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Insect and Mite Pest Management in Greenhouses

(*Amar Singh[1] and Akshay Kumar Singh Pratihar[2])
[1]Department of Entomology, Agriculture University, Jodhpur
[2]Department of Entomology, Rajasthan College of Agriculture, Udaipur
*Corresponding Author's email: amarchahar15@gmail.com

Integrated Pest Management (IPM) is a term which refers to the use of various strategies to manage greenhouse insect and mite pests. The focus of IPM is to use a variety of management strategies to deal with existing pest problems, rather than relying solely on pest control materials such as insecticides and/or miticides. IPM involves the use of cultural, physical, biological, and/or pesticidal management strategies.

An effective IPM program begins by regularly scouting the greenhouse crop for insect and mite pests. An IPM program may involve setting action thresholds for specific insect and/or mite pests and implementing a pest management strategy once a threshold is reached. Greenhouse growers who have successfully implemented IPM programs indicate that they have reduced costs and increased worker safety.

Pest Management Basics

1. **Identification:** Identifying insect or mite pests and the number of each species in a greenhouse requires diligence, but this information is critical for greenhouse producers to avoid spraying an inappropriate pest control material such as an insecticide or miticide. When greenhouse producers know exactly what pests are present and the plants, they are present on, then the appropriate insecticide or miticide can be applied. A valuable pictorial guide for pest identification is Identification of Insects and Related Pests of Horticultural Plants by R.K. Lindquist and R.A. Cloyd which is published by O.F.A. Services, Inc.
2. **Sanitation:** Clean greenhouses provide fewer opportunities for insect and mite pests to establish and thrive. Weeds under pots or benches serve as reservoirs for many greenhouses insect and mite pests. Weeds under benches are generally not sprayed with insecticides and softeners. In addition, many weeds serve as sources of viruses transmitted by insects, such as the western flower thrips (*Frankliniella occidentalis*). Avoid standing water and allow water to drain properly from the greenhouse as excess water provides an ideal breeding environment for fungus, gnats and shore flies. Remove plant debris and old stock plants from greenhouses or keep in containers with tightly sealing lids as winged adult insects will leave plant material and move on to the main crop.
3. **Exclusion:** It is easy to prevent insect pests or weevils from entering the greenhouse after they have entered the greenhouse. Many greenhouse growers introduce insect and mite pests into greenhouses when they receive a shipment of infected plant material from another source. Careful inspection of new plants before placing them in the greenhouse can reduce problems with insect and mite pests. Exclusion can also be achieved by screening greenhouse openings, including side and ridge vents, with specially designed screening material.

Management

Once insect or mite pest populations are at or above the action threshold, application of an insecticide or miticide may be warranted. Insecticides and miticides are expensive, so it is important to select the appropriate product and follow proper application procedures (see label). There has been an increase in the use of alternative pest control materials. These materials have relatively low mammalian toxicity and are generally less harmful to biological control agents or natural enemies than most conventional pest control materials. Biological control is the use of natural enemies such as predators, parasitoids and/or pathogens to manage insect or mite pests. Predators eat their prey (host) either partially or completely, while parasites lay their eggs inside or on their prey. The immature parasite then feeds on the internal contents of the prey. Eventually, the parasite matures and the adult either emerges from the dead host or exits through a chewed hole. Pathogens including beneficial fungi and entomopathogenic nematodes act like parasitoids because they consume the inside of the target insect host as well. Biological control requires considerable management skill and education in order to be successful in commercial greenhouse production systems.

Scouting for Insect and Mite Pests in the Greenhouse

Scouting is a key component in developing a successful IPM program. It is not possible to make pest management decisions without routinely examining sticky cards or visually inspecting plants for the presence of insect and mite pests and determine their numbers. Detecting insect and mite pests when populations are low allows for flexibility in selecting pest management strategies such as removing infested plants or plant parts, using reduced risk insecticides or miticides, and making spot applications to infested plants containing high numbers of insect and mite pests. The following information provides guidance for developing an insect and mite pest scouting program.

❖ What should be inspected while scouting for pests:

1) Sticky cards
2) Above-ground plant parts such as leaves, stems, and flowers
3) Roots

Insect and mite pests in Greenhouses

Sticky Cards

- Place sticky cards just above the plant canopy. Use sticky cards that are 3-by-5 inches.
- Thrips may be more attracted to blue cards; however, yellow sticky cards attracted insect pests including winged aphids, whiteflies, leaf miners, fungus gnats and shore flies.
- When scouting for fungus gnat adults, place sticky cards horizontally on pots or on the growing medium surface.
- It is not necessary to count all insects on a sticky card. Select a 1-inch vertical column (not horizontal) and be consistent each time sticky cards are monitored. In addition, one side of a sticky card may be used.

- Place one sticky card per 500 to 1,000 square feet of greenhouse space unless the situation requires the need for more, which will depend on crops grown and virus susceptibility.
- Scout sticky cards weekly, identifying all the insects on sticky cards with a 10X hand lens. Record insect numbers on a worksheet that allows you to monitor changes in populations of individual pest numbers and determine changes in insect and mite pest populations at each location through time.
- Replace sticky cards every week or if they become full of insects, which will make identification difficult.
- Insect pests that may be captured on sticky cards: Whitefly adults, Leaf miner adults, Thrips adults, scale, mealybug adult males, Fungus gnat adults and winged adult aphids
- Insect and mite pests not captured on sticky cards: non-winged aphids, Mites including two spotted spider mite, broad mite and cyclamen mite, Mealybug immatures and adult females.

Above ground Plant Parts and Roots

- Randomly examine plants over an area represented by a sticky card. Pay particular attention to specific plant varieties that are more susceptible to certain insect and mite pests.
- Examine leaf undersides, especially young leaves, for the life stages of whiteflies, mealybugs, aphids, spider mites, and scales.
- Examine the upper side of leaves for: Leaf miner tunnels, Distortion and discoloration resulting from feeding by thrips, aphids, whiteflies, spider, mites, scales, and mealybugs or egg-laying damage from leaf miner females. Honeydew a sticky, clear substance excreted by aphids, soft scales, whiteflies, and mealybugs. Sooty mold — a dark fungal growth that uses honeydew as a food source.
- Examine terminal growth for immature thrips and aphids.
- Examine open flowers for thrips larvae and adults.
- Examine the main plant stem for scales and mealybugs.
- Look at the base of stems, leaves and other protected crevices for mealybug life stages and immature thrips.
- Examine plant roots for the presence of fungus gnat larvae and root mealybug.

Management of Insects and Mite Pests of Greenhouse Crops

Biological Control: Biological control is the use of living organisms to reduce the population levels of insect and mite pests. Biological control agents (natural enemies or beneficials) typically will not eliminate the target insect or mite pest. Some beneficials can survive on alternate food sources such as pollen, nectar, or other insects and/or mite pests when populations of the target pests are too low to support continued reproduction of the given natural enemy. Biological control is more successful when applied before insect and mite pest populations reach damaging levels. Consequently, greenhouse workers must systematically scout for insect and mite pests regularly to prevent insect and mite pest populations from reaching harmful levels. Identification and early detection of insect and mite pests is important to determine the type of natural enemy or enemies and when releases should be applied to maximize effectiveness. Biological control is not a quick fix for control of existing insect and mite pest problems, but can be an effective part of a pest management program in which the goal is to reduce reliance on insecticides and herbicides.

Examples:

- Release Lacewings (*Chrysoperla* spp. and *Chrysopa* spp.), Ladybird beetle for aphid management
- Release *Cryptolaemus montrouzieri* for mealybug management.

Insect growth regulators: IGRs are used to kill the young (immature) stages of plant feeding insects including mealybugs, scales, and whiteflies. Insect growth regulators regulate insect development and are typically placed into three general categories: juvenile hormone mimics or analogs; ecdysone antagonists; and chitin synthesis inhibitors. Juvenile hormone mimics or analogs inhibit development and cause insects to remain in an immature stage thus preventing insects from completing their life cycle. Ecdysone antagonists disrupt the molting process of insects by inhibiting metabolism of the molting hormone ecdysone. Chitin synthesis inhibitors interfere with enzymes during the molting process that stimulate the synthesis and formation of chitin, an essential component of an insect's exoskeleton. As a result, insects fail to reach adulthood because they die in an immature stage, or they mature into sterile adult females.

Microbials: These are insecticides containing microorganisms such as bacteria or fungi which cause diseases of insects. They are usually very specific for the targeted insect pest and are slow-acting typically requiring repeat applications. Bacillus thuringiensis (Bt) is an example of a toxin-producing bacteria used against the larval stage of moths (caterpillars) and fungus gnats. *Beauvaria bassiana* is a fungal pathogen or entomopathogenic fungus used against aphids, mites, thrips, and whiteflies. Spores (conidia) of the fungus germinate on the surface of the insect and hyphae penetrate the cuticle. Like parasitoids, the fungus consumes the internal contents of the host. In addition, the insect dies from a toxin produced by the fungus.

Conventional Pest Control Materials

Selecting a Pest Control Material: Once a perceived pest threshold has reached, then pest control material (insecticide or miticide) applications may be initiated. A pest control material choice is dictated by:

- Effectiveness on the existing insect or mite pest(s)
- Mode of action
- Application method
- Human toxicity
- Potential phytotoxicity
- Potential impact on non-target organisms including natural enemies
- Cost
- Restricted entry interval (REI)

Examples:

- Used Adept (diflubenzuron) for control aphid, mite, thrips and mealybug.
- Used akari 5SC (fenpyroximate) for control aphid, thrips, mealybug, whiteflies and leaf miner.