphasis on techniques such as crop rotation and companion planting. Biological pest control, mixed cropping and the fostering of insect predators are encouraged. Organic standards are designed to allow the use of naturally occurring substances while prohibiting or strictly limiting synthetic substances. Organic farmers also use animal manure, certain processed fertilizers such as seed meal and various mineral powders such as rock phosphate and green sand, a naturally occurring form of potash that provides potassium.

Organic agricultural methods are internationally regulated and legally enforced by many nations, based in large part on the standards set by the International Federation of Organic Agriculture Movements (IFOAM), an international umbrella organization for organic farming organizations established in 1972. Organic agriculture can be defined as "an integrated farming system that strives for sustainability, the enhancement of soil fertility and biological diversity while, with rare exceptions, prohibiting synthetic pesticides, antibiotics, synthetic fertilizers, genetically modified organisms, and growth hormones".

Organic farming practices that avoid or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additives etc) and to the maximum extent feasible rely upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection.

Organic farming advocates claim advantages in sustainability,openness, self sufficiency, autonomy/ independence, health, food security, and food safety.

## Conclusion

Organic farming can be a valuable method for enhancing crop productivity for farmers. It will be good practices for the improvement of soil fertility without any chemical fertilizers. It can maintain soil microflora and soil nutrition values.

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# Precision Farming : The Evergreen Revolutionary Approach

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## INTRODUCTION

Precision farming is a method where the inputs are utilized in particular quantities to get expanded common yields in contrast to usual cultivation techniques. Hence, it is a complete device designed to optimize manufacturing by using the usage of key factors of information, technology, and management, so as to enlarge manufacturing efficiency, improves product quality, improves the efficiency of crop chemical use, preserve energy and defend environment. Farming is turning into extra scientific, with remote sensing, GPS and data analytics all being introduced as farming equipment. Tractors can map fields, drive themselves and check its own movement within inches so that it doesn't waste fertilizer, seed or fuel. In India, to set up precision farming, one most important trouble is the small field size. Commercial as well as horticultural crops additionally exhibit a wider scope for precision agriculture in the cooperative farms.

The first agricultural revolution was once the expand of mechanized agriculture, from 1900 to 1930. Each farmer produced adequate foods to feed about 26 human beings throughout this time. The 1990s prompted the Green Revolution with new strategies of genetic modification, which led to every farmer feeding about one hundred fifty five people. It is predicted that by way of 2050 the world populace will attain about 9.6 billion, with new technological developments in the agricultural revolution of precision farming; every farmer will be capable to feed 265 humans on the same acreage.

**Definition of Precision Farming:** Precision Agriculture is "an integrated information- and production-based farming system that is designed to increase long term, site-specific and whole farm production efficiency, productivity and profitability while minimizing unintended impacts on wildlife and the environment". Site-Specific Crop Management (SSCM) is "a form of Precision Farming whereby decisions on resource application and agronomic practices are improved to better match soil and crop requirements as they vary in the field".

**The Need for Precision Farming:** The 'green revolution' during 1960's has made our country self sufficient in food production. This has been possible due to high input application with increase amount of fertilization, irrigation, pesticides, higher utilization of HYV's and increase of mechanization in agriculture-

1. The world's highest productive countries have much more potentiality for producing crop than India. Even India can't touch them through their high yielding varieties as there have lacking of advanced technologies like precision farming.

2. The green revolution is also associated with negative ecological/environmental consequences. In this context, there is a need to convert the green revolution into an

evergreen revolution, which will be triggered by following systematic approach of farming that can help to produce more from the available land, water, labour and natural resources, without either ecological or social harm.

**Advantages of precision farming:** The goal of precision farming is to improve agricultural yield and reduction of environmental risks, while benefits are:

- Monitor the soil and plant physic-chemical parameters.
- Obtain data in real time.
- Enhance agricultural productivity and prevent soil degradation.
- Reduce excessive chemical usage in crop production.
- Water resources will be utilized efficiently.
- Improve quality, quantity and reduced cost of production in agricultural crops.
- Non-uniform fields can be sub-divided into smaller plots based on their unique requirements.
- Provide better farm records essential for sale and succession

**Limitation of Precision Farming in India:** There are many limitations for adoption of Precision Farming in developing countries especially in India-

- High capital costs may discourage farmers not to adopt this type of farming.
- Precision agriculture techniques are still under development and require expert advice before the implementation.
- It may take several years to collect the sufficient data for fully implementation of this system.
- It is an extremely difficult task particularly the collection and analysis of the data.
- Small farm size in India is another problem.
- Lack of success stories.
- Heterogeneity of cropping systems and market imperfections.
- Land ownership, infrastructure and institutional constrains.

**How could India benefit from precision farming? :** Site-specific application of irrigation in wheat of Punjab and Haryana, use of pesticides in cotton and fertilizers applications in oil palm plantation in South India, and coffee and tea garden of eastern India can highly reduce the production costs and also reduce environmental loading of chemicals. Farmers can mitigate problems like water stress, nutrient deficiency, and pests/diseases. It also increases opportunities for skilled employment in the agriculture sector and also provides new tools for evaluating multifunctional aspects including non-market functions. It has the essential role in the monitoring of greenhouse conditions.

**Application of precision farming in Horticulture**: Horticulture produce goes through spoilage at the time of harvesting, handling, storage, marketing and processing, resulting in huge wastage. Efficient management of wastage can help preserving essential nutrient of the food and feeds bringing down the production cost of processed product; besides minimize the pollution hazard and purify the environmental condition. Recycling and reduction of horticultural waste is one of the most important aspects.

The policy approach to deal with precision farming at farm level:

- Identify the specialty zones for the advancement of crop specific precision farming.

- Creation of multidisciplinary teams involving agricultural scientists in various fields of engineers, manufacturers and economists to study the overall scope of precision agriculture.
- Provide complete technical backup support to the farmers to develop pilots or models, which can be recreated on a large scale.
- Pilot study ought to be led on farmers' fields to show the after effects of precision agriculture implementation.
- Creating awareness among farmers about consequences of applying imbalanced doses of different inputs like irrigation, fertilizers, insecticides and pesticides.

Tools and Equipments of Precision Farming:

- **Global positioning system (GPS)**:
  1. GPS is a navigation system based on a network of satellites that helps users to record positional information of latitude, longitude and elevation.
  2. It permits farmers to find the specific situation of field information, such as soil type, pest occurrence, weed invasion, water holes, boundaries and obstructions.
  3. This system allows farmers to identify field locations so that different inputs (seeds, fertilizers, pesticides, herbicides and irrigation water) can be applied to an individual field, in light on performance criteria and previous input applications.
- **Sensor technologies**:
  1. Various technologies such as electromagnetic, conductivity, photo electricity and ultra sounds are used to measure humidity, density of vegetation, temperature, texture-structure, nutrient level and physical character of soil, vapour and air etc.
  2. Remote sensing data are used to distinguish crop species, diagnosis of stress conditions, identify pests and weeds, and monitor drought, soil and plant conditions.

- **Geographic information system (GIS)**: This system comprises hardware, software and procedures, designed to support the compilation, storage, retrieval and analysis of feature attributes and location data to produce maps. A farming GIS dataset can provide information on filed topography, soil types, surface drainage, subsurface drainage, soil testing, irrigation, chemical application rates and crop yield.

- **Variable-rate fertilizer (VRT) application:** VRT systems set the rate of delivery of farm inputs depending on the soil type noted in a soil map. Information available from the GIS can control different processes, such as seeding, fertilizer and pesticide application, herbicide selection and application at a variable rate in the right place at the right time

- **Crop management:** Satellite data provide a better understanding of the variation in soil conditions and topography that influence crop performance within the field. Farmers can, therefore, precisely manage production factors, such as seeds, fertilizers, pesticides, herbicides and water control, to expand yield and efficiency.

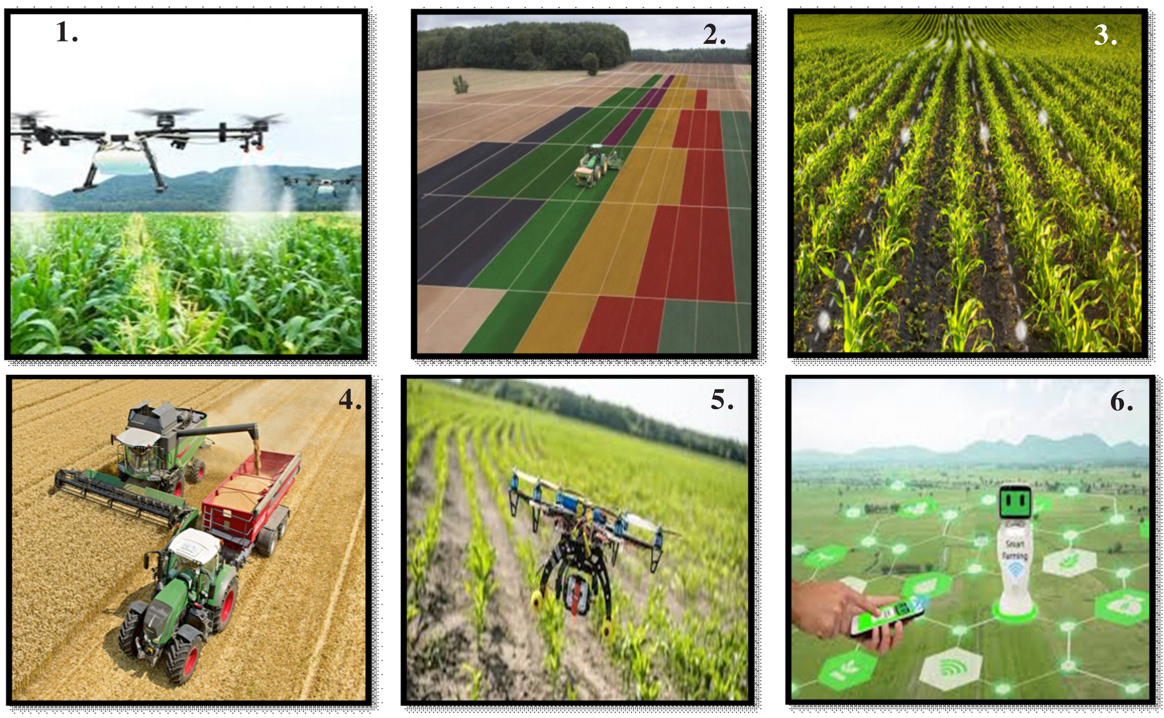
- **Soil and plant sensors:** Sensor technology is an important component of precision agriculture technology and their use has been widely reported to provide information on soil properties and plant fertility/ water status.

- **Rate controllers:** Rate controllers are the devices, designed to control the delivery rate of chemical inputs such as fertilizers and pesticides, either in liquid or granular form. These rate regulators monitor the speed of the farm vehicle/sprayer traveling across the field, as well as the flow rate and pressure (if liquid) of the material, making delivery adjustments in real-time to apply with in a target rate.

➢ **Precision irrigation through pressurized systems:** Recent developments are being released for commercial use in sprinkler irrigation by controlling the irrigation machines motion with GPS based controllers. In addition to control the motion, wireless communication and sensor technologies are being developed to monitor soil and ambient conditions, along with operation parameters of the irrigation machines (*i.e.* flow and pressure) to accomplish higher water application efficiency and utilization by the crop.

➢ **Software**: Use of software to carry out diverse tasks such as display-controller interfacing, information layers mapping, pre and post processing data analysis and interpretation.

➢ **Yield monitor:** The sensors measure the mass or the volume of grain flow (grain flow sensors), separator speed and ground speed. In case of grains, yield is continuously recorded by measuring the force of the grain flow as it impacts a sensible plate in the clean grain elevator of the combine.




**1. Use of drones to spray chemicals, 2. Integration of sensor data in crop model 3. Soil moisture sensor, 4. Harvesting 5. Checking crop growth 6. Creating marketing channel**

➢ **Precision farming on arable land**: The use of precision farming techniques on arable land is the most widely used and most advanced amongst farmers. Controlled traffic methods involve restricting all field vehicles to the minimal area of permanent traffic lanes with the aid of GNSS technology and decision support systems. Another important application of precision agriculture in arable land is to optimize the use of fertilizers, starting with the three main nutrients Nitrogen, Phosphorus and Potassium.

➢ **Precision farming within Horticulture sectors:** In fruit and vegetable farming the recent rapid adoption of machine vision methods allows growers to grade the products and to monitor the food quality and safety, with automation systems. These include colour, size, shape, external defects, sugar content, acidity, and other internal qualities. Moreover, tracking of field operations such as chemicals sprayed and use of fertilizers can be conceivable to provide complete fruit and vegetable processing methods.

➢ **Precision livestock farming (PLF):** Precision livestock farming (PLF) is defined as the management of livestock production using the principles and technology of precision agriculture. It include animal growth, milk and egg production, detection and monitoring of diseases and aspects related to animal behaviour and the physical environment such as the thermal micro-environment and emissions of gaseous pollutants.

**Conclusion:** Precision farming is sometimes misinterpreted as sustainable agriculture. Precision farming is a tool to help make agriculture more sustainable however it is not the total answer. Precision farming aims at maximum production efficiency with little environmental impact.

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# Role of Rootstocks in Citrus Propagation

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## INTRODUCTION

In India, citrus is 3rd important fruit crop after mango and banana with total production of 44.3 lakh tonnes. India ranks 6th among the top citrus producing countries contributing 4.8 per cent to the total world citrus production. However, the average national productivity is confined to mere 8.9 t/ha which is far behind the productivity of advanced citrus producing countries like Brazil, USA, Spain, Japan etc. where it is 25-30 t/ha.

Specifically, speaking about Maharashtra, it tops highest in the list of total area under citrus i.e. 73,115 ha, however, it ranks far behind in the list of productivity i.e. 5.7 t/ha.

Thus, to increase the productivity of India as well as Maharashtra, it is a must to adopt the advanced package of practices in citrus production. One of the most important aspects for successful cultivation of citrus is proper selection of planting material. Citrus being polyembryonic, propagation of certain citrus sp. is done by seeds. However, vegetative propagation is more preferred as it gives true to type plants, uniform quality an early and regular bearing with good yielding capacity. However, for the production of standard quality fruits, which is necessary for citrus industry, budded citrus plantations from selected parents as deemed essential. Thus, selection of root-stocks that are compatible with specific species (scion) and resistant to different pests and diseases, soil and climatic conditions giving a successful scion-stock unionare of prime importance. Rootstocks exert profound influence on the vigor, productivity, quality of fruits, longevity of the scion and also response to different pests and diseases. It is therefore, important to appreciable the need for using the appropriate rootstocks suiting to particular agroclimatic (location) so that the threat of dieback can be minimized. The selection of proper rootstock far different regions is quite complicated and requires serious attention. It has also been well established that not only the different species / varieties require different combinations, but it should be also different far different set of agroclimatic conditions. A satisfactory stock must be congenial with the top budded on it and must form a good union that permits good growth, long life, good yield with quality fruits and scion variety. A wrong choice of rootstock, may lead to complete failure of crop and once the orchard is established with wrong rootstocks, it is not possible to change the plantation without incurring serious losses. The selection of rootstocks is thus an important aspect on which the success of rootstock and scion depends, includes vigor, yield, quality, probable length of productive life of tree and compatibility.

### Rootstock Abilities

i) **Nursery adaptability** : Includes ready availability of seeds, high percentage of polyembryony, good germination and seedling growth, ability to attain graftable size in short period, free from pests attack period and easy budding.

ii) **Soil adaptability** : The relative vigor of growth on soils of varied depth, texture, structure, pH, salinity, moisture and nutrient supply.

iii) **Climatic adaptability** : The degree of hardiness to cold conferred by the stock.

iv) **Biotic adaptability** : the degree of freedom from or resistance to various soil borne diseases or the effect of the stock in its relation to the scion on the resistance of the system to various diseases complexes.

Some rootstocks may be found superior in one or more of these qualities but inferior in other but none is outstanding superior in all respects. It is indeed very difficult to find an ideal and universal root-stocks that possess all the desirable qualities and be equally successful under widely varying condition and situations with different scions. Each of rootstocks presently used has its own merits and demerits and therefore suitable one can choose among the existing lot of rootstocks provided by the selector ha a thorough knowledge of the problems to be faced in the proposed area and the scion.

**Polyembryony**

Most of the rootstocks cultivars used on commercial scale are highly polyembryonic. However, percentage of zygotic seedlings in the seed bed may vary from 1 to 40 % depending on the cultivars. The zygotic seedlings should be roughed out because trees budded on them will be variable and often inferior in size and production. It is recognised that in citrus, variant seedlings may influence the size and yield of mature orchard trees. In most of the citrus varieties/ rootstocks, the existence of polyembryony make available apomiotic seedlings of nucellar origin and ensure uniform seedlings tree to seed parent at nursery level. This also helps to raise healthy plants as citrus virus are not transmitted through seed. The percentage of polyembryony in certain root stocks are given in following Table 1.

**Table 1. Polyembryony in rootstocks**

| Sr. No. | Rootstocks | Polyem-bryony (%) | Status range of embryos |
|---|---|---|---|
| 1 | Rough lemon | 100 | 3-4 |
| 2 | Rangpur lime | 60 | 1-2 |
| 3 | Cleopatra mandarin | 93 | 1-6 |
| 4 | Pomeroy trifoliate | 66 | 1-3 |
| 5 | Troyer citrange | 86 | 1-6 |
| 6 | Carrizo citrange | 73 | 1-5 |
| 7 | Citrumelo | 100 | 2-4 |
| 8 | Kodakithuli | 100 | 2-7 |
| 9 | Kitchli73 | 1-4 | |
| 10 | Kharna khatta | 20 | 1-2 |

**Frost tolerance**

Cleopatra and Jatti Khatti are tolerant to frost. Hamlin on Cleopatra and Tryoler rootstocks was least damaged by frost and the damage was maximum in Carrizo

**Salinity tolerance**

The problems of salinity and alkalinity exist in different degree in every citrus growing region. It is well known that certain rootstocks do well under particular soil conditions than others. Trifoliate orange exhibit poor tolerance to salts and lime and a moderate tolerance to boron. Whereas Rough lemon and sour orange stock exhibit good tolerance for lime and moderate tolerance for salts and boron. Certain rootstock scion accumulates more Chloride than others and may suffer from such toxicity. The different rootstocks have their own capacity of exchangeable sodium tolerance limit of ESP. It is reported that Jatti Khatti, Cleopatra mandarin, Karna Khatta, Rangpur lime, Carrizo and Jullundhari Khatti have their sodium tolerance limit of ESP 16.7, 9.5, 10.2, 11.7 and 13.4, respectively. Rangpur lime and Cleopatra mandarin as tolerant, Rough lemon, Minneola tangelo, Sampson tangles, Sour orange and Pummelos as moderate and Calamondin Florida sweet orange.

**Suitability of Rootstocks**

Rootstock investigation in citrus has been in progress for a pretty long time in all citrus growing countries in the world. In this regard, every aspect of citrus tree such as growth, longevity, performance, disease resistance, fruit quality etc. are influenced by the root stock. Root stock variability has been reported and careful selection of parent trees is considered necessary. The habit of growth of the scion and intake of mineral elements from the soil also depends much on the rootstock used. A good rootstock for citrus should ensure on economic orchard life about 30-50 years alongwith its tolerance or resist to soil and virus diseases. In addition to it must be polyembryonic, easily propogable with adequate and cheap source of seeds. Troyer citrange, Kichili were found suitable for sweet orange and mandarin. The recommended of some selected rootstocks are summarized and given in Table 2.

**Table 2. Recommended important rootstocks**

| Place | Scion | Best-rootstock |
|---|---|---|
| Punjab (Abohar) | Kinnow<br>Mosambi<br>Valencia | Jatti khatti, Kharna khatta<br>Rangpur lime<br>Jatti khatti |
| Karnataka (Chetali) | Coorg orange | Rough lemon, Rangpur lime, Cleopatra mandarin |
| Andhra Pradesh (Kodur and Tirupati) | Sathgudi Acid lime | Gajanimma, Sathgudi, Gajanimma |
| Tamil Nadu (Periakulum) | Satgudi<br>Acid lime | Kichili, Rough lemon, Sour orange<br>Rough lemon, Troyer citrange |
| Maharashtra (Rahuri and Akola) | Mosambi<br>Nagpur mandrin | Rangpur lime, Marmalade orange<br>Rangpur lime, Rough lemon |
| Assam | Khassi mandrin | Kata jamir |
| Meghalaya | Khasi mandrin | Rangpur lime |
| Uttar Pradesh (Pantnagar) | Lemon<br>Sweet orange | Jambhiri and Trifoliate orange<br>Kharna Khatta |

## CONCLUSIONS

Select rootstocks having following desirable attributes.

i) Compatibility with the important scion cultivars

ii) Resistance to root-rot disease caused by Phytophthora which seem to take a heavy toll of grown up trees in the field.

iii) Resistance to nematodes, virus diseases like tristeza.

iv) Tolerance to excess salt, drought, water logging.

v) High yield and quality of the fruits.

vi) Tree size control without reducing the yield.

vii) Higher number of seeds/ fruit and high rate of nucellar embryony.

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# Science Communication Need in India

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## INTRODUCTION

Ever needed Science communication in India, the idea is to help science and a scientific culture penetrate India's socio-culturally diverse society, and to transform it into a nation of scientifically thinking and scientifically aware people. However, the trends in our country are not encouraging and the little coverage and poor presentation of science and technology in media are well recognized. Coverage of science in the media is dismal and has been declining over the years, said Dr. Narender K Sehgal, the noted science communicator and UNESCO Kalinga Prize Winner who chaired the inaugural session of the 17th Indian Science Communication Congress in New Delhi. Prof. K. G. Suresh, Director-General, Indian Institute of Mass Communication in his keynote address also said that to reach the masses, scientists have to be communicators as well. Poor science communication can be a potential impediment in the journey of India becoming a developed country and a knowledge economy.

The knowledge gap has a direct relationship with societal and developmental issues. This was recognized by the late Malaysian Prime Minister Mahathir Mohammed way back in 1991 when he said, "It can be no accident that there is today no wealthy developed nation that is information-poor, and no information-rich country that is poor and underdeveloped."[1,2] It was also recognized by the International Development Research Council in a report that the most vital difference between developed and developing, rich and poor countries is the knowledge gap – the capacity to generate, acquire, disseminate, and use scientific and technological knowledge[3].

During the 100th session of Indian Science Congress in 2013, renowned Agricultural Scientist Prof. M. S. Swaminathan (Father of Green Revolution in India) also suggested in his address- "our Universities should help in developing science communicators who can explain to the general people in local languages the significance of important scientific discoveries. Similarly issues of biodiversity, biotechnology, nuclear technology and nano-technology need priority attention in efforts designed to bridge the scientist-society perception gap"[4].

And the Israel Prime Minister Benjamin Netanyahu has said knowledge is the future.

A number of organizations/ institutions/ universities/ laboratories have been making immense progress in generation of scientific and technological information/knowledge (I&K) in our country. But how much that I&K is being disseminated and made available to the society for any use is a big question. If the I&K so created is not being properly disseminated and not being used by the end-users, then it is a national loss – a loss due to the gap so created between I&K generation and its proper utilization. Information about science and technology must reach the grassroots level for India to become a developed nation and a information rich country.

## Conclusion

But it is frightening to note that science popularization initiatives and efforts in India are not in harmony with the aspirations of the diverse Indian society. Therefore, collective efforts on a larger scale are needed for communicating and popularizing scientific knowledge and practices to the general public through science communicators.

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# Small Scale Oyster Mushroom Production: Business Plan

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## INTRODUCTION

If we want to wish to consume protein in a large quantity and are vegetarian, only source for this is oyster mushroom this time. Then initiative of growing mushrooms as a business is good idea because, it's easy to grow mushrooms and very little investment can help in good earning. Demand of food industry made it popular and encourage its production in Europe and Asian countries. As awareness regarding its nutritive values is increasing its demand as mandatory ingredient in cooking and as supplement is increasing. Now a days, the scope of mushroom farming as business is increasing. Government is also supporting this in village areas and many big investors are also showing their interest in mushroom cultivation. Through this article, you will get idea how to start mushroom farming to make profit out of this. Easiest process of cultivation of mushroom is for edible Oyster mushroom which is most common these days. According to literature it was first cultivated in Germany and is now grown commercially around the world for consumption. Beauty of oyster cultivation business is that it does not required any target place or area since it includes a number of varieties, if some countries do not have specific variety, they import it from grower countries. It also opens opportunities for export of mushrooms and in flourishing mushroom business because it will be more beneficial. Best thing about oyster is that it can be grown in artificial conditions if environmental conditions are not in support then investment cost just got hike. Local market for this is also good option. Apart from selling and exporting you can go for spawn and substrate formation. Followings are the business opportunities in Oyster mushroom cultivation at small scale

**Substrate formation**: Substrate is a mixture of some ingredients for the growth of mushroom. Mushrooms cultivation can create opportunities for small-scale industries where outsourcing for assistance in substrate formation can be done. Any person with training can provide service by producing perfect substrates for each type of mushrooms and thus this service will earn that person profits.

**Spawn Production** – If your investment is more than you can choose to produce spawn alone in laboratory in aseptic conditions. Spawn production is spreading of mycelium of mushroom on substrate which is used as seed for the initiation of growth of mushroom on substrate. For good quality spawn production persons needs technical knowledge and heavy equipment's due to which small-scale industries do not waste their time on production of spawn rather purchase from spawn production laboratories. This also help them in saving their time and labour expenses. That could be a good opportunity to generate income by supplying spawn for their production.

**Demand of Oyster mushroom** -Aware population always try to use products have unique nutritive quality in concern with food and nutrition. Oyster mushroom is having more nutrition than button mushroom so gaining importance in market these days. Thus, it is a favourable time for the startup of this business. Which need a little attention and knowledge of maintaining favourable conditions for the good production of it.

**Oyster Mushroom cultivation in Small Scale**

Mushrooms cultivation business can be start from a small, dark (No direct sun light), ventilated and sterilize room. This is one of the major reasons people are paying attention and investing their money in mushroom farming. Humidity and a place free from heavy heat conditions is suitable. A place such as an extra room which has proper ventilation can be productively used for start.

**Basic Requirements in Mushroom Cultivation**

**Substrate-** Any substrate which can support in and out growth of mycelium and fruiting bodies of mushroom can be used for this purpose. For oyster mushroom substrates such as wheat strow, rice strow etc are suitable one. It is easily available in market as used for the feed of cattle with low cost. It is better to avoid the purchase of substrate from outside sellers.

**Spawn-** Spawn is the base containing mycelium which in suitable conditions, in suitable environment gives yield of mushroom on substrate. Counted amount of spawn is required for the measured amount of substrate so Decided amount of spawn required for procure before starting the production process. Wheat grains are better options to meet the budget of low investment business.

**Bags** – Non-toxic polybags can be used for bedding of oyster mushroom.

**Spray bottle**– In order to keep moisture in environment for growth of mushrooms, water spray bottle is required. This will keep the setup humid and thus enhances the growth to some extent.

**Hygrometer**- for monitoring of humidity and temperature a simple hygrometer is required.

**Thermometer**- room temperature can be measured by advanced hygrometer but to measure bags inside temperature thermometer ids required.

**Process Involved in Mushroom Cultivation**

- **Step 1.** Sterilized room or area which is not exposed to direct sun light to keep substrates and spawn.
- **Step 2.** Now, in suitable time and proportion mix the substrate with spawn. Take the polybags to load the mixture in it. After mixing in proper manner fill bags with this mixture and keep them in dark room.
- **Step 3.**Dark room should be prepared and equipped with monitoring devices so that problem of humidity and temperature problems can be avoided. Each bag should be of distance of minimum 6 inches.
- **Step 4.** In darkroom mycelium grow well in full bag after 10-15 days and ready to protrude which will become into buds, give rise into fruiting bodies.
- **Step 5.** Two to three yield can be harvest after 4 ton5 days gap in favourable environment.
- **Step 6.** Repetition of the process by the same steps will give change on the form of increase in production.

At small scale you can cover local market and neighbours. When it became popular in local sell it with packing and logo of your company in nearby market hotels and another suitable place.This kind of small-scale business can be started from houses by the women also in spare of their time. It’s not much time-consuming business rather just proper monitoring and handling is required and that can be taken by training from any government organisation.

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# Studies of Canine Babesiosis in Two Casaes of Dogs

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## INTRODUCTION

Babesia species are tick-transmitted apicomplexan parasites infesting a wide range of wild and domestic animal hosts (Kuttler, 1988). Canine piroplasms belong to two distinct species, the large (4–5 ìm) *Babesia canis* and the small (1–2.5 ìm) *Babesia gibsoni*. Differences in geographical distribution, vector specificity and antigenic properties subdivided the former species into three subspecies, namely *Babesia canis* transmitted by *Dermacentor reticulatus* in Europe, *B. canis vogeli* transmitted by *Rhipicephalus sanguineus* in tropical and subtropical regions and *B. canis rossi* transmitted by *Haemaphysalis leachi* in South Africa (Uilenberg *et al.*, 1989). *B. gibsoni* occurs in Asia, North America, Northern and Eastern Africa, Australia and Europe (Birkenheuer *et al.*, 1999; Muhlnickel *et al.*, 2002; Criado-Fornelio *et al.*, 2003). The purpose of the present study was to find out the disease pattern of canine babesiosis in relation to various parameters (age, sex, and breed of the dogs and season of the year) for future prophylaxis and to identify responsible vector species.

**Case History and Observations:**

**Case-1:** A 12 months old, male Pomeranian dog was Veterinary Clinical Complex chilla Prayagraj with history of Anorexia and dullness. Clinical examination of the dog revealed rise in body temperature (104.4ºF), increased heart rate (122/min), congested mucus membranes, dullness. Peripheral blood, whole blood with EDTA was collected for laboratory examination. Peripheral blood smear examination revealed

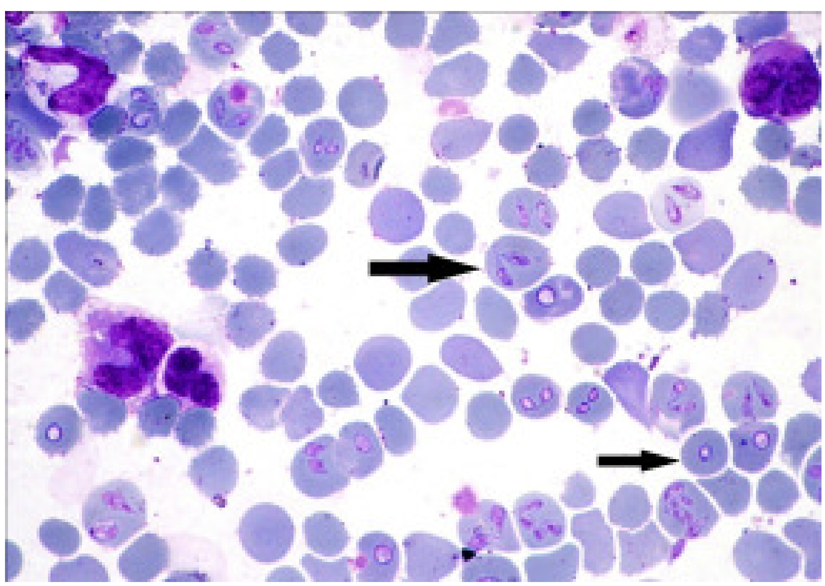

**Figure-1: Presence of *Babesia* organisms in peripheral blood smears** *(100X with 4x camera magnification)* presence of piroplasmic organisms in the RBC (figure - 1). Haemotology revealed leucocytosis (9600/cumm) with neutrophilia (6912/cumm), Lymphocytosis (2496/cumm) and Eosinophilia (192/cumm). Decreased haemoglobin (8.8 g/dl), TEC (4.9 x 106/cumm) was noticed.

**Case-2:** A 5 years old, female Pomeranian dog was presented to Teaching Veterinary Clinical Complex chilla Prayagraj with a history of Hyperexia, in appetence, passing of yellowish urine and occasional vomitions from the past one week. Dog was under treatment at local dispensaries with antibiotics from the past 5 days, but no recovery was noticed. Dog was regularly dewormed and vaccinated against rabies and Canine Distemper, Canine Adenovirus 2, Canine Parainfluenza, Parvo Virus Infection, Leptospirosis (Canicola, icterohaemorrhagiae). Clinical examination of the dog revealed rise in body temperature (103.8ºF), slight yellowish pale mucus membranes, yellowish discolorations of lower side foot (figure - 2), increased heart rate (132/min) and respiratory rate (56/min) along with distress, bilateral enlarged lymph nodes. Dog had tensed and slight yellowish discoloration of abdomen. Dog had decreased urine output, with passage of reddish colour urine along with constipation, vomitions. Peripheral blood, whole blood with EDTA was collected for laboratory examination. Peripheral blood smear examination revealed presence of piroplasmic organisms in the RBC (Figure-3). Haemotology revealed decreased haemoglobin (6.3 g/dl), TEC (3.8 x 106/cumm). Haemotology revealed leucocytosis (10640/ cumm), Neutrophils (7236/ cumm), Lymphocytes (3192/ cumm) and Eosinophils (212/ cumm) and decreased platelet count of (82,000/il). Serum biochemical parameters revealed decreased total protein (6.0 g/dL), serum albumin (2.2g/ dL). Increased BUN (28 mg/ dL), creatinine (1.8 mg/dL), SGPT (224 IU/L) levels and urine analysis revealed positive hays test and presence of RBC in the sediment of urine.

**Figure-2: Yellowish discoloration of the foot lession**

Based on the clinical signs, and laboratory examination, the condition was diagnosed as babesiosis in both the dogs. Initially treatment was given with inj.Nurobion forte @ 2 ml, inj. Meloxicam @ 0.5 mg/kg body weight, on the day of presentation. After confirmation of the condition inj. diminazine aceturate @ 5 mg/kg body, IM, body weight was given to both the dogs. For case-1supportive therapy was given with inj.Nurobion forte @ 2 ml, inj. Meloxicam @ 0.5 mg/kg body weight for three days and advised parentral administration of four doses of iron dextron @ 2ml/ animal at weekly twice, daily supplementation of sharkoferol pet syrup @ 5 ml per day as a general supplementation. After completion of two weeks of therapy Case-1 was responded well and attains its normal activities. For cae-2 inj. ondansetron @ 2ml/dog, 5%DNS @ 5 ml /kg body weight along with above therapy and Liv-52 was oral daily 5 ml was advised. But case was not responded to the therapy and died on the 3rd day of therapy. Dogs with uncomplicated babesiosis (case-1) showed the signs of fever, anorexia, depression, and these findings in accordance with the Taboada and Merchant (Taboadaj *et al*., 1998). In complicated form of babesiosis clinical manifestations depend up on the type of particular complication that develops. Clinical signs observed in the present cases include depression, tachy cardia, tachypnoea, anorexia, weakness and fever. It is thought that the clinical signs are the result of tissue hypoxia following the anemia and a concomitant systemic inflammatory response syndrome caused by marked cytokine release (Lobetti *et al*., 2006). In the severe form of the disease (case-2) can observe marked hemolytic anemia, severe acidbase abnormalities with frequent secondary multiple organ failure and complications such as acute renal failure (ARF), hepatopathy with marked icterus, hypoglycemia (Keller *et al*., 2004). Dogs with haemoconcentrated babesiosis and cases developing acute renal failure, acute respiratory distress syndrome or cerebral babesiosis have the worst prognosis and mortality can be greater than 50 % in some cases approaching 100 %, despite intensive, technically advanced interventions (Welz *et al*., 2001). Oliguria is an ominous sign in dogs affected with renal impairment due to babesiosis presently observed in the case-2 (Lobetti *et al*., 2001). Present observed clinical signs were in agreement with the previous reports (Reddy *et al*., 2014) and observed haematological and serum biochemical values differ from the local apparently healthy dogs values (Reddy *et al*., 2014). Diagnosis of Babesia was done based on the peripheral blood smear examination and same procedure was used for diagnosis of *T.evansi* in different animals previously (Sivajothi *et al*., 2013). Dogs with babesiosis treated with a single intramuscular injection of Diminazene aceturate at a dose of 5 mg/kg (Taboadaj *et al*., 1998). In dogs affected with babesiosis early diagnosis and treatment, the prognosis is good, but severely affected or untreated animals may die. Current chemotherapeutic agents used to treat canine babesiosis would be incapable of completely eliminating the disease at the recommended dose; they only are capable of limiting mortality and the severity of clinical signs (Birkenheuer *et al*., 1999). The most common abnormality in the investigated parameters was thrombocytopenia.

## Conclusion

The mechanisms of the thrombocytopenia are not yet fully understood in babesiosis (Boozer *et al*., 2003). Babesia initiates a mechanism of antibody-mediated cytotoxic destruction of circulating erythrocytes. Auto-antibodies are directed against components of the membranes of infected and uninfected erythrocytes. This causes intravascular and extravascular haemolysis, which leads to anemia. Furlanello et al recorded the anaemia in 74% of dogs with babesiosis and in all the cases the anemia was normocytic and normochromic (Furlanelo *et al*., 2005). Current treatment strategies for babesiosis often ameliorate the clinical signs of infection, but these hemoparasites are seldom completely eliminated, and when immunocompromised, recrudescence may occur (Irwin, 2010). So, advised the owners Regular control of the ticks was done by regular spraying of cypermethrin preparations to prevent recurrence and spreading of infection in case-1.

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# Use of Plant Tissue Culture and Transgenicsa in Crop Improvement in India

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## INTRODUCTION

In order to fight a number of biotic and abiotic stresses, several approaches have been followed by the scientists to improve the existing cultivars of the crop plants. Some of the important approaches are, production of transgenic cultivars, manipulation of the culture media to develop salt, drought and disease resistant cultivars making use of somaclonal variation, micropropagation of elite species, another culture, development of isogenic lines etc. Plant tissue culture is a very useful technique in all these approaches. The type of tissue culture and transgenic research that is being done in India is summarized here.

### Micropropagation

Tissue culture is now a very powerful mean for the mass production of plants of desired varieties at a minimum cost, and in a limited space. The technique which is known as micropropagation is very effective and economical for cloning elite varieties of plants. In India, a lot of micropropagation work has been done on several plants including horticultural or ornamental plants (e.g. orchids, gerbera, chrysanthemum, rose, carnation), cash crops (sugarcane, potato), fruit plants (banana, grapes, pineapple, papaya, mulberry, guava), vegetable (tomato), spices (Turmeric, cardamom, ginger, tamarind), plantation crops (tea, coffee, vanilla), medicinal plants (Neem, ashwagandha , Aloe, Taxus, Gloriosa) and forest trees including angiosperms (Acacia nilotica, Albizia lebbeck, Albizia procera, Azadirachta indica, Bauhinia purpurea, Butea monosperma, Dalbergia sp., Dendrocalamus strictus, Eucalyptus sp., Ficus religiosa, Morus sp., Populus sp., Shorea robusta, Tectona grandis), gymnosperms (Biota orientalis, Cedrus deodara, Cryptomeria japonica, Picea smithiana, Pinus sp.). Woody ornamentals like Tabebuia bear colorful and showy blossoms and play a pivotal role in the bioaesthetic planning. Successfu) micropropagation to Tabebuia has been achieved in the Botany Department of Mysore University. Work is underway to establish and standardize a protocol for the mass propagation of Tabebuia on a commercial scale.

Jackfruit is a source of an important vegetable that has been successfully cloned in vitro by the Department of Horticulture, Mysore University. Attempts are now being made to standardize the protocol for the mass clonal propagation part and success has been achieved in the tissue culture of aonla. A number of Himalayan multipurpose trees such as Bauhinia, Diploknema and Sapium have been selected for in vitro.

Commercially propagated plants through micro-propagation in India

1. **Fruits-** Banana, Pineapple, Strawberry,

2. **Cash crops-** Sugarcane, Potato

3. **Spices-** Turmeric, Ginger, Vanilla, Large cardamom, Small Cardamom

4. **Medicinal plants-** *Aloe vera*, *Geranium*, *Stevia*, Patchouli, Neem

5. **Ornamentals-** Gerbera, Carnation, *Anthurium*, Lily, *Syngonium*, *Cymbidium*

6. **Woody plants-** Teak, Bamboo, Eucalyptus, *Populus*

7. **Bio fuel-** *Jatropha*, *Pongamia*

Indian jasmine is a tree noted for its aroma. Micropropagation of jasmine has been achieved. Chrysanthemum root suckers can now be obtained from the tissue culture generated plants. Micropropagation of Dieffenbachia and Gerbera, two of the beautiful ornamental plants, has resulted in the protocols using which large number of plantlets can be generated in the laboratory. The micropropagation of rice cultivars, banana, pigeonpea, sunflower and potato has been achieved and protocols are being developed to generate these plants in large number, and to improve the existing cultivars.

*Delonix reoia* is a tropical legume ornamental tree. Micropropagation of this ornamental tree has achieved. Likewise, protocols are now being standardized for the tissue culture of such important forest tree species as sisam and teak in a bid to improve the quality of their wood and for the mass propagation of these trees.

The tissue culture of mango has not been very successful so far. In a major headway in mango tissue culture some commercially important varieties such as Dasheri, Chausa, Langra and Safeda have been cultured *in vitro* at the National Botanical Research Institute, Lucknow. Further, studies are on the way to improve the protocol for tissue culture. Clonal propagation of peach and aonla is now a distinct possibility. Studies on the micropropagation of mulberry varieties at Mysore University have yielded protocols for their mass propagation.

**Micropropagation work in India**

Keeping in the view, the need for large scale production of planting material of elite plant species through micropropagation, Department of Biotechnology, Government of India established two pilot plants, one at TERI, New Delhi and other at NCL, Pune. Consortium on Micropropagation Research and Technology Development (CMRTD) was also established by DBT that includes 'Micropropagation Technology Parks', Regional Hardening facilities and National Facility for Virus Diagnosis and Quality Control of Tissue Culture Raised Plants in different parts of the country. National Facility for Plant Tissue Culture Repository (NFPTCR) was also established at NBPGR, New Delhi for the slow growth or short-term conservation of germplasm of economically important crops like- tuber and bulbous crops, spices, fruit crops, medicinal and aromatic plants and other endangered plant species. Micropropagation work for quality seed production in some sugarcane varieties including CoC 671, CoS 8436, CoS 96268, CoH 56, CoH 99 Co 89003, CoS 96275, Co 0238, Co 0239, CoJ 64 and Co 86032 is also going on at Navsari Agricultural University, Gujarat, Vasantdada Sugar Institute, Pune, Sugarcane Breeding Institute, Coimbatore, Uttar Pradesh Council of Sugarcane Research (UPCSR), Shahjahanpur, Indian Institute of Sugarcane Research, Lucknow and Department of Agriculture

Biotechnology, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh. In India, the micropropagation work is also going on in more than 100 private laboratories for the commercial propagation of various plant species including Cash crops, fruit crops, medicinal plants, spices and forest trees. The first Indian commercial tissue culture plant was set up in 1987-88 by A.V. Thomas & Company in Cochin.

**Synthetic seeds or artificial seeds**

T. Murashige of USA for the first time gave the concept of artificial seeds at a symposium in Belgium in 1977. Artificial seeds are the somatic embryos covered with a protecting gel. These seeds are compared to the true seeds. In these seeds, the gel acts as seed coat and artificial endosperm providing nutrients as in true seeds. Synthetic seeds can be efficiently used for the management of transgenic and seedless plant species, polyploid plants with elite traits and plant lines that are difficult to propagate through conventional propagation methods and for long term conservation of valuable germplasm and its easy exchange across countries. The production of artificial seeds in Eucalyptus sp. has been reported by Muralidharan and Mascarenhas in 1987 by encapsulating somatic embryos in Na/Ca alginate beads. In India, this technique of synthetic seeds was standardized and practiced at Bhabha Atomic Research Centre (BARC), Bombay for sandalwood and mulberry. In several other plants including *Ocimum americanum* (hoary basil), *O. basilicum* (sweet basil), *O. gratissimum* (shrubby basil), *O. sanctum* (sacred basil), *Morus alba, M. australis, M. bombycis, M. cathyana, M. latifolia* and *M. nigra* (mulberry), *Musa spp.* AAB group (banana cv. 'Rasthali'), *Adhatoda vasica* (vasaka), *Dendrobium, Oncidium* and *Cattleya* (orchids), *Dalbergia sissoo* (sissoo), *Oryza sativa* (hybrid rice), *Rotula aquatic* (takad), *Ananus comosus* (pineapple), *Punica granatum* (pomegranate), *Vanilla planifolia* (vanilla), *Phyllanthus amarus* (bahupatra), *Citrus nobilis×C. deliciosa* (Kinnow mandarin), *Coleus forskohlii* (makandi), *Psidium guajava* (guava), *Cannabis sativa* (marijuana), *Curculigo orchioides* (black musali), *Spilanthes mauritiana* & Spilanthes acmella (toothache plant), *Vitex negundo* (five-leaved chaste tree), *Vitis vinifera* (grape), *Cucumis sativus* (cucumber) and *Picrorhiza kurrooa* (katuka) synthetic seed development also recorded in the last years.

**Tissue culture of herbal plants and production of Secondary metabolites**

The production of useful compounds (pharmaceuticals, essential oils, food flavorings and colourings) by *in vitro* cultured plant cells has become a field of special interest in various biotechnological programs. Several secondary metabolites including alkaloids, terpenoids, phenolics etc. have also been produced through *in vitro* cultured plant cells. In India, for the enhancement of secondary metabolites production, systems have been developed at BARC, Bombay, Regional Research Laboratory, Jammu and Botany Department, University of Jaipur, Rajasthan.

Attempts are being made to generate know how for mass propagation and genetic improvement of rare and threatened plants of Thar Desert and Arawali. Tissue culture methods have been defined for such plants as *Caralluma, Ceropegia, Dipcadi, Psoralea* etc.

Tea is a major plantation crop of India. With the support of Department of Biotechnology, Government of India, tea tissue culture is being pursued in the G. B. Pant Institute of Himalayan Environmental and Development, Almora.

Micro-tuber formation for mass cultivation of Kalazeera, an important medicinal plant, and micropropagation of other medicinal plants such as fennel, cumin, ocimum, *Achyranthes* etc. is being done in M. S. University of Baroda. These plants produce high yields of desired compounds. Two other medicinally important plants, namely, *Ammi majus* and *Datura*, for the production of hyoscyamine and furocoumarin have been successfully culture *in vitro* in Hamdard University, New Delhi.

Alpha-bisabalol is an important raw material for cosmetic industry. Studies to produce this compound by the callus of popular generated from the tissue culture are in progress in Pantnagar. Further, studies are in progress to standardize the protocol in the Department of Molecular Biology and Genetic Engineering in Pantnagar.

**Somaclonal variations**

In 1981, P.J. Larkin and Scowcroft at the Division of Plant Industry, C.S.I.R.O., Australia gave the term somaclonal variation to genetic variability generated during tissue culture. The mass occurrence of somaclonal variants, increase in the resistance, productivity and vital force of the plant (heterotic effects) has been explained by Carlson (1983). Most significant achievement of somaclonal variation was made by Sheppard and co-workers in old varieties of potatoes. Moreover, somaclonal variations are applicable for seed propagated plants only *e.g.* rice, wheat, maize, tobacco *etc.* not for vegetatively propagated plants. Thus, somaclonal variations have been proved alternative tool to plant breeding for generating new varieties that can exhibit disease resistance and improvement in quality and yield in plants such as cereals, legumes, oilseeds, tuber crops, fruit crops, *etc*. In India, somaclonal variations have been utilized to produce new cultivars of sugarcane and salt tolerant safflower. Another culture has been used to produce fine grain type rice tolerant to submergence. Sugarcane Breeding Institute, Coimbatore has released sugarcane variety Co 94012 through the process of somaclonal variation for commercial cultivation in Maharashtra and is found to give high sugar recovery. A somaclonal variant of lemon grass (*Citronella java*), a medicinal plant has been released as 'Bio-13' for commercial cultivation by Central Institute for Medicinal and Aromatic Plants (CIMAP), Lucknow, Uttar Pradesh. Bio-13 yields 37% more oil and 39% more citronellon than control variant. However, some other new cultivars through this approach have been obtained in rice (IARI, New Delhi), turmeric and custard apple (NCL, Pune), Pusa Jaikisan (Bio-902) variety of *Brassica Juncea* and 'Ratan' a low neurotoxin somaclonal variant of Khesari (*Lathyrus sativus*) has been developed by IARI, New Delhi for commercial cultivation

Using somaclonal variation the genetic improvement of finger millets has been achieved, similarly somaclonal variation has been used to select Basmati Rice- 370 tolerant to high salt. Again somaclonal variation has been used to develop lines of wheat tolerant to leaf blight. Attempts are also being made to produce transgenic wheat lines with high lysine content in their seed proteins using biolistic methods. Similarly genetic transformation has been attempted in chickpea to develop resistant lines to pod borer (*Helicoverpa armigera*) using *Agrobacterium* mediated transformation.

The storage proteins of mungbean and pigeonpea generated through tissue culture are being studied. Gamma radiation has been used to generate variations in sugarcane during the tissue culture by the scientists of Indian Institute of Sugarcane Research, Lucknow.

The technique is being used to enhance somaclonal variation in sugarcane. In an interesting study the ploidy level of plants generated through tissue culture of cotton has been studied to improve the existing cultivars of cotton. Safflower is an important oilseed bearing plants. Studies are in progress in agriculture and food engineering department of IIT Kharagpur to improve the present cultivars of safflower through tissue culture. In a bid to develop new varieties of grass used for fodder, studies are underway in the Indian Grassland and Fodder Research Institute in Jhansi on marble grass and buffelgrass and considerable success has been achieved in the tissue culture of these grasses.

Neem is a panacea for all maladies. Dabur research foundation has achieved success in somatic embryogenesis studies in neem and complete plantlets have been generated *in vitro*.

**Anther culture**

In India, work on anther culture was started during 1950 at the Department of Botany, University of Delhi, by Panchanan Maheswari who is regarded as father of embryology in India. Different tissue culture methodologies were involved for morphogenic studies involving ovary, embryo, endosperm, ovules etc. At the same university, Supra Guha Mukherjee and S.C. Maheswari (1964-67) for the first time developed the haploid through anther and pollen culture of an angiospermic plant *Datura innoxia*. Discovery of haploid production was a landmark in the development of plant tissue culture. At present, more than 250 plant species and hybrids belonging to 40 genera and 36 families of dicots and monocots have been regenerated through anther culture technique. Till date, in India, no variety in any crop has been developed through anther culture or haploid breeding.

Ovary culture derived rice plants in Pantnagar are being tested for their performance. In an interesting study done in the department of Plant Physiology in Pantnagar, it has been possible to produce miniature cobs in maize in tissue-culture generated plants. It is now possible to generate these miniature cobs at will and the system is being explored further to locate the genes and their regulator sequences responsible for the development of cobs. Using tissue culture it has been possible to develop haploids and dihaploids in *Brassica juncea*, the major oilseed crop of India. In an interesting study done in the Department of Molecular Biology and Genetic Engineering in Pantnagar, production of *in vitro* flowering plants regenerated from the *Brassica capestris* (yellow sarson protoplasts have been achieved). The system is now being used to introduce genes into the *Brassica campestris* plants to make them resistant to early blight.

**Embryo rescue and triploid plants**

Embryo rescue technique is very useful in wide hybridization, complete growth of embryo in plant, breaking dormancy of certain seeds where dormancy period is very long. By using embryo rescue technique wild varieties can be crossed with cultivars. At International Centre for Research in Semi Arid Tropics (ICRISAT, Hyderabad) has been used embryo rescue technique to improve groundnut, chickpea and pigeonpea. A new hybrid variety of pigeonpea (ICPH8) has been developed at ICRISAT that matures in 100 days instead of 200 days and have resistance against pathogen and pest and yields 20% more yield than original cultivars.

Triploid plants are of great importance because these are self-sterile and seedless. These characteristics increase edibility of fruits and desirable in fruit plants such as apple, banana, grape, mulberry, mango, watermelon etc. The triploids of poplar have better quality pulpwood. In India, first time B.M. Johri and S.S. Bhojwani (1965) at the University of Delhi reported the endosperm culture for triploid production. Some examples of triploid plants raised from endosperm culture are, *Asparagus officinalis*, Barley, rice, maize, *Prunus persica, Citrus grandis,* sandalwood etc. Till date, Solanaceae is the most common family for the development of somatic hybrids. In India, a collaborative research programme in family Brassicaceae was undertaken at IARI, TERI and Delhi University for the development somatic hybrids.

### *In Vitro* screening for biotic and abiotic stress tolerance

Tissue culture techniques can be used utilized for the production of virus-free plants either through meristems culture or chemotherapy or selective chemotherapy of larger explants from donor plants or dormant propagules or a combination of two. In India, Sood and Palni (1992) have developed various steps for the production virus-free plants in Easter lily plant (*Lilium longoflorum*). Rao (1989) raised a cell line of pearl millet (*Penisetum americanum*) which was resistant to downy mildew caused by *Sclerospora graminicola.* Rao and Palni also reviewed *in vitro* selection of cell lines for disease resistant in plants. *In vitro* screening for various biotic and abiotic stress tolerances was also done in plants including *Chrysanthemum morifolium* (Chrysanthemum), *Triticum aestivum* (wheat), *Vigna radiate* (mungbean), *Brassica juncea* (Indian mustard), *Cymbopogon martinii* (palma rosa), *Dendrocalamus strictus* (bamboo), *Morus* sp. (mulberry), *Oryza sativa* (rice) for salt tolerance, in *Arachis hypogaea* (groundnut), *Brassica juncea* (Indian mustard), *Cocos nucifera* (Coconut), *Oryza sativa* (rice) for drought tolerance, *Nicotiana tabacum* (Tobacco) for Copper tolerance, *Setaria italic* (foxtail millet), *Brassica* sp. (Indian mustard) for Zinc and Manganese tolerance. *Arachis hypogaea* (groundnut) for resistance against *Cercosporidium personatum*, in *Carthamus tinctorius* (safflower) against *Alternaria carthami*, in *Curcuma longa* (turmeric) against *Pythium graminicolum*, in *Gossypium hirsutum* (Cotton) against *Fusarium oxysporum and Alternaria macrospora, in Hordeum vulgare* against *Fusaric acid Fusarium sp.,* in *Mangifera indica* against *Colletotrichum gloeosporioides* in *Oryza sativa* (rice) against *Helminthosporium oryzae*, in *Saccharum* sp. (sugarcane) against *Colletotrichum falcatum* and in *Vitis vinifera* (grapes) against *Elsinoe ampelina.* In India, a lot of research works have also done for the development of *Citrus tristeza* virus and Indian citrus ringspot virus (ICRSV) free plants through plant tissue culture techniques.

### Developmental Biology

Tissue culture is a powerful tool in the studies in the field of developmental biology. Transgenic plants of soybean have been generated and the enzyme glutamine synthetase has been successfully used as a marker of ammonia assimilation. Tissue culture is also a means to induce somatic embryogenesis in winged bean. Studies on the polyamine biosynthesis in relation to stress tolerance in egg plant, and the effects of polyamines in somatic embryogenesis of egg plants are underway in the Department of Genetics in the Delhi University.

### National certification system for tissue culture raised plants (NCS-TCP)

Micropropagation, a technique of plant tissue culture is effectively used for producing contamination and diseases free quality planting material for directly using either by farmers or researchers for their purposes. But there may be some chances of virus presence in those plants and their inadvertent propagation will not only result in poor performance of the crops but also tend to spread hazardous viruses. Beside this, there also may be the chances of deleterious variations in these plants that can affect yield and carry viruses and other pathogens that are difficult to diagnose. This area is of great concern so, there is need to develop a well structured and organized system to support the tissue culture industry to ensure virus-free quality planting material for commercial production. To fulfill the objective of production and distribution of quality planting materials through tissue culture techniques Department of Biotechnology (DBT), Government of India has established a National Certification System for Tissue Culture Raised Plants (NCS TCP). It was notified on 10th March 2006 of Ministry of Agriculture under section 8 of the Seeds Act, 1966. DBT also works as certification agency for the certification of Tissue culture raised plants/propagules up to laboratory level and to regulate its genetic fidelity as authorized vides the Gazette of India.

**Commercialization of Tissue Culture and Development of Technology**

In view of the enforcement of intellectual property rights (IPR), and with the opening of world market, and the liberalization of trade and commerce in the post GATT era, it has become essential that in India we utilize such a powerful technique as the tissue culture, for cloning and mass production of elite varieties of crops, forest trees and ornamental plants. India with its vast biodiversity has unlimited potential to earn foreign exchange competing successfully in the world market. There is going to be a global demand of over 2 billion plants by the turn of the century against 500 million plants produced presently by micropropagation and the market for it is expected to be worth US $ 50 billion per year.

At present, there are about 300 tissue culture laboratories in India of the capacity for producing more than 135 million plants annually. Covered area under floriculture is about 35000 hectares in the Netherlands. But whereas, the worlds share of India is a hefty 67%. The Indian government has however announced certain intensives and concessions for promoting export of flowers with the target of about 100 crores in 1995. It is heartening that the representatives of the sizeable number of industries are also participating in the symposium and an entire session shall be devoted to discuss the process of commercialization of tissue culture and to develop viable technology.

**Status of plant tissue culture in India**

In India, a large number of scientists are involved in the field of plant tissue culture for research in the development of improved planting material for Agriculture, horticulture and forestry. These researches are funded by various organizations including DBT, DST, ICAR, UPCAR, ICMR etc. Till date, more than 100 commercial and semi-commercial laboratory/companies including NBPGR, NBRI, IARI, TERI, CPRI, Delhi University, Rubber Research Institute, Regional Research Laboratory, Jammu & Kashmir, IISR, NCL, CIMAP, BARC, Hindustan Liver Bombay, Indo American Hybrid Seeds, Tree Tech Corporation, Nath Seeds, Aurangabad, Bio Tissue Culture Lab, Hyderabad etc. are involved in plant tissue culture of many plant species for human welfare.

**Major Indian developments in transgenics/field trials**

In India, a lot of research work on transgenic plant development has been done by various government and non-government organizations. Table-1 shows the status of transgenic research in India. Phosphinothricin acetyl transferase (PAT) gene bar for obtaining transgenic rice plants using PEG-mediated DNA uptake, transgenic plants of rice were obtained. The plants were resistant to the herbicide Basta. Similarly bialaphos resistance (bar) gene has been introduced in wheat under the control of rice actin promoter: Bialaphos resistant transgenic plants were selected, likewise using *Agrobacterium* containing ZYMV-CP gene genetically engineered cucurbit plants resistant to virus have been developed. *Bacillus thuringiensis* which is a gram positive spore forming bacteria has been used widely as a biopesticide *Cry* IA (C) gene, after suitable modification from *Bacillus thuringiensis* has been successfully transferred to the plants of tobacco using *Agrobacterium* mediated transformation. Genetic improvement of aromatic crops such as *Mentha arvensis, M. piperita, M. pulegium* and *Melissa officinalis* has been achieved through the transfer of foreign DNA using *Agrobacterium.*

At Delhi University South Campus, transgenic *Brassica juncea* was developed for herbicide resistance by transferring bar, barnase and barstar genes and the plants were used for the production of hybrid seeds. A collaborative research project was launched between TERI, India and Monsanto and Michigan State University, USA to develop golden mustard. It yields cooking oil with high content of beta-carotene (provitamin A).

In India, in the year 2002 for the first time *Bt*-cotton was approved for commercial cultivation that revolutionized Indian cotton industry. Till date, India has occupied largest area (about 11.0 mha) in the world under Bt-cotton cultivation which comprises more than 87% of the total cotton area. After that, in 2008, *Bt*-brinjal was approved for large-scale seed multiplication and in 2009, it was also approved for GEAC for release to farmers but unfortunately in 2009 an indefinite moratorium imposed by Ministry of Environment and Forest, Govt. of India.

**Table-1: Major Indian developments/field trials in transgenic research**

| Institute/University | Crop plant | Transgene inserted | Purpose of the development |
|---|---|---|---|
| Bose Institute, Kolkata (W. B.) | Rice | 5-adenosylmethionine decarboxylase | To generate stress tolerant plants |
| CICR, Nagpur | Cotton | *Bt Cry* genes | To generate insect resistant plants |
| CPRI, Shimla (H. P.) | Potato | *Bt Cry* IA (b) | To generate insect resistant plants |
| CRRI, Cuttack (Orissa) | Rice | *Bt Cry* IA (b), *Xa*21 | To develop plants resistant to pests and bacteria |
| Delhi University (South Campus) | Mustard/ Rapeseed | *bar, barnase, barstar* | To generate herbicide tolerant plants |
| | Brinjal | Chitinase, Glucanase | To develop disease resistant plants |
| | Basmati rice | Pusa *cod*A, *cor*47 | To develop abiotic and biotic stress tolerant plants |
| IARI, New Delhi | Brinjal, | *Bt Cry* IA (a) and *Cry* IA (abc) | To generate insect resistant plants |
| | Cauliflower Cabbage | *Bt Cry* IA (b) | |
| | Tomato | Antisense replicase gene of tomato leaf curl virus | To generate virus resistant plants |

| Institute/University | Crop plant | Transgene inserted | Purpose of the development |
|---|---|---|---|
| ICGEB, New Delhi | Tobacco | *Bt Cry* IIa5 | To generate insect resistant plants |
| ICRISAT, Hyderabad | Groundnut | Chitinase gene from rice (Rchit) | To develop fungus resistant plants |
| Madurai Kamraj University, Madurai | Coffee | Chitinase, beta-1,3-glucanase and osmatin genes | To develop fungus resistant plants |
| NBRI, Lucknow (U. P.) to bacteria and fungi | Rice | *Bt Cry* (b) genes | To generate plants resistant |
| PAU, Ludhiana (Punjab) | Rice | *Bt Cry* IA (b), *Bt Cry* I A (c) | To develop plants resistant to pests |
| TNAU, Coimbatore (Tamilnadu) | Rice | GNA genes, rice chitinase (chi11) or tobacco osmotin gene | To develop plants resistant to pest gall midge |
| UAS, Dharwad | Muskmelon | Rabies glycoprotein genes | To develop edible vaccine |
| Mahyco, Mumbai | Rice | *Cry*1Ac, *Cry*2Ab | To develop plants resistant to insect and pests |
| | Tomato | *Cry*1Ac | |
| | Brinjal | *Cry*1Ac | |
| | Okra | *Cry*1Ac, *Cry*2Ab | |
| Monsanto, Mumbai | Corn | *Cry*1Ab gene | (Mon 810 event) |
| Sungro Seeds Ltd, New Delhi | Brinjal | *Cry*1Ac | |
| | Cauliflower | *Cry*1Ac, *Cry*1Ba and *Cry*1Ca | |
| M/s. Nunhems India Pvt. Ltd., Gurgaon | Cabbage | *Cry*1Ba and *Cry*1Ca | |
| | Cauliflower | *Cry*1Ac, *Cry*1Ba and *Cry*1Ca | |

**Conclusion**

Plant tissue culture is now a well established technology which has made significant contributions to the propagation and improvement of agricultural crops in general.Greater contribution is envisaged from this technology in years to come, both in its own right and as an adjunct to the application of molecular biology.

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# Yield and Quality Mapping: A New Technology of Precision Farming for Horticulture

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## INTRODUCTION

Spatial variability of yield is an important factor in terms of precision farming. Yield is an ultimate indicator of variation of different agronomical parameters in different parts within a field. Hence, mapping of yield and its interpretation and correlation with the spatial and temporal variability helps in development of next season's crop management strategy. In practice of precision agriculture, most important thing is to realize the spatial and temporal variability of the field conditions, yield, soil fertilizer and crop growing status. Yield map helps in understanding the yield fluctuation inside a field, by analyzing the reasons of variation, and improving management in order to increase the profit. Present day yield monitors measure the volume or mass flow rate to generate time periodic record and quantity of harvested crop. High-value crops like carrots, sweet potatoes, green beans, onions, tomatoes and others, need smart farming technology for promising yield quantity. Representation of these agricultural data through yield and fruit quality maps allows crop management in a precise way which means agricultural operations may also be carried out considering intra-orchard variability, thus resulting in greater efficiency.

### Yield mapping/ Yield monitoring:

It is a technique which uses GPS data to analyze variables such as crop yield and moisture content in a given field. It was developed in 1990's and uses a combination of GPS technology and physical sensors.

Data obtained from a yield map can be used to compare yield distribution within the field from year to year, giving farmers a beforehand idea to determine areas of the field that may need to be taken care of which are not yielding properly. It also allows farmers to show the effects of change in field-management techniques, to develop nutrient management strategies for their fields.

**Some basics of yield monitoring in Precision Agriculture:** Yield mapping helps to provide farmers with adequate information to make right decision for their fields. Yield monitors are recently developed tools in precision agriculture that include farm equipments such as combine harvesters or tractors to gather a huge amount of information, including grain yield, moisture levels, soil properties, and much more. It also helps in assessing things i.e. harvesting time, fertilizer doses, the effects of weather, and other factors.

**Working steps of yield monitors:** The grain is harvested and fed into the grain elevator which has the sensors that can read moisture content of the grain. After the grain is being delivered to the holding tank, the sensors monitor the grain yield. Then, the information is sent to the driver cab and is displayed on a screen. Further, the information is geo-referenced so it can be mapped on later time.

**Benefits of farmers to use yield monitoring technology:**

- It helps to give the farmer accurate and often geo-referenced data about their field.
- A farmer can better understand crop yield and crop related information to mitigate potential threats or enhance possible opportunities.
- A yield monitoring system includes the ability for a farmer to export the information onto a personal computer. This information can be available in a variety of different formats.
- In home or office, a farmer can easily use the specialized computer software for better understanding of the recorded information.

**Benefits of yield monitoring:**

**1. Yield data analysis:** It is an essential aspect of smart farming. Numerous cultivators underestimate this data since they think it is a misuse of cash and time. A farmer can better understand crop yield and crop related information to mitigate potential threats or enhance possible opportunities by knowing yield data analysis including crop visualizing and crop variability.

**2. Moisture content measurement in soil-** Water level in the soil gives an overall idea for better farm production. A few crops do well in low-volume water content while others do not. Knowing about the moisture level in the soil gives an idea about which area to add or where to lessen water input.

**3. Avoiding excessive fertilizer application-** High value crops can be grown by using appropriate fertilizer quantity. Growers are using this technology to assess the yield potentiality of their field. If for instance, in the last few years there are areas in a farm consistently yielding less. In such cases, yield maps are proved to be beneficial by indicating the appropriate amount of fertilizer application required for drawing better results.

**4. Saving of money-** This technology helps monitoring the top performing section of a given land. Thus, giving an idea to farm in an area that has maximum potential rather than farming a whole block that gives the same yield.

**5. Better hybrid choosing capabilty-** The money spent on selecting wrong hybrids and application of unwanted fertilizer will result in reduced yields. Through yield mapping, farmers get to know which hybrid goes well with which soil.

**6. Choosing the best management strategy according to performance rate of soil-** Yield mapping helps to pinpoint the low performing areas and have a map to locate exact areas of concern. It also aids to figure out how to fix those problems/challenges by planning a good management strategy.

**Tools used for yield monitoring**

**(a) Mass Flow Sensor :** It helps to provide enough information to establish a grain yield measurement. The mass flow sensor works by utilizing a load cell which is fixed to the highest point of a clean grain elevator. At the point when the harvested grain is fed through the combine, it eventually hit up against the heap cell, this is then transformed into an electrical signal and handed-off to the yield monitor.

**(b) Moisture Sensor :** The moisture content in harvested grain is extremely valuable information for harvesting, drying and storing of crops. The moisture sensor works when the grain moves in-between two conductive surfaces, which measure how much electric charge the grain can store.

**(c) GPS Receiver :** It is a remote sensor that measures a variety of different pieces of data, including where the equipment is located, its speed, altitude, etc. It is one of the key components that can assist to transform yield monitoring data from graphs and charts, into tangible maps that the farmer can utilize.

**(d) Yield Monitor :** Monitor that is located in the cab of the combine or tractors. Its main function is to display the information gathered by the different sensors to allow the operator to know about the different moisture levels and crop yield. These monitors also have the capability to store as well as transfer memory to a laptop or home computer.

Yield monitor for handpicked horticultural crops:

| Crop | Method of yield mapping |
|---|---|
| Citrus | Weighing pallet bins using load cells from neighboring trees on tractor platforms. Estimating yield by tree canopy (ultrasonic sensor, Lidar, multi-spectral camera). |
| Apples / Pears / Olives | Weighing bins of handpicked fruits of neighboring trees, geo-referenced using DGPS. |
| Palm / Plum / Pear / Cranberry | Numbering each tree before harvest and measuring the mass of fruits picked manually. Topographic model or local referencing. |
| Peaches / Kiwis | RFID or barcodes on the bins together with a weighing machine, RFID or barcode reader and DGPS. |
| Potatoes | Load cells under the conveying chains. 2-D vision system above the conveying belt |
| Pecan / Broccoli | Load cells and GPS to weigh the volume and position of the platforms transferring the crop in the field on the go. |
| Onions / Watermelons | Dividing the field into block and weighing the platforms carrying the fruits per block. |
| Processed tomato | For using load cells under the conveying chains of the machine. |

**Quality Mapping :** Quantity and quality are the two components of the field production. Quality is very important and its variability is the object of relevant research. Several laboratories are working to develop different sensors to measure quality of the products. In high value crops, quality offer premium prices and increased income to the farmers.

Some information about quality mapping

➢ In high value crops, quality is seen as the crucial factor for marketing. In the past, the Organisation for Economic Co-operation and Development (OECD) set standards considering size, colour, and sometimes shape of the produce.

➢ Regional programmes were established targeting fruit quality and the OECD responded by developing guideline aiming at promoting uniform quality control procedures: "Guidance on Objective Tests for Determining the Ripeness of Fruit" (OECD, 1998). Here, the internal properties of produce are recognized, *e.g.*, sweetness, acidity, fruit flesh firmness, internal browning, glassiness.

➢ It is expected that plant growth and soil parameters may be correlated with yield mapping. Nutritional and water issues causing the huge spatial variability. The influence of spatial variability of chemical soil properties on spatial pattern of fruit diameter was analysed in different fruits grown in continental, temperate climate.

- It was found that areas of high yields had lower fruit quality, which can be explained by high crop load and inadequate leaf area per fruit. Consequently, for mapping fruit quality can be done at least every season. Analysis of quality during fruit developmental stages even several measurements per season or continuous monitoring would be beneficial.

**Spectral photometric methods for in-situ analysis of fruit.**

| Measuring Principle | Feature |
|---|---|
| Hyper- and multispectral spectroscopy | Anthocyanins, carotenoids, chlorophylls, |
| Near infrared spectroscopy | Dry matter, soluble solids content |
| Hyper- and multispectral imaging | Same as visible or NIR |
| Photogrammetry | Size, shape, colour, biospeckle |
| Fluorescence | Chlorophyll, phenols |
| Distribution of time of flight | Anthocyanins, carotenoids, chlorophylls, effective path length |
| Spatially-resolved hyper- and multispectral Imaging | Wavelength-dependent, same as NIR and scattering properties |

**Conclusions :**

Horticultural crops represent an emerging and challenging sector for adopting precision agriculture technology and management. From most research reported, spatial variability of yield was confirmed even in small fields, where the majority of horticultural crops are grown in contrary to arable crops.

Variability of growth factors affecting yield are the rationale of precision agriculture. Nevertheless, no mainstream technologies or strategies for measuring yield in orchards and vegetable production are yet in place but it is essential for especially horticultural crops using more automated methods for yield mapping.

Quality management is one major component in horticultural crops. As many horticultural crops are growing in small fields but it shares the major part in the world economy. Site-specific technologies and strategies should be developed for small fields, which should be economically viable and easy for small farmers to adopt.

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# Nitrogen Fixing and Phosphate Solublizing Bio-Fertilizers

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## INTRODUCTION

Appropriate biofertilizers need to be selected for specific crops or, purpose. The general recommendations are:

1. Rizobium for legume crops
2. Azotobacter and Azospirillum for non-legume crops
3. Acetobacter for sugarcane only
4. BGA and Azolla for low land paddy

### Nitrogen Fixing Biofertilizer

Nitrogen is one of the major importance nutrients very essential for crop growth. Atmosphere contains about 80 percent of Nitrogen by volume in free state. The major part of the elemental Nitrogen that finds it way in to the soil is entirely due to its fixation by certain specialized group of microorganism, The natural supply of Nitrogen comes from irrigation water, rainfall and atmosphere, which is also utilized by soil micro flora and recycled, to crops during decomposition. Biological Nitrogen Fixation is considered to be an important process, which determines Nitrogen balance in soil ecosystem.

### Rhizobium

The Genus has gone under tremendous changes recently and has been divided in to three well- known genera.

1. Rhizobium
2. Brady Rhizobium and
3. Azo Rhizobium.

There are some specific problems of Rhizobium of inoculants. Strains competition and variety strain compatibility are important. Strain competition is well known fact that inoculated strain and soil native strains of Rhizobium compete for nodulation site on host plant roots. For variety strain compatibility, both the parents of the symbiosis should be compatible to each other to form the effective symbiosis. Inoculation may generally increase Nitrogen fixation by 40-60 kg/ha (kumar Rao and Patil, 1976).

**Table 1: Fast Growing Rhizobium**

| Rhizobium species | Rhizobium species |
|---|---|
| Rhizobium meliloti | Medicago, Melilotus,Trigonella |
| R.leguminosarum biovar trifoli | Trifolium spp |
| R.lrusegummnosarum biovar phaseoli | phaseolus sp. |
| R.legumincsarum biovar viceae | pisum, Lathyrus, Lens. |

**Table 2. Slow Growing Rhizobium**

| Rhizobium species | Rhizobium species |
|---|---|
| Rhizobium species | Genera of Los Legume |
| Brady Rhizobium japonica | Glycine |
| Brady Rhizobium sp. (vigna) | Vigna and numerous other genera and species |
| Brady Rhizobium sp. (lupimus) | Lypinus sp. Lotus pedunculatus |

(source: Bergy's manual of determinative Bacteriology)

**Azolla**

Major limitation in the use of Azolla as biofertilizer is lack of water particularly in the north Indian and temperature sensitiveness of Azolla species. Maintenance of Azolla cultures in ponds during winter is a big problem. High temperature than $40^{O}C$ is also harmful for the fern. The multiplication of Azolla along with rice crop also suppresses the aquatic weed populations.Besids nitrogen contribution; weed suppression in wetland rice by Azolla is an added economic advantage to the rice growers.

**Azospirilum:**

Azospirilum is an aerobic, motile helical or, vibroid, gram-negative bacteria. It is found in Rhizosphere of different plants and has been reported to have association with C-4 plants like maize, sugarcane pearl millet etc. this bacterium is microaerophilic in nature and does not have much high potential of nitrogen fixation; however, it produces growth-promoting substances in Rhizosphere. Crops like bajra, jowar, ragi, maize, cotton, forage crops and sugarcane responded favorably to the inoculation of Azospirilum by increasing yield in the range of 5-10%. In the form of nitrogen it contributes about 20-30kg N per ha on inoculation. (Subbarao, N.S., 1973).

**Azotobacter:**

It is a free-living nitrogen fixer also found in the Rhizosphere of different crops. It is a pleomorphoc, gram-negative bacterium, motile by peritrichous flagella, depend upon the energy derived from the degradation of plant residues. Like Azospirillum, it can also used for all kinds of crops and trees. This organism is poor nitrogen fixer and yield increases are seldom statistically significant. However, Azotobacter is also known for its plant growth promoting and fungicidal activity. Its contribution in terms of nitrogen fixation is about 10-20 kg N $ha^{-1}$.

**Cynobacteria: (BGA):**

BGA is suitable nitrogen fixer for paddy fields. Cynobacteria are known to fix about 20-25 kg $ha^{-1}$ $year^{-1}$ and increase rice yield by about 10% (Kannaiyan, 1978). Besides BGA also adds considerable biomass I soil, which in turn liberate organic acids and organic compounds having chelating property so help in converting insoluble form of phosphorus to soluble form. Besides N fixation BGA also produce growth-promoting substances including B-12. They also improve soil structure by binding soil particles and adding organic matter in soil.

**Phosphate Mobilizer:**

These are some microorganisms that increase the availability of phosphorus to plants. Phosphorus differs fundamentally from nitrogen cycle in the sense that is no natural channel exists for return of large amount of phosphorus losses occurring annually. Hence the supply inevitably shrinking and deposits are limited. In this context the release of insoluble phosphorus in soil and fixed phosphorus in the clay mineral by microbes assumes significance.

**Phosphate Solubilizing Bacteria (PSB):**

Rock phosphate is a material having variable amount of phosphorus but unavailable to plant as such. There are basic raw material for phosphate fertilizer production. India though has about 100 million tones of rock phosphate deposits yet banning about 16 – 17 %, rest is iow grade and cannot be used for fertilizer production (Subbarao, 1982). Similarly into unavailable by reaction with soil iron or aluminum in acidic and with calcium in alkali soils.

**Vesicular – Arbuscular Mycorrhizae Biofertilizer:**

Evidence is accumulating to show that indigenous and introduced VAM fungi are involved in the development of different crop production system including plantation crop and transplantable horticultural crops. Phosphate transport by VAM is a key factor in plant nutrition. VAM can absorb several times more phosphate and have greater phosphate inflow rates than roots. The phosphate absorbed by VAM fungi as polyphosphate granules and this represents 16 – 40 % of the total phosphate in VAM fungi.

The VAM fungal population levels and specific composition are highly variable and is influenced by plants characteristics and environment factor viz temperature, soil, pH, moisture and nutrients. Various mechanisms are suggested for increase in 'p' uptake by mycorrhizal plants.These includes:

- Physical exploration of soil
- Faster movement of 'p' into mycorrhizal hyphae, and
- Modification of root environment.

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# Therapeutic Ingredients Based Whey Beverages

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## INTRODUCTION

Milk is a complete food with nine major nutrients viz. Calcium, Protein, Potassium, Phosphorus, Vitamin D, Vitamin B12, Vitamin A, Riboflavin (B2) and Niacin ((National Dairy Council). Children need the milk for their healthy growth good health, but they usually avoid natural taste or flavour of regularmilk and milk products. To overcome this issue, flavours should be added to milk and other dairy products. As we know, India is the largest producer of milk with annual milk production around 187.7 MT (NDDB 2020). So, this value addition to milk and milk products will increase its value in the market. There are alreadymany flavoured milk products in the market, but most of them contain artificial flavours and colours that may be quite unhealthy for us, especially children.

On the other hand, people are becoming more health-conscious day by day.Also, in India, there are many spices and herbs, which our ancestors used to add in their food, but now, these spices and herbs are being replaced byartificial and unhealthy flavours. But now, people are moving back to healthy and nutrition-rich food. If we talk about milk products, whey beverages are one of them.

Whey is the watery part and a byproduct that remains after the separation of coagulated milk products like cheese. *In manufacturing these products, only 10% to 20% milk portion is recovered as the desired end product and rest 80% to 90% remaining liquid is whey where most of it is disposed as a waste, which is very sad.* Whey can be sweet or acid depending upon the type of casein coagulation. Whey protein contains less than 1% of dry matter.

Whey can be used as a very healthybeverage. Whey liquid has protein, calcium, magnesium, iron, sodium, potassium, carbohydrates and low fat (0.4 g per 100 g whey). This excellent nutrition value makes it healthy for the consumption of children to old age persons. The old ages and health-conscious people who avoid milk due to the risk of fat and cholesterol can drink whey drinks without thinking twice.

Production of whey-based beverages was started in 1970, and the mixing of native, acid or sweet whey with different additives like fruits, vanilla, cocoa, chocolates etc. develops a variety of whey-based beverages. There are also fortified whey beverages in which vitamins and other nutrients are fortified to enhance its nutrition value. Instead of artificial flavours, colours and additives, the addition of natural healthy flavours or spices can improve the nutrition and taste of whey drinks, which increases its market valueresulting in economic benefits. Many healthy ingredients like cardamom, fennel, cinnamon, basil, CuminCumin, coriander, jaggery, and honey should be added to make sweet and salted whey beverages which not only give a good taste but also have therapeutic properties to cure many diseases. The following healthy ingredients not only convert the whey into a delicious beverage but also have therapeutic benefits:

**Cardamom:**

Cardamom is a highly aromatic and flavorful herb, whichhelps in curing many diseases. It can help in the treatment of stomach problems by flushing out the toxins from our body. Cardamom is also found beneficial in weight loss by boosting metabolism. Cardamom helps in curing cough and cold. It improves our blood circulation and checks the blood sugar level. It is also useful in treating sleep troubles. On the other hand, this therapeutic spice gives a lovely aroma and flavour (NDTV food). It can be used in whey to convert it into a delicious and therapeutic beverage.

**Fennel:**

Fennel is a traditional herb full of medicinal properties. It is highly nutritious. It helps in reducing bad cholesterol. Also, fennel seeds have vitamins A, Vitamin C, which is not present in natural whey liquid. It improves digestion and is highly beneficial for skin and hair, regulates blood pressure, reduces water retention, purifies the blood, improves eyesight, reduces asthma symptoms and keeps cancer away (NDTV food). Also, its high aroma and flavour can give a very tasty whey drink.

**Cinnamon:**

Cinnamon is a potent herb, which carries a lot of medicinal properties. It is loaded with anti-diabetic effect, increases appetite, full of antioxidants, anti-inflammatory properties. It reduces the risk of heart attack by lowering bad cholesterol (LDL) and increasing good cholesterol (HDL). Cinnamon also helps in curing bacterial and fungal infections (source: healthline.com). This is why;Adding cinnamon in whey drinks can be a very healthy choice.

Holy Basil (Tulsi): Basil is a herb in the mint family. It not only adds a great flavour to the meal but also provides health benefits.It can add minerals, vitamins, beta-carotene, beta-cryptoxanthin and a lot of antioxidants in whey. It supports liver health, fights cancer, makes the skin and hair beautiful, reduces blood sugar, purifies the blood, promotes cardiovascular health, boosts mental health, reduces inflammation and swelling, and has many more benefits (Medical News Today). Tulsi extract can be easily incorporated into a whey drink, which will also increase its market value.

**Coriander and Cumin for salted whey beverages:**

These can be used for salted whey beverages for a delightful aroma and flavour. All the Coriander plant parts are edible, but the fresh leaves and dried seeds are mainly used for traditional cooking. Coriander hasCarbohydrates, protein, vitamin C, vitamin A, vitamin K as well as trace amounts of potassium, manganese, beta-carotene, folate, lutein, zeaxanthin and choline (Medical News Today). Coriander has a good source of antioxidants, anticancer effects, improves skin health and has antifungal & preservation properties. On the other hand, CuminCumin has protein, carbohydrates, calcium, iron magnesium, phosphorus, potassium, sodium, thiamine, niacin, vitamins (A, C, E, K, B6), zinc and very low sodium, saturated fat and cholesterol (source: organic facts). It aids digestion, improves immunity, relieves respiratory disorders, improves skin health, reduces the risk of diabetes, lowers cholesterol, improves bone health, soothes inflammation, cures a cold, improves memory and has anticancer potential. The salted beverages should be produced with rock salt or pink saltfor enhanced benefits.

**Jaggery and honey for sweetness in whey beverages:**

There are many sweet whey beverages where mainly sugar is used for sweetness, but it can be replaced withjaggery or honey for enhanced benefits. Jaggery and honey contain minerals like calcium, phosphorus, iron and micronutrients. Honey is also rich in vitamin B, vitamin C and potassium, whereas jaggery has a fair amount of copper, magnesium and iron.These ingredients improve digestion, memory, prevent anaemia, detoxify the liver, and make the immune systemhealthy.

**Conclusion :**

All these therapeutic ingredients are readily available and have a lot of medicinal benefits. Also, whey has a lot of nutrients, and incorporating these ingredients can give more and more health benefits by incorporating the nutrients and vitamins, which are absent in natural whey liquid.

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

**AUTHORS GUIDELINE**

All authors submitting articles must be annual or Life member of SAAHAS, KrishiUdyanDarpan E-Magazine (Hindi) / KrishiUdyanDarpan E-Magazine (English, Innovative Sustainable Farming). Articles must satisfy the minimum quality requirement and plagiarism policy. Authors can submit the original articles in Microsoft Word Format through provided http://saahasindia.org portal only along with scanned copy of duly signed Copyright Form. Authors can get **Copyright Form** from website of SAAHAS. Without duly signed Copyright Form, submitted manuscript will not be processed.

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- It should summarize the content of the article written in simple sentences. (Word limit 100 -150) and the full article should contains (1600 words maximum or 3 page of A4 Size).
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- Introduction must present main idea of article. It should be well explained but must be limited to the topic.
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- The main body of an article may include multiple paragraphs relevant to topic. Add brief subheads at appropriate places. It should be informative and completely self-explanatory.
- Submitted manuscript are only running article and contains the field of Agriculture, Horticulture and Allied sectors.
- All disputes subject to Prayagraj Jurisdiction only.

# ABOUT THE SOCIETY

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

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

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

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

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

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