

Integrated Pest Management: Making the Transition

Introduction

Integrated Pest Management (IPM) is an approach that uses a combination of techniques in an organized program to suppress pests effectively, economically and in an environmentally sound manner. IPM is a decision process involving identification and monitoring of pest populations, using monitoring information to decide the timing of treatments, integrating a variety of controls and finally, evaluating the results. The most common controls used in greenhouse IPM programs include:

- physical controls, such as sticky traps,
- biological controls, such as predators and parasites, and
- chemical controls, particularly those compatible with biological controls.

The basis for an effective IPM program is prevention of pest problems, through such management methods as:

- choosing resistant cultivars,
- providing ideal environmental conditions to grow healthy plants,
- removing breeding sites and overwintering sites for pests,
- using barriers, such as screening on greenhouse vents, to keep pests out.

Growers who want to use biological control agents in their greenhouse crops achieve the best results when they integrate a variety of preventative and control practices into an IPM program tailored to their site. Greenhouse and other controlled environments are ideal for biological control because the environment can be modified to discourage pests and to encourage biological control agents.

The following is a step-by-step process for making the transition to an IPM program based on biological controls.

Phase I : Clean up and Monitoring

1. **Find and eliminate sources of pest infestation.** This is an extremely important step that makes your other control efforts more effective. This includes removing weeds that can harbor pests, both inside the greenhouse and around the perimeter, inspecting incoming plant material for infestations and screening vents to keep pests from entering.
2. **Develop a monitoring program** to fit your situation. Through regular monitoring, you can determine when pests are first introduced in the crop, where they are located and their populations levels. Because you have more contact with the crop you will be able to catch problems earlier, as well as find out which pest controls are most effective. It may take 6-12 months to feel confident in monitoring, particularly if you are growing several different crops with a variety of pest problems.
 - Make a commitment. Managers and staff must be committed to monitoring programs because getting started takes some extra time and money. Once monitoring programs become routine, costs will be returned through better results and more efficient treatments.
 - Choose methods. Determine which pest populations you need to monitor and choose the monitoring methods to use. For example, yellow sticky traps are effective for monitoring the adult populations of fungus gnats and

whiteflies, but are positioned differently for each target pest. Sticky traps should be checked weekly and replaced every 3-4 weeks as the glue dries out. Some pests are monitored by inspecting plants or plant samples. Both methods may be combined for best results.

- Allow enough time. Set aside a specific time each week to monitor. For consistency, the same person(s) should do the monitoring. Don't put this on a "back burner" while other chores are done.
- Involve the staff. Trained staff can support and assist the monitoring process, particularly in early detection of outbreaks of insects that are not attracted to traps. Keep a map of the crop in the lunch area where employees can note the presence of pests or other problems in the crop.
- Keep good records. Accurate records of counts and observations are essential so that you can use them to improve results in the future. Don't trust your memory for weekly trap counts or the dates specific pests first appeared. Keep records of all pesticide applications, including product, rate, application method (high volume, low volume, spot spray), date and time of day.

Phase II: Modify the Spray Program

1. **Continue to refine the monitoring program.** Study monitoring records to find trends in the pest populations, including: which pests are present, where they are usually located in the greenhouse, the most susceptible cultivars, and the locations of hot spots within the crop. With detailed monitoring you may be able to determine the most likely origin of some pest infestations. Eventually, you will be able to fine tune your monitoring to reduce the time spent, without losing accuracy.
2. **Determine treatment thresholds** for pest populations. Begin to establish what levels of pests can be tolerated and when action is required (the treatment threshold). For example, mites in the lower canopy of cut roses can be tolerated at much higher levels than in the upper canopy where flowers are being harvested. More aphids can be tolerated on leaves of sweet peppers below the level of ripening fruit, than above, where honeydew contaminates the fruit.
3. **Modify the spray program** to make it favorable for introducing biological controls. When you are familiar with the life cycles of pests in the crop and are confident in monitoring for them, adjust your existing spray schedule to:
 - Eliminate ineffective applications. By comparing spray records and monitoring records you will be able to identify the chemicals and the timing of applications that have been most effective. Eliminate those that are ineffective.
 - Apply sprays according to monitoring results. Apply sprays only when and where your monitoring program shows they are needed, not according to a fixed schedule. Treating hot spots, rather than the whole crop, saves time and money, reduces pesticide use considerably and favours biological controls.
 - Time pesticides to target susceptible stages of pests. Adults and immature stages of pests are not equally controlled by all products. Review the life cycle of the target pest and time the pesticide application for the most susceptible stages. For example, do not reapply an adulticide in 3 days if there has not been enough time for emergence of new adults to occur.
 - Substitute pesticides compatible with biological controls. Less toxic, more selective pesticides, with short residual effects are becoming more available. When applied at the right time, for the correct stage of the pest, these are as effective against pests as broad spectrum pesticides, while allowing you to integrate biological controls into your pest management program.
4. **Continue to integrate other controls.** To improve pest management for target pests as well as other problems, continue to look for ways to modify the environment

to make it unfavorable for pests, such as controlling humidity to reduce powdery mildew, modifying watering practices to reduce root rot problems and eliminate fungus gnat breeding sites.

Phase III: Integrate Biological Controls

1. **Reduce toxic residues.** Biological control agents are particularly sensitive to low levels of some pesticides (see Sheet 180). Review all records of pesticide applications for the last six months to make sure that pesticides with long-term residues have not been used where you plan to release biological controls. [When importing plants, beware of plants with unidentified pesticide histories].
2. **Develop the biological control program.** When you know how to accurately monitor crop pests and have modified the spray programs to minimize the use of the toxic or residual chemicals, you can start planning to introduce biological controls.
 - Determine which biological control agents to release. Identify target pests, review information on biological control agents and choose the best ones to use. It is a good idea to start small and with a simple system, such as one target pest in a single crop (e.g., whiteflies in greenhouse tomatoes; aphids in cut roses; or spider mites in interior plantscapes)
 - Identify suppliers and delivery methods. Biological control agents are perishable, living organisms. Choose a distributor and work with them to determine the quickest and most reliable methods of delivery.
 - Determine introduction rates and times. Work with your distributor to determine the best rate and timing for your crop. For most species, it is essential to introduce biocontrols early, at the first sign of pest infestation; some, however, are best introduced before pest infestations are found. Use the higher recommended rates and frequencies at first, until you become more familiar with using biological controls.
 - Check the quality of biological controls. Learn how to inspect and count biological control products (see Sheet 170) and check samples immediately upon arrival. Always hold them at recommended temperatures on the label until applying them, apply them as soon as possible, and follow release instructions carefully.
 - Monitor pests and biological controls. It will now be necessary to evaluate the progress of the biological control agents as well as the pests. To learn how to monitor and what to look for, see technical sheets for each biological control.
 - Make environmental changes that favor biological controls. Look for way to adjust the greenhouse environment and management practices, such as misting interior plantscapes to increase relative humidity, which favours predator mites while suppressing spider mites.
 - Correct imbalances between pests and biocontrols, using compatible pesticides if necessary to reduce pest populations. Think carefully before applying a pesticide, however, because most compatible products can still have negative effects on biological control agents, such as reducing life span or total egg production.
3. **Adjust your expectations.** Low numbers of pests may be present at various times, but they may not be a problem for some stages of crop production.
4. **Be patient!** Biological controls take longer to reduce pest populations than chemical controls, but can be more effective in the long term.

Phase I: Clean up and Monitoring

- Eliminate sources of pest infestations.

- Develop a monitoring program.
 - Make a commitment to monitor.
 - Choose monitoring methods.
 - Allow enough time for monitoring.
 - Involve the staff in monitoring.
 - Keep good records.

Phase II: Modify the Spray Program

- Refine the monitoring program.
- Determine treatment thresholds.
- Modify the spray program.
- Eliminate ineffective applications.
 - Apply sprays according to monitoring results.
 - Time pesticides to target susceptible stages of pests.
 - Substitute pesticides compatible with biological controls.
- Continue to integrate other controls.

Phase III: Integrate Biological Controls

- Reduce toxic residues
- Develop the biological control program.
 - Determine which biological control agents to release .
 - Identify suppliers and delivery methods.
 - Determine introduction rates and times.
 - Check the quality of biological controls.
 - Monitor pests and biological controls.
 - Make environmental changes that favor biological controls.
 - Correct imbalances between pests and biocontrols.
- Adjust your expectations. Be patient!

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