



Greenhouse Integrated Pest Management

What is Integrated Pest Management?

Integrated Pest Management (IPM) is a holistic approach to managing insects, diseases, weeds, and cultural problems in the greenhouse. It is the use of a variety of different pest management tactics including **cultural, biological, physical, mechanical, and chemical controls**. Frequently, two tactics, such as cultural and biological controls, are combined to ensure a successful pest management program. Pest management decision-making is based upon information gathered from a regular monitoring program. Weekly, regular inspection of plants enables you to detect potential problems **early** before they develop into serious problems.

Some of the components of a Greenhouse IPM program include:

1. Initial information gathering on the identification and life history of key pests and biological control agents.
2. Establishment of a regular monitoring program for key pests and biological control agents.
3. Determination of a tolerance level for pest activity.
4. Development of a record keeping system.
5. Pest management decision. Make a decision or continue to monitor.
6. After a treatment is made, evaluate its effectiveness.

Prevention

Before introducing a crop, evaluate the entire greenhouse for the presence of potential problems such as unsold “pet plants”, weeds, algae, and growing media debris underneath benches, which provide a refuge for many greenhouse pests. Prevention of pests is easier if you identify, analyze and correct existing problems before plants are introduced. Many insects and diseases can be accidentally introduced into a greenhouse when infested cuttings, plugs, or plants are introduced. Inspect incoming plant material for the presence of insects and diseases and evaluate their general plant health and quality. If feasible, isolate infested plants in a separate greenhouse or growing area.

Cultural Controls and Sanitation

- Providing proper cultural controls for the crops you are growing is the key to a successful IPM program. By providing the proper environmental conditions (light, water, temperature, and nutritional levels), you can ensure high quality crops.
- Regular monitoring of electrical conductivity (EC) and pH of the growing media will help develop a successful nutritional program.
- Overfertilization, especially with nitrogen, encourages the development of **aphids, whiteflies, mealybugs** and **two spotted spider mites**. The resulting lush plant growth is more susceptible to Botrytis blight and Rhizoctonia web blight.
- High soluble salt levels encourage *Pythium* root and stem rot.
- Overwatering encourages the development of *Pythium* and other root rot diseases.



Figures 1 & 2: Regular use of meters to measure pH and EC levels (on left) and a clean, disinfected greenhouse between crops prevents many pests and disease problems (on right). Photos by L. Pundt

A clean greenhouse helps to prevent many potential pest problems.

- Keeping the walkways and areas under the benches free of spilled potting media, weeds and debris can help prevent many insect and disease outbreaks.
- Disinfecting benches and walkways between crops will help to minimize disease spread.
- Discard heavily infested plants into garbage containers with tight sealing lids to prevent winged insect pests from migrating back into the crop.
- Keeping the hose ends off the floor will help prevent many root and stem diseases.
- The cull pile should be kept as far from the greenhouse as possible to discourage reentry of winged insect pests and disease spores.
- Proper spacing of plants will promote healthy growth and discourage the development of foliar diseases such as *Botrytis* blight.
- Disease suppressive mixes and biological fungicides are being used successfully by many growers
- Growers are more likely to be successful in using biological controls if they are integrated with proper cultural controls and a regular, consistent monitoring program.

Initial Information

Gathering information on the biology and life history of key pests and biological control agents is critical to insure effective decision-making. Proper identification of insects, diseases, weeds, and cultural problems is critical to ensure that effective management tactics are employed.

Developing a Monitoring Program

By thorough, consistent scouting, you can detect potential problems early and gather current information on the identity, location and causes of pest problems. Consistent scouting will also enable you to evaluate the effectiveness of the biological control agents released.

Who Should Scout?

Scouting may be done in-house or by private consultants. Some of the advantages of in-house monitoring include:

- Familiarity with the greenhouse and its crop production practices.
- Ability to promptly inspect incoming plant material.
- Scouting must be considered a high priority by management to ensure inspections on a weekly or as needed basis.
- Adequate time and personnel need to be assigned this important activity to ensure that other, routine greenhouse tasks do not interfere with scouting.

Growers may also hire private pest management consultants. Some of the advantages of private consultants include:

- Ability to scout quickly and efficiently.
- Specialized up-to-date knowledge of pest management.

Some Useful Scouting Tools

- Trained employees.
- 10x to 20x hand lens or adjustable headband-mounted magnifier (Optivisor™).
- 2 x 4-inch magnifying glass.
- Sticky cards, clothespins, and bamboo stakes to monitor winged adult insects.
- Potato chunks or 1/4 of a potato to monitor fungus gnat larvae.
- Flagging tape or colored flag to mark pest infested indicator plants.
- Electrical conductivity (EC) and pH monitoring meters.
- Record keeping system including scouting forms.
- Resources to aid in identification of pest insect and mites, biological control agents, diseases, and cultural problems.



Figures 3 & 4: Using a hand lens to monitor for two-spotted spider mites (on left) and an Optivisor™ to monitor sticky cards (on right). Photos by L. Pundt

How to Scout a monitoring program consists of the use of sticky cards and random plant inspections and the selection of pest-infested plants to be used as indicator plants. Petunias or fava beans can also be used as indicator plants to monitor for the presence of thrips carrying tospoviruses (impatiens necrotic spot virus. (INSV) or tomato spotted wilt virus (TSWV)). You may adapt the following suggestions to your individual greenhouse.

Using Sticky Cards

- Use yellow sticky cards to detect infestations of adult whiteflies, fungus gnats, leafminers, shore flies thrips and winged aphids.
- Place at the minimum rate of one card per 1,000 square feet.
- Space the cards equally throughout the entire range in a grid pattern.
- Place additional cards near entrances and vents to detect insect migration from the outside.
- Check and change the cards weekly to detect pest population trends.
- Record numbers of adult whiteflies, leafminers, thrips, aphids, fungus gnats and shore flies in addition to any other insects caught on the cards.
- It is often helpful to graph data to look at trends and to determine if population levels are increasing or decreasing.
- Over time, you can correlate the number of insects found on the cards to the pest damage on the crops to develop your own tolerance level for pest activity.



Figures 5 & 6: Use of sticky cards. Photos by L. Pundt

Scouting Route in the Greenhouse

- Many insect pests, including whiteflies and spider mites, tend to be densely aggregated. Therefore, random plant inspection is needed to locate the various infestations.
- Based upon your experiences, focus on inspecting those species or cultivars that are more prone to insect, and mite infestations as well as diseases.
- For each area of 4,000 square feet, samples should be taken from at least five to ten random sites.
- Moving in an "M" or zigzag shaped pattern provides good sampling coverage.
- Closely inspect potential problem areas, such as the middle of the bench, which may have received less spray coverage or the ends of the benches where there may be less air circulation.
- Inspect hanging baskets and any crops grown on the floor.
- While scouting, note the presence of diseased plants or weeds to be removed, or any cultural or environmental controls that need to be implemented.
- Select and tag pest-infested plants to be used as indicator plants to track population development and evaluate treatment effectiveness.

Plant Inspection

- When visually inspecting plants, first consider their general health and vigor.
- Closely examine plants that show unusual growth patterns or appear to be under stress.
- Inspect leaves, stems, and roots.
- Closely examine roots to look for signs of root decay or fungus gnat feeding. Healthy roots should be white and actively growing. \

Record Keeping System

- Develop a record keeping system that will aid in effective decision-making.
- Keep records of sticky card counts, weekly monitoring, treatments applied and treatment effectiveness.
- Making graphs of population trends helps in decision-making.

Keep complete records of the product name of the pesticide used, the product's EPA registration number, the total amount applied, and the size of the area treated, the crop on which the pesticide was applied, and the date and location of the application. If releasing biological control agents, keep records of the number, type and where the biological control agents were released.

Pest Management Decision Making

Each week, the grower and scout should review the scouting information gathered from sticky card counts, plant inspections, and data from indicator plants. Looking at trends over a period will help decide what management strategies are needed.

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