IV. DEVELOPING, IMPLEMENTING, AND EVALUATING A MANAGEMENT PLAN

IPM growers use a variety of cost-effective methods to keep pests at acceptable levels. Some of these strategies are listed in table 5. Those appropriate to specific insects and diseases will be mentioned as those pests are discussed. A management technique for a specific problem aims to reduce its severity as well as prevent its recurrence.

Table 5. IPM approaches for bedding plants

Approach	Examples
Cultural	Adjust incorrect pH or salts to promote root health. Eliminate weeds and standing water. Use HAF fans to improve air movement.
Mechanical	Remove diseased leaves or plants. Remove plants infested with insects or mites. Screening, which prevents insects from entering the greenhouse, may be cost effective.
Biological	Apply biopesticides (insect toxins or pathogens sold as pesticides). Use fungal antagonists (naturally occurring soil fungi that displace plant pathogenic fungi). Release natural enemies.
Chemical	Use pesticides judiciously. Spot-treat in a timely fashion.
Resistant plant varieties	Limited use in bedding plant production at present

The short-term need is to reduce a problem to acceptable levels as quickly as possible. Doing so usually involves disposing of severely infested plant material and using pesticides. The least toxic materials that will be effective are used first, applied as spot treatments whenever possible.

Over the long term, there are several steps that should be taken to help prevent a problem from recurring. Whenever

possible, use a reputable supplier of clean plant material and develop a plan to prevent pests from entering and spreading in the greenhouse. For example, establish an isolation area in which incoming plants can be held and inspected for arthropod and disease problems before they enter the greenhouse, and keep the plants isolated until these problems have been treated. To help prevent the spread of problems, keep doors to bays off a common headhouse closed.

Change growing conditions that lead to pest problems, such as incorrect pH of irrigation water, algae around benches, or weeds in and around the greenhouse. The most obvious step is to simply stay on top of small problems before they become big ones.

Developing a Management Plan

Management strategies are developed before the bedding plant season so that the necessary management tools can be readied; these tactics are then modified as needed during the season.

Pest biology, production practices and equipment, and economics all need to be considered when management strategies are formulated. A pest present in high numbers that can spread or reproduce quickly will need to be controlled quickly, whereas a pest detected early at low levels could be managed with an insect growth regulator or biological control, which act more slowly.

Greenhouse style and pesticide application equipment will also determine what management approaches will be effective. For example, a crop in a large gutter-connected greenhouse that contains varied crops may not be a suitable candidate for biological control if pesticides are to be used on other nearby crops. Capillary mats or flood trays that block spray coverage from underneath could limit the effective use of contact insecticides, as could small, low-pressure sprayers that do not provide adequate coverage. Areas with frequent worker activity will need to be managed with techniques that have limited or no worker re-entry intervals.

Economics also play an important role in a management strategy. Important considerations are the cost of pesticides or natural enemies (including the labor to apply or release them) and the labor cost to rogue dead plants or plant parts.

It may be less costly to discard heavily infested plants than to apply pesticides and risk spread to clean plants. The value of the crop and impact of a pest on that value are also important. Botrytis on geranium flowers is not as urgent a problem as thrips on cyclamen.

Implementing a Management Plan

After each scouting session, record and summarize your observations. This information includes insect identification and counts, disease incidence and severity, location of weeds, and an evaluation of the effectiveness of previous control measures. Also make notes about cultural aspects of the crop (crop height, plant development, etc.) and management of soil fertility and water. A final part of an implementation plan is to have a clear understanding of whose responsibility it is develop and implement the management strategy. The information gathered during scouting should be given to this person as soon as the monitoring session is finished.

When a specific action needs to be taken, the grower should do so in a timely fashion. If pesticides are to be used, they should be applied as soon as possible after observing a problem, assuming the susceptible life stage is present. Apply a labeled pesticide correctly, using the appropriate equipment. Some control failures are the result of improper application techniques or equipment. Cryptic pests, such as thrips larvae or mealybugs, will need to be treated with a sprayer that provides excellent coverage with small particle sizes. A low-pressure backpack sprayer will not give adequate coverage in a dense crop with a large canopy.

Use of biological control requires commitment on the part of the grower. Because many biological controls are not compatible with many pesticides, the grower often has to be willing to use nonchemical methods to manage all pests found in the crop. Biological control agents act more slowly than chemical controls and cannot be expected to be a rescue treatment. Many biological controls are host-specific, and many operate only under specific environmental conditions. Essential to this method are 1) regular scouting to detect small problems that are more easily managed non-chemically, and 2) a reliable supplier of natural enemies. There are many

natural enemies of bedding plant arthropod and disease pests that are discussed in the biological control section.

Evaluation

Evaluation, a critical part of an IPM program, is accomplished during monitoring sessions. Because IPM is a dynamic process, management tactics are constantly evaluated and changed.

Begin an evaluation by checking the spray records before each scouting session. When scouting an area that received a pesticide application after your last visit, look for indications that it was effective. Signs of efficacy are dead, dried, or blackened insects and mites, a drop in trap catches or visual observations, or lack of disease progression. Indicator and sentinel plants, described in section III, are also important evaluation tools. Water-sensitive cards may be used to determine whether adequate coverage was obtained. Place these inconspicuously in the crop just before pesticides are applied. They will turn blue where water hits them, so a card with few blue areas indicates poor coverage.

There are several reasons why a pesticide application may not be effective (assuming a pesticide known to kill the insect, mite, or pathogen was used). Poor coverage of plant surfaces can result in incomplete contact with the pest. Water pH that is too high can cause pesticides to lose effectiveness. Also, pesticides that have been stored incorrectly, such as liquids that have been allowed to freeze, or dry materials that have become wet, can become less effective. Finally, some materials require irrigation. Too much or too little water will result in leaching or reduced plant uptake.