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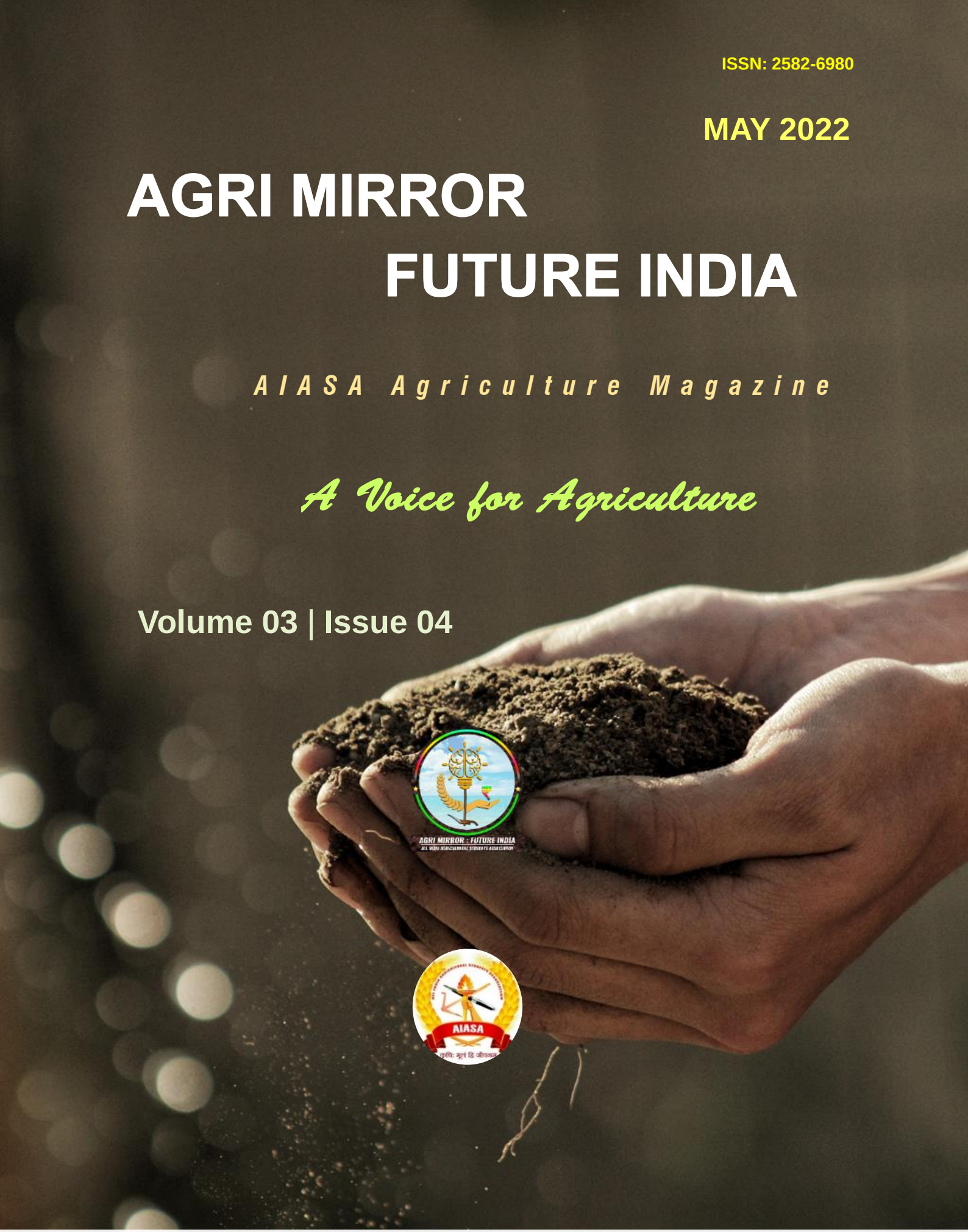

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A Voice for Agriculture

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EXTRAFLORAL NECTARIES IN PLANT INSECT INTERFACE REACTION

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Introduction

Nectar is a Greek word, "nektar" which is derived from the ancient Egyptian word "ntry". The nectar was first recorded in 1609 which means a "sweet plant secretion" and mentioned as floral nectar only. Plants have two types of nectars *viz*., floral nectar and extrafloral nectar. The floral nectars are obtained evolutionarily from extrafloral nectars.

Extrafloral nectaries

Nectar-secreting organs located on any above-ground plant parts which are not involved in pollination are called extrafloral nectaries (EFNs). EFNs reported in more than 100 families of plants. These function in plant defense against herbivory *via* the recruitment of ants and other predatory or parasitoid insects. The location of EFNs vary such as leaf blade, leaf petiole, cotyledon, stem, bract, stipule, fruit, pod, flower bud, peduncle, flower stalk, external surface of flowers. The EFN also known as Extranuptial nectaries or Non-reproductive nectaries or Extra-reproductive nectaries.

Extrafloral nectaries

Types of EFNs and visitors

Insect / arthropod	Plant parts	Plant
***a) Solenopsis* sp.**	Stem	*Passiflora sexocellata*
b) Ectatomma tuberculatum	Base of a leaf	*Qualea multiflora*
c) Camponotus crassus	Bract	*Oratea spectabilis*
d) Camponotus planatus	Underside of a leaf blade	*Hibiscus tiliaceus*
e) Oxyopes macroscelides	Leaf petiole	*Banisteriopsis mallifolia*
f) Ectatomma tuberculatum	Developing fruits	*Tocoyena formosa*

Types of EFNs and visitors

Extrafloral nectar

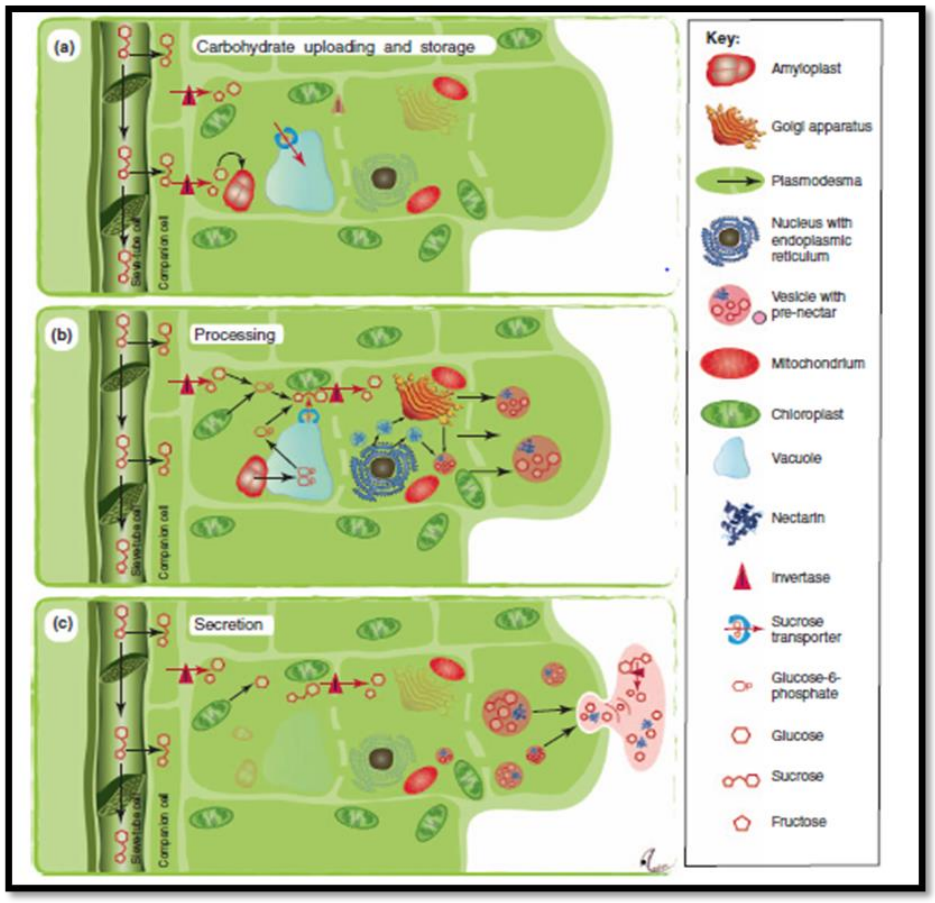
Extrafloral nectar is an aqueous solution containing sugars and amino acids which is secreted from extrafloral nectary organs. Extrafloral nectar is secreted on the vegetative parts and attracts members of the third trophic level - indirect defense against herbivores. The EFN is secreted in higher amount on young leaves, developing fruits and response to herbivore inflicted damage, mechanical damage and exogenous application of jasmonic acid (JA). EFN contains mono saccharides, disaccharides, amino acids, lipids and proteins.

e.g., The extrafloral nectaries of *Vicia faba* - leaf tissues surrounding the nectaries, exhibit high levels of L-3,4-dihydroxyphenylalanine (L-DOPA), a non-protein amino acid toxic to insects (Gish *et al.* 2016).

Plant Families with EFN

- Fabaceae
- Rosaceae
- Euphorbiaceae
- Bignoniaceae
- Asteraceae
- Malvaceae
- Salicaceae
- Cucurbitaceae
- Caprifoliaceae
- Apocynaceae
- Liliaceae
- Convolvulaceae

Extrafloral nectar secretion



Extrafloral nectar secretion

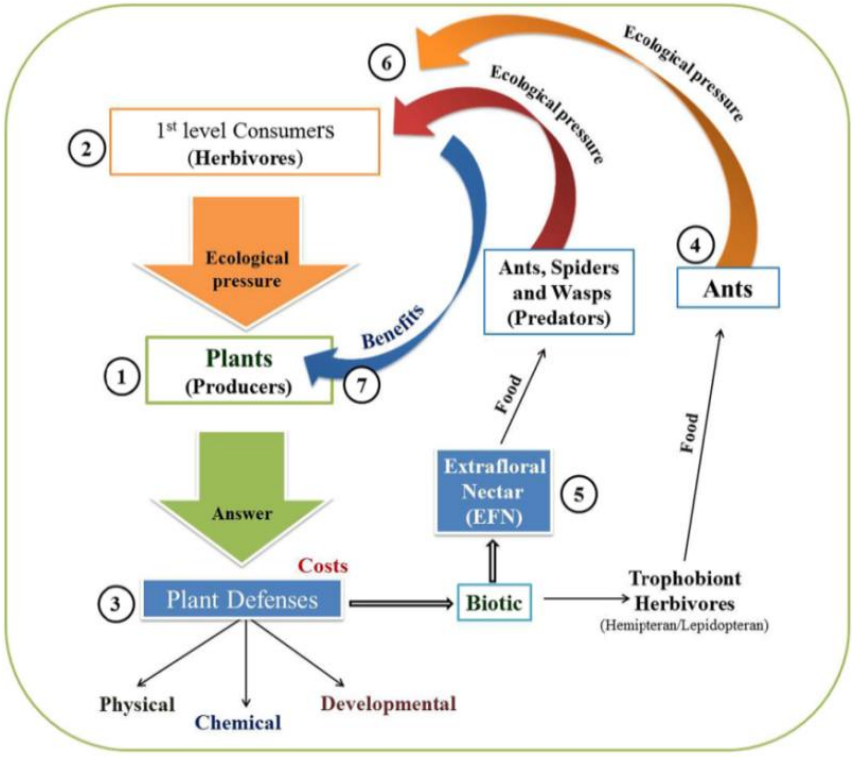
Nectar formation and secretion probably require three metabolically different phases:

(a) Optional carbohydrate uploading and storage,
(b) Nectar processing and the synthesis of non-carbohydrate components and
(c) Secretion.

Invertases seem to be involved in several steps: (i) the uploading of sucrose from the phloem into the nectariferous tissue; (ii) the formation of the sink required for the secretion of sugars into the extracellular space; and (iii) the formation of hexose-rich nectars. The last step can be catalysed by invertases that are localised in the nectariferous tissue or in the secreted nectar itself. The photosynthesis by chloroplasts *insitu* in the nectariferous tissue might provide additional carbohydrates. Nectariferous tissues are usually characterised by a dense, rough endoplasmic reticulum, the presence of many dictyosomes and an active Golgi apparatus. The presence of protein-rich inclusions point towards the synthesis and storage of nectarins in the nectariferous tissue itself, and the generally high abundance of mitochondria indicate high metabolic activity. Therefore, many of the non-carbohydrate components of the nectar are likely to be synthesised in the nectariferous tissue. It remains to be elucidated

whether the vesicles stem from the Golgi apparatus or directly from the endoplasmic reticulum and where carbohydrates and the other nectar components are combined to form the final nectar.

Extrafloral nectaries in plant-insect interaction

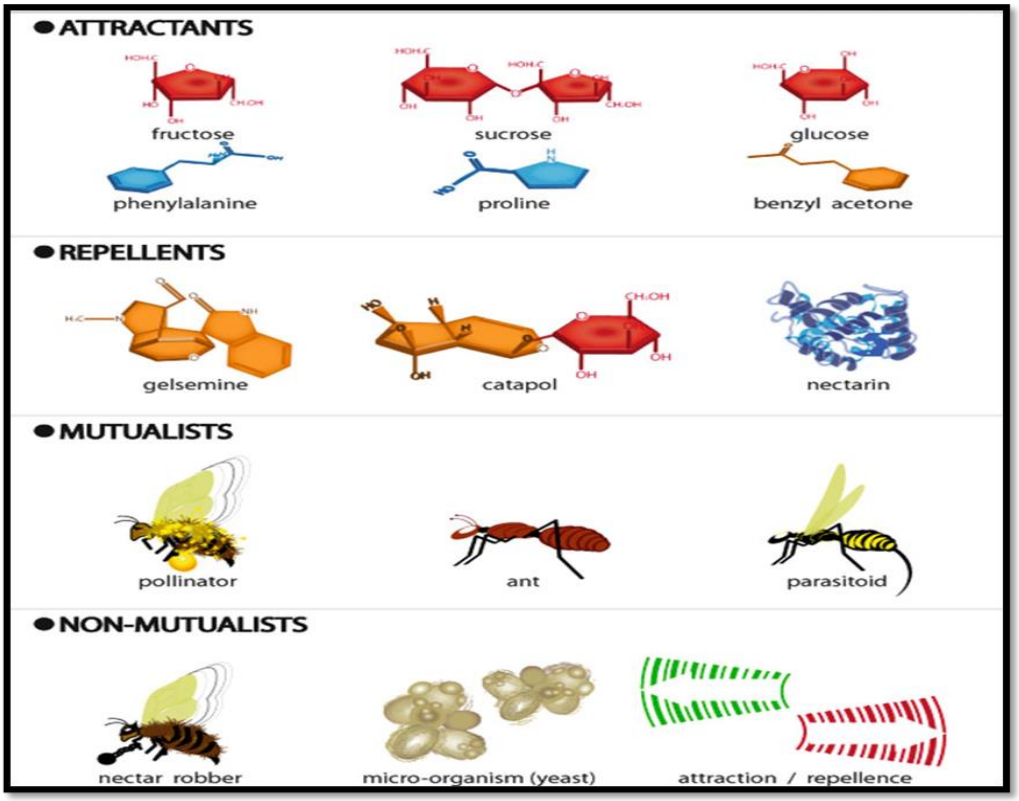


Plants (1) are the main food source to herbivores that exert strong ecological pressure (2) on them. Plants developed several distinct defenses (3) against herbivory (3) for example, the presence of trichomes (*i.e.* physical), alkaloids (*i.e.* chemical) and resprouting in dry season (*i.e.* developmental). In terrestrial environments, the association with a protective animal, mainly ants (but also spiders and wasps), is an important defense (biotic). The biotic defense occurs through an indirect association between the plant and ants, but possible also *via* herbivores (trophobiont) that produces exudates (like honeydew) that attracts and feed ants (4). Extrafloral nectar (EFN; mainly produced in leaves or inflorescences) is the main resource (5) plants offer to ants and other predators in exchange for protection. Nectar is an energetic food supply, but ants also need protein and will attack herbivores they find on plants (6) exerting an ecological pressure on the second trophic level that will directly benefit (7) the plants. Trophobiont herbivores (*i.e.* membracids) may benefit the host plant only when its damage produce fewer costs to the plant than the benefits produced by the ants (4) they associate.

Arthropods response to extrafloral nectar

Nectar chemistry serves both the attraction of mutualists such as defenders and protection. Nectar carbohydrates, amino acids and volatiles are apparently composed to provide an appetising meal to legitimate nectar consumers and/or to signal the presence of nectar to these mutualists from a distance. Being a nutritionally valuable reward, however,

nectar must also be protected from illegitimate consumers, which can be animals ("nectar thieves") but also microorganisms, such as bacteria, fungi and yeasts, which might use nectar as a suitable growing medium. The most important attractive classes of compounds are mono and disaccharides, amino acids and volatile components such as benzyl acetone. Repellent effects are exhibited by secondary compounds such as gelsemine and iridoid glycosides. Interestingly, gelsemine also repels legitimate pollinators. Nectar proteins (nectarins) mainly serve its protection from microbial infections.



Problems of EFNs in Agriculture

- Many growers, particularly large enterprises, set their pest control targets at a 100 per cent reduction in infestation. Such targets can only be achieved through the use of pesticides.
- Ants, vary in their defensive qualities. Production of EFN can result in colonization by parasitic ant species which consume nectar but either fail to defend their host plants.
- The degree to which ants act as predators or feed on plant derived carbohydrates can vary over the life of a colony and can be influenced by ecological conditions.
- Many growers are reluctant to encourage the presence of aggressive ants, as their bites and stings represent a potential irritant for farm workers and animals.
- Abiotic factors such as light or nutrient availability are also known to affect EFN production and influence its effectiveness as a plant defense.

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SPIDER MITES A DEEP MENACE IN CARNATION UNDER PROTECTED CULTIVATION

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Introduction:

Carnation/ clove pink (*Dianthus caryophyllus,* Family: Caryophyllaceae) is one of the most beautiful and commercially important flower crops. Originated from Mediterranean region represent one of the leading cut flowers in both domestic and international trade market. Carnations have a sweet fragrance, with varying colours, like red, salmon, pink, purple, yellow, orange, white and in varied combinations. Due to its excellent keeping quality, a wide range of varieties being available for selection, and quality to withstand long-distance during transport attract farmers towards Carnation cultivation. Jammu and Kashmir leads the country in area and production of carnation with 2350 Ha and 110 MT, respectively (2015-16) (Ministry of Agriculture and farmers welfare, GOI).

Mites are among the most important arthropods in greenhouses, both as pests causing economic injury to greenhouse crops, and as natural enemies used in the biological control of pest insects and other mites. Because of their minute size, mites are much less well known than insects. Spider mites (Tetranychidae) are among the most important pests on many greenhouse plants. False spider mites (Tenuipalpidae), which are related to spider mites, sometimes also become pests on greenhouse plants. Several species of tarsonemid mites and eriophyoid mites injure both vegetable crops and ornamental plants. Acarid mites of the genus *Rhizoglyphus* damages the bulbs of flowers and stored roots of many crops.

Varieties:

Standard Types: Killer, Malaga, Delphi, Madame Colette, Varna, Solar, Lady Green

Spray Types: Estimade, Indira, Vera, Durago, Amore, Kiss Siga

Soil and Climate: Well drained and Red loamy soil with the pH of 6 is most suitable. Temperature should be within the range of 25° C - 27° C.

Season: Throughout the year as it is cultivated under controlled conditions.

Propagation and Planting: Plantlets/suckers – 5-10 cm terminal cuttings treated with NAA at 500 ppm for 5 minutes. Cuttings are dipped in Carbendazim 2g/lit. solution. Raised beds at 3 feet width and 45 cm height are formed at 45 cm interval and planting is done on top of the bed at 15 x 15 cm spacing.

Growing condition - Day temperature - 20-25° C Night temperature - 10-15° C Critical photoperiod - 13 hours RH - 50-60%

Irrigation: Irrigation @ 4-5 lit/m2 /day is provided with drip system once in 2-3 days according to soil moisture to maintain water holding capacity at 60% to 65%.

Manuring: Basal: Neem cake 2.5 ton/ha. Phosphorus 400 g/100 sq.feet, Magnesium sulphate 0.5 kg/100 sq.feet.

Top dressing: Calcium Ammonium Nitrate + MOP at 5:3 ratio is mixed and applied @ 2.5 g/ plant/month.

Season of Flowering development and Harvest: Starts after 4 months of planting and continued up to one and half years. Daily harvest is made leaving bottom 5 nodes of stalk to facilitate side shoot development. To keep the stalk, erect, 4 – 5 stage stocking is provided.

Post-harvest Treatment: Citric acid is added to water to make the pH 4.5 to 5 and 5 mg of Sodium hypochloride is added to 1 litre of water. Cut flower stalk is soaked in this solution for 4 - 5 hours to improve vase life.

Grading: Based on stem thickness, stem length and quality of flower grading is done as A, B, C and D

Red spider mite- *Tetranychus urticae* Koch

Ubiquitous species that is common in greenhouses throughout the world. It is the most polyphagous species of spider mites and has been reported from over 150 host plant species. It attacks over 300 plant species in greenhouses. A recent checklist includes some 1,200 host plant species in 70 genera (Jeppson *et al.* (1975); Bolland *et al.* (1998)).

Appearance and damage symptoms:

The eggs are laid singly on the under surface of leaves. They are spherical in shape and amber in colour, often with a distinct pale brownish spot or traces of red. Newly hatched six-legged larvae are yellow to orange in colour and become greenish after feeding. Eight-legged nymphs are yellowish green with dark spots, their bodies rounded in shape with short legs. Adult females are about 400-500 μm and males are smaller with a tapered hysterosoma. The females (summer form) are dark red in colour with two black spots on the dorsolateral idiosoma, with carmine colour extending to the eyes and the rest of the propodosoma is yellowish. Males are straw-coloured. Overwintering females are pale red or purple.

***Tetranychus urticae* Koch**

Damage symptom:

Two-spotted spider mites often feed on cell chloroplasts on the under surface of the leaf. The upper surface of the leaf develops characteristic whitish or yellowish stippling, which may join and become brownish as mite feeding continues. As mites move around, their webbing can span leaves and stems. Heavy damage may cause leaves to dry and drop, and the plant may be covered with webbing and may die prematurely. Heavily infested plant may be discoloured stunted.

Development occurs between 12 and 40°C. Developmental time from egg to adult decreases with increasing temperature and is less than a week at optimal temperatures for development (30-32°C). Under a diurnal temperature cycle of 15 to 28°C, developmental time is about 16 days. Males develop slightly faster than females.

Carnation under protected cultivation

Infested bud

Inflorescence showing damage symptoms

Control

- Chemical control of spider mites is becoming more and more difficult due to the rapid development of resistance in mites and the decrease of the number of registered acaricides for use. Abamectin is one of the most widely used chemicals in greenhouses.
- Plant varieties having straight and flat leaves Spray dicofol 18.5 EC @ 2 ml/lit or wettable sulphur 50 WP 3 g/lit.
- Apply Abamectin (Vermitec) 1.9EC @ 0.5ml/litre
- Spray Azadiractin 50,000ppm 3ml/litre
- Discard the plant and leaf debris.

- Biological control of *T. urticae* by phytoseiid mites is now widely used by the greenhouse industry in Europe, some parts of Asia and Africa, Australasia and North America. The most commonly used species are: *P. persimilis, P. micropilis, Neoseiulus californicus, N. fallacis, N. longispinosus* and *Galemdromus occidentalis*.

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BACULOVIRUSES AN ECO-FRIENDLY VIRAL BIOPESTICDES FOR PEST MANAGEMENT IN SUSTAINABLE AGRICULTURE

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Baculoviruses are a large group of double-stranded DNA viruses (almost 1000 species have been described); the majority have been isolated from a few insect orders: Lepidoptera, Diptera, Hymenoptera and Coleoptera. Viral genome ranges in size from 80 to 200 kb. Individual baculoviruses usually have a narrow host range limited to a few closely related species. The most widely studied baculovirus is the *Autographa californica* nuclepolyhedrovirus (AcMNPV). Baculoviruses are arthropod viruses well known due to their potential as agents of biological control of pests in agriculture and forestry. They are also widely used as expression vectors in biotechnology. The family *Baculoviridae* contains diverse members and in the past the classification was based on virus morphology. It was divided into two genera: the *Nucleopolyhedrovirus* (NPVs) and the *Granulovirus* (GVs). Recently, this division was challenged (Jehle et al., 2006) because the comparison of 29 fully sequenced baculoviral genomes indicated that virus phylogeny followed more closely the classification of the hosts than the virion morphological traits, but the traditional division into two genera is still widely used. Baculoviruses infect arthropods and they do not replicate in vertebrates, plants and microorganisms. Although they do not replicate, they may, under special conditions, enter animal cells. This unexpected property made them a valuable tool in the last few years for studies of transient expression of foreign genes under vertebrate promoters introduced into baculovirus genome (Boyce and Bucher, 1996; Kost et al., 2005).

Baculovirus production technology

At present, commercial production of baculoviruses has been carried out only *in vivo*, either by applying the virus against the host insect in the field and collecting diseased or dead larvae, or by producing the target insect in the laboratory on an artificial diet. The latter is the most commonly used method for producing baculoviruses in many countries but both methods have been used successfully for commercial production of the *Anticarsia gemmatalis* baculovirus (AgMNPV) in Brazil (Moscardi, 1999 & 2007).

Baculovirus pesticides in the past

Two strategies of pest management with baculovirus pesticides are usually employed (Fuxa,2004):

- Infested areas are sprayed with highly concentrated baculovirus to suppress the pest as quickly as possible

• Infested areas are sprayed with lower concentration of baculovirus and this result in establishment of the virus for more than one generation.

At present the number of registered pesticides based on baculovirus exceeds fifty formulations, some of them being the same baculovirus preparations distributed under different trade names in different countries. Both NPVs and GVs are used as pesticides but the former group is larger.

Viral pesticides are bio-pesticides that offer tremendous livelihood options in promotion of organic product manufacturing, pollution control, ecological restoration, enhancement of soil fertility providing livelihood security, food safety, and nutritional security leading to sustainable rural development. There is a great demand for the organic food products both nationally and internationally as they fetch whose profits to the entrepreneurs.

Baculoviruses are naturally occurring insect pathogens. Because of their host-specificity and safety to non-target organisms, are ideal candidates for use as microbial insecticides in pest management in several field. Baculoviruses are of two types: NucleoPolyhedro viruses (NPVs) and Granuloviruses (GVs) based on the type of occlusion body formed. Baculo viruses are named on the basis of the host insect species from which they were first isolated. For example, HaNPV, SINPV and AjGV.

Baculovirus Formulation

Baculoviruses are available as aqueous suspensions in water. The preparation contains known number of occlusion bodies indicated as Polyhedral Occlusion Bodies (POBs) or Polyhedral Inclusion Bodies (PIBs). The storable formulation usually does not contain any other ingredients except the filtered virus prepared from ground diseased larvae. Contaminants, mostly bacteria that are not human pathogens, are present at levels below permissible limits. Baculovirus formulation should be stored under cool dark conditions for prolonged storage upto 1 year to preserve efficacy and quality

Field use recommendations

Baculovirus Type	Crop	Crop Stage	Dosage (LE/hectare)	Number of appl. Per crop season
Helicoverpa armigera (gram pod borer / American bollworm) NPV	Red gram	Flower Initiation, 50% flowering and peak flowering	250-500	2-3 at 10-14 days interval
	Chickpea	30 DAS and flowering	250	2-3 at 07-12 days interval
	Tomato	Fruiting stage	250	3 at 7 days interval

	Cotton	Fruiting stage	750	1-2 at 10 days interval
	Sunflower	Flower head	250	1
	Groundnut	Flowering onwards	250 – 500	3-4 at 7-10 days interval
Spodotera litura (tobacco caterpiller or leaf worm) NPV	Tobacco Vegetables Ground nut Cotton	Need based	250 – 500	1-3 application at 7-14 days interval
Achaea janata (Semilooper) (GV)	Castor	35-75 days after sowing	500	2 sprays first applied between 35-50 days and second at 60-75 days crop age based on pest incidents

Key to effective control

1. Apply spray in the evening hours to avoid inactivation of virus by sunlight.
2. Use high volume sprayer to wet the plants thoroughly but not to run-off.
3. Ensure that both upper and lower leaf surface are covered with spray.
4. Concentrate the spray on flowers and new growth.
5. Ensure pH of water is neutral and not alkaline.

Tank mix additives

1. Use tank mix additives such as fabric whitener (robin blue/ranipal/tinopal) as UV protectant @ 5 ml per tank (10 liter capacity) and jaggery as feeding stimulant @ 50 g per tank (10 liter capacity). HaNPV application in cotton is effective when mixed with boric acid (3 g/l).
2. Use wetting agent (Apsa or Sandovit or Triton-X -100) @ 5 ml for every 15 liters spray fluid
3. Baculoviruses can be mixed just before spray with fungicides such as mancozeb and copper oxy chloride.

General filed use guidelines

First mix jaggery in about 10 liters of water in a bucket and then add robin blue/tinopal and virus suspension. Mix thoroughly before the spray. The spray synergistically brings down the pest population more quickly and effectively.

Conclusion

Baculoviruses have no equivalent virus that infects plants or vertebrates. They have been shown to have no negative impacts on plants, mammals, birds, fish, or even on non-target insects (parasites and predators). This is especially desirable when beneficial insects are being conserved to aid in an overall IPM programme, or when an ecologically sensitive area is being treated. This group of viruses is therefore considered safe and ecologically acceptable for use. These viruses are excellent candidates for species-specific narrow spectrum insecticidal applications.

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HONEY BEE REARING FOR DOUBLING FARMERS INCOME IN INDIA: A WAY TO ACHIEVING SWEET REVOLUTION

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Beekeeping is an art and a mesmerizing science. In India beekeeping is mostly practised as a full-time occupation and an engrossing hobby to produce handsome income and table honey. Honeybees are special gift to mankind because beekeeping can be done for both their pollination services and their cherished products such as honey, beeswax, propolis, bee venom, etc. These products have their widespread use in different small and large scale industries in India.

As of now seven species of *Apis* have been described; India is an exclusive country which habitats four of these; two domesticated species, viz. *Apis cerana* (oriental honeybee) and *A. mellifera* (occidental or European honeybee) and two wild species, viz. *Apis dorsata* (giant/rock honeybee or dumna) and *A. florae* (dwarf honeybee). Among the four species, *A. mellifera*is an introduced species to India because it is resistant to Thai sacbrood virus (TSBV) and also highly suitable for commercial beekeeping. Because of the different climatic zones in India, there is a massive multiplicity of flora which helps in potential beekeeping. People of India have a long connection with beekeeping and honey since ancient times. Ancient Indians gifted some records about beekeeping as paintings or carvings on rocks. Honey and its medicinal uses were mentioned in the old Ayurveda books of India. After independence, the government of India took policy decision to revive various traditional village industries and an All India Khadi and Village Industries Board (KVIB) was formed in 1954. Through harmonized efforts of well-joined organizations like KVIC (Khadi Village Industries Commission) and State KVIBs, Beekeepers' Cooperatives and Public Institutions, the beekeeping industry came into limelight of village industries in India within two decades. In view of the budding importance of beekeeping, in 1981, an All India Coordinated Research Project (AICRP) on Honey bee Research and Training was launched by ICAR involving Agricultural Universities (Ramchandra et al., 2012; Sivaram, 2012). Later a Central Sector Scheme entitled "Development of beekeeping for improving crop productivity" was launched by the Ministry of Agriculture in 1994–1995 during the eighth 5-year plan. The scheme targets production and distribution of honeybee colonies, organizing trainings and awareness programmes. A Beekeeping Development Board also worked to organize the beekeeping activities. The scheme was approved for continuation during the ninth 5-year plan.

Indian Bee (*Apis cerana*)

Indian honeybee or Eastern honeybee is a well-known bee species in India. Prior to the introduction of Italian bee, this was the only rearable *Apis* bee spp. in India. It is also found and has been domesticated in Pakistan, Nepal, Burma, Bangladesh, Sri Lanka and Thailand. These are comparatively non-aggressive and rarely shift locations. These bees construct multiple parallel combs in dark places such as clay pots, logs, wall, tree openings, etc. and produce 7-9 kg of honey per colony per year. Ruttner (1988) classified *Apis cerana* into subspecies based on the living habitats and genetic diversity; of these *Apis cerana indica* and *Apis cerana cerana* occur in India. In India, the subspecies *Apis cerana indica* is recognized into two morphotypes like "hills bee" (black coloured) and plains bee (yellow coloured) (Ramchandra et al., 2012). Presently beekeeping with Indian bees is mostly done in south India and particularly in Kanyakumari district of Tamil Nadu, with more than 50,000 beekeepers involved.

Since these bees have built their colonies in dark cavities, it enables man to keep them in specially constructed movable frame hives. The combs of *A. cerana* colony are built parallel to each other and at uniform distance known as the "bee space", which is respected between them. Compared to rock bees and Italian bees, these are small in size but bigger than the dwarf bees. Brood comb consists of cells of two sizes: smaller for the worker brood and larger for the drone brood. The queen cells are built on the lower edge of the comb. Like other bee species, these bees also store honey in the upper part of their hive. Because of this behaviour, the bee boxes are designed in such a way that the super chamber or the honey chamber is in the upper part of the hive where these bees store honey which helps in easy honey extraction.

Honey bee larvae, *Apis mellifera* L., are fed mandibular and hypopharyngeal gland secretions produced by nurse bees. This food contains all the nutrients necessary for the development of queens, workers, and drones (Haydak, 1970; Johansson, 1955; Rembold, 1965; Weaver, 1966; Brouwers, 1984; Howe et al., 1985).

The in vitro rearing of worker honey bees (*Apis mellifera* L.) has become an increasingly important method in honey bee research in general, and in pesticide risk assessment specifically. The western honey bee (*Apis mellifera* L.) is an important pollinator species worldwide (Gallai et al., 2009; Klein et al., 2007). Pesticides, nutrition, parasites, and/or diseases are thought to be major contributors to recent honey bee declines (Fairbrother et al., 2014; National Agricultural Statistics Service, 2015). Substantial progress has been made with bioassays that can be used to rear immature honey bees in the laboratory over the past few decades (Aupinel et al., 2005; Crailsheim et al., 2013). Rembold and Lackner (1981) were among the first to feed larvae a balanced diet of sugars, royal jelly, water, and yeast in order to rear larvae successfully within the laboratory.

The advancements in the in vitro rearing protocol have given government, industry, and academia a new tool for accessing the risks pesticides and other chemicals pose to immature honey bee development and survival (Aupinel et al., 2005; Crailsheim et al., 2013). Honey bee in vitro rearing protocols have allowed researchers to standardize environmental

conditions (e.g. temperature, humidity) in which the immature bees develop, provide a uniform diet to each individual, and reduce pathogen exposure.

Bees collect nectar from flowers and convert it into honey. Honey is stored in the combs. Since ancient times honey is recognized as the most nourishing and energizing health food. Honey heals the body internally and externally. Honey is rich in nutrients and has easily digestible sugars (such as glucose and fructose), which are quickly absorbed by the body. Honey also contains minerals, enzymes and various vitamins that inhibit the growth of bacteria and make the body to infections resistant. Consumption of honey instantly gives strength and energy.

Royal Jelly

Bes produce Royal Jelly in glands situated at their mouth parts to feed the larvae. This special food makes the young queen larvae grow fast and develops them into queens. Taking royal jelly as its food the queen bee gains double its body weight and can lay up to 2000 eggs each day. Royal Jelly contains fat, proteins vitamins like B1, B2 and has antibiotic properties. Royal Jelly naturally activates the male and female hormones alike and therefore increases potency. Regular consumption of Royal Jelly helps to regenerate the body cells and protects the body against abnormal cell growth such as cancer and infections of joints and muscles. Medical science has proven that Royal Jelly is a very valuable natural food.

Bee Pollen

Bees carry Pollen grains from flowers to their hive in pollen baskets on the hind legs. Besides having highly nutritious, bee Pollen stimulates the forming of antibodies that help to make the body healthy and strong and retains the elasticity to the skin and therefore keeps us younger. Pollen contains vitamin B-complex, vitamin-E and 28 mineral salts essential for our body. Pollen improves body immunity, which helps fight allergies, cold, fever and rheumatism. It regulates the blood pressure as well as cholesterol.

Monofloral Honey

Monofloral honey i.e. from a single type of flower like Sun Flower, Jamun, Cotton, Mustard, Coriander, Lime, Eucalyptus, Rubber, Litchi and Neem etc., may have characteristic flavors and aromas. But, their sweetening power is the same. However, a few floral types of honey, which are very rich in fructose, may taste some what sweeter. There are more than 300 plant species that provides nectar worldwide.

Color & Flavor

Honey's color and flavor vary with its nectar source. The color of honey varies from water white to dark amber. The color of honey is related to its mineral content and is characteristic of its floral source. Light colored honey typically has a mild flavor, while dark colored honey usually has strong flavor.

Viscosity

Honey's viscosity is dependent upon its water content, temperature and floral source. The viscosity of honey decreases rapidly as temperature rises. Except all physical properties i.e. Color, Flavor, Taste and Viscosity, unifloral and multifloral honey's have same gross chemical composition.

Honey Preservation

Honey stored in sealed containers can remain stable for decades and even centuries. However, honey is susceptible to changes during storage, it tends to darken and lose its aroma and flavor, when stored at high temperatures. Honey can be kept at room temperature in air-tight containers. Crystallization or Granulation is a natural phenomenon. Storing honey in a refrigerator accelerates the crystallization. If honey crystallizes, it should be kept in sun or in warm water until the crystals dissolve. Do not boil or heat the honey directly over a flame.

Conclusion

Beekeeping can be a subsidiary as well as primary source of occupation have the potentiality to add to the farmers' income in resource poor states of the country. Involvement of rural youth will lead to a long future for the beekeeping sector. Youth involved in the sector of beekeeping can set up their own enterprises and also take up beekeeping as main occupation for earning their livelihoods. Skill development for proper management including increasing the honey production, production of bee products other than honey, proper preservation, processing and packaging for maintaining a standard quality to cope with the national and international market is very much necessary in the training programmes. Proper extension of market information of the beekeeping sector in the ground level should be implemented properly because the availability of information for the researchers of honey and honey market. Organising beekeepers' cooperatives through programmes and policies for improving the market efficiency is also very much important for increaing the farmers income and achieving the goal of sweet revolution.

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MEASURES TO SCALE UP AVAILABILITY OF QUALITY SEED TO FARMERS

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Seed is the most important and vital input for agricultural production. In fact, quality seed is the most cost efficient means of increasing agricultural production and productivity. Fertilizers, pesticides and irrigation as it is enhancing efficiency of seed quality. Seed quality of seed accounts for 20 to 25 percent of productivity. It is, therefore, important that quality seeds are made available to the farmers of the country, India. The Indian Seeds programme recognizes three generations of seeds, namely, breeder, foundation and certified seeds.

The States are primarily responsible to ensure production, availability and distribution/ supply of quality seeds to the farmers through its Department of Agriculture, state farms, State Seeds Corporation, State Agricultural Universities (SAUs), Cooperatives and Private Seed Companies etc. The Government of India supplements the efforts of the State Governments by providing breeder seeds for seed chain and coordinating seeds requirement and availability through the mechanism of Zonal Seeds Review Meetings prior to each sowing season and weekly video conferences.

Steps necessary for scaling up the availability of quality seeds to the farmers are:

i. The Government of India is providing financial assistance for production and distribution of seeds of High Yielding Varieties (HYVs) of different crops to the States and implementing agencies through various ongoing crop development programmes/ schemes viz. National Food Security Mission (NFSM), Bringing Green Revolution in Eastern India (BGREI), Rashtriya Krishi Vikas Yojana (RKVY), Sub-Mission on Seeds & Planting Material (SMSP) etc.

i. The states are encouraged by the Department of Agriculture, Cooperation & Farmers' Welfare (DAC&FW) to develop a Seed Rolling Plan in advance as per the estimated requirement of seeds in their state, so that the seeds of required variety could be made available at right time to the farmers. DAC&FW also ensures fixation of uniform breeder seeds price in consultation with Indian Council of Agricultural Research (ICAR) for minimization of foundation and certified seed costs.

ii. Indian Institute of Seed Science, ICAR is also coordinating the production of quality seed in the country through the network of 63 cooperating centres under National Seed Project of ICAR. Single window system for effective planning and implementation of seed production programme and computerized seed sale outlets have been established to guarantee ease in accessibility of quality seeds to farmers at all centres.

In some states quality seed is being made available at every village within the reach of farmers and farmer is facilitated to purchase seed of choice from the desired outlets. Similarly, procurements centres at villages have been established to facilitate procurement by the marketing department. Moreover, some states have well established mandis and generally the seed dealers and other agri-input dealers also have shops in these mandis avoiding involvement of middlemen.

Component details of development and strengthening of infrastructure facilities for distribution of quality seeds

The Department of Agriculture and Co-operation is implemented 'Development and Strengthening of Infrastructure Facilities for Production and Distribution of Quality Seeds' with the objective of the ongoing scheme is to ensure production and multiplication of high yielding certified/quality seeds of all crops in sufficient quantities and make the seeds available to farmers, including those in remote areas, not easily accessible by rail/road on time. The components are :-

Establishment & Maintenance of Seed Bank

In order to ensure that seeds are available to the farmers at the time of natural calamities like floods, droughts, etc. this component is implemented to establish a seed bank to maintain stocks of foundation and certified seeds of different crops / varieties which can be utilised for such contingent requirements. Under this component, grants-in-aid are released to National Seeds Corporation, State Farms Corporation of India, State Seeds Corporation, Kerala Seed Development Authority, Govt. of Tamil Nadu, Jharkhand, etc.

Quality Control Arrangement on Seeds

This component deals with arrangement to regulate the **quality of seeds** under the Seeds Act, 1966 to strengthen quality control organisations like State Seed Certification Agencies, State Seed Testing Laboratories, Central Seed Testing Laboratory and Central Seed Committee apart from imparting training to officials engaged in the seed sector and for enforcing the seed law in order to ensure the production and distribution of quality seeds to protect the interest of farmers.

Seed Village Programme

To upgrade the quality of farmer-saved seed, which is about 80-85% of the total seed used for crop production programme, financial assistance is provided for distribution of foundation/certified seeds at 50% cost of the seed of crops for production of certified/quality seeds only and for training on seed production and technology to the farmers. The seed produced in these seed villages are preserved/stored till the next sowing season.

In order to encourage farmers to develop storage capacity of appropriate quality, assistance is given to farmers for making/procuring of Pusa Bin/Mud bin/Bin made from paper pulp for storing of seed produced by the farmers on their farms.

Assistance for Creation/ Strengthening of Infrastructure Facilities in Public Sector

For construction of seed storage godown, assistance is provided at the standard rate of Rs.25 lakh per seed godown of 1000 MT capacity and multiples thereof.

Import policy of seeds in India

Import of seeds and planting materials are governed by New Policy on Seed Development, 1988. The provisions regarding import of seeds and planting material are:

- Import of seeds/tubers/bulbs/cuttings/saplings of vegetables, flowers and fruits is allowed without a licence in accordance with import permit granted under Plant Quarantine Order, 2003 (PQ Order).
- Import of seeds, planting materials and living plants by ICAR, etc. is allowed without a licence in accordance with conditions specified by the Ministry of Agriculture and Farmers Welfare, Government of India.
- Import of seeds/tuber of potato, garlic, fennel, coriander, cumin etc. is allowed in accordance with import permit granted under Plant Quarantine Order 2003 and amendments their under.
- Import of seeds of rye, barley, oats, maize, millets, jowar, bajra, ragi, other cereals, soybean, groundnut, linseed, palmnut, cotton, castor, sesame, mustard, safflower, clover etc. is allowed without the subject of New Policy on Seed Development and in accordance with import permit granted under Plant Quarantine Order 2003.

Measures to scale up availability of quality seed to all farmers

- Identify bottlenecks in existing seed systems
- Develop sustainable formal and informal seed systems that provide even dryland small farmers also to access to high quality seeds of modern varieties.
- Adopting voluntary seed system instead of compulsory variety release and seed certification and testing.
- Allowing farmers to share seed of protected varieties by reducing impact of IPR.
- The voluntary system should provide room for local initiative so that farmers can have their choice to purchase with or without label.
- Multiple criteria but not only yield based choosing varieties on uniformity may be slackened as it has no agronomic advantage but varieties with partial resistance to pests and diseases may also be included.
- Introducing digital market intelligence system to link-demand supply of seeds.
- Mainstreaming informal seed sector models to formal market linked system.
- Engaging women to harness entrepreneurial opportunity in seed sector.
- Creating most needed linkages between public-private institutes to strengthen seed systems.
- Evidence based policy advocacy for sustainable seed systems.

- Cost of seed chain- quality control should be reduced by slackening authoritative procedure.
- Organization of seed fairs to share locally adaptedor selected material of high quality seed of the climate resilient, nutritious, high yielding varieties etc.,
- Promoting active participation of NGO's and farmer groups in variety evaluation and release committee to meet diverse needs of farmers rather than standard variety release procedure.

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