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# Assessment of Semen Quality

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# Integrated Fish Farming System: An Promising Approach towards Regular Supply of Farm Income for Small and Marginal Farmers

**Prasad Mithare[1*], U.T Mundhe[2] and U.S. Biradar[3]**

*Department of ILFC, Veterinary College Bidar,*
*Karnataka Veterinary, Animal & Fisheries Sciences University, Bidar-585401 India.*
**Corresponding author: mithare.prasad@gmail.com*

Integrated fish farming is based on the concept that 'there is no waste, and waste is only a misplaced resource which can become a valuable material for another product. In integrated farming, the basic principles involve the utilization of the synergetic effects of inter-related farm activities and the conservation, including the full utilization of farm wastes. It is assumed that all the constituents of the system would benefit from such a combination. However, in most cases, the main beneficiary is the fishes which utilize the animal and agricultural wastes directly or indirectly as food. As integrated farming involves the recycling of wastes, it has been considered an economic and efficient means of environmental management. Raising fish in combination with pigs, poultry, cattle, and ducks can doubles family income and produce regular supply of balanced nutrition. Since animal waste makes good fertilizer for fish ponds, and about 55-60 percent of the cost of fish farming goes for feed, integrating livestock and fish farming makes sense. Practicing combination of different animals and crops that best suit to particular agro-climatic zones. Grow vegetables and other crops on the pond dykes. Use animal waste to run a biogas plant and then feed the biogas slurry to fish-it is better than raw waste as fish-pond fertilizer. Best suitable combinations include: Fish-cattle, Fish-duck, Fish-poultry, Fish-pig, and Fish-goat/sheep.

## LIVESTOCK-FISH FARMING SYSTEMS

Fish farming facilities is extremely safe technology in which the predetermined amount of livestock manure obtained by raising cattle is applied to a pond to raise the fish farm without additional nutrient input. The main potential links between animal husbandry and fish production are the use of nutrients, in livestock manure for fish production. Primarily elements such as nitrogen (N) and phosphorus (P), which act as fertilizers to stimulate natural food webs rather than the nutritional use of livestock as food components. The direct use of animal waste is the largest and most widely recognized type of integrated agriculture. Production waste includes manure, urine and spilled food these are used as fresh inputs or treated in one way or another before use. Depending on the type of livestock used for integration, there are many combinations in livestock-fish systems. Some of the combinations are listed and explained below.

## CATTLE-FISH CULTURE

A one-hectare fish pond needs about 10-15 tonnes of dung and urine per year to maintain its fertility. New ponds need higher doses of dung and urine. In general, the dung and urine of two cattle are sufficient to maintain a one-hectare pond. Watering a fish pond with cow dung is one of the common practices around the world. A healthy cow excretes more than 4,000 to 5,000 kg of manure, 3,500 to 4,000 liters of urine per year. Instead of raw cow dung, biogas sludge could be used with equally good production. 20-30 t of biogas slurry are recycled in a 1 ha water zone to obtain more than 4,000 kg of fish without feed or fertilizer application. Cow dung, is a rich source of natural food body and bacteria in the pond. A unit of 5-6 cows can provide enough fertilizer for 1 $ha^{-1}$ of pond and provide about 9,000 lit of milk, along with 3,000 to 4,000 kg of fish $ha^{-1}$ year can be harvested.

**Caution:** Your pond water should be brown. If the water suddenly turns dark green because of algal growth, stop the inflow of dung and urine until the water turns brown again. Stop the flow of dung and urine during persistent cloudy weather (2-3 days of continuous cloudiness). You do not have to stop the flow of dung and urine during rain. Raising fish and cattle together is quite profitable. Although wastes from cattle are not as rich as wastes from poultry and pigs, cattle farmers can still use cattle dung and urine to maintain a fish pond. Cattle waste as pond fertilizer if you own cattle, construct a shed close to your pond.

**Dung and Urine Slurry:** As a better alternative, mix dung and urine thoroughly, dilute with water and, using a bucket, evenly broadcast the mixture into your fish pond. Dung in the form of biogas slurry is even better. Apply 80-120 kg of fresh slurry per hectare of pond each day.

**Production:** About 2,500-3,000 kg of fish can be produced from one hectare of pond each year. The cattle provide milk and labour. Buffaloes can also be raised instead of cattle.

## POULTRY-FISH CULTURE

Poultry farming for meat (broiler) or eggs (layers) can be integrated into fish culture to reduce the cost of fertilizer and feed in fish culture and to maximize benefits. Poultry can be raised above or beside the ponds and the poultry excrement can be recycled to fertilize the fish ponds. Poultry houses, if built above the water level with bamboo poles, would directly fertilize fish ponds. In the integration of fish fowl, birds kept in intensive systems are considered to be the best. Birds are kept captive without access to the outside. Deep litter is well suited for this type of farming. An approximately 6-8 cm thick layer of chopped straw, dry leaves, sawdust or peanut shells are sufficient. Poultry manure in the form of fully built-up dip-litter contains: 3% nitrogen, 2% phosphate and 2% potash, therefore it acts as a good fertilizer and used as fish food. This reduces the cost of fish production by 60%. In one year 25-30 birds can produce 1 ton of dip-litter and based on that it is estimated that Between 500 and 600 birds will produce enough litter for a 1 ha fish pond. Using this system, 4,000-5,000 kg of fish 60,000 eggs and 1,200 kg of chicken can be produced annually. Every day at a rate of 50 kg $ha^{-1}$ of water catchment area, poultry manure is applied to the fish pond.

## Procedure

- Locate the poultry house near the fish pond.
- Construct the poultry house floor out of brick, concrete, or hard soil.
- Cover the floor to a depth of 15 cm with chopped straw, dry leaves, hay, groundnut shells, broken maize stocks, or sawdust.
- Provide 0.3 to 0.4 sq m per bird. Keep the birds on the litter to collect their droppings. Stir the bed regularly.
- Keep adding more organic matter to maintain the required depth of 15 cm. If the litter becomes damp, add superphosphate or lime to keep it dry.
- After 10-12 months, the litter is fully built up and its nitrogen content has reached about 3 percent. This litter can be used as fertilizer for your fish pond. Store the litter in a dry place and apply it to the pond at the rate of 15-20 kg/ha per day.
- Slatted floor system: Build a poultry house on stilts over the pond. Build the floor out of slatted bamboo or slatted wood so that the bird droppings fall directly into the pond.
- The birds can be kept in cages or allowed to move freely inside the poultry house.

## DUCK-FISH CULTURE

A fish pond, which is a semi-enclosed biological system with several aquatic animals and plants, provides an excellent disease-free environment for ducks. In return, ducks eat frogs, tadpoles and dragonflies, creating a safe environment for fish. Duck dropping goes directly into pond, which in turn provides vital nutrients to stimulate the growth of natural foods. This has two advantages, there is no energy loss and fertilization is homogeneous. This integrated agriculture was followed in West Bengal, Assam, Kerala, Tamil Nadu, Andhra Pradesh, Bihar, Orissa, Tripura and Karnataka. The most common breed for this system in India is the "Indian runners". It is very profitable as it greatly increases animal protein production in terms of fish and duck per unit area. Ducks are known as live fertilizers. Duck dropping contains 25 percent organic and 20 percent inorganic matter with a range of elements such as carbon, phosphorus, potassium, nitrogen, calcium, etc. Therefore, it forms a very good source of fertilizer in fish ponds for fish food organisms. In addition to fertilizing, ducks eliminate the unwanted insects, snails and their larvae, which can be the vectors of fish pathogens and water borne pathogens that infect humans. In addition, ducks also help in the release of nutrients from the bottom of ponds, especially when they move the banks of the pond. In duck-fish cultures, the ducks can move freely on a regular basis or be placed in shielded resting places above the water. The ducks can be stored in these sheds in an amount of 15 to 20 / m2. It is better if the ducks only stay in ponds until they reach a marketable size. Depending on the growth rate of ducks, they can be replaced once in two to three months. Ducks about 15-20 days old are generally selected. Fish farming usually lasts one year, and at a stocking density of 20,000 $ha^{-1}$, fish production of 3,000-4,000 kg $ha^{-1}$ per year was achieved in duck fish culture. Eggs and duck meat are also produced in good quantities every year.

### Benefits of Ducks

- Ducks contribute to high fish production while producing valuable eggs and meat.
- Ducks loosen the pond bottom, releasing nutrients which increase pond productivity.
- No additional land is required to raise ducks.
- Ducks get 50 to 75 percent of their feed from the pond in the form of aquatic weeds, insects, and mollusks. Ducks spread their droppings over the whole pond; this reduces the labour associated with pond manuring.
- Ducks and fish make a great combination. Just build a simple duck shelter next to the fish pond and reap the results. Fish will grow large on duck manure, spilled duck feed, and microscopic animals and plants made plentiful by the presence of the ducks.

### POND MANAGEMENT FOR DUCK-FISH CULTURE

- Six- to eight-week-old ducklings should be stocked on the pond.
- Vaccinate them prior to stocking.
- The ducks are likely to prey on small fingerlings.
- To avoid this, stock the pond with fingerlings more than 10 cm in length.
- **Selection of Ducks:** Indian runner, styles, mete, and megaswari are suitable breeds.
- **Construction of duck house:** Construct a house on the pond embankment to shelter the ducks at night and during egg laying.
- **Duck droppings as manure:** Droppings should be collected from the duck house at night and applied to the pond every morning. 200-300 ducks are sufficient to manure a 1 ha fish pond.
- **Feed supplements for ducks:** Supplementary food at the rate of 100 g per bird per day can come from household wastes such as kitchen leftovers, rice bran, and broken rice. Put this feed inside the duck house. Ducks start layers eggs at the age of 24 weeks and continue to lay until the age of two years. After this, sell them. About 3,000 kg of fish, 12,000 eggs, and 500 kg of duck meat can be produced per hectare of pond each year.

### PIG-FISH SYSTEM

Exotic breeds such as White Yorkshire, Landrace and Hampshire are reared in the pigsty near the fish pond the waste produced by 30-40 pigs equals 1 ton of ammonium sulfate. However, pig sty can also be built at a nearby site, where pork rings and manure first enter the oxidation tanks (digestion chambers) of biogas plants for domestic methane production. The manure (mud) is then thrown into the fish ponds through small ditches that cross the pond gangs. Alternatively, pig manure can be piled up in localized ponds or applied to fish ponds by dissolving in water. Pork manure contains over 70% digestible food for fish. Undigested solids in pig dung also serve as a direct food source for tilapia and carp. The optimum amount of pig manure per hectare was estimated at five tonnes for a one-year growing season. Fish such as grass carp, silver carp and carp (1: 2: 1) are suitable for integration with pigs. Pigs reach the slaughter maturity size (60-70 kg) within 6 months and give 6-12 piglets in each litter. Her age at first maturity varies from 6-8 months. The fish reach a marketable size in one year.

## FISH-LIVESTOCK-CROP PRODUCTION SYSTEM

An "integrated farm animal system" is a form of mixed production that uses crops and livestock to complement each other through space and time. The backbone of an integrated system is the herd of ruminants (animals such as sheep, goats or cattle) grazing a pasture to build the soil. Eventually enough organic soil builds up to the point where the plants can be supported. Animal can also be used for farms and transports. While crop residues provide feed for livestock and crops provides additional feed for productive animals. Animals play a key and multiple roles in the functioning of the farm, not only because they provide animal products (meat, milk, eggs, wool and skins) or can be turned into quick cash in emergencies.

- Improving the nutrient cycle: Excretion contains several nutrients (NPK) and organic matter essential for maintaining soil structure and fertility.
- Provision of energy: Excretes are the basis for the production of biogas and energy for domestic use (eg: cooking, lighting) or for the rural industry (eg: mills and water pumps).
- Fuel in the form of biogas or dung cake can replace charcoal and wood.

### Paddy-Cum-Fish Culture

Rice fields which are water-logged for 3-8 months in a year, there is always small population of fishes that gain access to such waters. This probably had given rise to the practice of deliberate stocking of fishes and harvesting. The trapping of prawns and fishes with the help of 'gamcha or dhoti' in fallow paddy-fields has been an age old practice in India.

## OBJECTIVES OF PADDY-CUM-FISH CULTURE

- Paddy-field aquaculture provides additional income to the farmers. In areas where rice and fish form the staple food, paddy-field aquaculture makes available an essential diet for the people.
- As paddy and fish can be grown either simultaneously or alternately in the same water mass, it requires very little extra input by way of additional costs, particularly in labour management.
- It provides off-season employment to the farmers and farm labors. Combination of paddy and fish farming is mutually beneficial.
- Fish cultivation promotes better paddy production by way of exercising an effective control on unwanted weeds, noxious insects and their larval stages.

**Criteria for Selecting of Paddy-Cum-Fish Culture**

- Fishes that can adapt to shallow waters necessary for paddy crops. Fishes that can tolerate high temperature. Fishes that can thrive on low dissolved oxygen, which is the characteristic of paddy-fields. Fishes that can tolerate fairly high turbidity, as the duration of culture is quite short, fishes that have high growth rate is to be selected, so that it can reach marketable size within these few months.
- Fishes that can live in confinement and do not tend to escape from the cultivated area.
- Fishes that are cultured in such waters in India are Mugil spp, Mystus gulio, Puntius sp., Channa spp, prawns and shrimps.

**Management of Paddy-Fields**

- A continuous flow of water in the field, with proper inlet and outlet is to be maintained.
- The water in the field is to be maintained at a desired level.
- Proper drainage of water from the field has to be made in case of flooding.
- At the point of entry and exit of water, some controls have to be provided to prevent the cultivated species from escaping and stopping the entry of wild fishes into the paddy-field.
- Deep pits or other devices have to be provided as shelter to the cultivated fishes at the time of distress.

**Advantages of Simultaneous Cultivation**

- There is no additional cost for fish production. Fishes contribute to the enhancement of paddy production by destroying weeds, causing tillering and mineral enrichment by their digging activity, and for the fertilization of soil by their excrement and also by the unutilized artificial feed. Due to fish cultivation paddy production gets increased by 5 to 15%.

## ADVANTAGES OF PADDY-FISH ROTATION

- There is no water depth limitation either to paddy or fish cultivation.
- Shallow water depth is maintained till the harvesting of paddy, after which the water depth is raised for culture of fishes.

- Through this adequate water level management, suitable water temperature and dissolved oxygen content can be maintained.
- After harvesting of paddy, the submerged stubbles decompose and fertilize the water. This leads to the development of fish food organisms and ultimately stimulates higher productivity.
- The interval between paddy harvesting and fish stocking is sufficient enough to allow degradation of pesticides.
- Insect pest infestation gets reduced as their life-cycles are disrupted.
- Either monoculture or polyculture can be practised.

**Advantages of Integrated Farming System**

a) **Productivity:** IFS offers the opportunity to increase the economic yield per unit area & per unit of time through intensification of growers and related businesses, especially for small farmers.

b) **Profitability:** Feed costs for livestock account for approximately 65-75% of total production costs; however, the use of waste material and its by product reduces production costs.

c) **Sustainability:** In the IFS, the subsystem of one waste or by-product serves as input to the other subsystem, and its by-product or by-products are organic in nature, providing the opportunity to sustain the opportunities of the production base much longer than monoculture.

d) **Balanced nutrition:** All nutrient needs of humans are not found exclusively in individual foods. To meet these requirements, different foods must be consumed by the farmers.

e) **Environmental safety:** IFS effectively recycles waste by combining suitable components, minimizing environmental pollution.

f) **Recycling:** Effective recycling of products, by-products and wastes in IFS is the cornerstone of the sustainability of the agricultural system under resource-constrained conditions in rural areas.

g) **Income rounds the year:** Due to the interaction of companies with grains, eggs, meats and milk, cash flow offers year round farming community.

h) **Save energy:** Cattle are used as a means of transport in rural areas, more than cow manure is used as a burning material for cooking or biogas production, reducing dependence on gasoline/ diesel or fossil fuels available source within the agricultural system to save energy.

i) **Meeting feed crisis:** By-products and crop waste materials are used effectively as feed for livestock (ruminants) and products such as cereals; maize is used as feed for monogastric animals (pigs and poultry).

j) **Job creation:** The combination of crops with livestock farms would significantly increase the need for work and help to substantially reduce the problems of under employed workers.

## CONCLUSION

It has been accepted by all around the world that sustainable development is the only way to promote the rational use of resources and environmental protection without hampering economic growth. Developing countries around the world promote sustainable development through sustainable agricultural practices that help them tackle socio-economic and environmental issues at the same time. The concept of sustainable agriculture, "Integrated Fish Farming Systems" has a special position, because nothing is wasted in this system but becomes the by-product of one system as input to others. IFS module is an effective approach towards regular supply of farm income for small and marginal farmers as compared with single component unit in agriculture. In addition, the system helps poor peasants, who have very small areas for the production of crops & to diversify agricultural production, in terms of increase farm income, improve the quality and quantity of food produced, supply of nutritional security to farming community.

# The fall armyworm (*Spodoptera frugiperda*): A crop eating pest threaten high alert over India's maize crop

**Prasad Mithare[1*], U.T Mundhe[2] and U.S. Biradar[3]**

*Department of ILFC, Veterinary College Bidar,*
*Karnataka Veterinary, Animal & Fisheries Sciences University, Bidar-585401 India*
**Corresponding author: mithare.prasad@gmail.com*

The fall armyworm is native of western hemisphere from the United States. Fall armyworm (*Spodoptera frugiperda*) is a species in the order of Lepidoptera and is the larval life stage of a fall armyworm moth. The term "armyworm" can refer to several species, often describing the large-scale invasive behavior of the species' larval stage. It is regarded as a pest and can damage and destroy a wide variety of crops, which causes large economic damage. Its scientific name derives from *frugiperda,* which is Latin for *lost fruit*, named because of the species ability to destroy crops. Outbreaks of the true armyworm usually occur during the early part of the summer; the fall armyworm does most damage in the late summer in the southern part of the United States, and early fall in the northern regions. The fall armyworm is a strong flier, and disperses long distances annually during the summer months. However, as a regular and serious pest, its range tends to be mostly the southeastern states. In 2016 it was reported for the first time in West and Central Africa, so it now threatens Africa and Europe. The Indian Council of Agricultural Research (ICAR)–National Bureau of Agricultural Insect Resources (NBAIR) has sounded the alarm after the invasive agricultural pest fall armyworm was discovered in Karnataka state in this July 2018. Based on results of surveys conducted between July 9 and July 18 that recorded more than 70% prevalence of the Fall Armyworm (Spodoptera frugiperda) in a maize field in Chikkaballapur, Karnataka. India produces more than 20 million tonnes of maize every year, with the highest area under cultivation in Karnataka. Scientists at ICAR said the pest has spread in eight or nine districts of Karnataka such as Shimoga, Bellary, Belgaum and Hassan with up to 35% damage to 20-25 day young crops, and attacking even the tassel of the mature maize yields.

## What is Fall Armyworm?

Fall Armyworm or Spodoptera frugiperda is an insect native to tropical and subtropical regions of the Americas where they primarily attacked maize crops during the autumn months. It was first detected in Central and Western Africa in early 2016. In the larva stage, the insect causes damage to crops, feeding on more than 80 plant species. Fall Armyworm (FAW) primarily affects maize, but also rice and sorghum as well as cotton and some vegetables. The moth can fly up to 100 km per night and the female moth can lay up to a total of 1,000 eggs in her lifetime.

## Taxonomy

Genus Spodoptera was described by Guenee in 1852.
Genera - Spodoptera, Laphygma and Prodenia. All three combined to form Spodoptera.
25 species are in this genus. First described in 1797 as Phaleana frugiperda. In 1852, frugiperda was placed in genus Laphygma. In 1958 Laphygma and spodoptera were synonymized.

### Different Species in the Genus and their Common Names

- Spodoptera eridania: Southern armyworm.
- Spodoptera exigua: Beet armyworm.
- Spodoptera frugiperda: Fall armyworm.
- Spodoptera ornithogalli: Yellowstriped armyworm.
- Spodoptera praefica: Western yellow striped armyworm.
- Spodoptera exempta: Nutgrass armyworm.
- Spodoptera littoralis: Egyptian cotton leafworm.
- Spodoptera litura: Taro caterpillar.
- Spodoptera mauritia: Lawn armyworm.

### Current Distribution of Economically Important Species

- Spodoptera frugiperda: U.S, South America, Africa.
- Spodoptera littoralis: Africa, southern Europe, Western Arabian Peninsula, Islands of Indian Ocean, Islands of Atlantic ocean.
- Spodoptera exempta: Africa, Australia, Hawaii, Western Arabian Peninsula.
- Spodoptera litura: Australia, Pacific Islands, Asia.
- Spodoptera mauritia: Madagascar, Saudi Arabia, Asia, Pacific Islands, Hawaii.
- Spodoptera exigua: Africa, Western Arabian Peninsula, Islands of Indian Ocean.
- Spodoptera pectin: Asia.
- Spodoptera cilium: Africa, Western Arabian Peninsula, Islands of Indian Ocean.
- Spodoptera triturata: Africa

### Host Plants for each species

- Spodoptera exempta: Poaceae and Cyperacease.
- Spodoptera littoralis: 44 families including Leguminosae, Solanaceae, Malvaceae, Moraceae, Asteraceae, Poaceae, Chenopodiaceae, and Cruciferae.

- Spodoptera litura: Over 100 hosts, including crucifers, legumes, millets, deciduous fruit trees.
- Spodoptera mauritia: Poaceae, Cyperaceae, and Typhaceae
- Spodoptera pectin: Poaceae and Cyperaceae
- Spodoptera frugiperda: More than 100 plant species like Maize, rice, sorghum, sugarcane, cabbage, beet, peanut, soybean, alfalfa, onion, cotton, pasture grasses, millet, tomato, and potato.

**Fall Army Worm Strains**

- Corn Strain: Maize and sorghum.
- Rice strain: Rice and turf grass.
- Morphologically identical.
- Distinguished by molecular markers: -

- Allozyme polymorphisms
- Genetic polymorphisms.
- Mitochondrial haplotyping.
- Molecular differences are consistent with genetically distinct populations.
- Differ in susceptibility to chemical and biological agents.
- Florida haplotype profile: - Florida and Caribbean population.
- Texas haplotype profile: - Texas through Central America to Argentina.

**Life Cycle**

The life cycle is completed in about 30 days during the summer, but 60 days in the spring and autumn, and 80 to 90 days during the winter. The number of generations occurring in an area varies with the appearance of the dispersing adults. The ability to diapauses is not present in this species.

**Egg**

The egg is dome shaped; the base is flattened and the egg curves upward to a broadly rounded point at the apex. The egg measures about 0.4 mm in diameter and 0.3 mm in height. The number of eggs per mass varies considerably but is often 100 to 200, and total egg production per female averages about 1500 with a maximum of over 2000. The eggs are sometimes deposited in layers, but most eggs are spread over a single layer attached to foliage. The female also deposits a layer of grayish scales between the eggs and over the egg mass, imparting a furry or moldy appearance. Duration of the egg stage is only two to three days during the summer months.

**Larvae**

There usually are six instars in fall armyworm. Fully-grown larvae are 3.1 – 3.8 cm long, Vary in color from pale green to almost black, Three yellowish stripes running down the back, Wider dark stripe and a wavy yellow-red blotched stripe on each side, Predominant white, inverted Y-shaped suture on the head, Larval duration is about 14 days during the summer and 30 days during cool weather. Head capsule widths are about 0.35, 0.45, 0.75, 1.3, 2.0, and 2.6 mm, respectively, for instars 1-6. Larvae attain lengths of about 1.7, 3.5, 6.4, 10.0, 17.2, and 34.2 mm, respectively, during these instars. Young larvae are greenish with a black head, the head turning oranges in the second instar. In the second instar, but particularly the third instar, the dorsal surface of the body becomes brownish, and lateral white lines begin to form. In the fourth to the sixth instars the head is reddish brown, mottled with white, and the brownish body bears white sub dorsal and lateral lines. Elevated spots occur dorsally on the body; they are usually dark in color, and bear spines. The face of the mature larva is also marked with a white inverted "Y" and the epidermis of the larva is rough or granular in texture when examined closely. However, this larva does not feel rough to the touch, as does corn earworm, *Helicoverpa*, because it lacks the micro spines found on the similar-appearing corn earworm. In addition to the typical brownish form of the fall armyworm larva, the larva may be mostly green dorsally.

**Pupa:** Pupation normally takes place in the soil, at a depth 2 to 8 cm. The larva constructs a loose cocoon, oval in shape and 20 to 30 mm in length, by tying together particles of soil with silk. If the soil is too hard, larvae may web together leaf debris and other material to form a cocoon on the soil surface. The pupa is reddish brown in color, and measures 14 to 18 mm in length and about 4.5 mm in width. Duration of the pupal stage is about eight to nine days during the summer, but reaches 20 to 30 days during the winter. The pupal stage of fall armyworm cannot withstand protracted periods of cold weather.

**Adult:** The moths have a wingspan of 32 to 40 mm. In the male moth, the forewing generally is shaded gray and brown, with triangular white spots at the tip and near the center of the wing. The forewings of females are less distinctly marked, ranging from a uniform grayish brown to a fine mottling of gray and brown. The hind wing is iridescent silver-white with a narrow dark border in both sexes. Adults are nocturnal, and are most active during warm, humid evenings. After a pre oviposition period of three to four days, the female normally deposits most of her eggs during the first four to five days of life, but some oviposition occurs for up to three weeks. Duration of adult life is estimated to average about 10 days, with a range of about seven to 21 days.

## Host Plants

This species seemingly displays a very wide host range, with over 100 plants recorded, but clearly prefers grasses. The most frequently consumed plants are Maize, Sorghum, Pearlmillet, Bermuda grass, and grass weeds such as crabgrass, *Digitaria* spp. When the larvae are very numerous they defoliate the preferred plants, acquire an "armyworm" habit and disperse in large numbers, consuming nearly all vegetation in their path. Many host records reflect such periods of abundance, and are not truly indicative of oviposition and feeding behavior under normal conditions. Field crops are frequently injured, including Maize, alfalfa, barley, Bermuda grass, buckwheat, cotton, clover, oat, millet, peanut, rice, ryegrass, sorghum, sugarbeet, Sudan grass, soybean, sugarcane, timothy, tobacco, and wheat. Among vegetable crops, only sweet corn is regularly damaged, but others are attacked occasionally. Other crops sometimes injured are apple, grape, orange, papaya, peach, strawberry and a number of flowers. Weeds known to serve as hosts include bent grass, *Agrostis* sp.; crabgrass, *Digitaria* spp.; Johnson grass, *Sorghum halepense*; morning glory, *Ipomoea* spp.; nut sedge, *Cyperus* spp.; pigweed, *Amaranthus* spp.; and sandspur, *Cenchrus spp*.

**Damage occurred by Fall Armyworm**

Larvae cause damage by consuming foliage. Young larvae initially consume leaf tissue from one side, leaving the opposite epidermal layer intact. By the second or third instar, larvae begin to make holes in leaves, and eat from the edge of the leaves inward. Feeding in the whorl of corn often produces a characteristic row of perforations in the leaves. Larval densities are usually reduced to one to two per plant when larvae feed in close proximity to one another, due to cannibalistic behavior. Older larvae cause extensive defoliation, often leaving only the ribs and stalks of corn plants, or a ragged, torn appearance. Larvae also will burrow into the growing point (bud, whorl, etc.), destroying the growth potential of plants, or clipping the leaves. In corn, they sometimes burrow into the ear, feeding on kernels in the same manner as corn earworm, *Helicoverpa*. Unlike corn earworm, which tends to feed down through the silk before attacking the kernels at the tip of the ear, fall armyworm will feed by burrowing through the husk on the side of the ear. Studied larval feeding behavior, and reported that although young (vegetative stage) leaf tissue is suitable for growth and survival, on more mature plants the leaf tissue is unsuitable, and the larvae tend to settle and feed in the ear zone, and particularly on the silk tissues. However, silk is not very suitable for growth. Larvae attaining the corn kernels display the fastest rate of development. Also, although the closed tassel was suitable with respect to survival, it resulted in poor growth. Thus, tassel tissue may be suitable for initial feeding, perhaps until the larvae locate the silk and ears, but feeding only on tassel tissue is suboptimal.

## Damage on Maize

- Prefers young maize plants. Its attacks all stages of maize plant, foliar consumption is the major factor.
- Generally feeds on foliage, but during heavy infestations, also feed on maize ears.
- Foliar damage characterized by ragged feeding, and moist sawdust-like frass near the whorl and upper leaves of the plant.
- Indirect effects on grain production.

- Young larvae feed on one side of leaves leaving the epidermis intact on other side.
- Older larvae feed by making holes in leaves and eat from the edge of the leaves inward.
- Larval feeding causes extensive defoliation.
- Larvae can also burrow into the growing point and affect the growth of plants.
- Larvae sometimes bore into the ear through the husk and feed on kernels.

## Economic Losses

Outbreaks of Fall Armyworm have been reported in several countries in Africa. Around 330,000 hectares of staple crops, especially maize, have been affected. The remaining African countries remain at high risk. The severity of the impact on regional crop production is yet to be established.

## Monitoring

Often done by using black light traps and pheromone traps are very efficient, suspended at canopy height Insect catches indicate the presence of moths in the area but not good indicators of density Once the moths are detected, search for eggs and larvae To assess the proportion of plants infested, random sampling of 20 plants in five locations, or 10 plants in 10 locations, is considered adequate.

## Chemicals in Pheromone

(Z)-9-tetradecen-1-ol acetate.
(Z)-9-14: Ac; (Z)-7-dodecen- 1-ol acetate.
(Z)-7-12: Ac; (Z)-9-dodecen-1-ol acetate.
(Z)-9-12: Ac and (Z)-11-hexadecen-1-ol acetate.
(Z)-11-16: Ac. In the ratio of 81: 0.5: 0.5: 18, respectively.

## Companies producing pheromone traps

- ISCA Technologies, California, U.S.A.
- Russell IPM, England.
- Biocontrole.
- Pherobank.
- Scentry monitoring products.
- NovAgrica.
- Evergreen growers supply.
- Biocontrol Research Laboratory, Bangalore, India

## Control Measures

1. Physical control.
2. Cultural practices.
3. Chemical control.
4. Biological control.

5. IPM.

**1. Physical control**

- Handpicking egg masses and larvae.
- Deep plowing to kill pupae in the soil.
- Placing sand or ash in the whorls.

**2. Cultural practices**

- Intercropping with beans has shown to reduce the FAW infestations by 20-30 percent.
- Trap cropping with castor plant will be beneficial.

**3. Chemical control**

- Insecticides main control option: > 25 % plants damaged.
- Spot treatment for isolated areas effective.
- Late afternoon or early morning- best time.
- Recommended insecticides: pyrethroids, carbamates and organophosphates.
- Granular insecticides for young plants (whorl stage).

**Limitations of chemical control**

- ✓ Concealed larvae -Expensive and not affordable.
- ✓ Appropriate safety procedures may not be implemented on regular basis.
- ✓ Personal protective equipment not available.
- ✓ Increased risk of exposure -Resistance development.

**Insecticide Resistance**

- ✓ First noted in 1979, FAW collected from maize in Tifton, Georgia (U.S.) was shown to be resistant to carbaryl. In 1991, a strain of FAW collected from maize in northern Florida (U.S.) showed resistance to commonly used insecticides.

**Insecticide Resistance Management**

- ✓ Treat when needed: follow insect pest pressure and thresholds.
- ✓ Conservation Biological control. Augmentation biological control.
- ✓ Don't treat successive generations with products of the same mode of action.
- ✓ Use approximately 30 day window to conduct sprays of insecticides of same mode of action.
- ✓ Do not apply products of the same mode of action over more than 50% of the crop cycle.

**4. Biological control**

**a. Natural Enemies**

Cold climate, wet springs followed by warm, humid weather in the over wintering areas favor survival and reproduction of fall armyworm, allowing it to escape suppression by natural enemies. Once dispersal northward begins, the natural enemies are left behind. Therefore, although fall armyworm has many natural enemies, few act effectively enough to prevent crop injury.

**Table. 1 Insecticide Recommended for use**

| Active Ingredient | Trade Name |
|---|---|
| Chlorantaniliprole + lambda - cyhalothrin | Besiege |
| beta-cyfluthrin | Baythroid |
| gamma-cyhalothrin | Proaxis |
| lambda-cyhalothrin | Warrior II |
| zeta-cypermethrin | Respect |
| Dimethoate | Dimethoate |
| Imidacloprid | Admire Pro |
| Malathion | Malathion |
| Methoxyfenozide | Intrepid |
| Permethrin | Ambush |
| Spinetoram | Delegate |
| Spinosad | Success |

**b. Parasitoids**

The wasp parasitoids most frequently reared from larvae in the United States are Cotesia marginiventris (Cresson) and Chelonus texanus (Cresson) (both Hymenoptera: Braconidae), species that are also associated with other noctuid species. Among fly parasitoids, the most abundant is usually Archytas marmoratus (Townsend) (Diptera: Tachinidae). However, the dominant parasitoid often varies from place to place and from year to year.

**c. Predators**

Fall armyworm is general predators that attack many other caterpillars. Among the predators noted as important are various ground beetles (Coleoptera: Carabidae) the striped earwig, Labidura riparia (Pallas) (Dermaptera: Labiduridae); the spined soldier bug, Podisus maculiventris (Hemiptera: Pentatomidae) and the insidious flower bug, Orius insidiosus (Hemiptera: Anthocoridae). Vertebrates such as birds, skunks, and rodents also consume larvae and pupae readily.

**d. Pathogens**

Including viruses, fungi, protozoa, nematodes, and bacterium have been associated with fall armyworm but only a few cause epizootics. Among the most important are the Spodoptera frugiperda nuclear polyhedrosis virus (NPV), and the fungi Entomophaga aulicae, Nomuraea rileyi, and Erynia radicans.

## CONCLUSION

On the basis of the information described in the present article, some points are represented as conclusion as the Integrated Pest management measures has to be followed by the farmers to tackle the new devastating pest on maize & other host crops. As foliar spray of recommended chemical has to be sprayed on crops @ 15-20 days interval will be beneficial to decrease the crop damage & increase yield attributes & quality of crops by minimizing the biotic & abiotic stress. However, more information about these procedures is needed and this topic needs further study and research to be carried out. This topic will help the farmers and research person to carry out detail study over it and take a precautionary measures to avoid the losses.

**Eggs of the fall armyworm (*Spodoptera frugiperda*)**

**Egg mass of the fall armyworm (*Spodoptera frugiperda*)**

**Newly hatched larva of the fall armyworm (*Spodoptera frugiperda*)**

**Mature larva of the fall armyworm (*Spodoptera frugiperda*)**

| | |
|---|---|
|  |  |
| **Typical adult male fall armyworm (*Spodoptera frugiperda*)** | **Typical adult female fall armyworm (*Spodoptera frugiperda*)** |
|  |  |
| **Maize leaf damage caused by the fall armyworm (*Spodoptera frugiperda*)** | **Fifth instar larva of fall armyworm (*Spodoptera frugiperda*) damaging Maize plant** |

# Different Methods of Assessing Semen Quality

**Kennady Vijayalakshmy[1], Meenakshi Virmani[2], Dharmendra Kumar[3], Pradeep Kumar[4] and Habibar Rahman[5*]**

[1]Scientific Officer, International Livestock Research Institute, Pusa, New Delhi
[2]Assistant Professor, Lala LajpatRai University of Veterinary and Animal Sciences, Hisar, Haryana
[3,4]Senior Scientist, Central Institute for Research on Buffaloes, Hisar, Haryana
[5]Regional Representative- South Asia, International Livestock Research Institute, Pusa, New Delhi
*Corresponding Author: R.Habibar@cgiar.org

## INFERTILITY IN MALE ANIMALS

Male infertility is the key-determining factor that has to be primarily taken into consideration with relation to fertilization. Infertility is noticed both in male and female animals, but it is very crucial in case of male animals. Because, the semen collected from an individual male animal is used for Artificial Insemination to a number of female animals. Hence, assessing the fertility status of male animal is of prior importance. There are various ways to examine the semen quality. This includes physical examination, chemical examination, microscopic examination and biological tests.

## PHYSICAL EXAMINATION

Physical parameters of semen vary greatly with individual species. So, species difference has to be taken into consideration. Physical examination indicates the gross characteristics of semen.

**1. Volume of semen:**

Volume of semen is measured by suing a graduated tube or a small cylinder. Individual animal species has got individual difference in semen volume.

**2. Appearance of semen:**

Normal freshly collected semen has a cloudy white color. Intensity of cloudiness is directly correlated with sperm density. If the semen is yellow in color, it's an indication of any infection and the condition can be called as pyospermia. Brown and red color of semen indicates that the semen is mixed with blood, which may be because of any traumatic injuries in male reproductive tract and the condition is termed as hemospermia.

**3. Consistency of semen**, i.e., viscosity of semen:

Viscosity of semen is measured only after liquefaction. A glass rod is dipped into the semen sample and it is raised to measure the length of the semen thread. If the length is more, it indicates that the viscosity is less and vise-versa. High viscosity of semen indicates infection in genital tract especially prostrate and seminal vesicles.

**4. pH of the seminal fluid:**

pH of the semen can be measured by using pH paper, pH meter and indicator dyes. pH is mainly dependent on sperm concentration, semen collection and quality of semen. A drop of semen is spread evenly on pH paper and after 30 seconds; the color of impregnated zone is compared to calibration strip to read the pH.

## CHEMICAL EXAMINATION

Chemical examination includes various tests that utilize various chemicals to analyze the fertilization strategy

**1. Resistance to cold shock:**

This test is done to assess the freezability or preservability and fertilizing ability of the semen of a particular animal. Spermatozoa are subjected to cold stress by exposing the semen to ice. The percentage of live sperm after exposure to cold shock is counted. Examination or counting of live sperm has to be done immediately after collection. One ml of semen is taken in a clean test tube and it is placed on a beaker with crushed ice for 10 minutes. After 10 minutes, determine the live sperm % and sperm motility. Compare the observed values with the previous values and estimate the freezability of the desired semen sample.

**2. Millovanov's resistance test:**

It is the test that is used to assess the resistivity of spermatozoa towards 1% Sodium Chloride solution. The measurement of resistance is denoted as the millitre of 1% Sodium Chloride solution required stopping the progressive motility of spermatozoa in 0.02 ml of semen. Check the progressive motility of sperm before starting the experiment. Then, pipette out around 0.02 ml of semen into a conical flask. Add around 10 ml of 1% Sodium Chloride solution and assess the progressive motility. Likewise, keep on adding 10 ml of 1% NaCl solution and check for progressive motility upon each addition. Addition of NaCl has to be done upon complete ceasing of progressive motility.

**3. Methylene Blue Reduction Test:**

The principle behind this test is that libertation of hydrogen ions during metabolism of sperm will reduce the intense blue coloured methylene blue dye to a colorless leucomethylene blue. The dehydrogenase enzyme is the key determinant behind the release of hydrogen ions. The time taken for color change is directly proportional to the concentration and motility of spermatozoa. If the semen sample is having high degree of motility and concentration, it leads to release of more hydrogen ions. This makes the time required for color change from blue color to colorless at a faster rate. Take a 5ml test tube which is clean, add fresh semen sample of around 0.2 ml and add 0.8 ml of egg yolk citrate diluent. To this, add methylene blue dye of around 0.1 ml and mix the contents.

Place the test tubes in a water bath which is maintained at 46.5 C. Note down the time taken for a change in color from blue color to colorless.

4. **Resazurine reduction test:**

This test is considered as an indicator to assess the metabolic activity of semen. As like methylene blue reduction test, dehydrogenase enzyme activity is the key factor behind this test. The dehydrogenase helps in the liberation of hydrogen ions that makes the blue color of Resazurine to pink color at first and finally to a colorless solution. High quality good semen sample tends to reduce the blue color of Resazurine to pink within a minute and it requires only 4 minute making it to colorless.

5. **Fructolysis index:**

It is defined as the amount of fructose which is utilized by $10^9$ number of spermatozoa in one hour at a temperature of 37 C. The amount of fructose metabolized in the semen sample is directly proportional to the metabolic activity of spermatozoa. The rate of fructose utilization has got direct relationship with the semen quality. Measuring the disappearance of sugars and the lactic acid accumulation by a number of spermatozoa under specific condition and in a specified time is termed as fructolysis. Always, a significant correlation is found between fructolysis and sperm concentration.

6. **Oxygen Utilization Test:**

Active sperms can take-up the maximum volume of oxygen per unit time. Volume of $CO_2$ produced by the spermatozoa per unit of time divided by the volume of $O_2$ consumed in the same unit of time is termed as respiratory quotient ($ZO_2$). The $ZO_2$ value of Bull semen is found to be 21. This test indicates live percentage of spermatozoa and spermatozoa activity.

7. **Pyruvate Utilization Test:**

Semen quality could be graded in relation to the $O_2$ consumption after the addition of pyruvate and pyruvate plus 2:4 dinitrophenol. To reduce the exogenous metabolism to a low level, fluoride is added to the sample. Upon addition of pyruvate, there will be an increase in oxygen consumption in high fertile bull semen and low fertile bull semen. Upon addition of 2:4 dinitrophenol, uptake will be increased up to two folds and there will be no increase in low fertile bulls. Monometric equipment can be used to measure oxygen uptake.

## MICROSCOPIC EXAMINATION

Microscopic examination indicates analyzing the sperm characteristics using microscope

1. **Presence of other cells:**

The following are the materials may be present inside the semen. From the animals, the foreign materials may be dung, pus, urine, hair and dust. Semen can also be contaminated by sand, insects, bedding materials and dried dung, if the animals are not properly cleaned. While using Artificial Vagina, semen can be contaminated with lubricant jelly, dusting powder and water.

2. **Sperm motility (individual motility and mass activity):**

   It is the percentage of spermatozoa that are progressively motile. Sperm which swims forward briskly in a straight line is considered as progressive motile sperm. Mass activity is considered as a collective movement of sperms in a wave like motion. Mass activity is measured by placing a semen drop on a pre-warmed glass slide and place a cover slip over it and it is examined under low power microscope.

3. **Sperm concentration by using a hemocytometer chamber:**

   Semen has to be diluted with a diluent mixed with eosin stain. Aspirate the semen up to the notified mark in a diluting pipette and aspirate the diluting fluid. Clean the tip of diluting pipette and discard the few drops. Charge the haemocytometer by releasing the fluid below the coverslip which is placed over the hemocytometer. Avoid formation of air bubble and wait for 1-2 minutes to settle. Examine the charged hemocytometer under low power of microscope followed by high power microscope. Count the number of sperms in the desired chamber of hemocytometer. Total number of sperms has to be calculated by taking dilution factor into consideration.

4. **Sperm vitality (live and dead sperm %) by using various stains:**

   Place a drop of eosin dye and four drops of Nigrosin stain and add a small drop of semen on a grease free, clean slide. Mix the eosin and semen first and then mix it immediately with Nigrosin. The mixture should be taken on a slide edge and make a smear by pulling it across the top of another slide. Allow it to dry by moving in air. 200 spermatozoa are counted under the oil immersion of microscope in different areas of smear.

5. **Sperm morphology (sperm abnormalities):**

   Place a drop of eosin dye and four drops of Nigrosin stain and add a small drop of semen on grease free, clean slide. Mix the eosin and semen first and then mix it immediately with Nigrosin. The mixture should be taken on a slide edge and make a smear by pulling it across the top of another slide. Allow it to dry by moving in air. 200 spermatozoa are counted under the oil immersion of microscope in different areas of smear. Abnormal structures include bent tails, decapitated head, tail piece broken, mid piece broken and diadem effect. The sperm percentage with normal shape and size is determined. A major abnormality which has to be taken into consideration includes head, middle piece and tail abnormalities.

6. **Sperm membrane integrity by hypo-osmotic swelling test:**

   Integrity of plasma membrane is a key determining factor for maintenance of fertility. Capacitation and acrosome reaction are the essential physiological process which sperm has to achieve to attain fertilization. There is a need for a test which analyse the membrane integrity of spermatozoa. Under normo-osmotic conditions, there won't be any shrinkage and swelling of spermatozoa. Under hypo osmotic conditions, transport of fluid occurs in an intact cell membrane between outside and inside the cell. Bulging or tail bending will occur because of fluid influx. Higher rate of Hypo-osmotic swelling percentage indicates that the semen is having higher fertility rate. Hypo-osmotic swelling is directly proportional to the Freezability of semen.

7. **Acrosome Integrity Test:**

Take grease free, clean and pre-warmed slide and add a drop of diluted semen (1:5 to 1:10 in 2.9 per cent sodium citrate) and air dry the smear. Immerse the slide in 5% formaldehyde for 30 minutes for fixing the smear. Wash the slide in running tap water and air dry the smear. Then immerse the slide in Giemsa solution for about 3 hrs at 37C. Finally wash the slide with running tap water and dry the smear. Examine the slide under oil immersion of phase contrast microscope and count the 200 sperms. Check for the integrity of acrosome and the fresh semen should have 80% of acrosome integrity and frozen semen should have 65%. Hereditary defects like diadem defect and knobbed acrosome should not exceed 5%.

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# Role of Indigenous Technical Knowledge (ITK) in Sustainable Grassroots Innovations

**Pawan Kumar[1] and Vijay Daneva[2]**

[1]Department of Extension Education, CCS Haryana Agricultural University, Hisar (Haryana)
[2]Department of Forestry, CCS Haryana Agricultural University, Hisar (Haryana) -125004
*Corresponding Author: pawanbhukal26@gmail.com

Indigenous Technical Knowledge (ITK) has immense potential for innovation, especially at the grassroots level. India is a country populated by a number of indigenous communities, most of which have their own set of unique traditional knowledge and technology base. Many of these knowledge and technologies are at par with the modern knowledge and technology system and have been provided the indigenous communities with comfort and self-sufficiency. These traditional knowledge and technologies have played a significant role in the overall socio-economic development of the communities.

Indigenous knowledge develops within a particular community and maintains a non-formal means of dissemination. Such knowledge is collectively owned, developed over several generations and subject to adaptation, and imbedded in a community's way of life as means of survival. Within the broad framework of indigenous knowledge, the contribution of Indigenous Technical Knowledge is remarkable. This knowledge plays imperative role in many grassroots innovations. Such knowledge is responsible for improvement in many important rural enterprises such as poultry. Despite the wide recognition of indigenous peoples' contribution to the world's cultural and biological diversity and sustainable development, many challenges still remain in the area of traditional knowledge and technologies.

## CHARACTESTICS OF ITK:-

- Restricted to geographical scale of observation
- Reliance on mainly qualitative information
- Lack of built-in drive to accumulate more and more facts
- Slower speed in accumulation of facts
- More reliance on trials and error, rather than systematic experimentation.
- Limited scope of verification of prediction
- Lack of interest in general principles and theory building

## TRADITIONAL GRAIN STORAGE STRATEGIES:

### Kulumai:-

Kulumai is an indoor grain storage structure. It is an imperative indigenous storage structure for storing various food grains, especially paddy grains (Oryza sativa). It protects the grains from pests and diseases and even from rats and rodents. Paddy grains stored in the structure will have a keeping quality for about 3 yrs without much deterioration in quality. No other modern structure will exhibit same performance. In general, total storage capacity of the kulumai is about 600-700 kg but varies with the size and number of rings.

**Underground Grain Storage Pit:-**

This is a multipurpose and low cost structure for grain storage. The pit is dug beneath the ground usually either in the front yard or backyard of the house, with square, rectangular or circular shape. These pits are mainly used for storing themillets like sorghum, pearl millet, finger millet and other minor millets. Grains are usually stored in these underground pits for about 3-5 months. However, during the rainy season, such pits are not operated.

## TRADITIONAL WATER HARVESTING STRATEGIES:-

**Tanks: -**They were round or rectangular underground rooms that functioned as water tanks. Rainwater from the roof or terrace was directed towards an opening in the floor which led to the tankas.

**Stepwells: -**The stepwells of Gujarat consist of a vertical shaft in the middle from which water is drawn. This shaft is surrounded by corridors, chambers and steps which provide access to the well.

**Kunds or kundies:-**in Western Rajasthan and Gujarat harvest rainwater for drinking in the sandy tracts of the Thar Desert. The saucer-shaped catchment area gently slopes towards the pit in the centre which has a dome-shaped cover, to protect the water. The water inlets are covered with mesh

**Kuis or beris:-**Kuis or beris were deep pits dug near tanks to collect the seepage. They were also used to harvest rainwater in areas with scanty rainfall.

## INDIGENOUS SOIL AND FERTILITY MANAGEMENT TECHNIQUES:-

Soil is perceived as mother to different traditional communities and they found out some traditional management practices to maintain the soil fertility:-

- In rajassthan, a traditional method of controlling wind erosion, known as Kanabandi, is built up local vegetation.
- A traditional soil salanity management system namely jhoor in rajasthan. It invoves cutting of local shrubs and grasses into very small pieces and spreading over farmland before cultivation.
- Saline soils are brought back into production with green manure. Green manures are grown in-situ or green leaf manure is obtained from trees and bushes around the fields.

# Farm mechanization for conservation agriculture

[1]Pawan Kumar and [2]Harender

*[1]Department of Extension Education, [2]Department of Agronomy, CCS Haryana Agricultural University, Hisar (Haryana)- 125004*

**Corresponding Author Email: pawanbhukal26@gmail.com*

Conservation agriculture (CA) technologies involve minimum soil disturbance, permanent soil cover through crop residues or cover crops, and crop rotations for achieving higher productivity. In India, efforts to develop, refine and disseminate conservation-based agricultural technologies have been underway for nearly two decades and made significant progress. Particularly, tremendous efforts have been made on no-till in wheat under a rice-wheat rotation in the Indo-Gangetic plains. The technologies of CA provide opportunities to reduce the cost of production, save water and nutrients, increase yields, increase crop diversification, improve efficient use of resources, and benefit the environment. However, there are still constraints for promotion of CA technologies, such as lack of appropriate seeders especially for small and medium scale farmers, competition of crop residues between CA use and livestock feeding, burning of crop residues, availability of skilled and scientific manpower and overcoming the bias or mindset about tillage Conservation agriculture in India.

## PRINCIPLES OF CONSERVATION AGRICULTURE:-

- **Minimal mechanical soil disturbance: -**

Minimum soil disturbance provides/maintains optimum proportions of respiration gases in the rooting-zone, moderate organic matter oxidation, porosity for water movement, retention and release and limits the re-exposure of weed seeds and their germination.

- **Permanent organic soil cover: -**

A permanent soil cover is important to protect the soil against the deleterious effects of exposure to rain and sun; to provide the micro and macro organisms in the soil with a constant supply of "food"; and alter the microclimate in the soil for optimal growth and development of soil organisms, including plant roots.

- **Diversified crop rotations:-**

The rotation of crops is not only necessary to offer a diverse "diet" to the soil microorganisms, but also for exploring different soil layers for nutrients that have been leached to deeper layers that can be "recycled" by the crops in rotation. Furthermore, a diversity of crops in rotation leads to a diverse soil flora and fauna.

## MACHINERIES USED IN CONSERVATION AGRICULTURE:-

**Precision land leveling:**

In India, land leveling is practiced by farmers traditionally by using plankers drown by either draft animals or small tractors. Laser land leveling is one of the few mechanical inputs in intensively cultivated irrigated farming that meets the three objectives of achieving a better crop stand, saving irrigation water and improving the input use efficiencies. Laser land leveling facilitates uniformity in the placement of seed/seedlings and fertilizer that provides good plant stand, better nutrient use efficiency and higher yield. All these factors lead to about 1% increase in crop yield.

**No till system:**

Rice wheat is the dominant system in the indo-gangetic plains where conventional method of land preparation/sowing not only disturb the soil environment but also leads to atmospheric pollution. It has been demonstrated that CA have positive effects on soil health and environmental quality. This involves sowing with a specially designed zero-till seed-cum-fertilizer drill which has knife type tynes top to make a slit in the soil for planting seed and fertilizer.

Another machine used for CA is zero-till multi-crop planter. It is used for sowing bold grains like maize, groundnut, peas, cotton, sunflower and wheat on a tilled field.

**Bed planting:**

Bed planting technology is the growing of crops on raised beds for conserving inputs like seed, fertilizers, water etc. In India, a common bed planter is zero-till multi crop raised bed planter. The raised beds allow conduction of much of the activities from the ground. This planting method reduces the population of weeds on the top of bed and is ideal for sowing bold grains like maize, groundnut, peas, cotton and sunflower on the two raised bed formed by ridgers.

## CONSTRAINTS IN PROMOTION OF CA:-

- Lack of appropriate seeders especially for small and medium scale farmers.
- Farmers face a scarcity of crop residues due to less biomass production of different crops. There is competition between CA practice and livestock feeding for crop residue. This is a major constraint for promotion of CA under rainfed situations.
- For timely sowing of the next crop and without machinery for sowing under CA systems, farmers prefer to sow the crop in time by burning the residue. This has become a common feature in the rice-wheat system in north India. This creates environmental problems for the region.
- Lack of knowledge about the potential of CA to agriculture leaders, extension agents and farmers.
- There is need of skilled and scientific manpower for CA.

# Genetically modified organisms:
## a blessing or curse to mankind

**Sikha Snehal**

*[1]PhD Scholar, Department of Agricultural Biotechnology and Molecular Biology, Faculty of Basic Sciences and Humanities, Dr. Rajendra Prasad Central Agriculture University, PUSA, Samastipur, Bihar, India-848125.*
*Email id: sikha28snehal@gmail.com*

Genetically modified crops or GM crops are plants that have been genetically modified by the insertion of foreign DNA molecules into traditional crop strains. Scientific advances in the genetic engineering and modification of crops has led to the fear that the technology will harm human health and may have undesired impacts on the environment. So to access the potential ecological impact of field or commercial releases of GM crops in a given region, the likelihood and impact of cross-pollination into the natural environment in a region should be taken into consideration. Genetically modified foods (GMOs) are foods that have benefited from genetic engineering. Many strands of corn, soybeans, cotton and similar crops are frequently planted in US fields every year. According to the US Department of Agriculture, GMOs account for 90% or more of the most common crops that are grown by American farmers. Many believe that GMO foods are perfectly safe to eat and can be grown in greater yields than non-modified crops. There are also many that believe GMOs are unsafe to eat and could be contributing to an increase in common health issues. The benefits and threats related to GMOs are quite complex, so here are the key points to consider.


### WHAT ARE THE BENEFITS RELATED TO GMOS?

**1. Predictability of Food supplies is possible.**

When we are able to predict the crop yields, then it becomes very obvious to predict the food supply at the same time. This predictability provides us the ability to reduce the presence of food deserts around the world, and contributes to a well-rounded nutritional opportunity to a greater population, that may not have existed in the past. Genetically modified foods can also be engineered to grow in specific, sometimes challenging environments. Crops can be created that have a greater resistance to insects. They may be engineered to have a better tolerance to various herbicides that may be used. In return, farmers can typically receive a better crop yield at the end of the growing season, which increases their profits.

**2. Improvement in the nutritional content.**

There is lot more valuable traits that can be added when we take into account genetic modifications than just adding pest resistance or weather resistance to GMO crops. For example, the nutritional content of the crops can be altered, by providing a greater nutritional profile than that which was present in the previous generations. This as a result can help people to gain the same nutrition from lower levels of food consumption in future. It can be used to create stronger colors, eliminate seeds, or have the crop be more tolerant to severe weather changes. Many foods have been genetically modified to improve nutrient content, including calcium and protein. The UN Food and Agricultural Organization notes that genetically modified rice have helped to reduce global vitamin deficiencies as it was able to produce high levels of Vitamin A.

**3. Increasing the shelf life of the crops.**

According to Environmental Nutrition, many of the preservatives that is used to increase the shelf life of the crops are associated with a higher levels of carcinogen and allergens, thus pose a high risk to human health as it may cause heart disease, allergy and other dangerous diseases. So instead of relying on preservatives to maintain food freshness, genetically modified foods make it possible to extend food shelf life by augmenting the natural qualities of the food itself (M. Kramkowska, 2013).

**4. Medical benefits reaped from GMO crops.**

Through a process called "pharming," it is possible to produce certain proteins and vaccines, along with other pharmaceutical goods; this was made possible only by the use of genetic modifications. This practice provides cheaper methods of improving personal health and has the potential to change how a particular medication is provided to the patients in the future. The above importance of GMOs can be explained the following example: imagine being able to eat your dinner to get a tetanus booster instead of receiving a shot in the arm – that's the future of this technology.

**5. It makes the foods more appealing to eat.**

With the help of genetically modified foods the colors can be changed or improved so they turn out to be more pleasing to eat. According to the reports of Spoon University the foods that are brighter in colors changes how the brain perceives what is being eaten. Dark red colors make food seem to be sweeter, even if it is actually not that sweet. Brighter foods are usually associated with better nutrition and enriched flavors.

**5. Transportation of Genetically modified foods is easier.**

The planet currently produces 17% more food than what is required for the existing population levels. The amount of time that is taken for food to arrive in remote areas is large enough to spoil the food before it can be consumed. GMOs increase the lifespan of the food and its durability, allowing them to be shipped to a greater distances with less waste. Because GMO crops have a prolonged shelf life, it is easier to transport them to greater distances. This enhancement makes it possible to take excess food products from one community and deliver it to another that may be experiencing a food shortage. GMO foods give us the opportunity to limit food waste, especially in the developing world, so that hunger can be reduced and potentially eliminated.

**6. Herbicides and pesticides use is reduced.**

Herbicides and pesticides create certain hazards on croplands that can eventually make the soil unusable and toxic. Farmers growing genetically modified foods do not need to use herbicides and pesticides as often as farmers using traditional growing methods, allowing the soil to recover its nutrient base over time. Because of the genetic resistance being in the plant itself, the farmer still achieves a predictable yield at the same time. In a study done by PG Economics it was reported that the pesticide use on GMO cotton from 1996-2011, was 6.1% less in the number of herbicides that had been used as compared to expected value. More than 1.5 kg of herbicide is still used per hectare, however, and this figure is expected to rise to 3.5 kg per hectare by 2025.

## WHAT ARE THE THREATS RELATED TO GMOS?

**1. Health risks associated with GM foods.**

Three major health risks potentially associated with GM foods are: toxicity, allergenicity and genetic hazards. These arise from the potential sources ie. the inserted gene and their expressed proteins. Information from the CDC shows that food allergies in children have increased from 3.4% to 5.1% in the last decade. “Starlink” maize provides an example of a food hazard caused directly by the expression of the inserted gene (B.E. Tabashnik,1994), (D.D. Baulcombe, et al. 2014) . The modified plant was engineered with genetic information from Bacillus thuringinesis in order to endow the plant with resistance to certain insects. The inserted gene encodes a protein, called Cry9c, with pesticidal properties, but with an unintended, strong allergenicity. Several cases have been reported of allergic reaction in consumers after consuming the “Starlink” maize.

**2. GMOs may contribute to antibiotic resistance.**

GMOs are often incorporated with antibiotic-resistant genes in order to strengthen the crops that will grow. Thus, the machinations to genetically modify an organism carries the risk of transferring the genes of antibiotics resistance into the consumer of GM food, resistance may occur against the useful microflora of human and animal gastrointestinal tracts, or to pathogenic bacteria that can cause serious diseases (N. Gilbert,2013) .

**3. Just 6 companies control almost the entire GMO seed market and 70% of the global pesticide market.**

Much of the negative energy which surrounds GMOs tends to involve Monsanto. There are 5 other companies that, along with Monsanto, control nearly all of the GMO seed market. This includes Sungenta, Dow Agrosciences, Bayer, BASF, and DuPont. This means a majority of corn and soybean products are not only profiting the farmer, but they are profiting companies as well. To protect these profits, patents are sought on certain seeds, which have caused legal troubles for some farmers who have had GMO seeds cross-pollinate with their crops, despite not planting GMOs.

**4. Disruption of the food web**

Another issue is the possibility that the insect-resistant plants might increase the number of minor pests while reducing the major type of pest. The scenario here is that the pest population might shift from that put-off by the engineered plants to other, undaunted species. This shift, in turn, might set free a universal disruption of the entire food chain, with new predators of the new insect species, and so on up to the top of the chain (A.S. Bawa, 2013). Or the disruption might work in the other direction, whereby residues of herbicide or insect resistant plants might generate negative effects on organisms (e.g. bacteria, fungi, etc.) found in surrounding soil.

**5. Independent research is not allowed with GMO seeds from half of today's controlling organizations.**

User agreements with half of today's leading GMO seed producers prohibit the use of independent research on the final product. This helps to protect the royalties that the companies earn when farmers are able to harvest a yield through the use of their seeds. Since the seeds are considered company property, even the unintended growing of a GMO crop can result in the need to pay a royalty.

## CONCLUSION

In the benefits and threats related to GMOs, we find that there is just as much disinformation as there are facts. Another concern of GMO crops is the environmental impact that they may cause. They may be able to feed a hungry world, but they may also cause digestive issues in doing so. The question of whether or not humans should eat food from genetically modified organisms – and, therefore, if they should develop and propagate them – is clearly not open to a simple "yes" or "no". Indeed, a wise answer comprehends a diverse array of scientific expertise, not only in files of molecular biology, but also in agricultural economics, animal and microbial ecology and food technology. The immediate advantages are too tangible to ignore or set aside out of fear of the unknown and unintended disadvantages.

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# Extension strategies for enhancing adoption of conservation agriculture among farmers

**Sunil Kumar[1] and Rameti Jangir[2]**

*[1]Department of Extension Education, ICAR-NDRI Karnal*
*[2]Department of Agronomy, NAU Navsari Agriculture University*

**Corresponding Author: jangirsunil90@gmail.com*

One of the more famous results of poor tillage choice is the Dust Bowl of the 1930s in the in the U.S. Great Plains. This resulted from excessive tillage and exposure of soil to wind. The tragic dust storms of that time and place served as a wakeup call about how man's interventions in soil management and ploughing can lead to unsustainable agricultural systems. In the 1930s a person known as father of conservation agriculture i.e. Edward H Faulkner suggest to farmers of USA for the next 75 years, farmers have been adopting conservation tillage practices that reduce tillage and maintain a residue cover on the soil for mitigate this problem of air pollution due to dust . This is known as conservation tillage (CT) and is outlined as follows:
"Conservation tillage is that the collective umbrella term usually given to no-tillage, direct-drilling, minimum-tillage and/or ridge-tillage, to denote that the specific practice has a conservation goal of some nature. Usually, the retention of half-hour surface cowl by residues characterizes the lower limit of classification for conservation-tillage, however alternative conservation objectives for the observe embrace conservation of your time, fuel, earthworms, soil water, soil structure and nutrients. Thus residue levels alone don't adequately describe all conservation tillage practices." (Baker et al. 2002)
To add to the confusion, the term conservation agriculture has recently been introduced by the FAO (Food and Agriculture Organization website) and others and its goals defined by FAO as follows:

"Conservation agriculture (CA) aims to conserve, improve and build additional economical use of natural resources through integrated management of accessible soil, water and biological resources combined with external inputs. It contributes to environmental conservation also on increased and sustained agricultural production. It may be spoken as resource economical or resource effective agriculture." (FAO). Conservation agriculture doesn't simply mean not cultivation the soil and so doing everything else constant. It is a holistic system with interactions among households, crops, and livestock since rotations and residues have many uses within households; the result is a sustainable agriculture system that meets the needs of farmers. The rest of this paper appearance at the varied advantages of CA in terms of the setting and soil health, some equipment needs, and how CA is being adopted in the world. Note that CA can be done on the flat or on raised beds; in both cases the three pillars of CA are followed. The paper won't indicate that system is employed, though alternative papers at this conference can look specifically at bed planting, that is employed to additional improve water-use potency (Sayre and Hobbs 2004).

## FACTOR AFFECTING ADOPTION OF CA

- **Small and fragmented land holding:** About 85 percent of Indian farmer having small and marginal land considering less than 2 hector. Due to high cost of cultivation and equipment they are not able to access them and mostly doing conventional agriculture which is easy and beneficiary for them.
- **Mindset/ attitudinal change:** Some people are rigid to change**.** They are may be highly resources full person but due to their mind-set or negative attitude toward conservational agriculture practices they did not adopt it.
- **Lack of education**: Lack of education about conservational agriculture practices and its benefit also a big factor of not adoption it. Some farmer adopt some practices without their proper knowledge and after that if their crop will failure then his attitude will totally change and he also convinces to other farmer for not adopting that practices. This is only due to lack of knowledge or education.
- **Lack of finances:** Equipment of conservation agriculture practices having high cost so farmer alone cannot afford, especially who are small or marginal farmers.
- **Farmers are ill informed:** Farmer are not having proper information regarding conservational agriculture like, use of equipment, availability, appropriate timr cultural practice etc.
- **Non-availability suitable farm equipment/ Farmers' choice:** At village level availability of equipment which is used in conservational agriculture practices is less in number so during the time of sowing or harvesting it is not easily available. Therefor farmer are not are waiting for equipment and they have harry sowing and go for conventional practices with easily available machinery
- **Lack of skills to operate these machines:** Very less people or person who have the equipment, know only handling their mechanism so people may be dependent on other. Due to not availability of person timely they go for normal agriculture practices.
- **Alternate uses of crop residues:** The principle of conservational agriculture say that minimum 50 percent of land should be covered with crop residual but in village these residual have alternate use like use for animal feed, roof material and sell to other for animal feed and other purpose. So people preferred conventional agriculture rather than conservational agriculture practices**.**
- **CA needs higher management skills:** CA need high level of experiences, management and knowledge. If farmers not have it will be failure, result farmer will not go for further adoption of any new technology easily.

- **Necessary technologies are often unavailable:** Necessary technology like weed management, fertilizers application and residual management in filed is not available so farmer hesitate to adopt it.
- **Farmers are not ready to take risk**: some farmer are thinking that there is risk and they are not able to take it so they are not adopted conservational agriculture.
- **Lack of subsidy on equipment**: Equipment are very costly and subsidy provide by government is very less or not so farmers cannot afford it and adopt conventional practices.
- **Unsuitable govt. polices**
- **Lack of extension services/poor technology delivery system:** Support for any production systems should be oriented towards solving farmers' problems that inhibit productivity. However, when the transformational change occurs with the adoption of CA by farmers who have only known and practiced tillage agriculture, a new challenge is created. Farmers need support to understand new concepts and principles, enable an intellectual change in mind-set, commit to a longer-term process of change in their production system, test and adapt new practices, and change equipment and machinery. So due to non-availability of proper delivery system or extension services, adoption rate of CA is very less.

## EXTENSION STRATEGIES FOR ENHANCES THE ADOPTION OF CA

- Interaction among associations of interested people
- Organize promotional events such as field days, demonstration, training and FFS etc.
- Focus on participatory activities at farmers field
- Capacity building and improving communication with extension agent and farmers
- Strong public private partnership for knowledge sharing on CA
- Long term research platform trails (FLD) & Framers participatory trail
- Including CA in course curriculum at UG, PG or PhD levels to increase knowledge of students about CA
- R&D on CA to develop technologies by involving all partners (Farmer-scientist-stakeholders)
- Farmer- to-farmers knowledge sharing (make a local leader among villagers who convinces to all for adoption CA)
- Help of farmers by providing information when they needed
- Review of farmers experiences with CA- which components adopted or not adopted and why
- Farmers exchange visit (Visit of farmer on nearby field or state where good conservational agriculture practices is adopted and having great success. It will provide motivation to other farmers.
- Publish success stories of farmers for motivating other farmers
- Farmers perception and expectations through focus group discussion
- Provide credit to farmers to buy the equipment, machinery, and inputs through banks and credit agencies at reasonable interest rates
- Provide subsidy on the costly implements

- Integration of conservation agriculture with state and central govt. sachems like NFSM, RKVY, ADF etc.
- Setup cluster of input and implements suppler unit at field level (cluster basis in village) for providing implements to farmers on ruminative price or on rant.

# Custard apple farmers and scientist interactions


**[*1]Sable P. A., [2]Sheikh A. S. and [3]Lipane R. R.**

*[1]Scientist, Horticulture, [2]Sr. Scientist and Head, KVK (S.K.) Sardarkrushinagar Dantiwada Agricultural University, S. K. Nagar, Gujarat*
*[3]Assistant Professor (Plant Botany) College of Agriculture, Sonai, Maharashtra*
**Corresponding Author: sable.pating@gmail.com*


Custard apple (*Annona squamosa*) is most widely grown species of *Annona* and a native of tropical America and West Indies. Custard apple is known as Sugar apple or sweetsop. Total fruit crops production of the India is 92918 thousand tons from total an area 6373 thousand hectare. In India, Custard apple is grown in about 44 '000' hectare area with an annual production of 367'000' tons. (Horticultural Statistics at a Glance 2017).

### Custard apple farming and Planting

Custard apple flourishes best in dry and hot climate. It requires light soil and is generally grown on the slope of hills. The plants are raised from seeds and bear fruit in 3 to 4 years whereas, grafted Custard apple planting material that are capable of producing commercial yield from second year of planting. The plant flowers from April to May and bears fruit between August and November. Custard apple planting is done during rainy season. The pits of 60 x 60 x 60 cm at spacing 4 x 4 m, 5 x 5 m or 6 x 6 m depending on soil type are dug prior to monsoon and field with top soil, sand and a good quality organic manure in 3:1:1 or 2:1:1 ratio. FYM (10 Kg.), single super phosphate (250 g.) and neem cake (1 Kg.) used with drip irrigation system at planting 5 x 5 m has given good growth and better fruit setting.

### Nutrition

The nutritional requirement of matured Custard apple plant varies with the region, soil type and age. A dose of 30 to 40 Kg. well decomposed organic manure, 271.5 g. Urea (125 g. N), 781 g. Single super phosphate (125 g. P) and 208 g. Murate of potash (125 g. K.) to be applied per plant during monsoon season. Fertilizers are applied in basins by ring or at drip at a depth 15 to 20 cm. Area around the active root zone is at 30 cm from the trunk at a depth 30 cm. Split dose of Urea @ 271.5 g. (125 g. N) per plant to be applied in September to October. Twenty five gram each of Azospirillum and PSB may be applied per plant through 100 to 150 g. of FYM. (Directorate of Extension Education, MPKV, Rahuri- *Krushidarshani*, 2018).

**Important hints for economical Custard apple farming**

The farmers are advised to adopt single stem training system to graft or seedlings plants. A little pruning is required to develop a good crown by timely removal of misplaced limbs to built strong framework. It results into better yields over long period of time.

A flowering taken place on current seasons growth and occasionally on old wood, Custard apple require little pruning in second fortnight of February after leaf defoliation followed by fertilizer application and irrigation. Farmers are advised to adopt drip irrigation to obtain higher yield.

Mealy bug is severe pest in the Custard apple, to control it biologically *Verticillium lecani* @ 2 g. /liter of water to be sprayed. It can be controlled by *Verticillium lecani* @ 1 g. with triazophos @ 1 to 2 ml. /liter of water. (JAU, Junagadh).

**Mealy bug attack in Custard apple**

**NMK-1 (Golden) Custard apple variety**

Custard apple Farmers and Scientist interraection of North Gujarat, Sabarkantha region under juridiction of KVK, S.K., SDAU, Gujarat.

Custard apple Farmers and Scientist interraection of North Gujarat, Sabarkantha region under juridiction of KVK, S.K., SDAU, Gujarat.

# Summer/Rabi Onion farming

[1]Sable P. A., [2]Lipane R. R. and [3]Sheikh A. S.

[1]Scientist, Horticulture, [3]Sr. Scientist and Head, KVK (S.K.), Sardarkrushinagar Dantiwada Agricultural University, S. K. Nagar
[2]Assistant Professor, Plant Botany, College of Agriculture, Sonai, Maharashtra
*Corresponding Author: sable.pating@gmail.com

Onion (*Allium cepa*) is one of the second most important commercial crops of the India which is next to Potato. In the world, Onion crop is grown in about 5.30 million hectare area with an annual production of 88.48 million tons with productivity 16.70 tons per hectare. China stands first in the Onion production (22.61 million tons from an area 1.03 million hectares area) in the world with productivity 21.85 tones per hectare followed by India. In India, Onion crop is grown in about 1.20 million hectare area with an annual production of 19.40 million tons with productivity 16.12 tons per hectare**.** The quantity of Onion 2415.75 thousand tons is exported from India which outputs value of 3, 10,650.09 Rs. lakhs. (Anon, 2017).

**Summer /rabi Onion farming**

Summer/ *rabi* Onion is more commonly practiced for an irrigated crop, resulting in a high yield with large sized bulbs. Seedlings are first raised in the nursery. For summer/ *rabi* crop in India October to November is recomonded as sowing time. In Maharashtra it is transplanted during November to December. (Anon, 2018).

About 10 to 12 Kg. seed is required to raise seedlings for one hectare transplanting. The seedlings are ready for transplanting 45-60 days after sowing. Over-aged seedlings result in bolting, taking longer time to start new growth. The spacing 15 x 10 cm. (row to plant) is recomonded for optimum population and higher yield.

**Nutrition**

Onion needs a heavy dose of fertilizers for good yield. However, fertilizer a requirement is depends upon soil type and varieties etc. Completely decomposed organic manure @ 25 to 30 tons per hectare may be incorporated into the soil 15 days before transplanting. For one hectare, 108 Kg. Urea, 312 Kg. Single super phosphate and 83 Kg. Murate of potash to be applied at transplanting and again 108 Kg. Urea to be added equally into two splits at 30 and 45 days after transplanting. Forty five days after planting, no any N containing fertilizers should be applied. Sulphur @ 45 Kg. in the form of Gypsum to be added per hectare into the soil 15 days before transplanting. (Anon, 2018).

**Weed management**

As Onion plants are closely spaced and roots are shallow, it is essential to keep the crop weed free, especially 30 to 45 days from translating. Crop weed competition is recorded to higher from transplanting till almost 45 days, it may reduce yield up to 60 percents. Therefore, Oxifluorfen (24 % EC.) 1 to 1.25 ml. per liter of water (before 2 days of transplanting or within one week after transplanting) followed by one hand weeding at 30 to 45 days after transplanting is recomonded for effective weed control. (Sable *et al*., 2014).

**Plant protection**

Onion thrips (*Thrips tabaci*) is most destructive pests and Blight is severe disease of Onion. Spray fipronil 1.5 ml. with 1 ml. sticker per liter of water for effective control of thrips. Spray of Mencozeb 2.5 g. per liter of water is found to effective to control Onion Blight or Dithane M-45 @ 3 g. per liter of water is also found effective. These fungicides should be sprayed with 1 ml. sticker per liter of water, alternatively at 10 to 15 days intervals. (Anon, 2018) and Krushi Salla, *Agrowone* news paper, 1 March, 2018 of Maharashtra.

*Dr. Sable, P. A. (Scientist), Dr. Hari More (Ex. Dir. Ext. Edu., MPKV, Rahuri) Proff. Rajendra Lipane are with Onion growers in the field of Ahmednagar region of Maharashtra.*

*Dr. Sable, P. A. (Scientist), Dr. Hari More (Ex. Dir. Ext. Edu., MPKV, Rahuri) Proff. Rajendra Lipane are with Onion growers in the field of Ahmednagar region of Maharashtra.*

*General view of Onion crop field stand of Ahmednagar region of Maharashtar*

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# Sustainable dairy farming in India

***Suchit Kumar[1], Sunil Kumar[2]**

*[1]Animal Genetics & Breeding, Division, NDRI, Karnal-132001*
*[2]Animal Physiology Division, NDRI, Karnal-132001*
**Corresponding auther-suchitkumar636@gmail.com*

Livestock production is the vital sector which action a major source of income to the underprivileged rural households throughout the India. Dairying has become an important source of income for millions of rural families and providing employment and income opportunities for women and marginal farmers. It is the major livelihood sources for rural India and it contribute significantly to the country's agricultural economy. The major agricultural economy is contributed by livestock sector, comprises of milk and milk products, and plays major role in gross domestic product (GDP). It contributes approximately 4 to 5% to overall GDP. India is a rich reservoir of genetic diversity in cattle with 40 recognized cattle breeds. The total number of cattle population was 190.9 million (37.28% of total livestock population) out of which indigenous cattle population comprised of 151.17 million where as buffaloes population 108 million (19th Livestock Census, 2012). The per capita availability of milk in India has increased from 176 grams per day in 1990-91 to 322 grams per day by 2014-15. It is more than the world average of 294 grams per day during 2013. The annual milk production reached to 155.5 million tonnes with cattle contributing 72.85 million tonnes (47%) and rest produces by buffaloes. It is projected to increase production to 192 million tonnes up to 2020, hence there is a need to increase productivity (Economic survey 2015-2016). The dairy industry is still predominantly unorganized and faces many problems with only 20-25% of milk production being routed through the organized channel. India is one among the fastest growing economics of the world and mainly depends on the agrarian sector as a tool for progress. Sustainable dairy farming is an interaction of many factors that influence production and reproduction environment and input management.

## PROBLEMS CONFRONTING SUSTAINABLE DAIRY PRODUCTION:

There is wide variation in

1. Agro-climatic condition,
2. Biodiversity and ecology
3. Socio economic and cultural background of people,
4. Types/breeds of dairy cattle reared.

It is therefore necessary to plan for dairy development Sustainability of Indian Dairy Farming System specific to each level

## DIFFERENT STEP INVOLVES IN SUSTAINABILITY DAIRY FARMING

Sustainable dairy farming are crucial to ensure the profitability of dairy farmers by ensuring lower cost of milk production and quality and clean milk to the end consumers.

### A) Feed and Fodder Management:

Feed and fodder of livestock constitutes approximately 60% to 70% of the operating expenses are critical components for ensuring good milk yield. With shrinking of land for cultivation of feed and fodder day by day and natural resources availability maintenance of good quality feed and fodder is increasingly becoming a challenge. Maximum use of crop residues and leguminous forages, promotion of balanced feed rations formulation, integrated watershed management development and training and encouraging farmers for silage preparation are the measures to optimize feed and fodder production.

### B) Breeding and Health Care Management:

Record keeping and progeny testing is the key element for improving herd quality. It can be achieve by creating awareness among the dairy farmers and providing technical skills. It can be addressed through expansion of artificial insemination (AI) network and extension services provided by research institutions and private sector. Breeding policy using superior quality, disease free germplasm helps in improving the income of farmers. Timely identification of diseases and knowledge about preventive measures will help in minimizing the cost of production which will further improve productivity and quality of milk.

### C) Impact of Climate Change on Sustainability:

The annual milk loss occur due to heat stress in cattle and buffalo in India is about 1.8–2.0 million tonnes. This can be overcome by animal selection and breeding, cattle nutrition, manure and effluent handling which also helps in reduction in greenhouse gases (GHG) emissions through cost effective and scalable interventions. Effective management of nitrogen in dairy farms and precise feeding as per the nutrient requirements of animal will maximize production and minimize greenhouse gas (GHG) emissions. Feeding a nutritionally balanced ration with the available feed resources could be a practical approach for mitigating GHG emissions for large ruminants in India.

### D) Extension Services and Skill Development:

Augmenting knowledge and skill among dairy farmer is essential to enhance resource productivity, boost innovation, manage finance, mitigate risks and improve decision making ability which will enable sustainable dairy farming. Private sector participation in extension services needs to be aligned with the public schemes and market led practices are to be encouraged to increase resilience in the smallholder dairy farming ecosystem.

**E) Access to Finance:**

Dairy sector play important role in rural employment and revenue generation. Animal husbandry and dairying is concerned with the state government, and major proportion of their development comes from it. The central government contributes about 10% to the total investment through central and centrally-sponsored schemes as to supplement state governments' resources. Financial institutions need to design innovative and tailor made suite of financial products including systems to immediately credit milk payment in farmers' accounts. This would pave the way for financial literacy of the farmers and reduce their dependence on moneylenders for credit requirements.

**F) Information Technology:**

Information technology is an important tool which can helpful for efficient management of small scale dairy farms in India. It is important to invest in the information systems to make strategic decisions on optimization of dairy supply chain and costs involved. It can also be used for real time monitoring of transactions for efficiently managing the payment cycle of farmers. Small holder famers do not have direct access to basic financial services including insurance. IT can play pivotal role in bringing a large chunk of small holder farmers under the ambit of financial services. Each of the farmers may be assigned a single account where all the transactions pertaining to payments, financial services, insurance etc. can be monitored through a single platform. This will also enable the government to keep a track of the small scale farmers in order to pass on the benefits of several important schemes run by it.

## Enhancing Sustainability By Innovative Farming Models

From the past decade, there have been initiatives in the direction of establishing large scale dairy farming with more than 1000 animals by private sector to achieve better product quality, and increase productivity with lower cost of production. But most of the investor is able to achieve limited success due to high operating costs, low productivity, large investment and lack of adequate knowledge to manage large scale farms. Due to current diversity in nature of farming systems, prevailing infrastructure, farmer capacities, socio-cultural realities and climatic patterns, dairy farmers faces lot limitation. To sort out these limitations some of the key innovative models emerging in dairy farming are listed below.

## Integrated dairy farms

Large scale integrated dairy farms consists of high yielding cross bred dairy animals as well as milk processing and storage facilities along with feed production systems. In these farms, ownership and responsibility for the operation and maintenance lies with a private player. In these system farm owner may make tie up with the farmers for supply of green fodder, a major input for enhancing milk yield of dairy animals. In India most of the farm owner faces the problem of continuous supply green feed and fodder round the year. In this integrated farming the milk is either sold to other dairies or used for processing into value added milk products at its own plant. The significant benefit of this model is efficiency in scale of operations, end to end product traceability and high level of product and process control.

### Enlightened dairy farming model

Middle size dairy farms with 300-500 dairy animals may employ to have comparative advantage of size economics in the business through efficient management of labour, veterinary services and feed etc. This is an entrepreneurship model in which there is without incurring substantial capital expenditure; benefits can be assured from a consistent and good quality supply of milk. In this system technical support, veterinary care, feed management, training and financial support provided by private sector to the farms. Government also provides support to small farmers by giving subsidies for purchase of animals and also by way of administration of breeding programs. This model also has many constrained of limited capital investment capacity of farmers however this can be an excellent partnership between farmers and processors if limitation of capital investment is sort out.

### Community dairy farms

This model envisages investment in farm infrastructure by a private player with ownership of the stall lying with the individual milk producers, who are responsible for housing of cows and managing them under guidance of the private player. The milk is purchased under the buy-back arrangement by the private player. This model enables the smallest of the dairy farmers to avail the benefits of technology, scale and systems.

### Hub and spoke model

Hub and spoke model of dairy farming includes the main farm i.e. hub having all the integrated facilities including processing and other basic infrastructure for milking and feeding. The connected/satellite farms (spokes), with 50 to 200 dairy animals each, have basic infrastructure for milking and animal management system and are owned by progressive dairy farmers/rural entrepreneurs in close proximity to the main farm. The main farm provides technical support veterinary care, feed management, training to the satellite farms. This model offers the benefits of end-to-end product and reasonable level of product and process control, with significantly lesser capital expenditure. Essential elements of this model are the control systems that ensure that farm management administration maintain milk quality to the set standards. In comparison to Single Location Large Scale model, in this farm is distributed over multiple locations.

### Industry supported farming model

In this model various private stakeholder provide financial support through tie-ups and technical assistance to farmers for scaling up of their herd size along with extension activities related to farm management, modern breeding techniques and feed management.

## CONCLUSION

Suitable policies sustainable dairy development at farm level should be developed by the government keeping in view the ensuring socio-economic dynamics and the existing competitive resource advantages. The key strengths of Indian dairying lies in maintaining its milk production growth at rate to meet its domestic needs but with demand rising at a faster pace as economic development takes place it will have to look into better ways to meet its domestic needs. The challenges of small holder dairy farmers and considerable gains in productivity can be reaped through improved management by linking production system to consumer demand. Concerted efforts in the areas of feed and nutrition management, improved breeding and health care systems, financial inclusion, dedicated extension services and procurement infrastructure development with ICT support is required. One of the major constraints is the feed prices which are quite high relative to the milk prices. This gap has to be minimized by making suitable policies for dairy farmer interest. There is great opportunity to exploit the world markets provided India is able to take care of its constraints and strengthen its value chain to deliver quality milk.

# Forcing of Some Important Ornamental Bulbous Crop

**Tara Bhuyan*, Pranamika Sharma, Rimi Deuri, Anil Kumar Jena and Toyir Nyori**

*Assistant professor, Agriculture, Faculty of Agricultural sciences, Arunachal University of Studies, Namsai, Arunachal Pradesh, India*

** Corresponding author: bhuyantara@gmail.com*

**ABSTRACT**

Forcing is the process of hastening a plant to maturity, or of growing it to the flowering stage out of its normal season. Bulbs require warm-cold-warm temperature for completing its development cycle. When storage, transit and forcing conditions are not properly chosen, physiological disorders may occur. The pre – planting treatment of gladiolus bulbs with $GA_3$ (125ppm), Benzyl Adenine (150ppm) or NAA (150ppm) reduces the days to sprouting and increase the percentage of sprouting (Kumar *et al.,* 2009). When tuberose bulbs are pre-treated with 5°C for 3 months and subsequent temperature treatment of 20°C for 6 weeks it resulted in early sprouting and flowering (Watako and Ngamau, 2013). Durso and De Hertogh (1977) found that dahlia cv. Dark Princess produced early and best quality flower at 25°C day temperature and 16°C night temperature. Faneli and De Hertogh (2002) reported that when *Lilium* cv. Neillie White when pre-cooled at 7°C for 7 weeks produced early flowering and dwarf plant. Imanishi, (2007) found that bulbs pretreated with high temperature and ethylene showed higher flowering percentage and earlier flowering when subjected to pre-cooling without storage at 34°C. De Hertogh (1974 ) found that when hyacinth bulbs first exposed to 34°C for 5 days followed by subsequent temperature 25.5°C and then temperature of 17°C for 3 weeks resulted in early flowering .

## INTRODUCTION

A bulb is a modified underground organ. “Flower bulb” refers to all taxa of ornamental flowering “bulbs” having true bulbs, corms, tubers, rhizomes, tuberous roots as underground storage organs and are known as geophytes (De Hertogh and Le Nard, 1993). In Horticulture the plants which are propagated through modified under-ground stems are called as ‘Bulbous plants’

Forcing is the process of hastening a plant to maturity, or of growing it to the flowering stage out of its normal season. The use of artificial growth conditions for the flowering of bulbs, to simulate those required by nature, is called “forcing” (Le Nard and De Hertogh , 1993). Forcing is done to get off season production and specific date production (Christmas, New Year, Mother’s Day etc.). To precise technology for bulb forcing depends upon climatic conditions prevailing during transport , which influence the physiological and morphological development of the bulb. Forcing helps in avoiding danger of epidermis as in-season production of cut flowers are subjected to a number of insect –pest attacks and disease epidemics due to the presence of favorable climatic conditions for their growth. It is important in the sense of distributing employment and farmers income. It is the florist custom to import cut flowers from abroad to satisfy the demand of the customers during certain time of the year at a higher rate. Off- season cut flowers, help to reduce the imports and balance the trade.

## FACTORS AFFECTING FORCING

**Temperature**- Temperature plays an very important role in forcing. Temperature uis particularly effective in flower initiation of bulbs and flowering. Low temperature storage of bulb breaks dormancy resulting in early sprouting. Dormancy can be broken by storing corms at 4°C to 5°C for 3-4 months( Arora et al., 2002). Hartsmen (1961) reported that the optimum temperature range for Lilium is 13°C to 23°C, showing best result from 15°C to 17°C. Storing bulbs at low temperature (4°C ) increases the cytokinin activity in the bulbs (Rakhimbaev et al., 1978).

**Photoperiod** - This is a cycle of day length within a 24hr period. Flowering of a plant in response to photoperiod is known as photoperiodism. Plants can be classified as a short-day, long - day and day neutral plant. A short-day plant is the one in which flowering takes place when the day length is shorter than a critical value , while a long-day plant is the one in which flowering takes place when the day length is longer than a critical value. In tulip, stem length at anthesis was shortest in short day ( 8 hours) compared with 12-16 hours day. Smith and Langhans (1962) found that with increasing day length from 8 hours to 18 hours , plant height increased but number of flowers decreased.

**Moisture** – Bulbs should be always handled under moist conditions prevent desiccation. The freshly harvested bulbs are packed in shipping cases in peat moss and directly pre-cooled for 6weeks.

## PROCESS OF FORCING

1. **Chemical flower forcing** - In this, different types of chemical are used:

Growth regulators: Dormancy can be overcome by storing bulbs at low temperature, using ethylene and $GA_3$. Cold storage and treatment with 6-benzyladenine promote germination in gladiolus corrnels ( Ginzburg, 1973).

Growth retardants: The application of ancymidol and cycocel inhibit the stem elongation resulting in stunted growth.

Other chemicals: The application of thiourea and potassium nitrate resulted in early flowering.

2. **Mechanical flower forcing:**

Low temperature storage: Dormancy of gladiolus corm is broken by storing corm at 4-5°C for 3-4 months. Under low temperature storage starch content declines with increasing in reducing sugars, sucrose and fructosyl sucrose. The hydrolyzing enzymes such as α-amylase and phosphorylase are involved in this process.

Pinching and disbudding: Pinching involves removal of the terminal bud to promote lateral shoots and produce more flowers. Disbudding refers to the removal of auxillary buds to increase flower size. This to operation are important in dahlia forcing.

## TYPES OF FORCING

**Forcing In Soil :**

Begin in October by potting the bulbs in clean, sterile plastic pots. Do not bury the bulbs. The "noses" (where the leaves come out) should be exposed. High quality potting soil is acceptable or mix equal parts potting soil, coir fiber and perlite or vermiculite for best results. Plant the bulbs close together in the pot. The flat side of the tulip bulb should be placed next to the rim of the pot since the largest leaf will always emerge and grow on that side, producing a more attractive looking pot. When planting, the pot should be loosely filled with soil. Don't press the bulbs into the soil. Allow 1/4-inch of space at the top of the pot so it can be watered easily. The bulbs should be watered immediately upon planting.

Example - Tulip ( 6 bulbs) , Daffodils (6 bulbs), Hyacinth (3 bulbs) in 12-15cm depth pots.

**Forcing in water:**

The bulb is placed in the upper portion, water in the lower portion. The vase is then kept in a cool, dark room (preferably under 50 degrees F) for four to eight weeks until the root system has developed and the top elongates. At this point it should be placed in a bright window, where the plant soon will blossom. Example – Hyacinth and Daffodil **.**

## PHASES OF FORCING SYSTEM

1. **Production phase**- It involves the production of high quality bulbs which is suitable for forcing or outdoor flower production.
2. **Programming phase** – It includes the procedure adopted from harvesting till it is planted in the greenhouse. It is the most important phase in bulbous ornamental crops.
3. **Greenhouse phase**- it involves planting the bulb in the greenhouse till it is marketed as cut flowers or potted plants.

## SEVEN STAGES OF DEVELOPMENT OF BULB (ORGANOGENESIS)

- Formation of one or more foliage ( Stage I)
- All foliage formed ( Stage II)
- Formation of outer whorl of perianth (Stage P1)
- Formation of inner whorl of flower perianth (Stage P2)
- Formation of outer whorls of androecia (Stage A1)
- Formation on inner whorls of androecia ( Stage A2)
- Formation of pistil ( Stage G)
- **ORNAMENTAL BULBOUS CROP**
- **GLADIOLUS :** Gladiolus prefer long day photoperiod and perform well under 10-28° C day temperature and 16°C night temperature .Dormancy of gladiolus corm is broken by storing corm at 4-5°C for 3-4 months. Gladiolus initiates floral buds at 2-3 leaf stage and continues to 5-7 leaf stage. So, low temperature will prolong ( 2- 5°C) reduces flower percentage (Arora *et al.,* 2002) .

## DEVELOPMENT CYCLE OF BULBS

Bulbs requires a warm-cold –warm temperature developmental sequences

| Bulb | Initial Warm Temperature (°C) | Low Temperature (°C) | Final Warm Temperature (°C) |
|---|---|---|---|
| Tulip | 17-34 | 1-9 | 13-18 |
| Lilium | 20-24 | 2-6 | 16-18 |
| Hyacinth | 25.5 | 7-9 | 17-23 |
| Dutch Iris | 17-21 | 8-11 | 15-18 |
| Gladiolus | 23-28 | 4-5 | 16-18 |
| Daffodil | 27-34 | 9 | 14-16 |

**Forcing of Corms**

**Early flowering**: In cool climate : Preheating corms before planting for two weeks at 27-32$^{o}$C. In warm climate: Soaking corms in $GA_3$ solution (10 - 25 ppm) before planting will accelerate flower by hastening differentiation of flower primordia.

**Late flowering**: To get late flowering, gladiolus corms are exposed to low temperature range (12-15°C) for about 5- 6 weeks.

**LILIUM:** The bulbs of most cultivars of *Lilium longiforum* are forced as potted plants in U.S.A. and Canada especially for ' Easter' and are called as ' Easter Lily'.

**Forcing System:**

**Programming system:**

Since Easter lily marketed during the occasion of ' Easter', precision programming of the crop is of immense importance to produce marketable blooms at this occasion. Bulbs are harvested 6-8weeks after flowering. The bulbs are handled under moist condition to prevent desiccation. Temperature for pre-cooling varies with the cultivar i.e. 2-5°C to 5-7°C. For forcing, it can be delayed and bulbs should be held at 16°C.

**Late flowering**: To delay flowering, pre-cooling can be delayed and bulbs should be held at 16°C till they are cooled.

**Early flowering:** forcing method in programming phase .

**1. Natural Cooling :** After shipping, bulbs are planted and placed in unheated greenhouse or outdoors, they must receive 6 weeks of pre-cooling . The pots are placed in greenhouse around Christmas for forcing.

**2.Controlled Temperature Forcing** : The bulbs are shifted to forcer at October, potted immediately at 17°C for 3-4 weeks for rooting and sprouting and then cooled at 2-5°C for 6 weeks.

**Greenhouse phase :** It has been divided into 3 stages i.e. initiation, development and flower opening.

- Stage I : Apical meristem is transformed into reproductive stage and controlled by initial greenhouse temperature
- Stage II : Determines number of flower to be developed on the plant, temperature above or below 16-18°C decrease the number of flowers .

- Stage III : Duration from visibility of first flower to opening of first flower. It requires about 35 days at 17- 18°C to complete flowering . To delay flowering, the potted plants could be store at 5-10°C when the buds are well developed but unopened.

**DAHLIA :**Dahlia forcing is done for potted plants. It requires a high light intensity and 10-14 hours of natural day length. They respond to both temperature and day length. By optmising temperature conditions, light intensity and using pinching and disbudding techniques dahlia can be forced in the greenhouse.

**Forcing in greenhouse:**

Dahlia cv. Dark Princess, forced at 15cm depth in pots, under day temperature 22-25 °C and night temperature 15-18°C and found the early and best quality flowers where obtained under day temperature 25°C and night temperature 16°C (Durso and De Hertogh, 1977).

**TULIP :** Tulips are mainly forced for potted plants in the U.S.A and also for cut flower in the Western Europe, to get flowering from Christmas to Easter. In India, tulip is grown in temperate regions under greenhouse and outdoor conditions for cut flowers.

**Forcing –** Two types of forcing are followed in tulip viz. standard forcing and direct forcing. In-case of standard forcing both programming and greenhouse phase is followed, whereas, in direct forcing pre-cooled or un-rooted bulbs are directly planted in the greenhouse for rooting and flower development. Since, in direct forcing rooting occurs in greenhouse phase it is not suitable for potted plants.

**Standard Forcing:**

**Early flowering:** The bulbs are stored at 17-20°C for 1-2 weeks. The bulbs are than exposed to cold treatment of 9 °C for 13-20 weeks in trays or water for scape elongation and are well rooted. After that they are brought to greenhouse at 16-17°C and flowering obtained from December.

**Late flowering :** The bulbs are kept at -1.5°C for 6 -7 months and then exposed to moderate temperature of 17-20°C. The bulbs are then exposed to cold treatment of 9°C for 3-6 weeks on trays or water and are well rooted. After that they are brought to greenhouse at 16-17°C and flowering obtained during summer.

**Direct Forcing:**

The pre-cooled or un-rooted bulbs are planted directly in the greenhouse for rooting and flower development. The bulbs are than exposed to warm temperature 17-20 considered best for bringing bulbs at stage G (Rees, 1972).

**HYACINTH :**The bulbs of hyacinths grown around the world are produced in Holland . Hyacinths are forced for flowering from late December to late April for sales from Christmas through Easter. The hyaicnths are forced for early and late forcing (De Hertogh, 1974).

**Early Flowering :**

**Programming phase:** The bulbs should be first exposed to 34°C for 5 days. Floral development than occurs at 25.5°C which is optimum for cell division. As the uppermost floret has reached $P_2$ stage, the bulbs should be placed at 17°C for 3 weeks (De Hertogh, 1974).

**Greenhouse phase:** Hyacinths can be forced in greenhouse at 23°C. But, most growers use 16-18 °C, which is more economical.

**Late flowering:** The bulbs are first exposed to 20°C for 10 days immediately after harvest and then at 25.5 °C for floral development. Thereafter, the bulbs are planted in pots at 9- 13°C for development of roots and mobilization of flower stalk and leaves. Hyacinths requires approximately 10-13 weeks of cold treatment (De Hertogh, 1974).

**DAFFODIL :** Daffodil bulbs are used for forcing in North America and Western Europe, for cut flowers and also for potted plants. In India, it is grown outdoors for bedding and cut flowers production both under temperate and sub-tropical climates. The daffodil are forced to get flowering by Christmas.

**Programming phase :** For inducing early flowering, the bulbs should be exposed to 34 °C for 1 week. The bulbs are then held at 13°C till shipping or pre-cooled. For pre-cooling bulbs are stored at 9°C for 15 weeks. In case the flowering is to be delayed , the temperature in the rooting room is decrease to 5 °C and then to 1-2 °C in the dark room.

**Greenhouse phase:** The rooted bulbs are forced at 13-15 °C and high light intensity. Temperature above 17 °C produced shorter stems and used to produce dwarf potted plants (De Hertogh,1974) . Exposing bulbs to smoke and ethylene during storage gives higher and early flowering (Imanishi, 1997)

## CONCLUSION

Forcing is the process of hastening a plant to maturity, or of growing it to the flowering stage out of its normal season. It helps in off- season production of flowers with higher income. Bulbs requires a warm- cold- warm temperature sequences for completing its life cycle. But, for forcing proper temperature , photoperiod should be followed. When storage, transit and forcing conditions are not properly chosen, physiological disorders may occur.

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# Development of Industrial Agroforestry in India

Ravindra Kumar Dhaka[1], S. K. Jha[2*] and Chintankumar Chaudhari[3]

[1]Ph. D. Research Scholar, [2]Associate Professor, [3]M.Sc. Forestry
[1,2,3]Department of Forest Biology and Tree Improvement, College of Forestry, ACHF, Navsari Agricultural University, Navsari, Gujarat – 396 450 India
*Corresponding Author: sumanfort@gmail.com

Growing trees in combination with agricultural crops and/or animals has been practiced by farmers for thousands of years. Nowadays, farmers are more concerned about more economic gain on the same unit land and minimize the agricultural crop failure loss in abrupt climate change. Agroforestry is rapidly evolving as an applied science involving more applications of novel ideas. For making agroforestry more profitable and easy to adopt, the Government of India formulated National Agroforestry Policy (2014) which has made India a first country worldwide to take such positive initiative for promoting agroforestry. Rising of trees on farm lands for industrial use is known as **Industrial Agroforestry**. In the era of rapidly growing wood based industry and widening gap in demand and supply of raw material, industrial agroforestry will be proved as profitable and ecological friendly venture for increasing farmer income.

### Major Wood Based Industries in India

Wood based industries has grown at very rapid rate in last two decades. The major wood based industries in India are: ***1. Paper and Paper Board Industry, 2. Newsprint Industry, 3. Construction Industry, 4. Furniture Industry, 5. Packaging Industry, 6. Rayon Grade Pulp Industry, 7. Automobile Industry, 8. Agricultural implement Industry, 9.Railway Sleeper Industry, 10. Sports Good Industry, 11. Handicraft Industry, 12. Plywood Industry, 13. Veneer Industry, 14. Particle Board Industry, 15. MDF Board Industry 16. Match Box Industry, 17. Mining Industry, 18. Catamaram Industry, 19. Pencil Industry and 20. Miscellaneous Industry.***

### Wood Demand for Major Wood Based Industries

The total industrial wood demand for the year 2020 has been projected to 153 million $m^3$ in India (FAO 2009). From 2000 to 2020, the average annual rate of growth of demand for wood is projected to be 5.49% (Table 1.).

**Table 1. Growth pattern of future demand of wood**

| Year | Demand (million m³ ) | Percentage increase (average per annum) |
|---|---|---|
| 2000 | 58.00 | - |
| 2005 | 74.00 | 5.52 |
| 2010 | 95.00 | 5.68 |
| 2015 | 123.00 | 5.89 |
| 2020 | 153.00 | 4.88 |

(Source: FAO, 2009)

**Wood demand from short and long rotation tree species**

The demand of wood has been classified into short rotation (SR) species and long rotation (LR) species. The short rotation species are primarily used for pulp and paper industries, packing, agricultural implements, sport goods, plywood, match and other miscellaneous industries. The projected demand for short rotation species ranged between 0.35 million $m^3$ (Veneer) and 35.84 million $m^3$ (Paper and paper board) (FAO 2009). The overall projected demand for various wood based industries is projected at 87.70 million $m^3$ for the year 2020 (Table 2.).

**Table 2. Projected demand for raw wood material from SR species (million m³)**

| S. No. | Industry | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|---|
| 1 | Paper and paperboard | 4.48 | 8.96 | 15.50 | 26.64 | 35.84 |
| 2 | Newsprint | 1.78 | 2.56 | 3.42 | 4.63 | 6.22 |
| 3 | Rayon grade pulp | 2.50 | 2.80 | 3.10 | 3.40 | 3.80 |
| 4 | Construction industry | 3.18 | 3.88 | 4.42 | 5.26 | 5.70 |
| 5 | Packaging | 2.31 | 2.77 | 3.20 | 3.78 | 4.50 |
| 6 | Agricultural implements | 1.06 | 1.17 | 1.25 | 1.25 | 1.25 |
| 7 | Sports goods | 0.18 | 0.29 | 0.49 | 0.84 | 1.37 |
| 8 | Plywood | 5.50 | 7.00 | 8.98 | 11.45 | 14.60 |
| 9 | Veneer | 0.14 | 0.17 | 0.22 | 0.27 | 0.35 |
| 10 | Matchbox | 2.30 | 2.60 | 3.00 | 3.40 | 4.00 |
| 11 | Mining | 1.60 | 1.75 | 2.00 | 2.25 | 2.50 |
| 12 | Miscellaneous industry | 2.85 | 3.35 | 4.70 | 5.60 | 7.58 |
| **Total** | | **27.87** | **37.30** | **50.18** | **68.76** | **87.70** |

(Source: FAO 2009)

In 2005, the demand of short rotation (SR) species is almost equal to long rotation (LR) species for wood. The projected demand of SR species will be 33% higher than LR species by 2020 (Table 3.). However, the projected demand of LR species ranged between 0.16 million $m^3$ (Catamaran) and 22.80 million $m^3$ (Construction industry) (FAO 2009). The overall projected demand for various wood based industries is projected at 65.10 million $m^3$ for the year 2020 (Table 3.).

**Table 3. Projected demand for raw wood material from LR species (million m$^3$)**

| S. No. | Industry | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|---|
| 1 | Construction industry | 12.72 | 15.52 | 17.68 | 21.04 | 22.80 |
| 2 | Packaging | 2.31 | 2.77 | 3.20 | 3.78 | 4.50 |
| 3 | Furniture | 2.52 | 3.36 | 4.62 | 5.90 | 7.53 |
| 4 | Automobile | 0.19 | 0.28 | 0.41 | 0.60 | 0.87 |
| 5 | Agricultural implements | 1.06 | 1.17 | 1.25 | 1.25 | 1.25 |
| 6 | Railway sleepers | 0.03 | 0.03 | 0.22 | 0.02 | 0.02 |
| 7 | Sport goods | 0.18 | 0.29 | 0.49 | 0.84 | 1.37 |
| 8 | Handicrafts | 0.45 | 0.54 | 0.65 | 0.78 | 0.95 |
| 9 | Plywood | 5.50 | 7.00 | 8.98 | 11.45 | 14.60 |
| 10 | Veneer | 0.14 | 0.17 | 0.22 | 0.27 | 0.35 |
| 11 | Particleboard | 0.14 | 0.18 | 0.22 | 0.28 | 0.35 |
| 12 | MDF board | 0.14 | 0.17 | 0.21 | 0.24 | 0.28 |
| 13 | Mining | 1.60 | 1.75 | 2.00 | 2.25 | 2.50 |
| 14 | Catamaran | 0.03 | 0.05 | 0.07 | 0.11 | 0.16 |
| 15 | Miscellaneous industry | 2.85 | 3.35 | 4.70 | 5.60 | 7.58 |
| **Total** | | **29.85** | **36.63** | **44.92** | **54.40** | **65.10** |

(Source: FAO 2009)

**Demand of Indian paper and pulp industries**

In India, there are 700 plus pulp and paper mills which manufacturing a variety of papers and paper products. Around 35 % paper industries are based on chemical pulp, 44 % on recycled waste paper and 21 % on agro residues. However, about 25 to 30 paper industries are based on wood and bamboo as main source of raw material till the date in India. Total raw material demands of some important paper industries in India are shown in Table 4.

**Table 4. Indian paper industries wood demand (Metric Ton)**

| S.No. | Company's Name | Bamboo Demand | Wood Demand | Total Demand |
|---|---|---|---|---|
| 1 | ITC | 160000 | 640000 | 800000 |
| 2 | TNPL | - | 400000 | 400000 |
| 3 | Century Paper | 60000 | 240000 | 300000 |
| 4 | JK Paper | 130000 | 420000 | 300000 |
| 5 | Orient Paper | 120000 | 100000 | 220000 |
| 6 | Star Paper | 100000 | 130000 | 230000 |
| 7 | Sirpur Paper | 100000 | 230000 | 330000 |
| 8 | BILT | 300000 | 1100000 | 1400000 |
| 9 | SPB | - | 400000 | 400000 |
| 10 | IP-APPM | 160000 | 640000 | 800000 |
| 11 | WCPM | - | 960000 | 960000 |
| 12 | Hindustan | 700000 | 150000 | 850000 |
| 13 | Mysore Paper | 30000 | 190000 | 220000 |
| **Total** | | **1860000** | **5600000** | **7460000** |

(Source: Sharma 2018)

**Development of Industrial agroforestry in india**

Prior to eighties, majorities of wood based industries of the country were continuously gathering raw material from the natural forest. The large scale degradation of natural forests and loss of biodiversity occurred due to continuous withdrawal the raw material from the natural forests in unsustainable manner. Therefore, Forest Conservation Act was enacted in 1980 to control reckless deforestation in India. In 1988, National Forest Policy (1988) guided the wood based industries to meet their demand from resources outside the forest or from the farmer's field by proving good quality planting material and technology to the tree growers. However, in the year 1996, the Honorable Supreme Court of India passed an order to a complete ban on the felling of trees form the natural forest. All these has resulted a huge gap in raw materials supply to wood based industries. In early initiative, WIMCO introduced G-48 and G-3 clones poplar in 1969 at Bareilly (UP) for matchwood industry. It started contract tree farming directly with the farmers of Punjab, Haryana and UP in 1984 for buy back the trees on maturity. In 1987, ITC Bhadrachalam launched a scheme with the help of financial support from NABARD where the company started proving superior quality eucalyptus seedling to the farmers with technical assistance and buy back contract at market price. In 1990, WIMCO developed a tripartite agreement involving farmers, bank and company. Now days, there are several paper and pulp wood industries such as Star, Century, JK, BILT, ITC, Orient, IP-APPM, SPB, TNPL, WCPM and Mysore papers which promotes clonal plantations on farmer's land (Sharma 2018) to meet their raw material demand. In the year 2008, a project on "A Value Chain on Industrial Agroforestry in Tamil Nadu" was implemented by TNAU (Tamil Nadu) in a consortium mode involving two paper industries (TNPL and SPBL) and a match industry (Vasan Match Works). They developed Bipartite, tripartite and quadpartite model of contract farming (involving farmers, research institutes, wood based industries and financial institution) to supply the sustained raw material for the wood based industries. Such initiatives has largely increased the area under tree plantation which is confirmed by the India State of Forest Report (2011) which estimated 3.17 million $m^3$ timber production from government forests, whereas, 42.77 million $m^3$ potential timber production from TOFs including industrial plantations, social and farm forestry.

The proactive initiatives of educational and research institutes like Tamilnadu Agricultural University has given boost to the contract tree farming. The increasing budget of industries toward development of improved quality planting material has further increased the productivity of tree which has proved to be beneficial to the farmers in monetary term and industries in form of persistent raw material supply. The farmer are adopting one of the following three contract farming model.

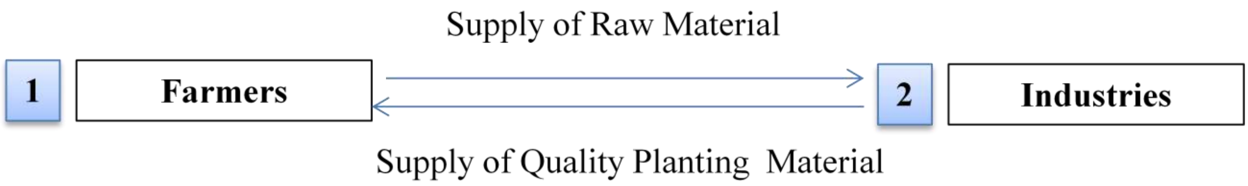


**Figure 1. Bipartite contract farming models (Source: modified from Parthiban *et al.* 2014)**

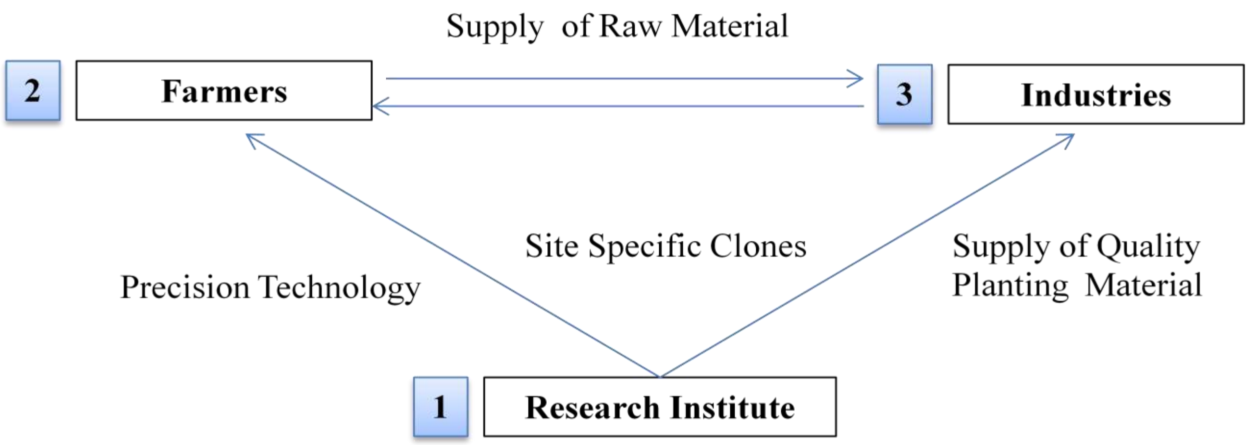


*Figure 2. Tripartite contract farming models (Source: modified from Parthiban et al. 2014)*

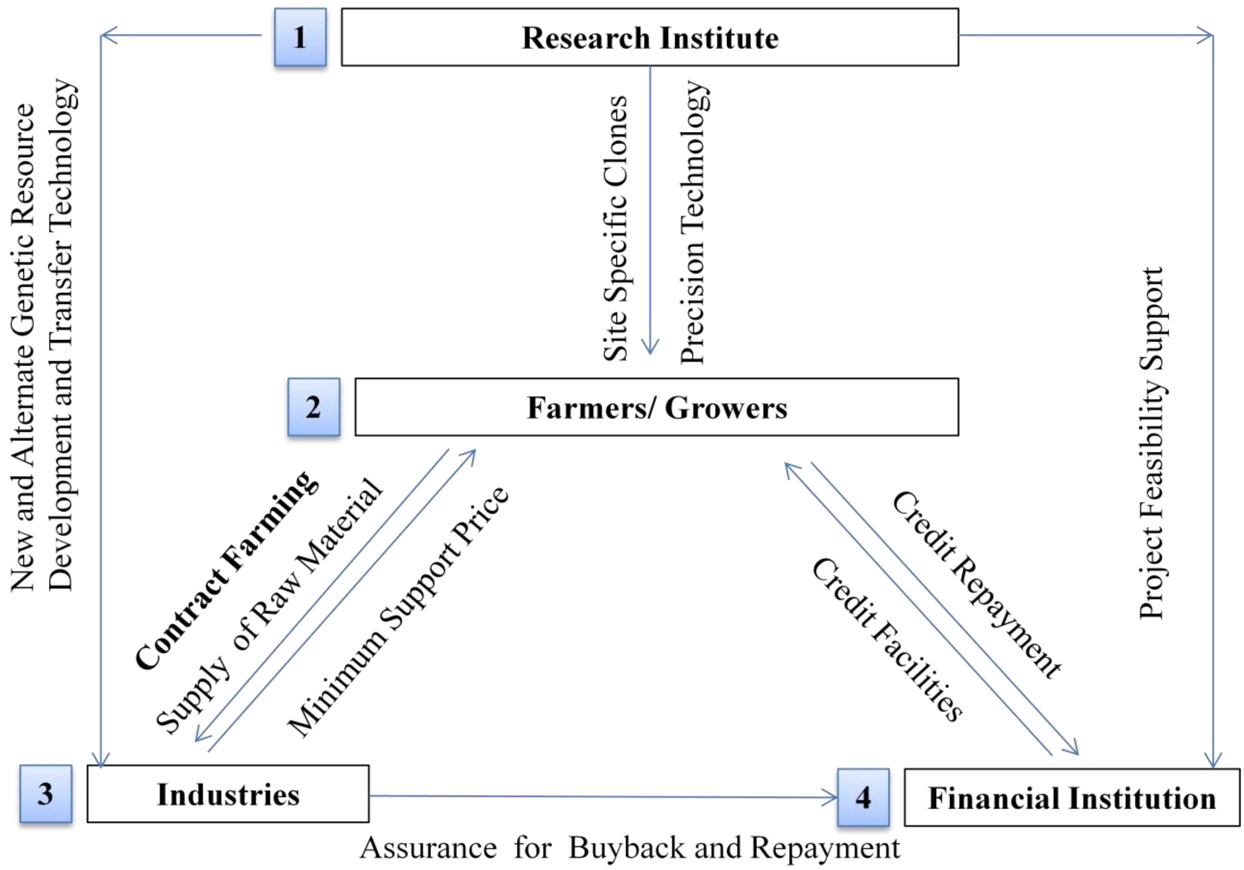


*Figure 3. Quadpartite contract farming model (Source: modified from Parthiban et al. 2014)*

**Minimum Support Price**

The strong linkage between the tree growers and industrial partners resulted into effective buy back arrangement for the farm grown industrial wood species. The minimum support price of Rs. 4000/t at the farm gate for pulpwood species and 7000/t at the industry gate for matchwood species is effective in Tamil Nadu (Parthiban *et al.*, 2014). This has increased reliance of the farmer toward industrial agroforestry.

**Potential identified and developed short rotation tree species**

High yielding short rotation clonal varieties of Casuarina, Eucalyptus, Melia, Subabul, Gmelina, Ailanthus and Dalbergia have been promoted for plantations and this has witnessed increased wood production (150 ton/ha) and reduction in rotation (3-5 Years). The identified tree species tested for physical, chemical and strength properties for their acceptability in the paper and match industry. Now days, paper and pulp wood industries are promoting the clone of following potential tree species.

1. Eucalyptus species
2. Poplus species (*Populus deltoids*)
3. Salix species
4. Casuarina species
5. Subabul (*Leucaena leucocephala*)
6. Gmelina (*Gmelina arboria*)
7. Ailanthus species
8. Shisham (*Dalbergia sissoo*)
9. Melia (*Melia dubia*)
10. Albizia species
11. Kadamb (*Anthocephalas cadamba*)
12. Acacia species (*Acacia mangium, Acacia auriculiformis*)

## CONCLUSION

Industrial agro-forestry has a major role to play in increasing farmer's income along with sustenance of wood based industry. TNAU has successfully demonstrated that the involvement of agricultural university can play a major role in looking after the need of both farmer and industry which ultimately can enhance inclination of farmers toward industrial agro-forestry as profitable venture. Such model is needed to be adopted in other parts of the country, too.

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# Exploring organic certification: concept and process

**S. Rajna and K.V. Praveen**

*Scientists, ICAR- Indian Agricultural Research Institute, New Delhi*
**Corresponding Author: veenkv@gmail.com*

The traditional way of agriculture in India is organic, and it was only after the green revolution of 1960s that the chemical fertilizers and pesticides started substituting their organic counterparts. The recent change in perception in favour of the environment that came as a result of understanding the mounting environmental costs of chemical use in agriculture necessitates a revisit to the traditional organic farming. However, the crop response to the organic inputs may be lesser when compared to the chemical ones. Thus the farmers practicing organic agriculture will have to deal with more and more challenges, before harvesting their crop and marketing them. Finally if the market fails to provide premium price to the organic products, due to its inability to segregate between organic and non-organic products, then the whole efforts of farmers in avoiding chemicals from their fields will go in vain. Organic certification is a process developed to ensure premium price to the organic products.

**Concept of organic certification**

Organic certification is the process that certifies the organic food producers. Business activities closely dealing with food production like seed suppliers, food processors, retailers, restaurants etc. can also be certified in addition to the certification of farmers. The certification, however requires these actors to comply with certain standards at different stages of their operations like crop growing, storing, processing, packaging, transporting etc. These standards mainly target to avoid the chemical inputs and genetically modified organisms from use in agricultural fields, use the crop land that is free from such chemical for the last 3 years or more, maintain proper records related to farm activities etc.

**Regulation of organic certification in India**

National Program on Organic Production (NPOP) conceptualised and initiated by the Ministry of Commerce and Industry, Government of India in the year 2001, provides the details on the standards to be maintained, the procedures to be followed, and the criteria under which organic certification can be issued. NPOP also provides details on the inspecting and certifying agencies, as well as the organic logo and the restrictions for its use. As per NPOP, the following principal standards need to be maintained for organic certification:

- The land must be converted to organic farming must be done.
- Only natural inputs are allowed for use in the farm
- Genetically modified inputs and the irradiation technology is prohibited for use
- Physical, biological and mechanical processes followed must be integrated all the times
- Contamination from the neighbouring farms or other external sources must be prevented
- Follow sustainable agricultural practices only

**Organic certification process**

Individual farmers, or farmer collectives can apply for organic certification, provided that the number of members in such farmer groups are in between 25 and 500, and they have land in the same geographical region. Organic certification will be provided to the organically produced agricultural products, however the land cannot be certified as organic. Such products which are organically certified can then be sold in the domestic as well as foreign market with the organic label. Since the foreign markets provide better incentives for the farmers producing organic products, large volumes of organic certified agricultural products from India are exported. The Agricultural & Processed Food Products Export Development Authority (APEDA) provided electronic service in the form of TraceNet to facilitate certification of the organic agricultural goods produced in India for export purpose. Thousands of stakeholders make use of the TraceNet facility that compiles all data on the traceability provided by the producers, operators and certification organizations in the organic supply chain. The products that get organic certification can use the logo "India Organic" for marketing.

**Steps in organic certification in India**

In India, accredited bodies under NPOP are responsible for carrying out organic certification. NPOP also provides norms for organic agriculture and targets to promote organic farming in India. The standards issued by NPOP for organic production and the accreditation procedure is accepted by the USDA, European commission and Switzerland. This means that those countries consider the NPOP standards as equivalent to theirs. The important steps in organic certification in India are:

- Application for organic certification sent to accredited organic certification body by individual farmer or group of farmers
- The accredited body will then issue the standards and other operational details to the applicant
- Fee payment
- Auditing the documents related to the farm operations
- Field inspection and documentation of details by the external inspector along with farm manager
- Checking the compliance with standards through thorough inspection
- Report writing by the field inspector
- Review of report by a designated body
- Final decision to be made on the certification

**Benefits of organic certification**

- Organic certified products attracts premium price
- Such products can access, regional, national and international markets
- Empower and support domestic farmers and economy
- Attract funding and technical guidance
- Environmental friendly production process

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# Cardinal temperature: A key of Agriculture Production

**Surya Prakash Singh*, Anil Kumar Jena, Rimi Deuri, Toyir Nyori**

*Assistant Professor, Faculty of Agricultural Sciences,*
*Arunachal University of Studies, Namsai, Arunachal Pradesh, 792103, India*

** Corresponding Author: suryanduat@gmail.com*

**Abstract**

Temperature is very important factor to deciding crop phenological development and crop growth. In the temperature cardinal temperature is very valuable part of temperature because every crop has very specific temperature without at this temperature crop can't grow and product high temperature. According to temperature we can decide crop and varieties on the place. Every crop need to optimum temperature for crop growth and production so here need to know every former, agriculturist and researchers of these optimum criteria of this temperature. These criteria have been divided in three part minimum, maximum and optimum temperature of the every crop. This is called cardinal temperature. Kharif crops require more temperature then rabi crops. Cardinal temperature is a base temperature or threshold temperature of every crop. We have observe in barley and toria varieties when temperature goes high from optimum then plant complete life cycle as flowering and maturity very early.

**Key word**: Phenological development, cardinal temperature, threshold temperature.

## INTRODUCTION

Temperature is very important not only to plants but also to all the biological species. Physical and chemical processes within the plants are governed by temperature. The diffusion rate of gases and liquids in soil-plant-atmospheric system changes with temperature. Temperature affects crops by causing (i) variations in duration of phenological events or crop development. (ii) variation in magnitude and time of occurrence of peak in biomass, (iii) significant increase / decrease in growth rates, (iv) variation in growth pattern deviating from sigmoidal curve and ultimately affecting grain yield or harvest index.

**Role of temperature in crop production:**

1. Temperature influences distribution of crop plants and vegetation.
1. The surface air temperature is one of the important variables, which influences all stages of crop during its growth development and reproductive phase.
2. Air temperature affects leaf production, expansion and flowering.
3. The diffusion rates of gases and liquid changes with temperature.

4. Solubility of different substances is dependent on temperature.
5. Biochemical reactions in crops (double or more with each 10°C rise) are influenced by air temperature.
6. Equilibrium of various systems and compounds is a function of temperature.
7. Temperature affects the stability of enzymatic systems in the plants.
8. Most of the higher plants grow between 0°C – 60°C and crop plants are further restricted from 10 – 40°C, however, maximum dry matter is produced between 20 and 30°C.
9. At high temperature and high humidity, most of the crop plants are affected by pests and diseases.
10. High night temperature increases respiration and metabolism.
11. A short duration crop becomes medium duration or long duration crop depending upon its environmental temperature under which it is grown.
12. Most of the crops have upper and lower limits of temperature below or above which, they may not come up and an optimum temperature when the crop growth is maximum. These are known as cardinal temperatures and different crops have different temperatures.

The most commonly utilized sensor for measuring temperature are still the mercury thermometers. Maximum and minimum thermometers use mercury and alcohol. Bimetallic thermographs are the most common mechanical temperature recorders. They are easy to read and maintain. However, mechanical thermographs do require verification and adjustment of the position of the pen recorder. These instruments are installed in shelters that are naturally ventilated. Modern temperature sensors have been developed, namely the thermistor and the thermocouple. These provide very accurate analogue measurements and are normally utilized in automatic weather stations. Thermistors provide independent measurements of air or soil temperature, whereas thermocouples require an additional base temperature reading, normally provided by a thermistor. To maintain the accuracy and representativeness of these instruments, they are installed in special radiation shields (shelters) having natural ventilation. Occasionally the shields or shelters are artificially aspirated to reduce biases caused by heat loading from the sun.

## COMBINED INFLUENCE OF TEMPERATURE AND PHOTO-PERIOD:

Though development of crops is mainly driven by temperature, some plant species respond to photo-period or day length. The photo thermal effects on phenology in many crops were reported. For all tropical and sub-tropical species, the warmest temperature combined with shortest photo period hastened flowering and fruit maturity (Keating *et al*, 1998). However, all
temperate species both flowered and matured sooner at the warmest temperature combined with
longest photo period. Cardinal points or temperature thresholds (°C) for some major crops are listed in Table-3.

Table-3.Temperature thresholds (°C) during growing season for some major crops

| **Crop** | **Minimum** | **Optimum** | **Maximum** |
|---|---|---|---|
| Sugarcane | 13 | 35-37 | >40 |
| Wheat | 0-5 | 25-31 | 31-37 |
| Rice | 10-12 | 31-37 | 40-45 |
| Maize | 8-13 | 25-30 | 32-37 |
| Potato | 5-10 | 15-20 | 25 |
| Sorghum | 8-10 | 32-35 | 40 |

**Low temperature affect**

Low temperature affects several aspects of crop growth, *viz*., survival, cell division, photosynthesis, water transport, growth and finally yield.

**High temperature affects**

High temperature adversely affects mineral nutrition, shoot growth and pollen development resulting in low yield. Adverse effects of high temperature during critical growth stages of some major crops were mentioned in Table-4.

Table-4. High temperature effects on key development stages of five major arable crops

| **Crop** | **Effect** |
|---|---|
| Wheat | T > 30°C for > 8 hrs can reverse vernalisation |
| Rice | T > 35°C for > 1 hr at anthesis causes spike let sterility |
| Maize | T > 36 °C reduces pollen viability |
| Potato | T > 20°C reduces tuber initiation and bulking |
| Cotton | T> 40ºC for more than 6 hours causes bolls to abort |

Source: Acock and Acock (1993)

## CONCLUSIONS AND RECOMMENDATIONS

We can say cardinal temperature is very important principal for crop production in present and future time because we already know this time major problem of climate change and global warming. When we will cultivate according to cardinal temperature then more possibilities to increase agriculture production and less affect of climate change and global warming. Cardinal temperature is also useful in dry-land agriculture and we can select crop and their varieties according to their cardinal temperature.

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# Nutritional benefits and value added products of bael

Nadia Bashir*, Monika Sood, Julie D. Bandral and Umaymah Ashraf

*Division of Food Science and Technology*
*Faculty of Agriculture*
*SK University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu*
**Corresponding author:* nadiabashir00@gmail.com

Bael (*Aegle marmelos*) is an inherent fruit of India belonging belongs to family Rutaceae and is commonly known as *Indian quince*, *Golden apple*, *Holy fruit*, *Bel, Belwa*, *Sriphal*, *Stone apple* and *Maredo* in India. It is a sub-tropical, globular fruit with grey or yellowish hard woody shell. The shell contains soft yellow or orange coloured mucilaginous pulp with numerous seeds which are densely covered with fibrous hairs. It is one of the most nutritious fruits having immense medicinal properties.

**Table 1: Chemical Composition (per 100g)**

| Component | Amount |
|---|---|
| Moisture (g) | 61.0 |
| Protein (g) | 1.6 |
| Fat (g) | 0.2 |
| Mineral (g) | 1.9 |
| Fibre (g) | 2.9 |
| Calcium (mg) | 80.0 |
| Phosphorus (mg) | 52.0 |
| Iron (mg) | 0.5 |
| Carotene (µg) | 55.0 |
| Thiamine (mg) | 0.12 |
| Niacin (mg) | 1.0 |
| Vitamin C (mg) | 8.0 |
| Potassium (mg) | 610 |
| Copper(mg) | 0.20 |

(Singh *et al.*, 2014)

**Medicinal properties**

Bael fruit is well known for its medicinal properties. Bael fruit is known for its ability to combat constipation because of presence of high amounts of fibre and thereby acts a laxative (Singh and Chaurasiya, 2014). The presence of tannin in the bael fruit helps in curing diseases like diarrhoea and cholera. Bael fruit contains certain phenolic compounds making it suitable for treatment of gastric ulcers. The extract of bael fruit posses anti viral and anti fungal properties that protect body from various infections. Bael being rich source of vitamin C helps in prevention of scurvy disease. In addition Bael extract is useful in treatment of respiratory infections and posses anti-inflammatory properties (Kumar *et al*. 2012).

**Processing of bael fruit**

The storage life of the fruit is dependent upon the stage of harvesting. The shelf life of bael fruit at normal temperature varies from 10 to 15 days. As storage life of bael fruit is not too long, processing bael into various products makes it available throughout the year and also adds value to the fruit. It can be processed into preserves, beverages, leather, jams, jellies, candies etc. Some of the processed products of bael fruit are as under:

**I. Bael Beverages**

**a) Bael Ready to serve beverage (RTS)**

For the preparation of bael RTS, raw bael fruits are taken, cleaned and cut into halves using knife. The seeds and pulp are removed from rind and subjected to boiling with little quantity of water for some time. The boiled pulp is then filtered and then mixed with sugar syrup to prepare RTS of specific TSS (10 °B) and pulp percentage (10 %).

Ripe bael fruit
↓
Washing Breaking
↓
Scooping of pulp with seeds and fibres
↓
Addition of 1 litre water to each 1 kg bael pulp (1:1)
↓
Kneading and heating at 70 °C for 1 minute
↓
Straining bael fruit pulp
↓
Analysis of TSS (%) and acidity (%) in bael fruit pulp
↓
Preparation of sugar syrup
↓
Straining and cooling of sugar syrup
↓
Mixing it with bael fruit pulp
↓
Homogenization
↓
Bottling, Sealing and pasteurization
↓
Cooling, labelling and storage

**Flow-chart for bael ready-to-serve beverage**

**b) Bael Fruit Squash**

An ideal composition of fruit squash is 50 per cent extracted pulp, 50 °Brix and 1 per cent acidity. The squash was chemically preserved by addition of 300 ppm $SO_2$ (Singh and Chaurasiya, 2014). In the preparation of bael squash the pulp extracted is mixed sugar syrup and then preservatives like sodium metabisulphite @ 350 ppm $SO_2$ and sodium benzoate @ 1g/litre (Verma and Gehlot, 2006) are added. The squash is then filled in sterilized bottles, crowned and pasteurized at 80°C for 30 minute followed by cooling.

Ripe bael fruit
↓
Washing and removal of woody shell
↓
Removal of pulp with seeds and fibres
↓
Addition of 1 litre water to each 1 kg bael pulp (1:1)
↓
Kneading and heating at 70 °C for 1 minute
↓
Straining bael fruit pulp
↓
Analysis of TSS (%) and acidity (%) in bael fruit pulp
↓
Preparation of sugar syrup as per treatment
↓
Straining and cooling of sugar syrup
↓
Mixing it with Bael fruit pulp
↓
Addition of preservatives
↓
Homogenization
↓
Bottling and sealing
↓
Labelling and storage

**Flow-chart for bael fruit squash**

## II. Dehydrated Bael

In preparation of dehydrated bael, mature green fruits are selected, washed and cut into1-1.5cm thick slices of fruit pulp after removing its hard shell. These slices are then fumigated with sulphur dioxide fumes for an hour in sulphur box and then subjected to drying at 55-60°c in oven till constant weight is achieved. The dried slices in are then packed in polyethylene bags or glass jar for future use.

**III. Bael powder**

Bael powder can be prepared by simply grinding dehydrated (either sun dried or oven dried) fruit slices in a grinder followed by packing in polyethylene bags. The polyethene bags with bael powder are then sealed and stored in cool and dry place.

**IV. Bael Jam**

A fruit jam should contain minimum 45% of fruit portion and minimum 68% of total soluble solids. The method of making Bael jam is given as under:

Ripe firm fruits
↓
Washing and Peeling
↓
Pulping (removal of seed and core)
↓
Addition of sugar (add water if necessary)
↓
Boiling (with continuous stirring)
↓
Addition of citric acid
↓
Judging of end-point by further cooking up to 105°C or 68-70%TSS or by sheet test
↓
Filling hot into sterilized bottles
↓
Cooling
↓
Waxing and Capping
↓
Storage (at ambient temperature)

**Flow chart for bael jam**

**V. Preserve and Candy**

For the preparation of preserve (*murraba*) the bael fruits are peeled, sliced cross wise into pieces of about 2 cm thickness followed by washing with water. The slices are pricked with stainless steel fork on both sides and then blanched in boiling water for 5 min. Sugar syrup of 40 % concentration is prepared and citric acid is added to it @ 0.6%. The blanched fruits are then placed in stainless steel container and sugar syrup is added. Then next day sugar syrup is decanted and strength of sugar syrup is raised by addition of solution containing 300 g sugar. This is repeated on $4^{th}$ and $6^{th}$ day so that final sugar concentration of 70 per cent is reached. The *murraba* is then packed in glass jars and stored at ambient conditions.

The preparation of candy making is similar to preserve but the slices treated with 70 per cent sugar solution are drained out and dried at 55-60°C for 8-10 h in oven.

**VI. Bael slab**

It is also known as leather or paper. For preparation of slab ripe fruits are utilized. The ripened fruits are washed and pulp is obtained by breaking fruits and removing its hard shell. The extracted pulp is mixed with water (200-300ml for one kg of fruit pulp) and heated it up to 80°C. The fruit pulp is strained through stainless steel sieve and seeds are removed. The pulp is added with sugar, citric acid and potassium meta-bisulphite (KMS) so it contains 35 per cent TSS, 0.5 per cent total acidity and 0.07 per cent KMS. The treated pulp is then spread on aluminium trays smeared with butter and dried at 55-60°C for 15-16 hrs. The dried pulp slab is then cut into pieces wrapped in butter paper and pack in polyethylene bags.

**VII. Toffee**

Bael fruit pulp provides toffees of good nutritional and medicinal properties. Bael fruit toffes are prepared by mixing 40 parts of cane sugar, 4.5 parts of glucose, 10 parts of skim milk powder and 6 parts of hydrogenated fat to 100 parts of extracted pulp followed by drying to about 8.5 per cent moisture (Singh and Chaurasiya, 2014).

**VIII. Bael panjiri**

This product is highly nutritive, restorative and is prescribed for stomach ailments. It is prepared by mixing Bael powder 1 kg, desi ghee (butter oil) 1kg, sugar powder 1.5 kg, wheat flour and dry fruits as per taste. Bael powder and wheat flour are roasted in desi ghee and other ingredients added.

## UTILIZATION OF PROCESSING WASTE OF BAEL

The bael peel and pomace generated during processing of fruit comprises 35-40 per cent of total fruit weight. The use of this generated waste as cattle feed reduces feeding cost besides protecting environmental contamination and pollution.

## CONCLUSION

Bael (*A. marmelos*) is a highly nutritious fruit possessing medicinal properties. It can be processed into variety of products. However, it still comes under category of underutilized fruits and little efforts have been made for commercial utilization of its value added products. The focused research should be carried out encouraging the utilization of Bael fruit and creating market for value added products of this fruit.

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# Potentials of organic farming towards sustainable agriculture in India

**S. Alagappan**

Ph.D Research Scholar,
*Department of Agronomy, Directorate of Crop Management,*
*Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.*
*Corresponding Author: alga.s@rediffmail.com*

**Abstract**

The prime principle of organic farming results in response to health, environment and sustainability in agriculture towards food security to the growing population despite the climate change issues in India. Organic farming emerged as a potential alternative for meeting food demand, maintaining soil fertility and increasing soil carbon pool. However, Indian organic farming industry is almost entirely export oriented, running as contract farming under financial agreement with contracting firms Most of the farmers are opting organic farming due to price margins which may shift motive of the commercial farmers towards economic vantage rather than for safe agricultural produce to competitively discourage small farm holders. Additionally, limitations regarding bulk availability of organic supplements further constrain organic farming in India. Despite these issues, the increasing market demand and institutional support coupled with growing inclination of farmers to go organic have resulted in rapid growth in certified organic area during last 2-3 years. Farmers apprehension towards OF in India is rooted in non-availability of sufficient organic supplements, bio fertilizers and local market for organic produce and poor access to guidelines, certification and input costs. Capital-driven regulation by contracting firms further discourages small farm holders. An integrated effort is needed from government and nongovernment agencies to encourage farmers to adopt OF as a solution to climate change, health and sustainability in Indian agriculture.

**Keywords:** Organic farming, Climate change, Indian farmers, organic food industry.

## INTRODUCTION

Increased / indiscriminate use of chemical fertilizers and pesticides during green revolution period resulted in several harmful effects on soil, water and air causing their pollution. This has reduced the productivity of the soil by deteriorating soil health in terms of soil fertility and biological activity. The excess / indiscriminate use of pesticides has led to the entry of harmful compounds into food chain, death of natural enemies and development of resurgence / resistance to pesticides. Out breaks of insect pests have occurred after insecticides were over used. Hence, enhancement and maintenance of system productivity and resource quality is essential for sustainable agriculture. It is believed that organic farming can solve many of these problems as this system is believed to maintain soil productivity and pest control by enhancing natural processes and cycles in harmony with environment. Organic farming is defined as a production system which largely excludes or avoids the use of fertilisers, pesticides, growth regulators, etc. and relies mainly on organic sources to maintain soil health, supply plant nutrients and minimise insects, weeds and other pests.

## WORLD SCENARIO OF ORGANIC FARMING

Based on the global survey on organic farming carried out in 2009 by the Research Institute of Organic Agriculture (FiBL), the International Federation of Organic Agriculture Movements (IFOAM) and Foundation Ecology & Agriculture (SOEL), the organic agriculture is developing rapidly and is now practiced in more than 141 countries of the world. Its share of agricultural land and farms continues to grow in many countries. According to the latest survey on global organic farming, about 32.2 million hectares of agricultural land is managed organically as of 2007. Oceania has the largest share of organic agricultural land (37%), followed by Europe (24%) and Latin America (20%). The proportion of organically compared to conventionally managed land, however, is highest in Oceania and in Europe. In the European Union 4% of the land is under organic management. Most producers are in Latin America. The total organic area in Asia is 2.9 m.ha. This constitutes 9% of the world's organic agricultural land. The leading countries are China (1.6 m.ha) and India (1 m.ha). The country with the largest organic area is Australia (12 million hectares). Global demand for organic products remains robust, with sales increasing by over five billion US Dollars a year. Organic Monitor estimates international sales to have reached 46.1 billion US Dollars in 2007. Consumer demand for organic products is concentrated in North America and Europe; these two regions comprise 97% of global revenues. Asia, Latin America and Australasia are important producer countries of the world. Its share of agricultural land and farms continues to grow in many countries.

## INDIAN EXPERIENCE OF ORGANIC FARMING

Organic Agriculture is not a new concept to India and traditionally Indian farmers are organic. But, gradually changed to chemical based cultivation since 1950's and chemicals were increasingly applied during the Green Revolution period. Though the introduction of Green Revolution agricultural technology in the 1960's reached the main production areas of the country, there were still certain areas (especially mountain areas) and communities (especially certain tribes) that did not adopt the use of agro-chemicals. Therefore, some areas can be classified as *organic by default* though their significance and extent has been rather overemphasized. However, an increasing number of farmers have consciously abandoned agro chemicals and now produce organically, as a viable alternative to Green Revolution agriculture. Currently, India ranks 33rd in terms of total land under organic cultivation and 88th position for agriculture land under organic crops to total farming area. In India about 2.8 million hectares area is under certified organic farming (this includes wild herb collection area of MP and UP) with about 1,95,741 farmers engaged in organic farming. The Indian organic farming industry is estimated at US $ 100.4 million and is almost entirely export oriented. According to APEDA (2009), a nodal agency involved in promoting Indian organic agriculture, about 9,76,646 MT of organic products worth 498 crores rupees are being exported from India.

## CERTIFIED ORGANIC PRODUCTS PRODUCED & EXPORTED FROM INDIA

India has competitive advantages in the world markets due to low production costs and availability of diverse climates to grow a large number of crops round the year. During 2008-09, India exported 86 items with total volume of 37,533 MT, valued around Rs. 498 crores worth and cotton (43% contribution) leads (16,503 MT) among the products exported followed by Basmati rice (15% contribution). Organic products are mainly exported to EU, US, Australia, Japan, Switzerland and middle East.

## ORGANIC RICE CULTIVATION

India has tremendous potential to become a major exporter of organic rice in the International market. Agricultural and Processed Food Products Export Development Authority (APEDA) made efforts to produce and export basmati rice, aromatic rice and other rice varieties by establishing model farms in states like Punjab, Haryana and Uttar Pradesh. During 2008-09, around 5630 MT of organic basmati rice was exported from India through APEDA. Rice is the major crop that receives maximum quantity of fertilizers (40%) and pesticides (17-18%) and there are two major challenges in organic rice farming. They are: nutrient management and pest management.

**Table: Cost and Returns of Selected Organically Grown Crops (Rs/ha)**

| Crops | Gross Cost | Gross Returns | Net Returns | Net Returns over Cost (per rupee) |
|---|---|---|---|---|
| Coconut | 14000 | 140000 | 126000 | 9.0 |
| Sapota | 16000 | 87000 | 72000 | 4.5 |
| Turmeric | 7800 | 30000 | 22200 | 2.9 |
| Grapes | 40000 | 150000 | 110000 | 2.8 |
| Groundnut | 6000 | 22000 | 16000 | 2.7 |
| Tomato | 80000 | 250000 | 170000 | 2.1 |
| **Rice** | **10000** | **30000** | **20000** | **2.0** |
| Tea | 90000 | NA | NA | NA |
| Curry leaves | NA | 15000 | 15000 | NA |

Note: For groundnut and rice costs and returns were worked out for one crop season and for other crops for one year. Source: Rajendran (1998) and (2002).

### 1. Nutrient management

***a) Nursery:*** Preferably, organically grown seed should be selected. From second year onwards, seed from the same organic farm can be used. In seed bed preparation, organic manures such as FYM, compost, vermi-compost can be used @ 5t/ha. For Seed treatment, azospirillum and phosphorus solubilizing bacteria (PSB) @ 10 g /kg seed can be used. Seedling root dipping can also be done in azospirillum and/or PSB suspension prepared with 600 g of culture for seedlings sufficient to transplant in a hectare of land.

**b) *Main field:*** Only organic manures/crop residues/green manures are to be utilized to supply plant nutrients based on soil test recommendations of the location. Nutrient concentrations and moisture content of organic manures, their contribution to plant uptake and crop nutrient requirement are to be considered to estimate the quantity of organic sources. During land preparation and puddling, 10 tons of FYM/ha along with 5 tons/ha of paddy straw and 10 tons/ha of *insitu* grown dhaincha/sunhemp green manure to be incorporated. In the last puddle, vermi-compost @ 2 t/ha may be applied. Through these organics, approximately 150 kg N, 40 -50 kg P2O5 and 100 – 120 kg K2O will be supplied which takes care of crop NPK needs to a large extent depending on their mineralization and release of nutrients. In addition to NPK, these organics supply micronutrients also in required quantities. Bio-fertilizers such as azospirillum or PSB @ 2 – 3 kg culture/ha can be mixed with 25 kg FYM or vermi-compost and applied to the soil just before planting. Blue green algae @ 10 kg/ha, 10 days after planting is also recommended. If possible, azolla @ 1 t/ha can be added 7 – 10 days after transplanting and incorporated after 3 weeks. Azolla can also be used as a green manure @ 6 t/ha and incorporated before transplanting. All these bio-fertilizers may add 30 – 40 kg N on an average. Combination of different organic sources based on their availability is preferred.

**2. Pest management**

Only bio-pesticides and botanicals are recommended. Herbicides should not be used. Only hand weeding or mechanical weeding is to be done. Further, other organic sprays such as panchagavya and amruthajalam, may also be used 2 – 3 times during active growth period of the crop @ 250 ml/ 10 litres solution as they have insecticidal properties and also supply plant nutrients. In the nursery, seed treatment with biopesticides like *Pseudomonas* and *Trichoderma* is also recommended @ 10 g/kg seed. The major steps in management of pests are: 1. Cultivation of tolerant varieties 2. Cultural control 3. Mechanical control 4. Biological control 5. Use of pheromone traps 6. Use of Biopesticides.

## CONCLUSION

Global demand for organically grown foods is increasing and organic agriculture is growing fast in recent years. As a result, the area under organic farming and the number of countries practicing it are also increasing every year. India is also not an exception with considerable land area under organic farming and most of the north eastern states have been declared as organic by default. The organic system of rice production needs more than two years period to stabilize rice productivity and bring about perceptible improvement in soil quality, sustainability indices and economic returns under intensive, irrigated rice-rice system in tropical climate. Hence, using easily available local natural resources, organic farming can be practiced with a view to protect/preserve/safe guard our own natural resources and environment for a fertile soil, healthy crop and quality food and let our future generations enjoy the benefits of non-chemical agriculture. Given the same profitability, organic farming is more advantageous than conventional farming considering its contribution to health, environment, and sustainability in Indian agriculture.

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# Allelopathy and annidation in cropping system

**S. Alagappan**

Ph.D Research Scholar
*Department of Agronomy, Directorate of Crop Management,*
*Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.*
*Corresponding Author: alga.s@rediffmail.com*

Greek derivation: "allelon" and "pathos" = mutual suffering.Allelopathy the term was coined by Prof. Hans Molish, German Botanist in 1937. The effect of one plant on another plant through release of a chemical compound into the environment. Allelopathy is any direct or indirect harmful effect that one plant has on another through the production of chemical substances that escape into the environment (Rice, 1974). Allelopathy refers to any process, involving secondary metabolites produced by plants , micro organisms, viruses, fungi that influence the growth and development of agricultural and biological systems. - International Allelopathy Society (1996).

## Types of Allelopathy

**Negative Allelopathy**: Which stimulates the growth of this associated crop by release of hormone like substances (Tukey ,1970).
**Functional Allelopathy**: Toxic substances may be converted into active substances by some micro-organisms.
**True Allelopathy:** The toxic substances may be released as such from the plant .
**Allo inhibition**: The chemical released by one species may inhibit species of plants other than the one releasing it.
**Auto inhibition**: May inhibit more strongly plants of the producer species itself.

## Allelopathy Effects

The type and quantity of allelo chemicals produced will vary depending on the environment and genetic make up of the plant. Some allelo chemical may be produced by the aerial portion of the plant and may reach the ground through raindrops, falling leaves or insects , inhibition the growth of the species growing underneath (Trenbath,1976).
Allelo chemicals produced from the leaves of Eucalyptus globules drastically reduced the germination of mustard (Brassica spp.) seed sown underneath.Many plant exudates from their roots (allelo chemicals) inhibit the growth of the neighboring species living roots of Walnut ( Juggles nigra),cucumber (Curcumas sativa) and Path ( Prunes persia) are known to exudates toxic substances which inhibit the growth of the plants growing

near them. Release of N from root nodules of legume is not considered to be a form an allelopathy.

**Crops can be allelopathic to weeds**: Rye as an allelopathic cover crop in field studies.– Reduced common ragweed (43%), green foxtail (80%), red root pigweed (95%), and common purslane(100%).

**Weeds can be allelopathic to the crop:** Over 240 allelopathicweed species documented. Velvet leaf: radish, corn, soybean, tomato. Common lambs quarters: corn, cucumber, oat, soybean, tomato, wheat. Redroot pigweed: barley, cabbage, carrot, cauliflower, corn, cotton, eggplant, pepper, squash, soybean, tobacco, tomato, wheat.

**Natural Herbicides: Synthetic herbicides based on natural plant compounds.**

**Advantages:** new target sites, water soluble, perceived as more environmentally friendly

**Disadvantages:** chemically complex, difficult to isolate and produce, not stable, short lived.

**Example:** sorgoleone, from sorghum, inhibits photosynthesis better than atrazine.

**Natural Herbicides:** Recent advances in the microbial and plant biochemistry have stimulated scientific interest in the possible role of secondary plant metabolites and microbial toxins as herbicides.

Caffeine inhibits the germination of *Amaranthus spinosus.*Strigol a sesqui-terphenoid derivative from cotton roots is a potent germination stimulant of witch weed ( *Striga asiatica*) an obligate parasite on sorghum and maize. Dhurrin in sorghum, gallic acid in spurge, Phlorizin in apple root, trimethyl xanthene in coffee and cinch in eucalyptus are some of the plant products having promising herbicidal action. 'Herbiacae' the herbicide from microbial natural product bialaphos in Japan has opened up a new era in weed management. Other microbial phyto toxins found to suppress weed growth include anisomycin, tentoxin, biopoloroxin, herbimycin etc.

## Tree allelopathic effect on weeds

Wheat grown in alleys of *Dalbergia sissoo* recorded 30% less weed population due to the production of benzoic acid by the leaf fall during winter from tree and its fast decomposition suppress the weed population. Allelo chemicals from eucalyptus could be successfully exploited for the control of noxious weeds. Oils from *Eucalyptus globulus* and *Eucalyptus citriodora* completely reduce the germination of *Parthenium hysterophorus* seeds and affected the growth of mature weed plants. Oils of eucalyptus checks the root development of *Lantana camera* weed.

**Allelopathic effects :** Complementary effects from N- fixing legumes, Blue Green Algae (BGA), Azolla, Green manure, forage legume, grain legume. **Crop mixtures intercropping.** Maize + cowpea mixture 30% N taken up by maize is obtained from the legume besides legume acts as mulch and green manure. N transfer through legume intercropping. P transfer through VAM application non legume to legume crop. Plant bio mass produces beneficial allelo chemicals. Crop residues produces allelo chemicals. Forest tree litters produces allelo chemicals.

**Allelopathic effects on: Weed Management**: Cover crops and residue mulches, Inter cropping, Crop rotations ,Resistant phytotoxicc varieties, Natural herbicides and Tree farming.**Nematodes Management:** Plant materials as nematocides, Oil seed cakes and by products, Nematicidal allelopathic compounds. **Insect pest management**: Cropping systems, crop rotation,, crop mixture/ inter cropping ,resistant varieties, insecticidal allelo chemicals, **Diseases Management:** Cropping systems, crop residues, organic amendments, Allelo chemicals acts as growth regulators. Recent research evidences on allelopathy. Integrating multiple control options enhances.

**Auto toxic effects of plants:** Phenolic acid released into rhizosphere by Tea plants suppresses the growth of the other species(weeds, parasites etc,) but at the same time reduces the root growth of tea over the years and thus reducing the tea yield over years due to autotoxic effect. Autotoxins produced by leaf surfaces dissolves in water, rainfall, fog, mist, dew, which falls on earth( not the root exudates, soil colloids and phenolic acid) different substances suppresses the other species growth by allelopathic effect. *Liu - Ghu et al 2011.*

## What is Annidation?

Annidations is complementary use of resources by exploiting the environmental supplies in different ways by the component of a community(Lugwig,1959). Annidation normally occurs in complementary interaction with respect to time or space or of both.

### Annidations in Space

The leaf canopies of component crops may occupy different vertical layers with taller component tolerant to strong light and high evaporative demand and shorter component favouring shade and high relative humidity. Thus, one component crop helps the outer. Multi-storeyed cropping in coconut and planting of shade trees in coffee, tea and cocoa plantation use this principle (Nair, 1949). Eg: Coconut + pepper+ cocoa+ pineapple (multi-storied cropping).

Similarly, root system of component crops exploits nutrients from different layers of soil and thus utilizing the resources efficiently. Generally, one component with shallow root system and another with deep root system are selected for intercropping as in set area (sorghum (shallow)with red gram (deep)) intercropping system.

### Annidations in Time

When two crops of widely varying duration are planted, their peak demands for light and nutrients are likely to occur at different periods, thus reducing competition. When the early maturing crops are harvested, condition becomes factorable for the late maturing crops to put forth its full vigour. Examples are , Sorghum + Red gram, Groundnut + Red gram, Maize + Green gram inter cropping system.

### Complementary Effect in Intercropping Systems

In an intercropping system, involving as legume and non-legume, part of the nitrogen fixed in the root nodule of the legume may become available to the non-legume component. The numerous reports of such beneficial effect of legumes on non-legumes are available in literature (IARI, 1975, Palaniappan *et al* 1976, Merchant *et al* 1977, Soundarajan and Palaniappan 1979).

## CONCLUSION

The presence of rhizosphere micro flora and mycorrhiza, one species may lead P mobilization and greater availability of nutrients not only to the species concentrated, but also to the associated species (Christen et al 1974). Another example is the provision of physical support by one species to the intercropped is climbing species may improve the yield of the climber. Example, Coconut + Pepper and Maize + Beans. The taller component acts as wind barrier protecting the short crop as in Maize+ Groundnut, Onion + Castor, Turmeric + Castor. When two crops are to be grown together, they are chosen in such a way that there is variation in their growth duration. The peak periods of growth of the two crop species should not coincide. In such arrangements, a quick maturing crop completes its life cycle before the other crop starts. Example, Growing of Sorghum with Cowpea / Blackgram / Green Gram / Groundnut. (or) Sorghum with Pigeon pea. Similarly, Growing of Maize with Bean /Cowpea / Blackgram / Greengram.

# Blood in Milk in Bovines: Causes and Available Treatment Options

**Kushal Grakh[1], Shivanagouda Patil[2], Vishal[3] and Saurabh Jyoti Talukdar[4]**

*[1]Department of Veterinary Public Health and Epidemiology*
*[2]Department of Veterinary Gynaecology and Obstetrics*
*[3]Department of Veterinary Surgery and Radiology*
*[4]Department of Veterinary Microbiology*
*Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana-125004*
**Corresponding author: kushalgrakh24@gmail.com*

The animal husbandry and dairying sector in India contributes about 33% to GDP and thus a promising industry for the growth of the country. Among many constraints to the dairy industry in terms of infectious and metabolic diseases, a condition like Hemolactia (blood in milk) also leads to heavy economic losses to the dairy farmers. Dairy farmers and farmers with one or two animals frequently seek the veterinary help for the treatment of cows and buffaloes with hemolactia condition. Cases of the condition are sporadic but several lactating animals can be affected at a time. This condition adds to economic losses as milk have to be discarded due to rejection by consumers due to its abnormal color and also the treatment cost. So, the knowledge of etiology and cheap and effective treatment strategies can help the farmers to cut down the economic losses.

## CAUSES

There can be multiple causes for this condition. A few important causes are as below:

1. **Physiological Hyperemia and Hemorrhage**: Hyperemia (increased blood supply to an organ/tissue) of the mammary gland which is occasionally seen at late gestation and for a short period just after parturition. Blood in milk due to this state normally persists no longer than 14 days at the most. However, if such udder is not milked completely can precipitate the condition at any stage of lactation.

Hemorrhage by diapedesis (passage of blood cells through capillary walls into the tissues), is quite common just after calving or as sequalae to physiological hyperemia. Hemorrhage due to diapedesis can occur at any stage during the lactation. The color of the milk can be slight pinkish tinged to red depending upon the severity of hemorrhage. Harsh milking by hand or machine may result in hemorrhage due to epithelial damage. Trauma to udder and teat is also one of the common causes of blood in milk due to hemorrhage. If hemorrhage is due to rupture of major vein of udder then frank venous blood like secretion can be there in milk.

2. **Systemic infections:** Several bacterial infections including *Leptospira* species, *Brevibacterium erythrogenes*, *Serratia marcescens, Micrococcus* species, *Lactorubefaciens gruber, Sarcina rubra* etc., along with some viruses and red yeast like *Monascus purpureus* may cause systemic infections which can lead to intravascular hemolysis and capillary damage in udder and causes pinkish to reddish discoloration of milk.

Among systemic infections, **Leptospirosis** is one of the common causes of blood in milk in dairy animals. Red colored milk with thick consistency from all four teats may or may not be accompanied with blood and milk clots is characteristic of *Leptospira* infection. Soft udder and cold mastitis (mastitis with no sign of inflammation) is another characteristic clinical feature of leptospiral mastitis which develop after some non-specific signs of fever, decreased milk yield, hemoglobinuria etc.

3. **Natural toxins or dyes:** Sometimes toxins from plants viz; conifers, poplars, alders, ranunculi etc. (shown in fig.1) may cause capillary damage leading to reddish discoloration of milk. Moldy sweet clover (dicoumarin poisoning- anticoagulant) can cause bloody milk. Sometimes dye containing leafy plants can cause reddish discoloration of milk without any pathological condition.


**Fig.1** Plants containing toxins and dyes. A. Conifers B. Sweet clover C. Poplar trees D. Alders

4. **Deficiency of blood platelets (Thrombocytopenia):** Cattle with diseases where low platelet count occurs as one of the manifestation, may show reddish or pinkish discoloration of milk due to leakage of blood into milk.

5. **Acute or chronic mastitis**: In chronic mastitis, due to harsh milking, straining of tissue or due to lying on uneven surfaces can cause temporary or protracted hemorrhage into the milk due to rupture of vascular granulation tissue.

6. **Miscellaneous causes**: Vitamin C deficiency, penetrating lacerations, whip injuries, horn injuries.

**Table 1. Treatment Options Available for Hemolactia in Bovines**

| Treatment strategies | Remarks |
|---|---|
| **Calcium borogluconate**<br>• Intravenous 300-450 ml (for 2-3 day) | Calcium has a coagulant effect |
| **Coagulants**<br>Parenteral/ Local<br>• Tranexamic acid, 500 mg/ml; 10-15ml i/m bid<br>• Etamsylate, 250 mg/ml; 5-10 mg/kg b. wt. i/m | Local application/intramammary is considered as more efficient than parenteral in |

| | |
|---|---|
| • Adrenochrome monosemicarbazone, 5 mg/ml, i/m (50mg total) | severe cases. |
| **Vasoconstrictors**: Parenteral/Local<br>• 5-8 ml (1:1000) epinephrine s/c<br>• 5ml epinephrine+ 20ml Normal saline intramammary<br>• Ergonovine maleate (total 10-20mg) i/m<br>• Methylergometrine hydrogen maleate (total dose 2mg) i/m | Circulatory system of the udder is very sensitive to the vasoconstrictor action of adrenaline. |
| **Vitamin C**<br>• Ascorbic acid injection @ 7.5 mg/kg body weight intra-muscular<br>• Ascorbic acid tablets (20-30 tablets each containing 500 mg vitamin C) | Vitamin C has anti-oxidant effect. |
| **Antibiotics**<br>• For leptospiral mastitis: Streptomycin (25mg /kg b.wt. i/m for 3-5 days) or after antimicrobial susceptibility testing for other causes of mastitis | Intramammary or parenteral antibiotics can be given |
| **Vitamin K** @ 10 ml i/m for 3 days | Vitamin K is anti-hemorrhagic |
| **Formalin**<br>• 35% (5ml) + Dextrose saline (500ml) i/v<br>• 10% Formalin (10-30 ml) orally<br>• 0.37% solution of Formalin in normal saline i/v for 3-4 days | Ismail, Z. B. (2016) |
| **Styplon® Vet** bolus 1-2 bolus bid 3-4 days | Silk cotton tree(*Shalmali*) And Malabur nut (*Vasaka*) are key ingredients. |
| **Camphor**<br>• 20 parts camphor powder (finely ground) in 80 parts of olive oil) 30-60 ml of camphorated oil i/m | Volatile acids released by camphor act as styptic (Ethno-veterinary Treatment) |
| **Homeopathic treatment**<br>• Homeopathic complex of *Phytolacca* 200c, *Calcarea fluorica* 200c, *Silicea* 30c, *Belladona* 30c, *Bryonia* 30c, *Arnica* 30c, *Conium* 30c and *Ipecacuanaha* 30c. 10 pills four times daily until recovery | Research findings of Varsheny and Naresh, (2004) |
| **Tonophosphan Vet®** @ 10 ml i/m for 3-4 days | Phosphorus maintains the RBC membrane integrity |

| | |
|---|---|
| 200 gram of curry leaves (*Murraya Koengii*) + juice of 10 normal sized lemons (*Citrus limon*) p.o. twice daily for 3-4 days | Case study findings Umadevi and Umakanthan, 2010 |
| 250 grams of turmeric powder in one liter of warm milk + 250 grams of '*sambaloo*' leaves and giving as a drench for 2-3 days. | Ethno-veterinary treatment |

## SUPPORTIVE TREATMENT AND OTHER MEASURES

1. Application of ice cold water or crushed ice (packed in a cloth) helps in control of hemorrhage through vasoconstriction.
2. The sand hosed with cold water at least four times can be used as bedding material for affected animals, so that when the animal rest on sand, it will lead to vasoconstriction and control of hemorrhage in the udder or teat.
3. The feed suspected for causing blood in milk should be changed.
4. Cleaning of the animal shed and to provide *kutcha floor* with even surface for animals.

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# Artificial Intelligence: Leading Agriculture towards an Golden Era

**Rajeswari Das[1] and Satyabrata Sahoo[2]**

*[1]PhD Scholar , Department of Soil Science and Agricultural chemistry, College of Agriculture , Dr Rajendra Prasad Central Agriculture University, Pusa, Samastipur, Bihar, India- 848125*
*[2]Assistant Horticulture Officer,*
*Department of Agriculture and Farmer's Empowerment, Government of Odisha*
**Corresponding author email id: kunmun.babli@gmail.com*

Though agriculture sector has grown into a highly competitive and globalized industry still it is facing tremendous challenges as it have to feed the growing population of world through continuous increase in food production from a limited source of cultivation (Arable land). Where as expected and observable changes in global climate, shifting rainfall patterns, global warming, drought or the increasing frequency and duration of extreme weather event endangers traditional production areas and thereby brings new risks uncertainties for global harvest yields. Agriculture requires a continuous and sustainable increase in productivity along with efficiency on levels of agricultural production to cope with the challenges going to be raised in future. While careful and efficient use of resources like water, energy, fertilisers etc. is needed in order to protect and sustain the environment and the soil quality.

## Need for Artificial Intelligence in Agriculture

Agriculture is seeing rapid adoption of Artificial Intelligence (AI) in terms of agricultural products and in-field farming techniques. According to UN Food and Agriculture Organization, the population will increase by 2 billion by 2050. However, only 4% additional land will come under cultivation by then. In this context, use of latest technological solutions to make farming more efficient, remains one of the greatest imperatives. While Artificial Intelligence (AI) sees a lot of direct application across sectors, it can also bring a paradigm shift in how we see farming today. AI-powered solutions will not only enable farmers to do more with less, it will also improve quality and ensure faster go-to-market for crops.Artificial Intelligence (also known as AI) is considered to be the biggest game-changer in the global economy. With its gradual increase in scope and application, it is estimated that by 2030, AI will contribute up to 15.7 trillion of the global economy which is more than the current output of China and India combined.

## Artificial Intelligence and its principle

Artificial intelligence (AI), sometimes called machine intelligence, is intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans and other animals. In computer science AI research is defined as the study of "intelligent agents": any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals. Colloquially, the term "artificial intelligence" is applied when a machine mimics "cognitive" functions that humans associate with other human minds, such as "learning" and "problem solving". The UN Artificial Intelligence Summit held in Geneva (2017) identified that AI has the potential to accelerate progress towards a dignified life, in peace and prosperity, for all people and have suggested to refocus the use of this technology, that is responsible for self-driving cars and voice/face recognition smart phones, on sustainable development and assisting global efforts to eliminate poverty and hunger, and to protect the environment and conserve natural resources.

The principle of artificial intelligence is one where a machine can perceive its environment, and through a certain capacity of flexible rationality, take action to address a specified goal related to that environment. Machine learning is when this same machine, according to a specified set of protocols, improves in its ability to address problems and goals related to the environment as the statistical nature of the data it receives increases. Put more plainly, as the system receives an increasing amount of similar sets of data that can be categorized into specified protocols, its ability to rationalize increases, allowing it to better “predict” on a range of outcomes.

## Artificial intelligence in recent Agricultural fields

As scientists still struggle to predict climate changes and other potential environmental hurdles or bottlenecks due to lack of algorithms for converting the collected useful data into required solutions, *Microsoft’s AI for Earth,* a 50 million dollar initiative, was announced in 2017 with the sole purpose to find solutions to various challenges related to climatic changes, agriculture, water and biodiversity.Currently, Microsoft is working with 175 farmers in Andhra Pradesh, India to provide advisory services for sowing, land, fertilizer and so on. This initiative has already resulted in 30% higher yield per hectare on an average compared to last year.

Other similar AI infused Earth applications are *iNaturalist* and *eBirds* that collect data from its vast circle of experts on the species encountered, which would help to keep track of their population, favorable eco systems and migration patterns. These applications have also played a significant role in the better identification and protection of fresh water and marine ecosystems.

If we look specifically towards the field of farming, quite a lot of research is being conducted. Research on topics like hydration characteristics of Wheat, applying machine learning to agricultural data show that farming activities can greatly benefit from AI. Every research being done aims to improve the control of input variables such as fertilizer, seed, chemicals or water with respect to the desired outcomes of increased profitability, reduced environmental risk or better product quality. Research on some specific important crops like wheat are being carried out to because crops like wheat, rice need high output to meet the mass demand and any case of crop failure means huge loss. So AI can reduce chances of crop failure due to improper farming activities. This all data is learned and used by AI. Hence a lot of research is being conducted for the same.

## AI startups in Agriculture:

I. Prospera, founded in 2014. This Israeli startup has revolutionized the way farming is done. It has developed a cloud-based solution that aggregates all existing data that farmers have like soil/water sensors, aerial images and so on. It then combines it with an in-field device that makes sense of it all. The Prospera device which can be used in green houses or in the field, is powered by a variety of sensors and technologies like computer vision. The inputs from these sensors are used to find a correlation between different data labels and make predictions.

II. Blue River technology, founded in 2011. This California-based startup combines artificial intelligence, computer vision and robotics to build next-generation agriculture equipment that reduces chemicals and saves costs. Computer vision identifies each individual plant, ML decides how to treat each individual plant and robotics enables the smart machines to take action.

III. Farm Bot, founded in 2011. This company has taken precision farming to a different level by enabling environment conscious people with precision farming technology to grow crops at their own place. The product, FarmBot comes at a price of $4000 and helps the owner to do end-to-end farming all by himself. Ranging from seed plantation to weed detection and soil testing to watering of plants, everything is taken care of by this physical bot using an open source of soft ware.

## Challenges in AI Adoption in Agriculture

Though Artificial Intelligence offers vast opportunities for application in agriculture, there still exists a lack of familiarity with high tech machine learning solutions in farms across most parts of the world. Exposure of farming to external factors like weather conditions, soil conditions and presence of pests is quite a lot. So what might look like a good solution while planning during the start of harvesting, may not be an optimal one because of changes in external parameters.

AI systems also need a lot of data to train machines and to make precise predictions. In case of vast agricultural land, though spatial data can be gathered easily, temporal data is hard to get. For example, most of the crop-specific data can be obtained only once in a year when the crops are growing. Since the data infrastructure takes time to mature, it requires a significant amount of time to build a robust machine learning model. This is one reason why AI sees a lot of use in agronomic products such as seeds, fertilizer, pesticides and so on rather than in-field precision solutions.

Controlling industrial emissions and waste management is another challenge that can be dealt with the advanced learning machines and smart networks that could detect leaks, potential hazards and diversions from industrial standards and governmental regulations. For example, IoT technology was incorporated into several industrial ventures, from refrigerators and thermostats and even retail shops.

## Conclusion

Agriculture is one of the most difficult fields to contain for the purpose of statistical quantification.Even within a single field, conditions are always changing from one section to the next. There's unpredictable weather, changes in soil quality, and the ever-present possibility that pests and disease may pay a visit. Growers may feel their prospects are good for an upcoming harvest, but until that day arrives, the outcome will always be uncertain. From the AI point of view, Agriculture offers a vast application area for all kinds of AI core technologies: Mobile, autonomous agents operating in uncontrolled environments, stand-alone or in collaborative settings, allow to investigate, test and exploit technologies from robotics, computer vision, sensing, and environment interaction. Integrating multiple partners and their heterogeneous information sources leads to application of semantic technologies. The complexity of the agricultural production asks for progress in modeling capabilities, handling of uncertainty, and in the algorithmic and usability aspects of location- and context-specific decision support. The growing interest in reliable predictions as a basis for planning and control of agricultural activities requires the interdisciplinary cooperation with domain experts e.g. from agricultural research. Modern agricultural machines shall use self-configuring components and shall be able to collaborate and exhibit aspects of self-organization and swarm intelligence.

# Organic Vegetable production in North East India

**Mohd Talha Ansari* and Md. Ramjan**

*College of Horiculture and Forestry, Central Agricutural University, Pasighat 791102, Arunachal Pradesh*

**Corresponding author: ansari.talha0@gmail.com*

Organic farming is receiving popularity among people in recent times due to negative effect of inorganic inputs on health and environment, but it was initiated in long back when ancient farmers started cultivation depending on natural sources only. There is brief mention of several organic inputs in our ancient literatures like *Rigveda, Ramayana, Mahabharata, Kautilya Arthasashthra, Holy Quran* etc (Bhattacharyya and Chakraborty, 2005). In fact, organic agriculture has its backgrounds in traditional agricultural practices that evolved in countless villages and farming communities over the long period.

India's rank in terms of World's Organic Agricultural land was 15 as per 2013 data (Source FIBL & IFOAM Year Book 2015). Organic Production in the country was estimated 1.35 million MT (2015-16). The total area of India of under organic certification is 5.71m ha (2015-16) which includes 26% cultivable area with 1.49 m ha and rest 74% (4.22 m ha) forest and wild area for collection of minor forest produces. Converting the whole country into organic cultivation is not feasible as it will reduce production in the initial year and may result in catastrophic failure but in the Northeast India less agricultural land is available which can be converted to organic without effecting the production.

### Present scenario and status of vegetable production

The productivity of vegetable in North eastern states is below national average (Table 1) with lowest in Arunachal Pradesh with only 5.2 MT/ha. This is because use of poor quality seeds and less input of fertilizer. Nagaland and Sikkim has very high area under organic certification which is a positive point for increasing area in other states also. Sikkim has been declared as organic state on 18$^{th}$ Jan, 2016. With the enhancement of connectivity in NE India there is good scope for export of organic products in foreign market. Airport is now functional in all the eight north eastern states with the latest addition in Sikkim (Pakyong, East Sikkim) and Arunachal Pradesh (Pasighat, East Siang).

### Potential for Organic vegetable production

In India, only 30% of total cultivable area is covered with fertilizers where irrigation facilities are available and in the remaining 70% of land is rain-fed in which very less amount of fertilizers is being used.

**Table 1**. Area, production and productivity (2013-14) of total vegetables in NEH Region and State wise Farm area (excluding Forest Area) under Organic Certification

| Sl. No. | State | Area(in 000' hectare) | Certified organic Area* (ha) | Production (000'MT) | Productivity (MT/Ha) |
|---|---|---|---|---|---|
| 1 | Arunachal Pradesh | 1.4 | 71.49 | 51.8 | 5.2 |
| 2 | Manipur | 25.2 | 0 | 271.0 | 11.8 |
| 3 | Meghalaya | 43.6 | 371.13 | 515.3 | 11.8 |
| 4 | Mizoram | 41.1 | 0 | 254.1 | 12.8 |
| 5 | Nagaland | 38.6 | 5168.16 | 492.4 | 12.8 |
| 6 | Tripura | 46.7 | 203.56 | 780.5 | 16.7 |
| 7 | Sikkim | 26.1 | 60843.51 | 135.4 | 16.0 |
| | **National** | **9396.0** | **203.56** | **162896.9** | **17.3** |

Source: Indian Horticulture Database 2014, NHB Ministry of Agric. GOI. * Source: APEDA (2013-14)

Farmers' in these areas often use organic manure as a source of nutrients that are readily available either in their own farm or in their locality. The bounties of green revolution could not benefit the farmers of the hills as the system of production in the hills remained low input-low risk-low yield technology base. The North Eastern region of India provides considerable opportunity for organic farming due to least utilization of chemical inputs (Table.2). It is estimated that 18 million hectare of such land is available in the NE, which can be exploited for organic production. The average fertilizer use of North eastern region per hectare is 51.73 kg/ha as compared to national average (128.34 kg/ha) in the year 2012-13. States like Nagaland, Arunachal Pradesh and Sikkim has less than 5 kg/ha inorganic fertilizer input.

A large part of the population in Mizoram, Nagaland and Meghalaya is tribal. Among the tribal practices in agriculture, Jhuming is prevalent, covering about 90% of agricultural land in Mizoram and Nagaland. Jhum or shifting cultivation is economically non-viable and ecologically damaging. At the moment over 16 lakh ha areas are under the shifting cultivation in the northeast where no chemical fertilizers or pesticides are used, which can be immediately converted into vast organic zones (Verma, 2008). The certification process can be accelerated by identifying certification agency within the region and reduction of certification cost (Bujarbaruah, 2004).

**Table.2 Consumption of fertilizers (state-wise, nutrient-wise) during 2012-13 in North East**

| States | Per hectare Fertilizer consumption in Kg/ha | | | |
|---|---|---|---|---|
| | N | $P_2O_5$ | $K_2O$ | Total |
| Assam | 36.31 | 11.80 | 18.15 | 66.26 |
| Tripura | 39.09 | 20.66 | 12.94 | 72.69 |
| Manipur | 26.09 | 3.68 | 1.38 | 31.15 |
| Meghalaya | 9.94 | 3.40 | 1.01 | 14.35 |
| Nagaland | 2.43 | 1.53 | 0.84 | 4.80 |
| Arunachal Pradesh | 1.62 | 0.11 | 0.32 | 2.05 |
| Mizoram | 12.33 | 0.68 | 0.23 | 13.23 |
| NE Total | 29.04 | 9.59 | 13.10 | 51.73 |
| **National** | **84.54** | **33.44** | **10.36** | **128.34** |

Indian Fertilizer Scenario, 2013 Source: Department of Agri. And Cooperation,

## CONCLUSIONS

Vegetable production requires less land which can be managed easily under organic production. The results of different experiments indicated that the productivity of vegetable crops under organic farming either maintained or improved over the years. Thus, it can be very well established that there is lot of scope for sustaining productivity of vegetable crops by improving soil quality through organic farming especially in the areas like North Eastern Region of India. For successful organic farming the resources available should be effectively used and a holistic approach should be adopted.

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# Importance of pollination for temperate fruit crop production

**Wasim H Raja*, Sajad Un Nabi, K.L. Kumawat, O.C.Sharma and D.B.Singh**

*ICAR-Central institute of Temperate Horticulture*
*Old Airfield, Rengreth, Srinagar, 191132, J&K, India*
**Corresponding Author: wasimiari@gmail.com*

## ABSTRACT

Pollination is the transfer of pollen from the male part of the flower to the female part of the flower. Some types of fruit trees may be pollinated with their own pollen and are considered self-fruitful or self-pollinating. Other types of trees require pollen from a different variety of the same type of tree and are considered self-unfruitful. The transfer of pollen from one variety to a different variety of the same type of tree is called cross pollination. Cross-pollination is essential for temperate fruits apple, pear, sweet cherry, and Japanese plum. Cross-pollination is not essential, but does improve the number of fruit that form on apricot, European plum/prune, tart cherries, peach and nectarine.

## INTRODUCTION

All temperate fruits require pollination to set fruit. Some fruits are self-fruitful and do not require more than one cultivar per block. Peach, nectarine, tart cherry, apricot, and some European plums are self-fruitful, and a solid block of one cultivar may be planted. Apple, pear, and sweet cherries require mixed plantings of different cultivars for adequate cross-pollination. The percentage of flowers that need to be set varies greatly between fruit crops. For crops like cherry, yield is the most important factor in a commercial crop, so 20 to 60 percent of sweet cherry and 20 to 75 percent of sour cherry blossoms need to be set for a commercial crop. For other fruit crops where size is more important commercially or to prevent biennial cropping, the percentage of flowers that need to be pollinated is much lower, apple, 2 to 8%; pear, 3 to 11%; peach, 15 to 20%; apricot, 20 to 25%; and plum, 3 to 20%. Improving pollination can lead to increased production owing to larger and better-shaped fruit and/or a greater number of fruit per tree. Research has shown that fruit size and calcium content are directly related to the number of seeds per fruit, with the number of seeds being dependent on good pollination. The more pollinizer trees in a planting, the better the potential for cross-pollination. However, using rows of pollinizers means the loss of some efficiency in orchard operations. Having two or more cultivars in an orchard may pose problems in spray-to-harvest and cultural practices, and it may confuse pickers, at the time of harvesting resulting in mixed cultivars. There also may be an inefficient use of land

owing to differences in growth habits. These disadvantages, however, are far outweighed by the greater yields associated with pollinizer use.
Five conditions are necessary for satisfactory cross-pollination:

- The bloom of the Pollinizer variety must bloom with the main variety.
- The pollinizer variety must have viable diploid pollen.
- The pollinizer variety must be located near the producing tree.
- Bees and other insects must be present in the orchard at the time of bloom and be active at bloom.
- Weed blossoms, such as dandelions, mustard, and wild radish, should not be present in quantity since they attract bees away from fruit tree blossoms.

## Pollinizer placement

The placement of Pollinizers in the orchard is very important. Ideally, every tree in an orchard should be located as close as to a Pollinizer tree. However, efficient orchard production practices do not include scattering pollinizers of commercial cultivars throughout a block. (An exception is the use of crabapples.) The preferred arrangement of pollinizers is in solid rows. One scheme is to alternate two rows of Pollinizers between four rows of the major cultivar. An exception is planting cultivars, such as Delicious, that have a tendency to be less fruitful. In these instances, and when it is desirable to maximize pollination, a pollinizer row should be set every third row.

## Supplemental pollination practices

Even with an adequate allowance for pollinizers, it may sometimes be necessary to provide for additional pollen when weather conditions do not favour cross-pollination. Using hive inserts with commercially obtained pollen is a common practice that can be used to increase pollen sources. Inserts are specially constructed to fit in the entrance of hives and are filled on a frequent basis with pollen. The inserts are constructed so that bees are forced to track across the pollen and carry it to the flowers as they forage. A second method of increasing pollen is to cut bouquets of flowering branches from trees elsewhere in the orchard and place them in large containers of water within the tree rows. Bouquets should be checked daily and replenished as needed. A third method is to graft selected limbs with a compatible pollinizer branch. The disadvantage of this method is the necessity to clearly mark the limb to prevent it from being pruned out in the winter and mixing of fruits at the time of harvest. All these methods should be viewed as supplemental means of increasing pollination. The best pollination method is to have an adequate number of pollinizer cultivars and strong, healthy honey bee colonies from other orchard.

## Pollination in important Temperate fruit crops

### Apple

All apple cultivars require cross-pollination with a Pollinizer to ensure commercial quality fruit and yields. Varieties differ in their self-fruitfulness. For example, Golden

Delicious is considered partially self-fruitful, while Red Delicious is not. Regardless of the degree of self-fruitfulness, provide cross-pollination in every planting. With respect to cross-pollination, all red sports and spur types are considered the same as the parent variety. Closely related varieties may not pollinate one another--for example, McIntosh, and Early McIntosh. Triploid varieties do not pollinate any varieties. Otherwise, all varieties with satisfactory pollen are pollinizers of one another if the bloom periods overlap.

Certain varieties have a biennial bearing tendency. During the "off" year of the pollinizer, the adjacent variety, although an annual bearer, will tend to become biennial because of the lack of cross-pollination. Summer applications of NAA or ethephon can help to promote return bloom. Trees that provide sufficient compatible pollen for the main cultivar(s) in the block are necessary for pollination. A desirable arrangement is a pollinizer located not more than 100 feet from the variety to be pollinated. In larger blocks, plant two rows of pollinizer (starting on the windward side of the block), four rows of main variety, two rows of another pollinizer, four rows of the main variety, then two rows of the first pollinizer, etc., and repeat the arrangement across the block. It is recommended that that no fewer than three pollen-compatible varieties be planted in an orchard. Thus, for example, if you are planting a Delicious block, select two additional suitable Pollinizer varieties. Where additional pollen is needed, graft a pollinizer branch into each tree. Select main variety and pollinizer trees with overlapping annual bloom times.

All apple varieties should be cross pollinated with another apple or crab apple variety such as Lodi, liberty, Empire, Winesap, Jonathan, Jonagold, Gala, Golden delicious, Rome and Grany Smith may be listed as fruitful , they will set more fruit on annual basis if they are cross pollinated. Some apple varieties such as Winesap, Stayman, Mutsu, and Jonagold, produce sterile pollen and therefore cannot be used to pollinate other apple varieties. Manchurian crabapple with profuse white flowers is commonly used to pollinate early and mid-blooming apple varieties, while snowdrift crabapple is used for mid to late blooming apple varieties. When using a crab apple tree as a pollinizer, it should be planted within a similar distance to an apple tree as listed above. Inadequate pollinizer proportion and their diversity is main concern of decreasing productivity. Almost 70-80 per cent of our; apple orchards have less pollinizers, than the recommended 33 per cent proportion.

**Pear**

Most of the pear varieties are self fruit unfruitful. However, nearly all pears are suitable pollinizers for other varieties that bloom at the same time. One exception is Seckel, which is not a good Pollinizer for Bartlett. Even though Anjou, Bartlett and Keiffer are partially self-fruitful, they should be cross pollinated to produce heavy and regular crops. Pear flowers produce only a small amount of nectar which is low in sugar. For this reason, more pollinizers and bees are needed for pears than any other tree fruit. Conference, Fertility and Flemish Beauty are good pollinizers for Bartlett group of varieties. There is lot of parthenocarpy is found in many pear varieties.

**Plum / prune**

European plums have both types of varieties, Self-fruitful such as Agen, Pershore, Purple Pershore, French Damson, and Stanley whereas self-unfruitful varieties are Italian Prune, President Grand Duke Etc. Most European type plum varieties will set fruit with their own pollen, but will produce better crops with pollinizers nearby. Except for Santa Rosa which is partially self-fertile, all Japanese plums require a Pollinizer. Japanese plums such as Burbank, Red heart, Shiro, Methley, and Ozark Premier, require pollination from another Japanese or American-Japanese hybrid

**Cherry**

Sweet cherries except the new self-fertile types (Stella, Compact Stella, Lapins, Bing, and Starkrimson) require cross-pollination between two different cultivars. Some cultivars are not compatible with each other or may not overlap sufficiently in bloom period. Tart or sour cherries are self-fertile and do not require any pollinizer variety. They are capable of fertilizing sweet cherries but bloom is generally too late to be considered a dependable pollinizers. Most other varieties of sweet cherries require cross pollination where as several varieties are inter sterile and cannot fertilize each other.

**Apricot**

Many apricot Varieties such as 'Tilton' are self-fruitful. Provide another variety of apricot for pollination of varieties such as Goldrich, Moorpark and Perfection. Rival requires an early blooming pollinizer such as Perfection for best results. Self-unfruitful varieties of apricot include Perfection, Riland, and Rival. These self unfruitful varieties can be pollinated by any other apricot variety.

**Peach**

Most varieties of peach and nectarine are self-fertile, where as J.H.Hale Peach variety are self-unfruitful variety but can be pollinated by almost any other peach variety with a synchronous bloom except Elberta.The varieties where in J.H.Hale is in their parentage (Early Hale' and Hale Haven) will require another variety as a Pollinizer for adequate fruit setting.

**Pollination of small fruit crops**

Strawberry, raspberry, and blackberry, plants are self-fruitful. However, blueberry, varieties require cross pollination for fruit set. Thus varieties that bloom at a similar time should be placed within rows in adjacent rows.

**Almond**

All Commercial almond varieties are self-unfruitful. Therefore it is necessary to provide every third row in each orchard with Pollinizer variety (33% pollinizer) so that their bloom should coincide with each other. The varieties which are generally used for commercial almond cultivation as pollinizer like IXL, Jordanalo, Ne-Plus-Ultra and Waris. Due to self-incompatibility; commercial varieties needed to be planted in the following combinations:

i) Combinations of two varieties: Non Pareil-Ne Plus Ultra, Ne Plus Ultra -IXL, Non Pareil-Drake, Thin shelled-Drake.

ii) Combination of three varieties : Non Pareil-Peerless-Ne Plus Ultra, Non Pareil-Ne Plus Ultra-Drake, Ne- Plus Ultra-Drake-IXL, Non Pareil-Thin shelled-Drake.

iii) Combination of more than three varieties : Non Pareil-Thin Shelled-Drake-Dhebar, Non Pareil-Drake-IXL-Ne Plus Ultra, IXL-Ne-Plus Ultra-Drake-Texas , Non Pareil-IXL-Drake-Dhebar, Peerless-Jordonalo-Non-Pareil-Texas.

**Walnut**

English walnut is a monoecious species bearing staminate and pistillate flowers separately on the same tree. Walnuts are generally self-fruitful, cross-compatible and dichogamous, having incomplete overlap of pollen shed and female receptivity. It is this characteristic which led to the recommendation that about 10% of the trees in a commercial planting be a cultivar with a pollen shed period overlapping pistillate flower receptivity of the main cultivar. Excessive pollen load has been implicated in the 'Serr' cultivar in pistillate flower abortion (PFA), the loss of the female flowers early in the season before fruit drop due to lack of pollination. PFA can be reduced and yield improved in 'Serr' orchards by reducing pollen load. PFA occurs to a lesser extent in other cultivars such as 'Chico', 'Chandler', 'Vina' and 'Howard'. This information has led to the reevaluation of pollinizer recommendations. Research focused on optimum pollinizer levels in 'Chandler', a cultivar of increasing importance to the California walnut industry, has been inconclusive. Lack of pollinizer may impact yields to a greater extent. In any case the previously recommended 10% appears to be excessive. Two to three percent is probably adequate to limit losses due to lack of pollination without resulting in excessive PFA. Factors to consider when determining the number of pollinators to plant include: cultivar susceptibility to PFA, walnut pollen load in the area and local pollination and fruit set experiences.

## CONCLUSION

Pollination plays a crucial role in horticultural production in temperate fruit crops. One can go for use of improved agricultural technologies, such as the use of quality planting material, high yielding verities, good agronomic practices like timely irrigation and fertilizers, but without pollination, neither fruit nor seed will be formed. Therefore adequate number of Pollinizers should be planted in the orchard keeping in view the recommdations.

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# Role of biochar in Agriculture

**Bhawani Singh Prajapat[1]* and Barkha Rani[2]**

*[1]Ph.D Research Scholar Dept. of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur*
*[2]Ph.D Research Scholar Dept.of Agril. Chem. and Soil Science. Rajasthan College of Agriculture, MPUAT, Udaipur*
**Corresponding author: bspagro1992@gmail.com*

Biochar is a carbon-rich material obtained from thermo chemical conversion (slow, intermediate, and fast pyrolysis or gasification) of biomass in an oxygen-limited environment. It can be produced from a range of feedstock, including forest and agriculture residues, such as straw, nut shells, rice hulls, wood chips/pellets, tree bark, and switch grass. It has good physical properties i.e. high porosity, large surface area (Van Zwieten *et al*., 2010). It is recalcitrant to decomposition because of its aromatic structure and crystalline graphing sheet present in its structure. It recalcitrant period in soil is 10-1000 times more than organic matter. The properties of bio char depend upon the type of biomass used for feed stock and pyrolysis conditions i.e. charring time, rate and temperature. Bio char produced through woody feed stock is coarser and more recalcitrant as compared to that produced through agronomic residues.

## History of Bio char

The highly fertile dark earth soils of the Amazon River basin indicate that a form of bio char has been used in agriculture for many hundreds of years. These dark soils, known as Terra Preta, contain a fine grained, carbon rich material. This material comes from charred organic materials like manure, crop residue and bones that added to the soil. Without sophisticated kilns and ovens to produce modern bio char, this ancient material was likely made by setting alight a pile of organic material before covering it with dirt to eliminate oxygen but hold in the heat from the fire which, in turn, baked the organic matter.

## How Bio char is Made:-

Bio char is made using a process called pyrolysis. The porous charcoal like bio char was once any kind of organic biomass. Pyrolysis involves placing the biomass into a special oven before heating in the presence of little or no oxygen. The result is a stable solid material rich in carbon content that can effectively capture carbon and lock the carbon into the soil. Temperatures required by this process vary and a different type of bio char is produced depending on the feed biomass used and the temperature reached in the pyrolysis process.

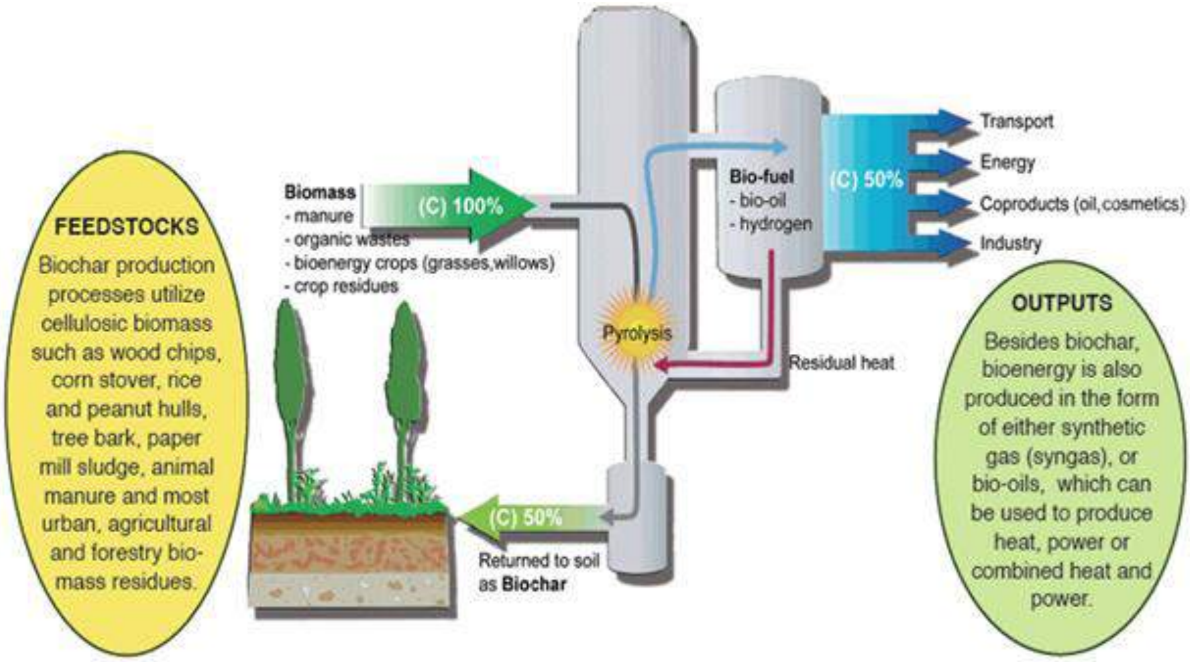


**Figure 1. Slow pyrolysis produces bio char and bioenergy.**

## Major Benefits of biochar in agriculture:-

1. **Act as amendment:**-Bio char application in acidic soil help in increasing soil ph . Increase in pH, the pH of bio char is often high (e.g. >9). This is beneficial in soil were the pH is lesser than optimal for the intended use, but not if the pH is higher than best.
2. **Improving physical properties of soil:-**
   Addition of bio char in the soils will result in the better soil texture, more porosity, good structure, and density and particle size distribution. As bio char have higher porosity and more surface area it will help in the providing space for microorganisms which are beneficial for the soil and also help in binding of important anions and cations.

Addition of bio char the growth rate of crop increased, quality of water improved, reduction in nutrient leaching, reduction in acidity of soil, more water retention, and decrease in fertilizer use. In the presence of added nutrients, the nutrients uptake by plants increased, growth rate increased significantly by the application of bio char in soils.

1. **Nutrient availability in soils:-** Bio char application leads to the increase in pH of the soil and that leads to improved availability of phosphorous and potassium. When bio char is applied on the soil, oxidation process is observed on the surface of particles. The reason for the reported high CEC is the oxidation of aromatic carbon which leads to the formation of carboxyl groups. The increase in CEC aids in increasing the fertility of soil, as the nutrients will remain attached to the soil opposing the leaching process because of CEC.

2. **Role in dealing with climate change:-**Carbon in biochar can persist in soils over long time scales. Beyond the carbon sequestered in the biochar itself, biochar incorporated in soils also offers numerous other potential climate benefits: Biochar can reduce emissions of nitrous oxide ($N_2O$) and methane ($CH_4$) two potent greenhouse gases from agricultural soils. Reduced emissions from feedstocks: Converting agricultural and forestry waste into biochar can avoid $CO_2$ and $CH_4$ emissions otherwise generated by the natural decomposition or burning of the waste. Energy generation: The heat energy—and also the bio-oils and synthesis gases—generated during biochar production can be used to displace carbon positive energy from fossil fuels.
3. **Improving crop production:-**Biochar can improve crop production through improvements in soil chemical or physical properties, with an improvement in physical properties tending to improve root growth as well as acquisition and retention of water and soluble nutrients (Sohi *et al*. 2010).When biochar is applied to soil, it can affect soil physical properties such as texture, structure, porosity, surface area and pore size distribution. These changes will then influence plant growth because the depth of roots and the availability of air and water within the root zone are largely determined by soil physical properties

## CONCLUSION

Biochar application in the fields helps in increasing the soil fertility, improved soil texture, improved sorption for nutrients which then helps in reducing the use of fertilizer which leads to the decrease in pollution through fertilizer run off. Biochar is highly efficient in increases in the crop production and yield. One of the major benefits of biochar is that it's helping in combating with climate change by sequestering the carbon dioxide from the atmosphere. It can also be used for the rehabilitation of destructed landforms. Biochar is posing many benefits to the environment agriculture and economy in the longer run, so it is highly recommended to incorporate it in agriculture practices.

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# Climate change and its impact on Agriculture

**Barkha Rani[1] and Bhawani Singh Prajapat[2]**

*[1]Ph.D Research Scholar Dept.of Agril. Chem. and Soil Science. Rajasthan College of Agriculture, MPUAT, Udaipur*
*[2]Ph.D Research Scholar Dept. of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur*
*Corresponding author: bspagro1992@gmail.com*

Climate change is the change that can be attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.(UNFCCC). Climate change is any significant long-term change in the expected patterns of average weather of region (or the whole Earth) over a significant period of time. It is about non-normal variations to the climate, and the effects of these variations on other parts of the Earth. These changes may take tens, hundreds or perhaps millions of year. But increased in anthropogenic activities such as industrialization, urbanization, deforestation, agriculture, change in land use pattern etc. leads to emission of green house gases due to which the rate of climate change is much faster. Climate change scenarios include higher temperatures, changes in precipitation, and higher atmospheric $CO_2$ concentrations.

## WORLD SCENERIO OF CLIMATE CHANGE

Six of the 10 countries most vulnerable to climate change are in the Asia-Pacific. Bangladesh tops the list followed by India, Nepal, the Philippines, Afghanistan and Myanmar. All climate models indicate a rising trend in temperature. Precipitation pattern has changed with decreased rainfall over south and south-east Asia.

## INDIAN SCENERIO OF CLIMATE CHANGE

The warming may be more pronounced in the northern parts of India. The extremes in maximum and minimum temperatures are expected to increase under changing climate , few places are expected to get more rain while some may remain dry. Leaving Punjab and Rajasthan in the North West and Tamil Nadu in the South, which show a slight decrease on an average a 20 per cent rise in all India summer monsoon rainfall over all states are expected. Gross per capita water availability in India will decline from 1820 m3/ yr in 2001 to as low as 1140 m3/yr in 2050.

## IMPACT OF CLIMATE ON AGRICULTURE

Climate change is likely to directly impact on food production across the globe. Increase in the mean seasonal temperature can reduce the duration of many crops and hence reduce final yield. In areas where temperatures are already close to the physiological maxima for crops, warming will impact yields more immediately (IPCC, 2007). Overall, agricultural productivity for the entire world is projected to decline between 3 and 16 % by 2080.

Impact of climate change on agriculture will be one of the major deciding factors influencing the future food security of mankind on the earth. Agriculture is not only sensitive to climate change but also one of the major drivers for climate change. Food production in India is sensitive to climate changes such as variability in monsoon rainfall and temperature changes within a season. Studies by Indian Agricultural Research Institute (IARI) and others indicate greater expected loss in the Rabi crop. Every 1°C rise in temperature reduces wheat production by 4-5 Million Tonnes. Small changes in temperature and rainfall have significant effects on the quality of fruits, vegetables, tea, coffee, aromatic and medicinal plants, and basmati rice. Pathogens and insect populations are strongly dependent upon temperature and humidity, and changes in these parameters may change their population dynamics.Other impacts on agricultural and related sectors include lower yields from dairy cattle and decline in fish breeding, migration, and harvests.

Different crops respond differently as the global warming will have a complex impact. The tropics are more dependent on agriculture as 75% of world population lives in tropics and two thirds of these people's main occupation is agriculture. With low levels of technology, wide range of pests, diseases and weeds, land degradation, unequal land distribution and rapid population growth, any impact on tropical agriculture will affect their livelihood.

**CURRENT ACTIONS TAKEN BY INDIAN GOVT.FOR MITIGATION**

- To minimize the impact of climate change Indian govt. are taken some actions e.g. relocating the communities living close to the sea shore, for instance, to cope with the rising sea level or switching to crops that can withstand higher temperatures.
- To reduce the emissions of greenhouse gases that cause climate change in the first place, e.g. by switching to renewable sources of energy such as solar energy or wind energy or nuclear energy instead of burning fossil fuel in thermal power stations.
- There are 8 national mission for achieving key goals in the context of climate change

i. National Solar Mission
ii. National Mission for Enhanced Energy Efficiency
iii. National Mission on Sustainable Habitat
iv. National Water Mission
v. National Mission for Sustaining the Himalayan Ecosystem
vi. National Mission for a "Green India"
vii. National Mission for Sustainable Agriculture
viii. National Mission on Strategic Knowledge for Climate

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# Relevance of plant growth regulators in flower crops

Rakesh Kumar, Ajay Kumar Singh*, K S Tomar and Geeta Pandey**

Assistant Professor and Associate Professor*
Department of Floriculture & Landscape Architecture, College of Horticulture,
Banda University of Agriculture and Technology, Banda, Uttar Pradesh and **Assistant Professor
Department of Floriculture & Landscaping, College of Agriculture, Orissa University of Agriculture & Technology, Bhubaneswar
*Corresponding author: rakeshkashav53@gmail.com

**Abstract**

*Plant growth regulators play an important role in enhancing growth and development of plant. These substances in very less amount have an influence on flower yield and quality. Growth regulators affect plant metabolism by bringing a change in nutritional and hormonal status of the plant. Growth regulators promote, inhibit or modify the physiological processes of the plant. Floriculture is one of the fastest growing areas in horticulture sector. The floriculture has given a new dimension to horticulture by creating employment opportunities, socio-economic upliftment of farmers and enhancing revenue from exports. There is great demand for flowers in mega cities of India and other countries also. India's export of floriculture products has gradually increased from Rs. 115.4 crore in 2001 to Rs. 649.83 crore in year 2008. India is currently exporting cut flowers, bulbs and foliage plants to U.K., U.S.A., Germany, Netherlands, Switzerland, France, Spain and Poland.*

The plant growth regulators are the organic compounds, other than the nutrients, which in very small amount promote, inhibit or modify any physiological process in plant system. The major categories of growth regulators are auxins, gibberellins, cytokinins, ethylene and abscisic acid. Apart from these, certain growth retardants are also being used commercially in flower crops to control growth of plants for specific purpose. The floriculture sector at present is in its budding stage and has a tremendous scope in future. The main factors responsible for rise in demand of flower crops are rapid industrialization, change in life style of the people due westernization of culture and rise in socio-economic status of the people. The farmers are also showing interest in adopting floriculture business due to better returns per unit area as compared to other crops. Plant growth regulators may increase yield and quality of cut flower via controlling plant height, acceleration of flowering and increasing of flower primordia (Khangoli, 2001; Hedayat, 2001; Parmar et. al., 2015). Plant growth retardants are the most effective PGRs which exceedingly applied in ornamental plants. These compounds delay cell division and growth in the beneath apex, but they do not have any effect on meristem (Hedayat, 2001). The effects of plant growth regulators on different aspects of plant growth and development i.e. germination, rooting, growth, flowering and extending post harvest life of flowers are discussed as under:

**Germination**

The most commonly used growth regulator for breaking dormancy is indole butyric acid (IBA). Auxins are reported to enhance germination in orchid seeds. The gibberellic acid is effective for germination of *Rudbeckia bicolor*, *Lupinus regalis, Lavendula angustifolia, Coreopsis drummondi and Campanula carpatica*. The growth regulators can break dormancy of seeds and bulbs. The bulbs and corms fail to germinate due to higher concentration of abscissic acid. So by treating with ethephon, kinetin and $GA_3$ dormancy can be broken. Ethylene also known to promote sprouting of tuberose and freesia bulbs. $GA_3$ gives high sprouting percentage in lily bulbs. The gradual decrease in content of abscissic acid and increase in level of auxin and gibberellin is responsible for sprouting of bulbs and corms.

**Root formation**

The large numbers of ornamental plants are propagated by vegetative means such as stem and leaf cuttings. In some of the hard-to-root species, use of growth regulators is beneficial for inducing rooting. So cuttings are treated with growth regulator such as indole- butyric acid, which is most commonly used for rooting. The concentration of rooting hormone and duration of treatment depend on species, age of cutting and method of application. The low concentration of auxin is required for root elongation, although at high concentration, auxin acts as root growth inhibitor. The NAA and IAA are used comparatively less as compared to indole-butyric acid. The indole-butyric acid is used for rooting of bougainvillea, carnation, rose, poinsettia, gardenia, hibiscus, jasmine, magnolia, pelargonium and rhododendron cuttings.

**Plant height control**

The cities are becoming congested day by day due to rapid increase in population. Due to this, peoples are facing problem of enough space for keeping plants. The plants which are compact in growth habit can be accommodated easily and are more preferred. So there is need to control or retard the height of plants by use of growth regulators. The growth retardants delays cell division and elongation in shoot tissues. This results in reduced stem elongation which causes dwarfing effect. These retardants act via inhibition of gibberellins biosynthesis. The bedding and pot plants with dwarf stature are more in demand than tall ones. The growth retardant may be utilized for arresting growth of bedding and pot plants to enhance their consumer acceptance due to compactness, attractiveness and uniformity. B-nine, Ethephon, Paclobutrazole and Malic hydrazide decrease shoot growth in rose and reduce plant height in chrysanthemum,bougainvillea, petunias and cosmos. B-nine, Cycocel (chlormequat), Ancymidol used to control plant height to produce pot aster plant and pot christmas poinsettia. Phosphone is very effective in lilies and cycocel in poinsettias and bougainvillea. Cycocel often used to control size of container grown ornamental plants in nurseries, greenhouses and shade houses. Gul et al., 2006 reported accelerated flowering and enhanced plant height with use of $GA_3$ in ornamental plants.

**Growth promotion**

The gibberellins are used for promoting growth in plants due to its role in cell division and elongation. The GA is most common growth regulator used for increasing length of spikes in cut flowers and over all plant height. The cut flowers with long stem fetch better prize in market. Ethephon, Daminozide and BA promote branching, which results in more number of flowers per plant. GA is used in rose, chrysanthemum, gladiolus, lily and tuberose for promoting growth. Ethephon increase number of secondary shoots in rose. Malic hydrazide promotes branching in chrysanthemum. $GA_3$ improves yield and quality of ornamental plants via plant growth incitation and stem elongation (Fathipour and Esmaellpour, 2000).

**Flower induction and regulation**

Flowering is one of most important aspect in floricultural crops because these are valued primarily for beautiful flowers. The growth regulators can enhance, hasten or delay flowering in ornamental plants. The date of flowering can be regulated with growth regulators to get flowering on a particular date or occassion. In many species, vernalization requirement may be replaced by gibberellin application. Application of gibberellin induces flowering in some long days plants under short day condition. GA has effect on size of flower bud, bud diameter and flower yield in rose. Daminozide and Chlormequat enhanced early flower bud appearance, while Ethrel delays flowering. Malic hydrazide delays flowering in lily. The CCC and B-9 induces early flowering in tuberose. Gibberellic acid and NAA induces early flowering in chrysanthemum and Cycocel drenching delays flowering.

**Delays flower senescence**

The plant growth regulators plays an important role in increasing shelf life of flowers. The cytokinins have significant effect on prolonging flower life. Inhibitors of ethylene biosynthesis and action are useful in post harvest preservation of flowers. Kinetin delays petal senescence in rose. Ethrel, B-nine and Cycocel extend shelf life of flowers. Ethylene binding inhibitor 1-methylcyclopropene (1-MCP) used for increasing shelf life of cut flower. In transgenic petunia, ethylene biosynthesis blocked by transformation of antisense version of ACC oxidase.

**Herbicide**

The 2, 4-D and dicamba are most widely used as herbicide that induces excessive cell expansion and subsequent plant death in weeds. These are used by home gardeners for control of weeds such as dandelions and daisies in lawns. The 2,4,5-T and MCPA are also used as herbicide.

**Mitigating Stress**

The role of abscisic acid in making plants to tolerate freezing, salt stress and water stress led to characterization of abscisic acid as stress hormone. Abscisic acid causes stomatal closure and its accumulation in stressed leaves plays an important role in reduction of water loss by transportation under water stress conditions.
As the effect of a growth regulator varies from crop to crop and from one growth stage to other. So the growth regulator should be used in proper growth stage in a specific concentration to get desired effect in a particular crop. Overall, the usefulness of growth regulators cannot be ignored in influencing growth, flowering and enhancing shelf life of cut flowers.

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# Participatory plant breeding an approach for crop improvement

**S. K. Jain**

*College of Agriculture Lalsot, Sri Karan Narendra Agriculture University Lalasot (Dausa), Rajasthan*
*Corresponding Author: skjain.pbg.coalalsot@sknau.ac.in*

**Abstract**

Participatory plant breeding (PPB) is the development of a plant breeding program in collaboration between breeders and farmers, marketers, processors, consumers, and policy makers. It is seen by several scientists as a way to overcome the limitations of conventional breeding by offering farmers the possibility to decide which varieties suit better their needs and conditions without exposing the household to any risk during the selection progress. The aims of PPB are also more targeted, focusing on breeding for individual environments and needs. In fact, most progress with PPB has been in marginal or neglected environments. Farmer participation can usefully occur at various times, depending on the crop, parent materials, target region, researcher capacity to assimilate farmer criteria, farmer capacity to handle different types of materials, traits of interest, and scale of the breeding program/number of materials to be screened. A number of PPB varieties have been already released for many crops e.g, rice, maize, sorghum, barley, etc. in India and abroad.

In recent years there has been increasing interest toward participatory research, in general, and toward participatory plant breeding (PPB), in particular. Scientists have become increasingly aware that users' participation in technology development may in fact increase the probability of success for the technology. Participatory plant breeding (PPB) is when farmers are involved in a breeding programme with opportunities to make discussions at different stages during the process. Farmer's involvement in PPB can include defining breeding goals and priorities, selecting and providing germplasm, hosting trials in their fields, selection of superior plants, involvement in research designs and administration process and also involvement in commercialization of selected genotypes.

In the context of plant breeding in the developing world, PPB is breeding that involves close farmer-researcher collaboration to bring about plant genetic improvement within a species. PPB is a strategy for plant breeding with its own set of methodologies that applies in situations where the demand for specific varietal traits among producers, traders, industries and consumers is poorly understood and difficult to diagnose with conventional market research methods. PPB is a complement to conventional breeding approaches. Participatory plant breeding is seen by several scientists as a way to overcome the limitations of conventional breeding by offering farmers the possibility to decide which varieties suit better their needs and conditions without exposing the household to any risk during the selection progress. A number of PPB varieties have been already released for many crops e.g, rice, maize, sorghum, barley, etc. PPB, in particular, defined as that type of plant breeding in which farmers, as well as other partners, such as extension staff, seed producers, traders, and NGOs, participate in the development of a new variety, is expected to produce varieties which are targeted (focused on the right farmers), relevant (responding to real needs, concerns, and preferences), and appropriate (able to produce results that can be adopted) (Bellon, 2006). It is termed "participatory" because users can have a research role in all major stages of the breeding and selection process. Such 'users' become co-researchers as they can: help set overall goals, determine specific breeding priorities, make crosses, screen germplasm entries in the pre-adaptive phases of research, take charge of adaptive testing and lead the subsequent seed multiplication and diffusion process (Sperling et al., 2001).

Broadly, PPB is the development of a plant breeding program in collaboration between breeders and farmers, marketers, processors, consumers, and policy makers (food security, health and nutrition, employment).

## Goals of PPB

1. Increase production and profitability of crop production through the development and enhanced adoption of suitable, usually improved, varieties.
2. Build farmer skills to enhance farmer selection and seed production efforts.
3. Increase food security of the resource poor households and communities.
4. Provide benefits to a specific type of user, or to deliberately address the needs of a broader range of users.

## Activities under PPB:

- Identifying breeding objectives
- Generating genetic variability (including the provision of plants to be included in breeding program)
- Selecting within variable populations to develop experimental varieties
- Evaluating experimental varieties (PVS - participatory variety selection)
- Variety release
- Popularization (diffusion of information about new variety and and how it is managed)
- Seed production

## Stage of Farmers Participation and their role:

Farmer participation can usefully occur at various times, depending on the crop, parent materials, target region, researcher capacity to assimilate farmer criteria, farmer capacity to handle different types of materials, traits of interest, and scale of the breeding program/number of materials to be screened. The possible roles of farmers in participatory plant breeding are described (i) provide technical leadership, (ii) provide key social organizational leadership (iii) information giving role (iv) trainer/skill builder role, (v) field laborer role, (vi) input supply role: provide land for 'realistic' bio-physical sites, and (VII)provide landrace or farmer material used for further breeding work.

Traditional breeder-directed breeding programs are very effective at developing varieties that can be used in farming systems that are fairly homogeneous, but less effective when the reality of the farmer is more complex and risk-prone. Note that the private sector, although not explicitly included, is a key participant in the maintenance of genetic diversity in the food/fiber system. PPB encourages two kinds of participation

<u>Functional Participation</u>

- Plant breeders can direct their research according to the needs of the specific groups of farmers (women, men, rich, poor). The physical and economic resource bases of different people necessitate tailored research approaches.
- Farmers can assure plant breeders that they are assessing tradeoffs among traits correctly.
- On-farm research assures that varieties will produce well under "real life" conditions. On-farm research can be managed by the researcher, by the farmer, or by both.
- PPB ensures greater success of adoption of innovation by the farmers.

<u>Empowering Participation</u>

- Increasing farmer knowledge and skills so that farmers can participate more fully in the collaborative breeding efforts and be better at their own, personal efforts.

## PPB vs conventional plant breeding

PPB was developed as an alternative and complementary breeding approach to conventional plant breeding (Fig. 2). Conventional plant breeding is generally carried out by trained breeders in laboratory or controlled environments, often under favorable farming conditions. The main objectives of conventional breeding programmes tend to focus on 'broad adaptability' or the capacity of a variety to produce high yields over a range of environments and years. Conversely, PPB involves breeders, farmers and other 'consumers' or end users such as rural farm associations or cooperatives in plant breeding research. This enables breeders to better understand the local farming conditions, the farmers' traditional ways for managing plant diversity as well as their specific needs and preferences. The aims of PPB are also more targeted, focusing on breeding for individual environments and needs. In fact, most progress with PPB has been in marginal or neglected environments (those that are naturally harsh climates or are excluded from connective infrastructure such as roads and markets).

Table 1. Conventional plant breeding vs Participatory (PPB) Breeding

| S. No. | Conventional plant breeding (PB) | Participatory (PPB) Breeding |
|---|---|---|
| **1** | Linear with a distinct finished product as the output, disposal of unwanted germplasm | Cyclical with materials continuously feeding into living adaptive processes in the field, germplasm enters into the production system throughout the process |
| **2** | Priority setting are Private sector, breeders, industrial users | Priority setting are Farmers and breeders, at times other user |
| 3 | Favorable robust environment | Heterogeneous fragile environment |
| 4 | Assured inputs | Low / inadequate inputs |
| 5 | Can be cost-intensive | Has to be cost-effective |
| 6 | Aims at widely applicable impact [Wide horizon] | Has to focus on site-specific methods [Narrow horizon] |
| 7 | Selection and testing by Breeders, at times including farmers in PVS towards the end of the process | Selection and testing by Farmers and breeders |
| 8 | Location of field trials :On-station | Location of field trials : In farmer fields and on-station |
| 9 | Can invest high technical skill | Constrained to farmer preference |
| 10 | Can work on high-tech mode | Learn to scale-up downstream technology |
| 11 | Unrestrained options base [Narrow genetic base] | Wide options to utilize site diversity both intra- and inter-specific [Broad genetic base] |
| 12 | Can rest on an innovative theoretical | Has to be practical with popular acceptance |
| 13 | High productivity is the usual target | Sustainability of production (though moderate) and local preference are targets |
| 14 | Generates new varieties and identifies growing targets [Exploiting G x E] | Site-specific varieties imperative [Utilizing G x E] |
| 15 | Product as Officially released varieties | Product as Improved materials for own use, sometimes officially released varieties |

**Advantages/ benefits of Participatory Breeding Methods**

1. At least one parent in any cross is well adapted to the local environment.
2. Genotypes x environment interactions are used positively because breeding is done in the target environment.

3. The impact of genotype x year interaction is probably reduced because local parental materials have adapted to local year-to-year variations.
4. Only a few crosses are made, so large F2 and F3 populations can be grown to increase the likelihood of selecting desirable segregants.
5. Adaptation of varieties on farmer's field.
6. Suitability of varieties to farmer's condition and needs.
7. Inclusion of farmer's own innovation and local knowledge.
8. Product varieties are targeted because they are focused on the right farmers; relevant because they respond to the real needs, concerns and preferences of farmers; appropriate because they can be adopted and used under the conditions in which farmers live.

**Achievements of PPB in India**

Plant breeders and farmers worked together to produce improved varieties of maize for the low-resource farmers of the Panchmahals district of Gujarat, India. Initially, farmers tested a range of maize varieties in a participatory varietal selection (PVS) programme. However, none of these proved to be very popular with farmers, although farmers who had more fertile fields adopted the variety Shweta from Uttar Pradesh. Hence, in 1994 a participatory plant breeding (PPB)programme was begun to generate new, more appropriate varieties. Yellow- and white-endospermed maize varieties were crossed that had been either adopted to some extent following PVS or had attributes, such as very early maturity, that farmers had said were desirable. In subsequent generations, the population was improved by mass selection for traits identified by farmers. In some generations, farmers did this in populations which were grown by breeders on land rented from a farmer. Soil fertility management was lower than that normally used on the research-station. The breeding programme produced several varieties that have performed well in research-station and on-farm trials. One of them, GDRM-187, has been officially released as GM-6 for cultivation in hill areas of Gujarat state, India. It yielded 18% more than the local control in research-station trials, while being seven days earlier to silk. In farmers' fields, where average yields were lower, the yield advantage was 28% and farmers perceived GDRM-187 to have better grain quality than local landraces. PPB produced a variety that was earlier to mature than any of those produced by conventional maize breeding, and took fewer years to do so. The returns from PPB, compared to conventional breeding, are higher because it is cheaper and benefits to farmers are realized earlier. New varieties of rice, Ashoka-200F and Ashoka-228 bred by client oriented breeding (COB) in Eastern India by Virk et al., (2003). Farmers in a remote area of India, where soils are highly degraded and production is subsistence oriented, could identify varieties of several major crops that provided them with new options, more food, and greater stability of production (Witcombe and Joshi, 1996). The documentation of adoption of the rice variety "Kalinga III" is a good example of the spread of a variety identified through farmers' participation in variety testing.

## CONCLUSION

Participatory plant breeding in the context of plant breeding in the developing world, PPB is breeding that involves close farmer-researcher collaboration to bring about plant genetic improvement within a species. It is seen by several scientists as a way to overcome the limitations of conventional breeding by offering farmers the possibility to decide which varieties suit better their needs and conditions without exposing the household to any risk during the selection progress. Farmer participation in breeding can improve the selection of suitable varieties for different complex environments because farmers' are given the opportunity to screen new varieties on their specific environment rather in controlled experiment stations; and farmers' selection criteria for varieties are better understood by breeders. Meeting farmer needs may be better tackled by creating different varieties rather than trying to produce multi-purpose varieties. PPB programmes in India is going on with collaboration of three universities in Madhya Pradesh, Rajasthan and Gujarat on six crops: maize, rice, horsegram, black gram, niger and sunn hemp. There are many achievements of PPB in India and abroad.

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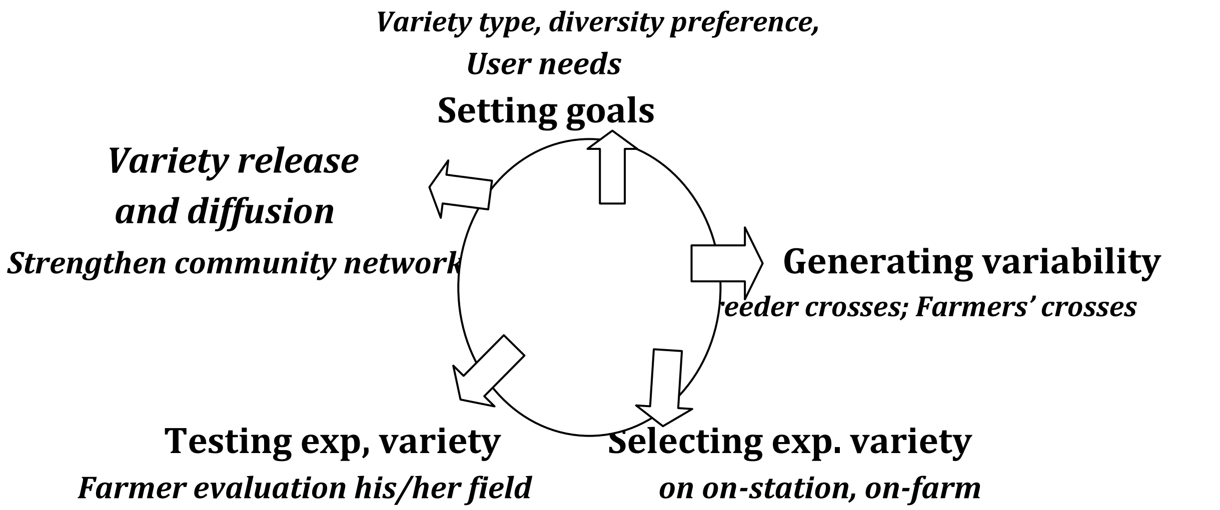


**Fig. 1: Cycle of plant breeding stages, where farmers can participate**

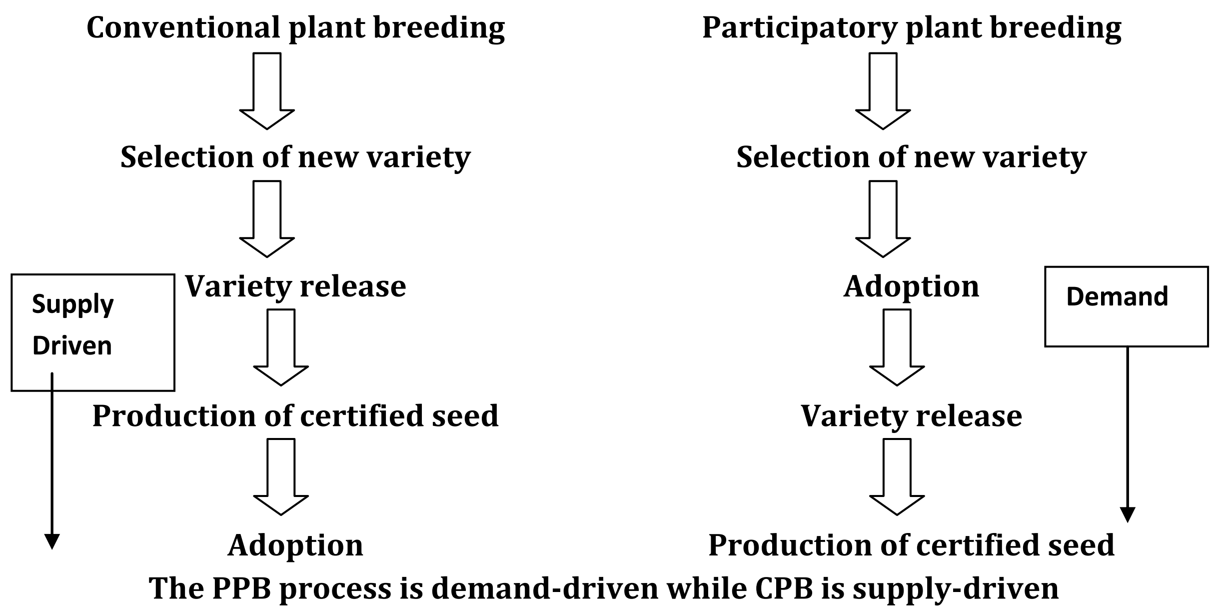


Fig. 2. In Conventional Plant Breeding (CPB) new varieties are released before knowing whether the farmers like them or not and the process is typically supply-driven. In Participatory Plant Breeding (PPB) the delivery phase is turned upside down because the process is driven by the initial adoption by farmers at the end of a full cycle of selection and is therefore demand-driven. (Source: Ceccarelli and Grando, 2007).

# How to formulate a project report for 20 dairy cow units

**Amit Kumar Singh[1*] and Surjyakanta Roy[2]**

[1]*M.Sc. LPM Scholar, ICAR-NDRI, Karnal, 132001*
[2]*M.Sc. Dairy Extension Scholar, ICAR-NDRI, Karnal, 132001*
[*]*Corresponding author email- amitkumarsingh5496@gmail.com*

It is always suggested by experts to open a small dairy unit to the farmers. Setting up small scale enterprise helps farmers which are having less or no previous experience. It may well provide them additional source of income. In future farmers can develop their farm gradually to big herds. For providing assistance to the farmers many banks or financial organizations provide loan under various development schemes.

**Small dairy units for the farmers**

For establishing a small herd, bank loan can be obtained by a matriculate or trained rural person having own required land for establishing farm for crossbred cattle**.** This borrowed money should earn such income that farmers can repay loan along with interest charged by the bank. Obtaining sufficient income from such availed loan amount depends upon one's ability to execute work in proper manner. Broad suggestion regarding working management is provided below:

**Factors considered for setting unit of 20 dairy crossbred cows**

**Calculating capital investment**

1. Cost of 20 milch cows @ Rs. 30,000/ cow Rs. 6,00,000
2. Cost of cattle shed with mud tile roof, brick floor and half brick wall (covered area- 70 sq. m. & open area- 140 sq.m.) Rs. 4,80,000
3. Cost of equipments like milk cans, pails, buckets, chains, balance, etc. Rs. 40,000
4. Miscellaneous Rs. 10,000

   **Total capital investment- Rs. 11, 30,000**

**SPACE REQUIREMENTS FOR DAIRY UNITS:**

Floor space requirements of dairy animals in loose housing (BIS: 1223 -1987)

| **Type of animal** | **Floor space per animal (m2)** | |
|---|---|---|
| | **Covered area** | **Open Area** |
| Young calves (< 8 weeks) | 1.0 | 2.0 |
| Older calves (> 8 wks) | 2.0 | 4.0 |
| Heifers | 2.0 | 4-5 |
| Adult cows | 3.5 | 7.0 |
| | | |
| Adult buffaloes | 4 | 8.0 |
| Cows approaching calving | 12 | 20.5 |
| Bulls | 12 | 120.0 |
| Bullocks | 3.5 | 7.0 |

Feeding manger and water trough requirements of dairy animals (BIS IS 11799:2005)

| Type of animal | Feeding manger length per animal (cm) | Water trough length per animal (cm) |
|---|---|---|
| Young calves (< 8 weeks) | 40-50 | 10-15 |
| Older calves (> 8 wks) | 40-50 | 10-15 |
| Heifers | 45-60 | 0-45 |
| Adult cows | 60-75 | 45-60 |
| Adult Buffaloes | 60-75 | 60-75 |
| Calving females | 60-75 | 60-75 |

| | | |
|---|---|---|
| Bulls | 60-75 | 60-75 |
| Bullocks | 60-75 | 60-75 |

**Calculation of average days in milk and dry;**

**Wet: Dry cow =** 80: 20

**Calculation for one year**

1. Milch cows in days- 16 * 365 = 5820 days
2. Dry cows in days- 4* 365= 1460 days
3. Milk yield/cow/day= 10 Kg
4. Total milk yield= 58400 Kg
5. Selling price of milk= Rs. 30/Kg

**Calculating operational/ recurring expense for one year:**

| **S.N.** | **Parameters** | **Expenditure (Rs.)** |
|---|---|---|
| 1 | Feed for milch cows- 5840 days * Rs. 100 | 584000 |
| 2 | Feed for dry cows 1460 days * Rs. 55 | 80300 |
| 3 | Insurance @ 3% | 24000 |
| 4 | Medicine Rs. 800/cow + vet. Cost | 40000 |
| 5 | A.I. cost @ Rs. 100/A.I. with 2A.I./ cow/conception | 4000 |
| 6 | Labour charges @ 200/day/labour * 365 days | 146000 |
| 7 | Depreciation charges for cows @ 10% | 60000 |
| 8 | Depreciation cost for shed and equipments @10% | 54000 |
| 9 | Miscellaneous | 10000 |

Total expenditure- Rs. 1002300

**Calculation of Income for a year:**

| S.N. | Parameters | Income (Rs.) |
|---|---|---|
| 1 | Sale of milk 58400 Kg * Rs. 30/Kg | 1752000 |
| 2 | Farm yard manure- 200 Kg/day @ Rs. 80/ qtl. * 365 | 43800 |
| 3 | Followers | 25000 |
| Total income | | 18,20,800 |

**Calculating profit for a year:**

1. **Annual profit=** Income- expenses
   = Rs. 18,20,800- Rs. 10,02,300
   = Rs. 8,18,500
2. **Profit / month=** Rs. 68208
3. **Profit/month/cow=** Rs. 3410

**Calculating repayment of loan:**

Assuming borrowed amount as loan of Rs. 10, 00,000 for capital investment, repayment would be for bank loan interest for capital given @ 12% interest p.a. as follows:

| Year | Profit (Rs.) | Installment (Rs.) | Interest @ 12% (Rs.) | Total payment (Rs.) | Surplus amount (Rs.) |
|---|---|---|---|---|---|
| 1 | 818500 | 200000 | 120000 | 320000 | 498500 |
| 2 | 818500 | 200000 | 96000 | 296000 | 522500 |
| 3 | 818500 | 200000 | 72000 | 272000 | 546500 |
| 4 | 818500 | 200000 | 48000 | 248000 | 570500 |
| 5 | 818500 | 200000 | 24000 | 224000 | 594500 |

**Production of fodder:**

12 acres of land would be sufficient to provide green fodder for 20 dairy units. Some fodder crops like Green maize, Cowpea, Berseem, Sorghum, Hybrid Napier, Sudan grass, Paragrass, oats can be sown for obtaining green fodder round the year. In summer season Green Maize, Cowpea, Sorghum, Sudan grass can be sown and cultivated. During winter season oats, Berseem, Maize, Lucerne can be utilized. Napier, Paragrass, Guinea grass can be well utilized in lean periods.

## CONCLUSIONS

Considering this model, it can be said that Rs. 5, 00,000 as annual income could be obtained from a 20 dairy cow herd with proper management strategies. However, this model will fluctuate with change in different parameters like market, climatic conditions, productive and reproductive traits of animals, etc. By seeing this model one can gradually, with experience, formulate his/her own project proposal.

***Note:*** *This is typical example of formulating financial statements for a general dairy unit. However, different places may have different rates, services and animal, also different productive and reproductive traits. So, those factors should be considered for developing such projects for dairy unit establishment.*

# Flaxseed and its health benefits

**Mohit Chaudhary* and Atman Poonia**

*Department of Genetics & Plant Breeding,*
*CCS Haryana Agricultural University, Hisar-125004*
**Corresponding Author: mohitgpb@gmail.com*

**Abstract**

*Flaxseed belongs to genus Linum, largest genus of family Linaceae. It is the sole species of agricultural importance in family Linaceae. This crop is grown for fibre, seed oil or both seed oil as well as fibre, but recently it has gained a new interest in the emerging market of functional food due to its high content of fatty acids, alpha linolenic acid (ALA), an essential Omega-3 fatty acid and lignin oligomers which constitute large proportion of total fatty acids in Flax-seed.*

## INTRODUCTION

Flaxseed belonging to family Lineaceae is one of the oldest crops, having been cultivated since ancient time. The Latin name of the flaxseed is *Linum usitatissimum*, which means "very useful". Every part of the flaxseed plant is utilized commercially, either directly or after processing. The stem yields good quality fibres having high strength and durability. Flaxseed is used to describe flax when consumed as food by humans while linseed is used to describe flax when it is used in the industry and feed purpose (Morris 2007). Flax fibre is extracted from the skin of the stem of the plant. Flax plant contains approximately 25 % seed and 75 % stem and leaves (Lay and Dybing 1989). The stem or non-seed parts are about 20 % fibre, which can be extracted by chemical or mechanical retting. A flax fibre is a natural and biodegradable, soft, lustrous and flexible. In the last two decades, flaxseed has been preferred as health food due to the potential health benefits associated with some of its biologically active components. Flaxseeds are rich source of ω-3 fatty acid: α-linolenic acid (ALA), short chain polyunsaturated fatty acids (PUFA), soluble and insoluble fibres, proteins and an array of antioxidants. Its gaining popularity due to role in reducing cardiovascular diseases, decreased risk of cancer, particularly of the mammary and prostate gland, laxative effect, alleviation of menopausal symptoms, anti-inflammatory activity and osteoporosis. It is cultivated in more than 50 countries. Major linseed growing countries are Canada, Russia, China, India, USA, Ethiopia. In India flaxseed is mainly cultivated in Madhya Pradesh, Maharashtra, Chattisgarh, Bihar, Uttar Pradesh, West Bengal and Assam. It is interesting to know that flaxseed was native of India and was a staple food crop. In India, flaxseed is still being consumed as food and as well as for medicinal purposes. It enjoys a good status among oilseeds because of its versatile uses.

## NUTRITIONAL COMPOSITION

Flaxseed is one of the richest plant sources of the ω-3 fatty acid i.e. α-linolenic acid (ALA) and lignans (phytoestrogens). The composition of flaxseed is presented in Table 1

Table 1 Nutritional composition of flaxseed Nutrients Amount per 100 g of edible flaxseed

| | |
|---|---|
| Moisture (g) | 6.5 |
| Protein (N×6.25) (g) | 20.3 |
| Fat (g) | 37.1 |
| Minerals (g) | 2.4 |
| Crude fibre (g) | 4.8 |
| Total dietary fibre (g) | 24.5 |
| Carbohydrates (g) | 28.9 |
| Energy (kcal) | 530.0 |
| Potassium | 750.0 |
| Calcium (mg) | 170.0 |
| Phosphorous (mg) | 370.0 |
| Iron (mg) 2.7 | 2.7 |
| Vitamin A (µg) 30.0 | 30.0 |
| Vitamin E (mg) 0.6 | 0.6 |
| Thiamine (B1) (mg) 0.23 | 0.23 |
| Riboflavin (B2) (mg) 0.07 | 0.07 |
| Niacin (mg) 1.0 | 1.0 |
| Pyridoxine (mg) 0.61 | 0.61 |
| Pantothenic acid 0.57 | 0.57 |
| Biotin (µg) 0.6 | 0.6 |
| Folic acid (µg) 112 | 112 |

Morris 2007; Gopalan et al. 2004; Payne 2000

Cotyledons are the major oil storage tissues, containing 75 % of the seed oil (Rubilar et al. 2010; Singh et al. 2011a, b). Flaxseed oil is rich in polyunsaturated fatty acid (73 %) having high α- linolenic acid concentration ranging from 39.00 to 60.42 % followed by oleic, linoleic, palmitic and stearic acids (Table 2). Nutritional value and amino acid profile of flaxseeds are comparable to that of soya proteins (Madhusudan and Singh 1985). Flaxseed protein is rich in arginine, aspartic acid and glutamic acid, while limiting in lysine hence flax protein is not considered to be a complete protein (Singh et al. 2011a, b; Chung et al. 2005). High level of linolenic acid in the oil causes it to be unsuitable for use in edible products because of undesirable odour and flavour that result from the auto-oxidation of this unsaturated fatty acid**.** The protein content of flaxseed varies from 20 to 30 %, constituting approximately 80% globulins and 20 % glutelin (Hall et al. 2006). Flaxseed contains no gluten (Hongzhi et al. 2004; Oomah

2001). Flax fibres contain both soluble and insoluble dietary fibres. The major insoluble fibre fraction consists of cellulose and lignin, and the soluble fibre fractions are the mucilage gums. Insoluble fibre helps improve laxation and prevent constipation, mainly by increasing fecal bulk and reducing bowel transit time.

## ANTI-NUTRITIONAL FACTORS

Flaxseed contains cyanogenic glycosides as the major anti-nutritional factor. Fibre type has a higher percentage of glycosides than the seed type, and ripe seed contains less glycoside than the immature seed. Cyanogenic glycosides are heat labile and easily destroyed by processing. Phytic acid, another anti-nutrient present in flaxseed supposed to interferes with the absorption of calcium, zinc, magnesium, copper and iron.

## HEALTH BENEFITS

Flaxseed oil offers a wide range of health benefits. There are some studies showing that flaxseed oil can reduce total cholesterol and LDL (low density lipoprotein also known as bad *cholesterol*). This, however, is dependent on how well the alpha-linolenic acid is broken down into EPA and DHA. Flaxseed oil is likely to make platelets less sticky, which could help to reduce the risk of heart attack. It may also lower blood pressure and triglyceride levels (fat in the blood). Flaxseed oil has anti-inflammatory properties and has been shown to regulate the heartbeat, further supporting good cardiovascular health. In addition, the flax seed contains compounds called lignans. Studies indicate that liganins rich diet reduce the risk of various hormone dependent cancers, heart diseases and osteoporosis. The ALA found in flaxseed inhibited tumor growth and incidence in animal studies.

## CONCLUSION

Flaxseeds are the richest source of α-linolenic acid and lignans. It is also a potential source of soluble fibre, antioxidants and high quality protein. Lignans and ω-3 fatty acid plays an active role in reducing the risks associated with cardiac and coronary disease and cancer (breast, colon, ovary and prostate). There is no doubt that a change to an omega-3 rich and high fibre diet would be beneficial. Hence, the use of flaxseed in whole seed or ground form can be recommended as a dietary supplement.

**Table 2**: Major fatty acids profile in flaxseed oil

| Fatty acid | Percentage (%) |
|---|---|
| Palmitic acid (C16:0) | 4.90-8.00 |
| Stearic acid (C18:0) | 2.24-4.59 |
| Oleic acid (C18:1) | 13.44-19.39 |
| Linoleic acid (C18:2) (ω-6) | 12.25-17.44 |
| α -Linolenic acid (C18:3) (ω-3) | 39.90-64.42 |

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# Way towards Animal Welfare

Nikita Sonawane[1], Deepika Tekam[2], Adhiti Bhanotra[3] and Manish Sawant[4*]

[1&2] M.V.Sc. Scholar (II Year); [3]Assistant Professor; [4]Associate Professor and In charge
Department of Veterinary and Animal Husbandry Extension,
Mumbai Veterinary College, Parel
Maharashtra Animal and Fishery Sciences University, Nagpur
*Corresponding Author: drmanishext@gmail.com

*The greatness of a nation can be judged by the way of its animals are treated*
***Mahatma Gandhi***

Animal welfare is defined as the avoidance of abuse and exploitation of animals by humans; by maintaining appropriate standards of accommodation, feeding and general care, the prevention and treatment of disease and the assurance of freedom from harassment, and unnecessary discomfort and pain.

The animal welfare concept arises from that the animals also have feeling and they also have freedom to express their behavior. Caring for animal welfare means keeping animals healthy and free from suffering (Broom, 1986). It can be achieved by keeping the animals in clean, well designed house or in natural conditions. Poor welfare is caused due to overcrowding or by neglect in unhygienic conditions that spreads disease in animals. Respect for animal welfare is often based on the belief that non – human animals are sentient & that consideration should be given to their well being or suffering, especially when they are under the care of humans. These concerns can include how animals are slaughtered for food, how they are used in scientific research, how they are kept as pets or in zoos, farms, and circus etc. & how human activities affect the welfare & survival of wild species. Animal welfare is the application of sensible and sensitive practices towards animals both in commercial farms and at domestic level. Animal welfare is based upon how the animal treated by its owner, does the animal have freedom to express the natural behavior.

## HISTORY

In India, animals are protected by Prevention of Cruelty to Animal Act, 1960. World Animal Day, an International day of action for animal rights and welfare is celebrated annually on October 4$^{th}$ in the memory of the feast day of Francis of Assisi, the patron saint of animals however it was originated by Heinrich Zimmermann the German writer who proposed the congress of the World's Animal Protection Organization on May 31 at Florence Italy to make 4$^{th}$ October as World Animal Day which was unanimously accepted. However the same is celebrated as World Animal Welfare day (also called by some persons as Animal Lover's day) to improve animal welfare standards globally through the support and involvement of national and international organizations that care and love animals (Bhatt *et al.,* 2018). World Animal Day celebrates relationship between human kind and animal kingdom. It is a wonderful reminder of different ways in which animals enhance our lives. Various activities are celebrated on that day such as launching of animal welfare camp, opening of rescue shelters for the animals and organization of funding raising events. The Animal Welfare Fortnight is also celebrated every year from January 14 to January 30 to create awareness in the civic society to create awareness to treat all animal life with respect kindness and compassion. (Press note of Ministry of Environment, Forest and Climate Change, 2012)

In India as a part of creating awareness the Animal Welfare Board, centre's apex body to ensure animal welfare laws decided to observe "Basantpanchami" as Animal Welfare Day across the country. Accordingly, India will celebrate its first Animal Welfare Day on 10$^{th}$ February (Times of India, 2019). The importance of animal welfare; that India accords to the protection of animals and their rights, reflected in the fact that constitution of India recognizes the need for their protection. Article 51 A gives every citizen of India the fundamental duty to have compassion for all living creatures. India was also one of the first countries to enact the law on animal cruelty: Prevention of Cruelty to Animals, 1960.

## INSTITUTIONS INVOLVED IN ANIMAL WELFARE

In India, first animal welfare law, the Prevention of Cruelty to Animals Act, 1960 criminalizes cruelty to animals, though exceptions are made for the treatment of animals used for food and scientific experiments. The above Act created the establishment of two statutory bodies viz, Animal Welfare Board of India (AWBI) and Committee for the Purpose of Supervision and Control of Experiments on Animals (CPCSEA).

Animal Welfare Board of India (AWBI) was established in 1962 to ensure the enforcement of anti-cruelty provisions and promote the cause of animal welfare. The animal welfare division is entrusted with the implementation of the provisions of the Prevention of Cruelty to Animals Act, 1960. In India the subject of wildlife protection there are most comprehensive laws but the domesticated animals do not have the specific protection as that of wildlife. As the welfare measures are not followed the AWBI had moved to the court against some erring states. The members of the board are regularly holding meetings with the Chief Minister of the States and sensitizing them on the issue and asking them to work proactively towards the rehabilitation of stray animals and take strict action against those who deliberately allow their cattle to roam on streets.

Apart from this, there is a subordinate body namely, National Institute of Animal Welfare (NIAW), Ballabhgarh, Haryana for imparting training and education regarding animal welfare. AWBI does work like recognition to over 3000 animal welfare organizations, release of grants-in-aid under various animal welfare schemes, inspection of slaughter houses, publication of newsletter and pamphlets, conducting trainings of Honorary Animal Welfare Officers and seminars on various aspects of animal welfare. It also provides fund for Gaushala and shelter house, animal birth control program, animal ambulance, relief to animals during natural calamities.

World Organization for Animal Health (OIE) an intergovernmental organization responsible for improving animal health worldwide. The OIE has been established "for the purpose of projects of international public utility relating to the control of animal diseases, including those affecting humans and the promotion of animal welfare and animal production food safety"

Another organistaion, World Animal Protection (WAP), an international organization protects animals across the globe. World Animal Protection's objectives are to include helping people to understand the critical importance of good animal welfare, encourage nations to commit to animal–friendly practices, and build the scientific case for the better treatment of animals. They are global in a sense that they have consultative status at the Council of Europe and collaborate with national governments, the United Nations, the Food and Agriculture Organization for animal health. There are many non-government organizations (NGOs) also which works day and night for the protection and animal welfare like People for the Ethical Treatment of Animals (PETA), Royal Society for the Prevention of Cruelty to Animals (RSPCA), Humane Society International (HSI), International Fund for Animal Welfare (IFAW), The Brooke, World Society for the Protection of Animals (WSPA), World Veterinary Association (WVA) etc.

## APPROACHES FOR ANIMAL WELFARE

In animal husbandry sector, the concept of five freedoms emerge in 1979 which are also considered as approaches for describing and defining animal welfare. The five freedoms are internationally recognized animal welfare standards which includes

1. **Freedom from thirst and hunger**

The diet provided must take account of the animal's physiological state i.e. lactation, pregnancy, growth, nutritional composition & quality of feed and climatic factors. Animals must have access to good quality food and drinking water to maintain good health, to meet their physiological and production requirements and minimize metabolic and nutritional disorders.

2. **Freedom from discomfort**

A clean, dry, comfortable bedded lying area and sufficient space should be allowed to prevent discomfort.

3. **Freedom from pain, injury and disease**

Animals must be protected from injury and from elements that may cause pain and disease. Their physical environment must be maintained in such a way that it promote good health. It can be achieved by rapid diagnosis & treatment of animal.

4. **Freedom from fear and distress**

In order to avoid stress to animal it is important to understand the basics of animal's behavior; particularly during the movement and when they are loaded or unloaded. Mixing of different social groups, ages, and different sex of animals can also be very stressful condition for them it may result in injury. Careful inspection is particularly important when there is a situation of disaster (either man-made or natural) or emergency such as outbreaks of contagious disease.

5. **Freedom to express natural behavior**

Animal should be provided with sufficient space and proper facilities like space for lying down/resting, moving, eating, drinking and the elimination of faeces and urine. The overcrowding of animals increases social and microbiological stress in all age groups, and therefore it increases risk of disease. As a general guideline, the minimum space provided should be 1 meter square per 100kg live weight, but the actual space allowance that is provided should ensure that the animals achieve adequate lying/resting space.

## ACTS REGARDING ANIMAL WELFARE

a. ***Draft Animal Welfare Act, 2011***

The salient features of the draft enactment are as follows :

- Augmenting animal welfare and wellbeing.
- Strengthening animal welfare organizations, and conscientious citizens who wish to espouse the cause of animal welfare and wellbeing.
- Enhancing penalties for animal abuse.
- Altering and enlarging the definition of animal abuse, in keeping with the times, and in keeping with judicial pronouncements.

b. ***Prevention of cruelty to animals in animal markets rules, 2018***

Environment ministry has brought the draft Prevention of Cruelty to Animals in animal markets rules, 2018 and has completely banned both the buyer and seller, from trading cattle for slaughter. The draft regulation has also omitted the lengthy procedure that required the seller to attest that the cattle were not being sold for slaughter. Proposed norms mandate the formation of a committee to prevent cruelty in markets in each district, replacing the earlier district animal market monitoring committee. They will comprise the district magistrate, one representative of state animal welfare board, super indent of police of the district, one representative of local nongovernmental organization, one member of society for the prevention of cruelty to animals, district veterinary officer, representatives from Zilla Parishad and chairman of municipal council.

**Recent verdict on Animal Welfare**

Uttarakhand High Court in recent judgment stated that the entire animal kingdom including avian and aquatic animals are legal entities having corresponding rights duties and liabilities of living person in short the court has extended the rights of living person to animal kingdom. The verdict also gave directions to the state government to ensure treatment of stray animals and also issued range of specific reactions to the government and local bodies regarding the welfare and prevention of cruelty to domesticated animals. This judgment might provide to wildlife populations living outside of protected areas. Thus, it might help saving elephants entering human habitation in Bengal and Assam, leopards roaming in the fields of sugarcane in Western

Maharashtra, from angry villagers seeking revenge who might have lost their crops, domesticated animals (Down to Earth, 2018).

## Animal welfare and future

When we take care of animal welfare it can help to protect environment and can help in sustainable food production. Few developing countries have realized that intensive farming is against welfare and is also not environmentally sustainable. It increases the chances of disease that are bad for both animals and people and also add pressures on viability of the farming. Therefore developed countries are focusing on extensive farming nowadays. Livestock kept in extensive farming use local resources and recycle the productivity of the land (Appleby, 2006).

## CONCLUSION

Farm animal welfare can help in improving the lives of both animals and people and also in protecting the environment so it should be given great consideration both in theoretical and practical aspects. To achieve wellbeing of the animals and to maintain it whenever the animals are used or any interaction is there people concerns about animal welfare should be maximized. Labeling should be done on the products which are tested on animal so that awareness about animal welfare can be created.

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