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Integrated approaches for the management of insect pest under protected condition: Practices

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The extra challenge in managing insect and pathogen in greenhouses is related to the long growing season for the crops. IPM is an important tool in the management of these pests. The primary goal of IPM is to optimize pest control in an economically and ecologically sound way. The warm, humid conditions and abundant food under protected conditions provide an excellent, stable environment for pest development. Often, the natural enemies that keep pests under control outside are not present under protected environment. For these reasons, pest situations often develop in the indoor environment more rapidly and with greater severity than outdoors. Therefore, IPM is a systematic approach to manage pests that combines a variety of techniques and strategies to either reduce pest populations or lessen their economic impact. IPM involves the integration of cultural, physical, biological and chemical practices to grow crops with minimal use of pesticides. Pest management, not eradication, is the goal of IPM.


Good agriculture practice in greenhouse

Protected cultivation including greenhouse production systems require adherence to Good Agriculture Practices (GAP) protocols because intensive cultivation in greenhouses often involves excessive use of chemicals since the stakes are high due to intensive inputs and high expectations on quality front. Therefore, perennial production coupled with indiscriminate chemcalization leads to severe pest infestation and consequent high levels of pesticide residues. Thus, disease and pest management have become one of the major restricting factors for protected vegetable cultivation. Generally, the natural enemies that keep pests under control outside are not present under protected condition. For these reasons, pest situations often develop in the indoor environment more rapidly and with greater severity than outdoors.

Insect pests under protected condition : The growing conditions within the protected environment of greenhouse/ polyhouse are highly favourable to arthropod pests. The detailed account of the insect-pests associated with crops under protected environment is being presented in Table 1.

– IPM for protected environment
– Insect pest exclusion methods
– Use of air tight entrance

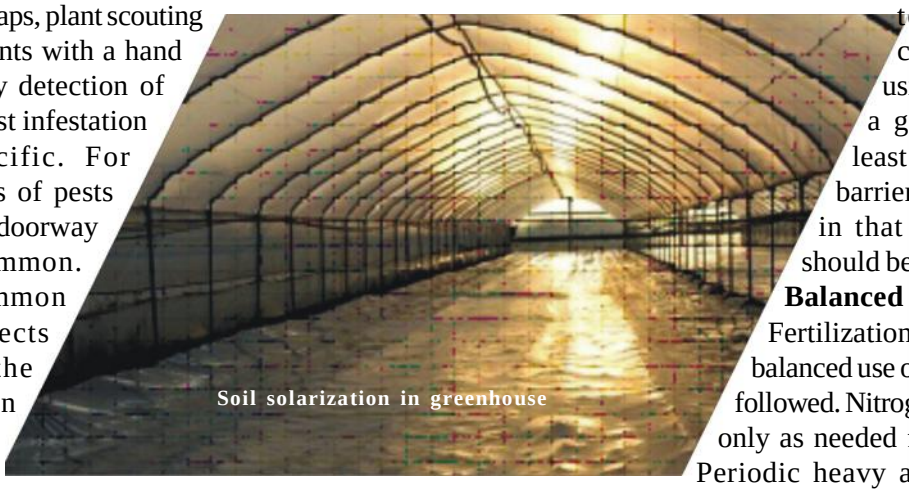
The walk-in doorways in the greenhouse provide an easy entrance to many pests. Growers need to evaluate various strategies to reduce the likelihood of pest entrance. In greenhouses with a fan and pad type ventilation, an air-lock entrance room is essential. The added room is attached to the exterior of the greenhouse enclosing the entry doorway. The double door system allows workers to enter the air lock room and close the outside door behind them prior to entering the greenhouse production area (*https://attra.ncat.org/attra-pub/summaries/summary.php*).

Ultra-violet radiation absorbing sheets : The first evidence that UV-absorbing films may reduce insect invasion of greenhouses came from Japan. Insects perceive light signals through their compound eyes. The anatomy and physiology of the compound eye is adapted to sense UV wavelengths alone or a mixture of UV and visible radiation. The UV part of the solar spectrum plays an important role in the ecological behaviour of insects, including orientation, navigation, feeding and interaction between the sexes. Spectrally modified sheets are produced commercially by the introduction of a UV-absorbing additive into the raw material which blocks the transmission of most wavelengths in the UV range below 370-380 nm without interfering with the transmission of photosynthetically active radiation (400-700 nm).

Insect proof screens : Modern technology in manufacturing has developed the capability to produce screening material so fine insects can be excluded from the greenhouse. Insect screens with a fine mesh that excludes insects from the greenhouse can be an important addition to an IPM programme. Screens can be used effectively in both passively ventilated and fan and pad

greenhouses.

Scouting and trapping : Even after implementing all the previous exclusion techniques, some insects will certainly get inside the greenhouse. Early detection of pests in the crop is crucial. Use pest monitoring tools and techniques like yellow sticky traps, plant scouting and examining plants with a hand lens to make early detection of pests. Usually a pest infestation is location specific. For instance, hot spots of pests near ventilation or doorway openings are common. Another common discovery is insects coming into the greenhouse on infested plants from other areas. If you purchase transplants, consider all factors related to the source of plants that can increase pest problems. For example, determine if the transplant growing facility is in an area where pest populations are high and if the growers implementing good IPM practices.



Soil solarization in greenhouse

Soil solarization : Soil solarization is the process of tarping moist soils with clear polyethylene to trap solar radiation and raise soil temperatures to levels lethal to most insect, pathogens and weed seeds (*https:// attra.ncat. org/attra-pub/summaries/summary.php*).

Sanitation : It is important to keep the area around the exterior of the greenhouse free of weeds and other plants that could harbor pests. The ground immediately adjacent to the greenhouse can be kept clean by using nursery cloth or a ground cover in at least a 10-20 foot wide barrier. If any weeds grow in that barrier area, they should be destroyed.

Balanced use of fertilizer : Fertilization schedules based on balanced use of nutrients should be followed. Nitrogen should be applied only as needed for optimal growth. Periodic heavy applications set up nitrogen surpluses that cause excessive growth, which favour the population growth of aphids and other pests. Application of potassium at desired levels has been found to reduce the incidence of insect-pests.

Trap crop : For early detection and trapping of the target pests, some of the preferred hosts of the target pests can be used. Planting border rows of *Portulaca oleracea* in rose can be used as a trap crop for tobacco caterpillar

Table 1 : Insect-pests scenario under protected environment in India

Common name	Scientific name of insect and mite pests	Host plant of different insect pest	Distribution
Aphids	*Aphis gossypii*	Capsicum	Punjab, Delhi
	Macrosiphoniella sanborni	Chrysanthemum	Karnataka, HP
	Macrosiphum luteum	Orchid	Sikkim
	Myzus escalonicus	Strawberry	New Delhi
	Myzus persicae	Capsicum, Gerbera,	Punjab, Maharashtra
	Toxoptera aurantii	Orchid	Sikkim
Caterpillars	*Helicoverpa armigera*	Capsicum, tomato, carnation	Punjab, Uttrakhand, H.P.
	Spodoptera litura	Rose, tomato, capsicum, cucumber	Karnataka, Punjab, HP
Leaf-miner	*Liriomyza trifolii*	Tomato, cucumber, chrysanthemum, gerbera and many ornamentals	Karnataka, H.P.
Mites	*Polyphagotarsonemus latus* (yellow mite)	Capsicum	Karnataka, Punjab, Delhi, H.P.
	Stenotarsonemus fragariae	Strawberry	New Delhi
	Tetranychus cinnabarinus	Carnation	Maharashtra
	Tetranychus neocalidonicus	Cucumber	New Delhi
	Tetranychus urticae (Spider mite)	Tomato, capsicum, cucumber, carnation, gerbera	H.P., Maharashtra
Thrips	*Scritothrips dorsalis*	Rose	Karnataka
	Thrips palmi	Gerbera	Karnataka
	Thrips tabaci	Gerbera	Maharashtra
Whiteflies	*Bemisia tabaci*	Gerbera, capsicum	Karnataka, Pumjab
	Trialeurodes vaporariorum	Tomato, cucumber, capsicum, beans, gerbera, and more than 30 hosts	H.P.and Nilgiri hills (TN)

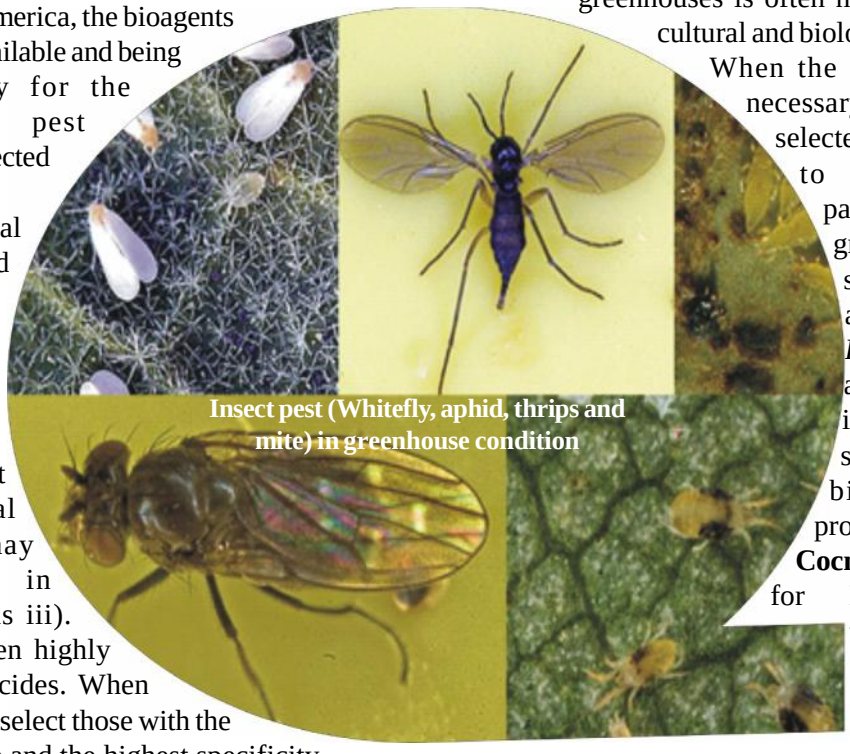
(Ajay, 2010)

under protected environment.

Biological control : Biological control is the use of living organisms to control crop pests. Biological control of greenhouse insect pests can be achieved through release of biocontrol agents like predatory mites, pirate bugs, soil-dwelling mites, and parasitic insects. In Western Europe and North America, the bioagents are commercially available and being used successfully for the management of pest problems under protected situations (Table 2).

Table 2 : Registered natural enemies for pest management in protected cultivation in Europe and United States

Target pest	Biocontrol agent	Scentific name
Whiteflies	Parasitic wasps	*Encarsia formosa*
Serpentine leaf miner	Leafminer parasitoid	*Dacnusca sibiriica* *Diglyphus isaea*
Spider mites	Predatory mites	*Amblyseius californicus* *Phytoseiulus longipes* *Phytoseiulus persimilis*
Thrips	Predatory mites	*Amblyseius cucumeris* *Amblyseius mckenziei*
Various soft-bodied insects and eggs	Lady beetles	*Hippodamia convergens* *Cryptolaemus montrouzeri*
Various soft-bodied insects and eggs	Green lacewings	*Chrysoperla carnea*



Insect pest (Whitefly, aphid, thrips and mite) in greenhouse condition

There are several items to keep in mind when using biological controls i) No single pest control method is 100% effective ii). This method often involves more work at first than chemical control and it may require changes in production methods iii). Biologicals are often highly susceptible to pesticides. When choosing pesticides, select those with the shortest residual life and the highest specificity. iv) Since many biologicals work slowly, they are best used when pest numbers are fairly low.

Insect growth regulators : Insect growth regulators (IGRs) are another least-toxic pesticide control option for pests. IGRs typically kill insects by disrupting their development. They have a complex mode of action that precludes insects from rapidly developing resistance. IGRs can work in one of several ways: 1) they can mimic juvenile hormones, so that insects never enter the reproductive stage of evelopment; 2) they can interfere with the production of chitin, which makes up the shell of most insects; or 3) they can interfere with the molting process.

Yellow sticky trap against sucking insect

Biorational pesticides: The integration of biorational pesticides (also known as least-toxic or biopesticides) in greenhouses is often necessary in addition to cultural and biological control measures. When the use of a pesticide is necessary, materials should be selected that are least harmful to the predators and parasites released into the greenhouse. Insecticidal soap, horticultural oils and the bacterium *Bacillus thuringiensis* are examples of insecticides that can be safely integrated into a biological control programme.

Cocnclusion : It is important for Indian greenhouse vegetable producers to implement as many IPM exclusion strategies as possible to manage pests. Many of the serious insect pests of greenhouse vegetables, including aphids, silverleaf whitefly, mite and thrips, require special control efforts due to their ability to vector plant viruses to the crop. Once these pests enter the greenhouse, growers have very few options to manage them. Therefore, excluding the pests from entering the greenhouse is critical.

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