

Pest management in controlled environment

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Introduction

The purpose of growing crops under Greenhouse conditions is to increase the yield and quality of the crop by controlling the microclimate and protecting them from adverse environmental conditions, such as extreme temperatures and precipitation and pests. We assume that protected structures are free of pest because very enclosed. But warm, humid

conditions and abundant food under protected conditions is excellent, stable environment for pest development. Indeed, pest population increase at an alarming speed in GH due lack of natural enemies. Pest enter when the GH doors are open and due to movement of the people. Once when pests are inside a GH it is very difficult to eradicate.

Reasons and causes for pest incidence inside a green house

- Type of crop – vegetables crop more prone to damage than ornamentals
- Closer spacing
- Pest is polyphagous
- Over-luxuriant foliage is conducive to greater damage by sap-sucking insects
- Continuous cropping without a fallow crop or free interval spread insects that pupate in the soil such as leaf miners and thrips
- GH crops are labour intensive and long period crops which require routine operations like tying, pruning, harvesting. This led to more risks of

spreading pathogens through workers, machinery, accidental wounds

- Over-use of pesticide leads to problems of resistance, checking natural enemies and bio control agents

Types of pest

- Major damage - Whiteflies, Aphids, Thrips, Mites
- Minor damage - Snails and slugs - Possible adaptation and exploit calcium poor environments

Types of damage

Insect pest can be categorized as those

- Feed on plants
- Transmit virus and cause viral disease

Pest tetrahedron

Plant pest, Host plant, Environment, Human activity are the 4 components which together influence each other and together determine the level of the pest

Pest Management strategies

Effective pest management in greenhouses (GH) is essential for maintaining plant health and productivity. Integrated Pest Management (IPM) offers a systematic approach that combines diverse techniques and strategies to control pests, aiming to reduce their

populations and minimize economic damage. IPM is a meticulously planned and monitored blend

- Genetical method
- Physical method
- Cultural methods
- Exclusion
- Sanitation
- Scouting
- Biological method
- Chemical methods

A. Genetical control

Varieties resistance to pest can be grown. But the difficulty is some time they may not be high yielding.

Mechanism

Morphological – waxy cuticle, thick cuticle, distribution of stomata

Chemical constituents - defence growth and germination of pest, internal secretions like phenolic acids in coloured onions and tomatine in tomato are inhibitors

B. Physical control

1. Citation of GH - Field crops adjacent to greenhouses can exacerbate pest issues during field operations, harvest, or senescence, as insects seek new hosts. To mitigate this, it is advisable to position greenhouses away from or upwind of outdoor crops. Optimal east-west orientation of greenhouses ensures uniform lighting, minimizing shaded areas that could promote insect proliferation and affect plant growth. Additionally, increasing gutter heights can prevent insects from entering greenhouses through vents.

2. Lighting system is designed not to attract insects into GH. Yellow and Mercury vapour lamps traps aphids and white flies

3. Boards, tins, buckets painted yellow and yellow polythene sheets -Delta trap to attract white flies

4. Manipulation of the environment in the greenhouse

C. Cultural practices:

- Crop barriers and trap crops - attract pests away from main crops – both in GH and open field
- Correct and wider spacing – prevents the microclimate conducive for pest and help in monitoring and control
- Pinching and Pruning – Lower leaf pruning control leaf miners
- Cover the medium with plastic mulch & soil less cultivation affect pest by incomplete life cycle - prevent pupae from falling in leaf miners and thrips

D. Exclusion

- **Insect screening** - Very fine mesh will block insects even in smallest size – Insect proof - Anti thrips screening is mostly practiced because thrips are smallest of most sucking insects. This method will exclude the insects not eradicate.
- **Airlock entry** - Reduce air flow and maintain balance between airflow and insect entry
- **Double door** - This control pests from entering through the door as workers enter and exit the structure

Screen mesh sizes needed to exclude major greenhouse pest species

Insect-Pest	Hole size (micron)	Mesh (No. of threads per linear inch)
Leafminer (<i>L. trifoli</i>)	610	34

Cotton whitefly (<i>B. tabaci</i>)	462	42
Aphid (<i>M. persicae</i>)	340	52
Greenhouse whitefly (<i>T. vaporariorum</i>)	290	58
Thrips (<i>Thrips</i> spp.)	192	76

E. Sanitation

- An essential aspect of pest and disease management involves maintaining cleanliness both inside and outside the structure. This includes ensuring cleanliness among workers, supplies, and plant materials.
- Begin crop with insect free transplants and quarantine them for several days
- Avoid growing other crops near the structure
- Controlling broad leaf weeds both inside and out side the structure - reduces the spread of tomato spotted wilt virus
- Remove debris and keep the GH clean
- Soil fumigation
- Not surprisingly, algae flourishes in GH environments - alga serve as a food source for pests
 - ❖ proper water and fertilization management can reduce this
 - ❖ Allow surface of media to dry between watering sessions
 - ❖ Avoid standing water
- Prompt spot treatments may prevent aphid or spider mite infestation from spreading
- Store dress for each structure separately
- Replace the disinfectant in the foot bath regularly
- Sterilize tools and equipment's used before and after use

F. Scouting

- Monitoring, also known as scouting, involves regularly and systematically inspecting plants and their surroundings to identify and evaluate pest issues. This process includes examining foliage and flowers, as well as using insect traps. Scouting and early detection are crucial for effectively managing insect infestations.

- It is recommended to walk through and inspect plants daily or 4-5 times per week. Examine leaf structure, buds, blooms and fruits
- 10-20 X hand lens is an important tool for scouting
- Take random sampling (bores, wastes, holes, Damages) - 1-2% of the total plant
- Information documented and evaluated to take appropriate action to limit negative impact
- Begin in monitoring in isolated spots
- Give extra attention to plants that show unusual symptoms / appearance
- Yellow sticky traps and pheromone traps are some insect monitoring method were we can do critical early detection
 - ❖ Yellow traps - White flies, Aphids - Yellow sticky cards 1-2 cards per/ 100 Sq.mt
 - ❖ Pheromone traps - Tomato pin worm
 - ❖ Sweet potato weevil female pheromones used to attract males to a water trap – there they are then drowned

G. Biological control

- Insects and microorganisms like predators, parasitosis introduced or sprayed to control other insects
- Complex and expensive because careful consideration and research is needed
- Difficulty to introduced natural predator because they are easily affected by insecticide
- *Encarsia formosa* specifically targets the greenhouse whitefly but does not affect the sweet potato whitefly.
- *Bacillus thuringiensis* (Bt) is utilized as a biological control agent against caterpillars. It involves applying bacterial

toxins to crop plants, which are ingested by the pests and lead to their mortality.

- These methods are also selective in their action and pose no harm to humans or the majority of non-target organisms.

Registered natural enemies for pest management in protected cultivation

Biocontrol agent	Scientific name	Target pest
Parasitic wasps	<i>Encarsia Formosa</i>	Whiteflies
Leaf miner parasitoid	<i>Dacnusa sibirica</i> <i>Diglyphus isaea</i>	Serpentine leaf miner
Predatory mites	<i>Amblyseius californicus</i> <i>Phytoseiulus longipes</i> <i>Phytoseiulus persimilis</i>	Spider mites
Predatory mites	<i>Amblyseius cucumeris</i> <i>Amblyseius mckenziei</i>	Thrips
Lady beetles	<i>Hippodamia convergens</i> <i>Cryptolaemus montrouzeri</i>	Various soft-bodied insects and eggs
Green lacewings	<i>Chrysoperla carnea</i>	Various soft-bodied Insects and eggs

H. Chemical control

- Modern techniques used in GH for pesticide application - low input of chemicals with good coverage of the right part of the plant
- Selective application direct the active ingredient to the right target with lowered effect on beneficial organisms
- Very few chemical pesticides are selective for natural enemies
- Ensure that pesticide has compliance with food safety, worker safety and environmental impact.

Common pest in GH

Name of pest	Symptom	control
Aphids Green peach aphid - <i>Myzus persicae</i> Potato aphid - <i>Macrosiphum euphorbia</i> Melon aphid- <i>Aphis gossypii</i>	Suck sap plant juices, curling, yellowing, failure of bloom set, excrete – sticky digested plant sap – honeydew- sooty mould fungus - interfere photosynthesis	Proper screening No weeds during non-crop periods Insecticides-Azadirachtin Malathion, and pyrethrums
Whiteflies Silverleaf whitefly - <i>Bemisia argentifolii</i> Greenhouse whitefly - <i>Trialeurodes vaporariorum</i>	Silver leaf whitefly bigger threat & vector for tomato viral diseases - irregular ripening - more difficult to control Sucking sap, honeydew, growth of sooty mould - large populations causing severe crop loss.	Yellow sticky cards Exclusion and sanitation <i>Encarsia Formosa</i> –control greenhouse whiteflies <i>Eretmocerus wasps</i> - control silverleaf whiteflies Bio-pesticides- <i>Beauveria bassiana</i> fungus Imidacloprid and acetamiprid
Thrips Tomato- <i>Frankliniella schultzei</i> Onion - <i>Thrips tabacci</i>	Scar on fruit , vector for viral disease TSWV	Exclusion and sanitation Fine mesh screening Remove Broad leaved weeds Malathion, azadirachtin
Leaf miner Tomato-Vegetable leaf miner – <i>Liriomyza sativae</i> -	Damage caused by larvae involves mining within the leaves, resulting in winding or blotch-shaped patterns. This reduces the photosynthetic area of the plant.	Pruning lower leaves Plastic mulch prevents pupae from falling biological control - <i>Diglyphus isaea</i> , <i>Dacnusa</i>

<p>Serpentine leafminer - <i>Liriomyza trifolii.</i></p>		<p><i>siberica</i> - wasps Azadirachtin, pyrethrums</p>
<p>Mites Spotted spider mite - <i>Tetranychus urticae</i></p>	<p>Sap-sucking insects cause discoloration, and in heavy infestations, they leave behind a fine webbing of silk.</p>	<p>Sanitation removal of broad leaved weeds Predatory mites - <i>Phytoseiulus persimilis</i></p>
<p>Tomato russet mites - <i>Aculops lycopersici</i></p>	<p>Leaf and stem russeting or bronzing, along with leaf curling, are symptoms typically spread by wind movement and can also be carried on clothing.</p>	<p>Sanitation Do not allow weeds to grow in GH between crops Miticides- Chlorofenapyr Sulphur, Vertimec</p>