NEW ENGLAND INTEGRATED PEST MANAGEMENT SCOUTING GUIDE for POINSETTIAS

A MANUAL FOR GROWERS AND SCOUTS

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In cooperation with the Cooperative Extension Systems of:
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University of New Hampshire, University of Rhode Island
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Poinsettias (*Euphorbia pulcherrima*) are a valuable potted crop in New England. As of 1996, the total wholesale value of this crop in Connecticut and Massachusetts was over 7.4 million dollars. Poinsettias are also ranked first in the total wholesale value of floriculture pot crops in the U.S. ($214 million in 1996).

This manual includes a brief introduction on integrated pest management (IPM), followed by a lengthy discussion on scouting and decision-making within a pest management program. Emphasis is placed on how to scout for insects, diseases and physiological disorders of greenhouse poinsettias. This manual is designed to be used as a reference tool for growers, managers, scouts, private consultants, and pesticide applicators. For current pesticide information, consult the most recent copy of “New England Greenhouse Floricultural Recommendations: A Management Guide for Insects, Diseases, Weeds and Growth Regulators” published by New England Floriculture, Inc. and available through the publication offices of the University of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont.

**INTEGRATED PEST MANAGEMENT**

Integrated Pest Management (IPM) is the use of a variety of scouting and pest control methods designed to produce high quality plants with judicious use of pesticides. IPM is fundamentally different from traditional chemical approaches to pest control in that IPM aims: 1) to utilize two or more control techniques (e.g. cultural control and biological control techniques) in an integrated fashion; 2) to maximize use of natural mortality factors; and 3) to apply chemical control measures only when necessary. An essential feature of IPM is flexible decision making about pest control based on pest levels in the crop at any given time. IPM attempts to optimize pest control in an economically and ecologically sound way. A successful IPM program combines accurate pest identification and scouting, with cultural, biological and chemical controls. Proper pest identification, and knowledge of the pest's life cycle and biology, combined with the knowledge of pest population levels and trends, will then optimize pest control.
Generation - from any stage in the life cycle to the same stage in the offspring.

Honeydew - the sweet liquid excretion of sap-feeding insects such as whiteflies, aphids and soft scales.

Host feeding - some parasites (and predators) partially feed on the insect species they attack. An example is adults of Encarsia formosa biting whitefly nymphs to supplement their diet of nectar and plant exudates.

Instar - stages (separated by molts) in the life of an insect larva or nymph.

Larva (pl., larvae) - the immature form of an insect that undergoes complete metamorphosis; the stage between egg and pupa.

Nymph - an immature stage (following hatching) of an insect that does not have a pupal stage.

Parasite - an organism that lives at the expense of another. Most greenhouse parasites are actually parasitoids; organisms that, as immatures, feed on just one host during their lifetime, eventually killing it.

Predator - an organism that feeds on many prey during its lifetime. For example, Cryptolanus montrouzieri, the mealybug destroyer.

Pupa (pl., pupae) - the stage between the larva and adult in insects with complete metamorphosis, a nonfeeding and usually inactive stage.

Resting spore - a sexual or other thick-walled spore of a fungus that is resistant to extremes in temperature and moisture, and which often germinates only after a certain period of time after formation.

Sooty mold - soot-like coating on the foliage formed by the dark hyphae of fungi that live on honeydew.

Spore - the reproductive unit of fungi consisting of one or more cells; it is analogous to the seed of green plants.
INTRODUCTION

A well-ordered scouting program consisting of the regular crop inspection for pests is the basis of IPM decision-making, regardless of the control strategies used. Through consistent scouting, a grower can gather current information on the identity and location of pests and evaluate treatment effectiveness. The IPM basics outlined in this reference manual were adapted from Poinsettia IPM programs recently conducted in Connecticut, Massachusetts, New Hampshire and Maine as well as New York.

In Connecticut, the Greenhouse IPM program has focused on intensive, hands-on educational training throughout the season. The goal is to provide greenhouse growers with the knowledge, skills, methods, experience and confidence needed to achieve effective implementation of IPM. The participating growers' questions during the educational sessions led to the development of this reference manual.

WHO SHOULD SCOUT?

Employees can be trained to scout or growers may do their own scouting. Advantages of in-house scouts include: familiarity with crop production practices and the ability to promptly inspect incoming plant material. However, scouting must be considered a high priority to ensure weekly inspections. Adequate time and personnel need to be assigned to this important activity. Other urgent greenhouse tasks should not interfere with scouting.

Growers may also hire private pest management consultants. The advantages of hiring private consultants include their ability to scout quickly and efficiently; and specialized, up-to-date knowledge of pest identification, biology and management. Some private consultants perform additional tasks including nutritional monitoring, crop programming and marketing advice, or training on specific pesticide regulations (i.e. Worker Protection Standards).

SCOUTING COSTS

Records from the Massachusetts IPM program were analyzed to determine the cost of scouting. The labor cost for the number of hours scouted per week and sticky cards used per week plus the total area scouted were considered. Among Massachusetts growers, the average scouting cost was 0.002 cents per square foot per week. This figure does not include the costs of spray equipment, pesticide certification or other costs associated with pesticide treatments. Pest population levels and the ease of movement around a greenhouse influence the length of time required and, therefore, the scouting costs. University-sponsored IPM programs may also collect more detailed information than is needed by a grower to make a treatment decision. Managers should determine their own scouting costs so they can include this cost in their production budget. Regular scouting helps to detect problems early, minimize losses and avoid unnecessary sprays.

TOOLS USED IN POINSETTIA IPM PROGRAMS

The list of essential scouting tools include:

- Trained personnel
- Yellow sticky cards, clothespins and bamboo stakes
- 10x hand lens or adjustable, headband mounted magnifier
- 2" x 4" magnifying glass (5x insert in corner for more magnification)
- Potato "chunks" or 1/4 of a potato
- Flagging tape or colored flags
- Record-keeping system, e.g., pen and clipboard or small notebook
- Maps of each greenhouse
- Labs for pest diagnosis and soil tests
- Electrical conductivity (EC) and pH monitoring meters
- Resource information including pesticide labels, identification, biology and life cycles of key pests

**Non-essential scouting tools:**
- Soil thermometer
- Field microscope
- Waterproof marker
- Microscope for detecting and identifying fungal pathogens
- Rulers to measure plant height for graphical tracking and crop scheduling

(See Table 2c.)

**SCOUTING PROGRAM**

A scouting program includes the use of yellow sticky cards (3" x 5"), random plant inspection and the selection of insect-infested plants to be used as "indicator plants." Growers may adapt the following suggestions to their individual greenhouse operations.

**Pre-crop Site Evaluation**

Four to six weeks before the introduction of the poinsettia crop, evaluate the entire greenhouse range. Note the presence of weeds in and around the greenhouse, drainage problems, algae build-up and debris under the benches. Record crops growing outdoors or in adjacent greenhouses as well as the presence of "pet plants." Place yellow sticky cards in the greenhouses to monitor for aphids, whiteflies, fungus gnats, shore flies, and thrips. Evaluate the clean-up program one week before the crop arrives. Review previous pest problems in the greenhouse and current pesticide application methods. A plan of action can then be developed to eliminate these problems prior to crop arrival. Prevention of pests is easier if the grower identifies, analyzes and corrects existing problems before poinsettias are introduced. This pre-crop inspection is the most important part of scouting because it is much easier to correct problems before the production plants are introduced into the greenhouse.

**Using Sticky Cards**

Yellow sticky cards are used to detect infestations of adult flying insects (See Figure 2a). Each sticky card should be numbered and placed in the greenhouse at the minimum rate of one card per 1,000 sq. ft. Space the cards equally throughout the entire range in a grid pattern. Place additional cards near all entryways and vents to detect insect migration from the outside. Change the cards weekly and place new cards in the same locations to monitor pest population trends. To reduce scouting time, you can divide the card into one-half to one-third segments to estimate the total number of insects trapped on the card. Spot check cards every three to four days to detect population trends during critical times for decision-making purposes. An example of a critical time may be when targeting foliar sprays for adult whiteflies before they begin to lay eggs.

<table>
<thead>
<tr>
<th><strong>Table 2a: Placement of Sticky Cards</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Insect</td>
</tr>
<tr>
<td>Fungus gnats</td>
</tr>
<tr>
<td>Thrips</td>
</tr>
<tr>
<td>Whiteflies</td>
</tr>
</tbody>
</table>

Yellow sticky cards attract adult whiteflies, fungus gnats, shore flies, winged aphids and thrips. Card height may be alternated with one card above the crop canopy, and then one card within the crop canopy to attract insects in both the upper and lower plant canopy (See Table 2a).
Identifying Insects on Sticky Cards

Use a 10x hand lens or magnifier to more closely examine and identify the trapped insects (See Table 2b). Occasionally, other insects will be caught on the cards.

Identify and record pest numbers in a notebook or on forms attached to a clipboard. A sample form for data collected from sticky cards is included on page 27. Record for each card, the number of days in place, and the approximate numbers of whiteflies, thrips, aphids, fungus gnats and shore flies in additional to any other insects caught on the cards. Over time, you can correlate the number of insects found on sticky cards to the amount of pest damage on your crops to develop your own tolerance levels for pest activity.

Do not rely completely on yellow sticky card counts, which only attract adult insects, for decision making purposes. Plant inspection is needed to locate the immature stages of many different insects and mites and to identify problem areas.

**Scouting Route in a Greenhouse**

Small greenhouses (less than 4,000 sq. ft.) can be scouted as one unit. Larger greenhouses should be divided into 2,000- to 3,000-sq.-ft. sections for ease of scouting. Many insect pests, including whiteflies and mites, tend to be densely aggregated. Therefore, random inspection is needed to locate the various infestations. Monitor key locations in a greenhouse on a regular basis. Areas with little air movement may harbor disease pathogens such as botrytis blight or powdery mildew. Scout damp locations which often harbor fungus gnats and shore flies.

While scouting, mark your route on a map or diagram. Establish a weekly scouting routine. For greenhouses of less than 4000 sq. ft., samples should be taken from at least five to 10 random sites. Moving in an M or zig-zag shaped pattern will provide good sampling coverage. (See Figure 2c.) Each plant should be randomly selected to represent a fair evaluation of the crop.

Inspect plants in the middle of the bench and also at the edge of a bench against the wall (where there may be less spray coverage or less air circulation) which can increase pest activity. Alternate the benches that are inspected each week in order to inspect different plants in different areas each week. Inspect hanging baskets and any crops grown on the floor. While scouting, note the presence of diseased plants or weeds that need to be removed and any environmental or cultural controls that need to be implemented.

**Plant Inspection**

Inspect plants for the presence of the following
Table 2b: How to Identify Insects Trapped on Sticky Cards.

<table>
<thead>
<tr>
<th>Insect</th>
<th>Identifying Characteristics</th>
<th>Approximate Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphids</td>
<td>Pear-shaped insect with two cornicles (&quot;tailpipes&quot;) projecting from the rear of the body. Their wings tend to be symmetrical on either side of their body. Look for two dark parallel veins along the front pair of wings.</td>
<td>0.06 to 0.10 inch (3/32 inch)</td>
</tr>
<tr>
<td>Fungus gnats</td>
<td>Small mosquito-like insect with long legs and antennae. Look for a Y-shaped vein at the tip of their grayish wings.</td>
<td>0.08 inch (3/32 inch)</td>
</tr>
<tr>
<td>Parasitic Wasps</td>
<td>Small, wasp-like insects with bowed antennae like an ant.</td>
<td>0.04 inch (3/64 inch)</td>
</tr>
<tr>
<td>Shore flies</td>
<td>House-fly like insect with short antennae and faint spots on their smoky wings.</td>
<td>0.08 inch (3/32 inch)</td>
</tr>
<tr>
<td>Thrips</td>
<td>Small, narrow yellow to reddish-brown insect. Look for antennae or wings to distinguish thrips from a grain of peat moss.</td>
<td>0.04-0.08 inch (1/16 inch)</td>
</tr>
<tr>
<td>Whiteflies</td>
<td>Small moth-like insect with powdery white wings. As its body disintegrates on the card, it may appear more orange in color than white.</td>
<td>0.06 inch (1/16 inch)</td>
</tr>
</tbody>
</table>

Indicator Plants

Indicator plants can be used in three ways: 1) to examine the pest’s development cycle, 2) to monitor the effectiveness of a treatment, and 3) to detect the presence of thrips carrying impatiens necrotic spot virus (INSV) by using fava beans or petunia indicator plants. Petunia or fava bean indicator plants may be used to detect the presence of thrips carrying the virus before susceptible spring crops are introduced into the greenhouse.

Indicator plants are chosen from among pest-infested plants in a greenhouse. Select one to three infested plants per 1000 sq. ft. Mark and number the plants with flagging tape to facilitate identifying and locating the indicator plants each week. Then, tag infested leaves with flagging tape. Circle with a waterproof marker the whitefly nymphs to be more closely monitored. The effectiveness of an insect growth regulator or release of parasitic wasps to be used for biological control against whitefly can be evaluated among whitefly nymphs on these plants. You can mark the date and number of living and dead nymphs on the flagging tape or on the scouting form on page 29 (See Figure 2d).

Making Pest Management Decisions

Each week, the grower and scout should review the scouting information. Pest numbers recorded from sticky cards and foliar inspections, data from indicator plants, and the location of reservoirs of pests all help to prioritize a pest management strategy. By examining this data over a period of time, pest population trends will emerge. Often graphing
the data is useful to show population trends over time and help decide if controls are needed. A decision must then be made that includes: the choice of pesticide or biological control agent, the rate, method and site of application; and any other

pest management techniques that may help solve the problem. Every pest management action should be recorded. Scouting is an ongoing part of the management strategy.

Table 2c: Some Sources of Pest Management and Nutritional Monitoring Tools

- E.C. Geiger, Inc.
  Rt. 63, Box 285, Harleysville, PA 19438
  Tel. 1-800-443-4437  Fax: 1-800-432-9434

- Gempler's
  PO Box 270, 211 Blue Mounds Rd.
  Mt. Horeb, WI 53572
  Tel. 1-800-382-8473  Fax: 1-800-551-1128

- The Green Spot, LTD
  93 Priest Road, Nottingham, NH 03290
  Tel. 603-942-8925  Fax: 603-942-8932

- Great Lakes IPM
  10220 Church Road NE, Vestaburg, MI 48891
  Tel. 517-268-5693  Fax: 517-268-5311

- Griffin Greenhouse and Nursery Supplies
  PO Box 38, Tewksbury, MA 01876
  Tel. 508-851-4346  Fax: 508-851-0012

- Hydro-Gardens, Inc.
  PO Box 25845, Colorado Springs, CO 80936
  Tel./Fax: 1-800-634-6362

- IPM Laboratories, Inc.
  PO Box 300, Locke, NY 13092-0300
  Tel. 315-497-2063  Fax: 315-497-3129

- W.H. Milikowski, Inc.
  75 Chestnut Hill, Route 190,
  Stafford Springs, CT 06076 - 4030
  Tel. 1-800-243-7170  Fax: 1-860-684-3022

This information is supplied with the understanding that no discrimination is intended and no endorsement is implied.

* For further information on suppliers and availability of biological control agents consult:

Hunter, C.D. 1997. Suppliers of Beneficial Organisms in North America. One free copy per request is available from:

California Environmental Protection Agency
Department of Pesticide Regulation
Environmental Monitoring and Pest Management Branch
1020 N Street, Room 161
Sacramento, California 95814

Figure 2d: Tagged Indicator Plants: use to evaluate treatment or the effectiveness of parasitic wasps for biological control.
SUMMARY OF THE SCOUTING PROCESS

Planning and Preparation
- Develop plan to clean up entire greenhouse concentrating on problem areas.
- Review previous pest problems and pesticide application methods.
- Inspect protective clothing and respirators.
- Have current pesticide labels and MSDS sheets readily available.
- Decide if additional scouting or monitoring tools are needed.

Before Crop is in Place
Do first inspection four to six weeks before plants will be introduced:
- Place yellow sticky cards in the greenhouse (at a minimum rate of one per 1000 sq. ft.) with additional cards placed near doors and vents.
- Check cards weekly for presence of whiteflies, fungus gnats, thrips, shore flies and winged aphids.
- Note the presence of weeds, diseased or infested “pet plants” that may need to be removed.
- Record what crops are growing in adjacent greenhouses or outdoors.

One week before plants or cuttings are introduced:
- Inspect greenhouse and surrounding areas to evaluate clean up program.

Cutting Inspection
- Inspect 10% of cuttings by variety or shipment.
- Inspect and record whitefly species and stage present.
- Inspect and record presence of stem and root rots (submit samples to diagnostic lab for identification).
- Inspect and record presence of powdery mildew colonies.
- Evaluate overall health and quality of cuttings.

Purchased Pre-finished Plant Inspection
- Randomly inspect as many plants as possible (10 per 1000 sq. ft.) for key pests.

Regular Weekly Scouting
- Review pesticide application record of the previous week.

Yellow sticky cards
- Inspect yellow sticky cards and record numbers of pests present (whiteflies, thrips, aphids, fungus gnats, shore flies and any unusual pests); estimate numbers to save time.
- Change cards weekly, graphs may help you look at trends and make pest management decisions.

Plant Inspections
- Randomly select five to 10 plants per 1000 sq. ft.
- Inspect the underside of six leaves per plant for whiteflies.
- While inspecting plants for whiteflies, look for fluffy, active, powdery mildew colonies on the lower leaves.
- Note the presence of botrytis blight on leaves, stems or bracts.
- Inspect root systems for overall health, signs of fungus gnat feeding or decayed roots.
- Test media for pH and conductivity (EC).

Indicator Plants
- Select indicator plants (one to three per 1000 sq. ft.).
- Use to track whitefly development in order to better time sprays and to evaluate their effectiveness.
- Use to monitor effectiveness of biological control agents.

Pest Management Decision Making
- Records of weekly pest activity are reviewed.
- Examine trends over time (the past several weeks compared to the current report) in order to make a decision.
- Decision is made (treatment, no treatment, continue to monitor).

Record Keeping
- Records are made of weekly scouting activities and every pest and nutrient management action.

End of the Season
- Evaluate total crop quality.
- Add scouting costs to total production costs.
- Summarize reports to better prepare for the next season.
INTRODUCTION

Both insect and mite pests may be inadvertently introduced into a greenhouse on incoming plant material. Crops in nearby ranges, infested “pet plants” or weeds also serve as reservoirs for pests. This chapter discusses how to inspect plants for whiteflies, fungus gnats plus other minor insect pests including shore flies, thrips, mites and mealybugs.

WHITEFLIES

While low populations may not cause serious plant injury, the presence of only one or two adult whiteflies may be objectionable to customers at the time of sale. At high population levels, whiteflies can cause the plant’s foliage to become yellowed and mottled. Occasionally, honeydew and sooty mold can further disfigure the plants.

Several species of whiteflies may infest poinsettias, including silverleaf whitefly (Bemisia argentifolii, formerly known as the sweet potato whitefly B. tabaci), greenhouse whitefly (Trialeurodes vaporariorum) and bandedwinged whitefly (T. abutilonea). Silverleaf whitefly is the most difficult species to control due to its high reproductive potential and resistance to many commonly-used insecticides. Both greenhouse and silverleaf whiteflies may be found on a poinsettia crop at the same time.

Native to New England, bandedwinged whiteflies are seen in late August through September on yellow sticky cards. It feeds on several weed species outside the greenhouse (ragweed, velvetleaf and beggar-ticks) and may enter the greenhouse. Although immatures have been found on poinsettias in New England, usually only one or two plants are infected and control is rarely needed.

Identification

The powdery-white (0.06 inch long) greenhouse whitefly adults have wings that tend to lie flat over their body. The yellowish silverleaf whitefly adults are slightly smaller (0.04 inch long) than greenhouse whitefly adults.

Adults of greenhouse whitefly and bandedwinged whitefly look similar and are distinguished apart by the two grayish bands that form a zig-zag pattern across each front wing of the bandedwinged whitefly adult (See Figure 3a).

It is easier to identify the different species by examining the pupae found on the undersides of the leaves. The greenhouse whitefly pupae are white with straight, elevated sides. With a 10x hand lens, you can see a fringe of wax filaments around the edge of this pupal case. The bandedwinged whitefly pupae are very similar to greenhouse whitefly pupae. However, the bandedwinged whitefly pupae have a dark band down the center of their pupal case.

Silverleaf whitefly pupae are yellowish with a more rounded edge and fewer waxy filaments than the greenhouse whitefly pupae.

Biology and Life Cycle

Greenhouse and silverleaf whiteflies develop from egg to adult in about one month, depending upon temperature. The four developmental stages are the egg, immature nymphs (1st, 2nd, 3rd, 4th

<table>
<thead>
<tr>
<th>Table 3a: Whitefly Development at 70°F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developmental Stage</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Egg</td>
</tr>
<tr>
<td>1st instar</td>
</tr>
<tr>
<td>2nd/3rd instar</td>
</tr>
<tr>
<td>Pupal (4th instar)</td>
</tr>
<tr>
<td>Adult</td>
</tr>
<tr>
<td>Egg-laying period</td>
</tr>
<tr>
<td>of adult female</td>
</tr>
<tr>
<td>Egg to Adult</td>
</tr>
<tr>
<td>Total number of eggs laid</td>
</tr>
</tbody>
</table>
instar), pupa (end of the 4th instar) and adult. Because the silverleaf whitefly produces more young than the greenhouse whitefly, it is more difficult to control (See Table 3a).

Scouting

Pre-Crop Site Evaluation
Inspect greenhouses at least four to six weeks prior to introducing the crop. This will allow time to clean up any potential sources of whitefly infestations. Place yellow sticky cards in the greenhouses at a minimum rate of one per 1000 sq. ft. Remove weeds and "pet plants" that may harbor whiteflies and other insect pests. Closely monitor favored whitefly hosts including: chenille plant, chrysanthemum, flowering maple, gerbera daisy, glorybower, hibiscus, lantana, Martha Washington geraniums, scarlet, tomato, rosemary (and other herbs), verbena and zinnia. To evaluate this clean-up program, inspect the production area one week before introducing poinsettias.

Cutting and Prefinished Plant Inspection
Adults are rarely found on poinsettia cuttings; however, eggs, small (1st & 2nd) instar immatures and a few pupae may be present. Look on the underside of the three lower leaves, where most of the whiteflies are generally found. Randomly inspect 10% of the cuttings. Inspect each shipment and cultivar separately. Record which shipments or cultivars will need follow-up treatments.

If pre-finished plants are purchased, randomly inspect at least 10 plants per 1000 sq. ft. Early detection will result in more effective management. Treating when the plant canopy is small and more open results in more thorough spray coverage to the underside of the leaves.

Whitefly management is more effective early in the production cycle than at the end of the season.

### Table 3b: How to Inspect Poinsettias for Whiteflies.

<table>
<thead>
<tr>
<th>Plant Canopy</th>
<th>Predominant Whitefly Life Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Canopy</td>
<td>Egg-laying adults</td>
</tr>
<tr>
<td>Middle Canopy</td>
<td>Small (1st &amp; 2nd) instar immatures</td>
</tr>
<tr>
<td>Lower Canopy</td>
<td>Medium and large (3rd &amp; 4th) instar immatures</td>
</tr>
</tbody>
</table>

### Foliar Inspection
Foliar inspection is needed to detect the immatures on the underside of the leaves (See Table 3b). When plants are small, inspect three leaves per plant; as the poinsettias get larger inspect six leaves. Select two leaves in the upper, middle, and lower canopy for a total of six leaves per plant.

Use a 10x hand lens or magnifier to distinguish between the small (1st & 2nd instar), medium (3rd instar), and larger (4th instar or pupal) whitefly stages. Knowing the predominant stage present aids in calculating the timing and selection of insecticide applications. The egg and pupa stages tend to be tolerant of most insecticides, whereas the adults and the small immatures are the most susceptible. Inspect at least five to 10 plants per 1000 square feet. Select plants throughout the greenhouse range. IPM programs in Connecticut and Massachusetts have successfully used this scouting protocol to assist growers in making treatment decisions (See Table 3c).

### Indicator Plants
While inspecting plants, select a whitefly-infested plant to be used as an "indicator plant." Tag the infested plant with flagging tape and mark both

### Table 3c: Scouting for Whiteflies.

<table>
<thead>
<tr>
<th>Production Phase</th>
<th>Scouting</th>
<th>How Many Plants to Inspect/Scout</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-production</td>
<td>Scout whitefly-favored hosts and weeds, place yellow sticky cards among plants. Record weeds and &quot;pet plants&quot; that need to be removed.</td>
<td>Inspect over 10% of crop in entire greenhouse to identify potential problem areas and a 10-to 20-ft. perimeter area outside the greenhouse.</td>
</tr>
<tr>
<td>At or before planting</td>
<td>Inspect lower three leaves for the the small immatures.</td>
<td>10% of cuttings; checking all shipments and cultivars.</td>
</tr>
<tr>
<td>During production</td>
<td>Use sticky cards to monitor for adults. Inspect the underside of six leaves per plant for adults and immatures. Tag whitefly-infested plants to use as &quot;indicator&quot; plants.</td>
<td>Inspect at least five to 10 plants per 1000 sq. ft. throughout the greenhouse. Inspect and make note of weeds that need to be removed.</td>
</tr>
</tbody>
</table>
the leaf and the whitefly-infested area on the leaf with a black, waterproof marker. Whitefly development can then be closely monitored to better time and evaluate pesticide applications. After treatment with insect growth regulators, whitefly pupae may become dried and discolored or adults may emerge, but appear distorted.

Indicator plants can be used to evaluate the effectiveness of the release of parasitic wasps for biological control. Greenhouse whitefly pupae that have been parasitized by Encarsia formosa will turn black. Feeding by the parasitic wasps on immature whiteflies will also reduce whitefly populations. Keep track of both living and dead nymphs to evaluate the wasps' effectiveness.

**FUNGUS GNATS**

The damp, moist environment in greenhouses favors development of fungus gnats. The larvae feed on fungi and decaying organic matter. During cutting propagation, they may feed upon the callus, slowing down or completely inhibiting rooting. They also can damage roots as they feed and tunnel into stems, causing the plant to wilt and sometimes die. Fungus gnat larvae can ingest the fungal spores of certain pathogens including Pythium. The first two generations of fungus gnats tend to be the most damaging to poinsettias and other pot crops.

**Identification**

Dark-winged fungus gnat adults (Bradysia sp., and Sciarina sp.) are slender (0.08 inch long) mosquito-like insects with long legs and many-segmented antennae. Their delicate gray wings have a characteristic Y-shaped vein near the wing tip (See Figure 3b). Larvae are slender (0.3 inch long) and white with a distinctive black head capsule, and no legs or wings.

**Biology and Life Cycle**

The life cycle from egg to adult is approximately one month, depending upon temperature. Overlapping and continuous generations in the greenhouse make effective management difficult (See Table 3d).

**Table 3d: Fungus Gnat Development at 72°F.**

<table>
<thead>
<tr>
<th>Developmental Stage</th>
<th>Number of Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg</td>
<td>4-6 days</td>
</tr>
<tr>
<td>Larva</td>
<td>10-14 days</td>
</tr>
<tr>
<td>Pupa</td>
<td>4-6 days</td>
</tr>
<tr>
<td>Adult</td>
<td>8-10 days</td>
</tr>
<tr>
<td>Egg-laying period</td>
<td>7 days</td>
</tr>
<tr>
<td>Egg to Adult</td>
<td>30 days</td>
</tr>
</tbody>
</table>

*Total number of eggs laid = 100-150*

**Scouting**

Use yellow sticky cards to monitor for adults. Adults are weak flyers and may also be seen running over the soil surface. Ohio State University researchers found that growing mixes with compost less than six months old are more attractive than others to fungus gnats and promote higher survival.

Larvae are found in the top one to two inches of growing media and sometimes in the bottom of the pot. Bench type (open versus closed) affects air flow and moisture levels surrounding the pots, and therefore influence population development. Favorable habitats include areas with standing pools of water, soil floors that encourage the growth of algae compared to concrete floors, and floors with spilled potting media, debris and weeds (See Table 3e). Use potato chunks (1/4 of a potato) to monitor for larvae. Place the chunks with the cut surface face down on the growing media. (Potato

**Table 3e: Scouting for Fungus Gnats.**

<table>
<thead>
<tr>
<th>Production Stage</th>
<th>Scouting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting Propagation</td>
<td>Inspect developing callus for fungus gnat feeding injury.</td>
</tr>
<tr>
<td>Crop Production</td>
<td>Use yellow sticky cards to monitor for adults. Use potato chunks to monitor for larvae; replace weekly. While inspecting plants for root health and signs of root rot pathogens, look for larvae and signs of their feeding (blunt root tips).</td>
</tr>
</tbody>
</table>
chunks tend to be more effective when the cut surface stays moist and does not dry out. Mark the pots with flagging tape to facilitate locating the cut potatoes for frequent inspection. Check both the growing media and the underside of the potato chunks for larvae. Replace during weekly scouting inspections and record on the scouting form (on page 27) the numbers of larvae found (See Figure 3c).

OTHER INSECT PESTS

MITES

Spider mites, including the twospotted spider mite, *Tetranychus urticae*, are very common greenhouse pests, but are only “occasional” pests of poinsettias. The Lewis mite (*Eotetranychus lewisi*), has been found on poinsettias in Ohio, Michigan, Massachusetts, California, Washington, Maryland, Canada and the southwestern U.S.

Identification and Scouting

Adult twospotted mite females are small (0.04 inch long), greenish-yellow mites with two characteristic dark, lateral spots. The Lewis mite is about the same size as the twospotted mite but is slender and straw-colored with several spots along each side of the body (See Figure 3d).

Inspect plants in hot, dry areas of the greenhouse for mites. To scout for mites, gently tap the foliage over a white sheet of paper. Wait a few seconds and then you will see the small mites, about the size of a printed period, moving across the paper. Or, with a 10x hand lens, inspect the underside of leaves. Fine stippling or flecking may be seen on the upper leaf surface. Mites feed on the underside of leaves by sucking out the cell contents. During mite outbreaks, webbing may also be evident on the plants.

SHORE FLIES

Growers often confuse shore flies (*Scatella* spp.) with fungus gnats (See Figure 3c). Both of these small flies are found in damp, moist locations within the greenhouse. However, shore fly larvae feed primarily on algae and other decaying organic matter and do not injure poinsettias by direct feeding. Adult shore flies are primarily a nuisance and may leave “fly specks” on the foliage. However, they may also help spread fungal diseases including *Pythium* sp.

Identification and Scouting

Shore fly adults (0.08 inch long) have stockier bodies with shorter legs and antennae than fungus gnats. Each wing has distinctive faint light spots. Use yellow sticky cards to monitor for adults. Shore fly larvae (0.10 inch long) are yellowish-brown, lack a head capsule and may be found near algae.

THRIPS

Western flower thrips, *Frankliniella occidentalis*, is the dominant thrips species found in New England greenhouses. However, poinsettia is not their favored host. Thrips feed by piercing plant cells

Figure 3d: Stages of the twospotted spider mite.

Continued on page 17.
Photo 1: Using a headband magnifier to scout for immature whiteflies on the underside of leaves. (Photo: Leanne Pandit)

Photo 2: Closeup of greenhouse whitefly adult. (Photo: Dr. Lance Osborne)

Photo 3: All stages of silverleaf whitefly (note the tent-shaped angle of the wings). (Photo: Dr. Lance Osborne)

Photo 4: (Left) Yellowish silverleaf whitefly pupa (note the red eyes).
Photo 4a: (Above) White greenhouse whitefly pupa.
(Photos 4, 4a: Leanne Pandit)

Photo 5: Immature greenhouse whiteflies (2nd and 3rd instars). (Note that they are flat and clear with two yellow spots).
(Photos: Leanne Pandit)

Photo 6: Bandedwinged whitefly pupa (note the dark center band). (Photo: Donna Ellis)
Photo 7: Abnormally elongated poinsettia branches infected with poinsettia scab. Photo 7a: Closeup of scab-like lesions. (Photos 7, 7a: Dr. Sharon Douglas)

Photo 8: (Right) Immature silverleaf whiteflies (note the yellow color).

Photo 9: A dead, distorted silverleaf whitefly adult (an insect growth regulator was applied).

Photo 10: (Above) Whitefly eggs (note the dusty appearance. Do not confuse with latex exuded on plant).

Photo 10a: Empty whitefly pupal case (note the T-shaped exit hole).

Photo 11: Alive (on right) and dead, discolored (on left) immature silver leaf whitefly.
Photo 12: Fungus gnat larva feeding within poinsettia stem (note the black head).

Photo 13: Thrips feeding injury (do not confuse with malformed leaves after a pinch or wind injury).

Photo 14: Healthy poinsettia (on right) and stunted plant with wilted leaves (on left) affected by a root rot disease.

Photo 15: (Right) Pythium root rot. Roots decay; larval feeding increases fungal injury.
(Photos 12, 13, 14: Leanne Pandit)

Photo 16: Poinsettia cutting with pythium root rot (note the rat-tail appearance).
(Photos 16, 17: Margery Daughtrey)

Photo 17: Rhizoctonia root rot.
Photo 18: Botrytis blight lesion at tip of leaf (note the whitish-gray cobwebby mold). (Photo: Leanne Pundt)

Photo 19: (Above) Closeup of botrytis sporulation. (Photo: Dr. Sharon Douglas)

Photo 20: (Left) Botrytis stem canker. (Photo: Margery Daughtrey)

Photo 21: Yellow spots caused by powdery mildew on upper surface of leaves. (Photo: Margery Daughtrey) Copyright 1995 by the American Phytopathological Society.

Photo 22: Powdery mildew (note the fungal mycelium radiating out from the center). (Photo: Leanne Pundt)

Photo 23: Whitish spray residue can mimic powdery mildew. (Photo: Leanne Pundt)
with their mouthparts and sucking up the plant
juices. Their feeding results in distorted, deformed
leaves when they feed within the buds or silvery,
flecked scarring and fecal spots when they feed on
expanded leaves. Western flower thrips also spreads
impatiens necrotic spot virus (INSV) which has
not yet been reported on poinsettia.

Identification and Scouting
Adult western flower thrips are slender (0.25 inch
long), yellow to reddish-brown winged insects. The
small (0.025 inch long) yellow larvae are wingless
and may be seen on the foliage. Thrips populations
peak as temperatures increase during the summer,
and this is when injury may be observed on poin-
settia. However, plants generally outgrow this dam-
age by the time they are ready for sale. Thrips feed-
ing damage may be confused with wind injury or
malformed leaves which may occur after a pinch
(See Table 3f).

For further information on insect identification
consult:
Gentile, A. G. and D. T. Scanlon. Revised by T.
Floricultural Crops in New England for Commercial
Growers. Available from: Bulletin Distribution
Center, Draper Hall, University of Massachusetts
Extension, Box 32010, Amherst, MA 01003-2010.

| Table 3f: Scouting for Other Insect Pests. |
| Insect   | Scouting                                      |
| Mites    | Look for stippling or flecking of the         |
|          | foliage, especially in hot, dry areas of      |
|          | the greenhouse. Look on underside             |
|          | of leaves for mites. Gently tap foliage over   |
|          | a white sheet of paper.                       |
| Shore flies | Yellow sticky cards for adults; look    |
|          | for larvae near algae.                       |
| Thrips   | Yellow sticky cards to monitor for            |
|          | adults; inspect plant leaves for larvae,      |
|          | feeding damage and black fecal spots.         |
|          | (Do not confuse with mite or wind             |
|          | injury, or distorted, malformed leaves which  |
|          | may occur after pinching.)                    |
INTRODUCTION

In order for a disease to develop, the following three conditions known as the disease triangle must occur: 1) a pathogen must be present; 2) a susceptible host plant must be present; and 3) favorable environmental conditions for disease development must exist. Proper sanitation is critical to prevent disease outbreaks. In spite of good sanitation practices, diseases may still be introduced. Learning to recognize some of the common diagnostic symptoms aids in the early detection of diseases and helps to limit economic losses. This chapter discusses how to scout for root and stem rots, botrytis blight and powdery mildew. Less commonly-occurring diseases including bacterial soft rot, poinsettia scab and rhizopus stem rot and blight are also covered.

ROOT AND STEM ROTS
Root and stem rots may be caused by the fungi Pythium, Phytophthora, Rhizoctonia and Thielaviopsis. Above ground symptoms are very similar and include wilting and yellowing of the foliage and plant stunting (See Table 4a). Feeding by fungus gnat larvae may also damage the roots causing wilting and plant death. For positive identification, symptomatic plants need to be submitted to a diagnostic laboratory. A specific diagnosis is important for selection of the most effective fungicide.

PYTHIUM ROOT AND STEM ROT
Pythium root and stem rot is caused by several different species of Pythium. Some species vary in their sensitivity to fungicides, making laboratory diagnosis important. The fungus may be introduced into the growing area on infested tools, pots, hands, hose ends and diseased plants or cuttings. Adult shore flies can also introduce Pythium into the growing medium. Although fungus gnat adults do not efficiently spread Pythium, their larvae can ingest the fungal spores. Spores may then be introduced into their feeding wounds on the roots or stems. Pythium can also be easily spread when water is splashed from diseased to healthy plants.

Ebb-and-flood systems can effectively spread Pythium, especially if the irrigation solution is heavily contaminated.

High fertilization levels increase the susceptibility of poinsettia to attack by Pythium. High salt levels injure the young roots which are then more vulnerable to infection. Growing mixes that do not drain well with a high moisture holding capacity also encourage this disease.

PHYTOPHTHORA ROOT AND STEM ROT
Phytophthora root and stem rot is caused by the fungus Phytophthora parasitica. All parts of the plant may become infected. The fungus is soilborne but may be spread by splashing during overhead watering. This disease is primarily a problem when poinsettias are grown in mixes containing field soil.

Management strategies for both Pythium and Phytophthora include proper sanitation and cultural practices, prompt removal of infected plants (especially in ebb-and-flood systems) and the timely use of appropriate fungicides.

RHIZOCTONIA ROOT AND STEM ROT
Rhizoctonia root and stem rot are caused by the fungus Rhizoctonia solani. Fungal strands and resting spores may move from infested soils onto tools and watering hoses. The fungus may also move from infected plants to healthy plants. Plants weakened and stressed during shipping are more likely to become infected. Unlike Pythium, Rhizoctonia may occur in well-drained media and is favored by evenly moist, warm soils. High ammonium levels in the growing mix can favor the development of Rhizoctonia. Poinsettias are most susceptible to this disease when cuttings are propagated and on mature plants. Management practices include sanitation and the use of fungicide drenches.

THIEILOPSIS ROOT ROT
Thielaviopsis root rot is caused by the fungus Thielaviopsis basicola. This disease is primarily a problem when poinsettias are grown in mixes containing field soil.
### Table 4a: Scouting for Root and Stem Rots.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Scouting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pythium root and stem rot</td>
<td><strong>On cuttings:</strong> Look for a tan to dark brown, water-soaked canker at the base.</td>
</tr>
<tr>
<td></td>
<td><strong>On mature plants:</strong> Leaves may suddenly wilt and drop. Roots may be brown and decayed. A diagnostic symptom is a cortex that “sloughs” off leaving a central core. Healthy roots will be white and firm.</td>
</tr>
<tr>
<td>Phytophthora root and stem rot</td>
<td><strong>On mature plants:</strong> Look for wet, grey lesions or dark, elongated streaks on the stems at the crown. Small, angular tan spots may be seen on the leaves. Leaves or petioles may bend down sharply.</td>
</tr>
<tr>
<td>Rhizoctonia root and stem rot</td>
<td><strong>On cuttings:</strong> Look for a dry, brown discoloration at the cutting base that may develop before or after rooting. <strong>On mature plants:</strong> Look for dry, brown stem canker at the soil line. Lower leaves may yellow and drop, roots rot and entire plants may die.</td>
</tr>
<tr>
<td>Thielaviopsis root rot</td>
<td><strong>On mature plants:</strong> Look for longitudinal cracking and black stem lesions at soil line. You may see black areas or streaks in the roots. Plants are stunted with chlorotic leaves that may drop.</td>
</tr>
</tbody>
</table>

**BOTRYTIS BLIGHT (GREY MOLD)**

Botrytis blight is caused by the fungus *Botrytis cinerea* which often survives saprophytically on dead and decaying plant tissue. Fungal spores are easily spread by air currents or splashing water throughout the greenhouse range infecting poinsettias during all phases of their production.

Favorable conditions for botrytis blight development include free moisture on the leaf for eight to 12 continuous hours, high relative humidity (93% or greater) and cool temperatures (55°F - 65°F). During “warmer than average” fall seasons, growers may be less likely to heat and ventilate their greenhouses in the evening. Excessive condensation forms and drips onto the vulnerable bracts. Weakened or stressed plant tissue is more likely to become infected by botrytis blight; but healthy tissue can also become infected.

Management of environmental conditions, good cultural practices and the selective use of fungicides are all needed to effectively manage this disease.

**Scouting**

Poinsettias are susceptible to botrytis blight during all stages of their production. A diagnostic feature of *Botrytis* is visible when the relative humidity is very high. With a 10x hand lens, look for a whitish-gray or light brown cobwebby mold on the blighted tissue. Scout for *Botrytis* where there is less air circulation, i.e. where plants are crowded together, or where there are fewer than the optimum number of horizontal airflow (HAP) fans, near endwalls or where pockets of condensation form.

**POWDERY MILDEW**

Powdery mildews are characterized by patches of a white powdery fungal growth. The fungi causing powdery mildews are obligate parasites that can grow and multiply only on living tissue. Tender poinsettia bracts are very susceptible to injury, rapidly becoming yellow, brittle, and falling off.

### Table 4b: Scouting for Botrytis Blight.

<table>
<thead>
<tr>
<th>Production Phase</th>
<th>Scouting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On Cuttings</strong></td>
<td>Look for blighted leaves or decayed cuttings.</td>
</tr>
<tr>
<td><strong>On Mature Plants</strong></td>
<td></td>
</tr>
<tr>
<td>On leaves:</td>
<td>Look for brown, blighted lesions.</td>
</tr>
<tr>
<td>On stems:</td>
<td>Look for tan, sunken cankers.</td>
</tr>
<tr>
<td>These cankers may develop on older stems, at the base of the petioles of blighted leaves.</td>
<td></td>
</tr>
<tr>
<td>On bracts:</td>
<td>Look for necrotic tissue at the edge of the bracts that gets darker as lesions expand. Do not confuse Botrytis blight with injury from pesticide sprays, overhead fertilization, or bract necrosis. A diagnostic symptom is the presence of a whitish-gray or light brown cobwebby mold that develops under conditions of high relative humidity.</td>
</tr>
</tbody>
</table>
ing disfigured with unsightly white colonies. Once a plant is infected, it is difficult to completely eradicate or cure this disease. Prompt application of the appropriate fungicide when the disease first occurs will help to minimize losses. Powdery mildew may continue to spread in the customer's home or retail florist shop.

Scouting

Most growers are familiar with the typical appearance of powdery mildew on a variety of greenhouse crops. However, in spite of the similar appearance of powdery mildews to the naked eye, the different species of powdery mildews are very host specific. For example, the powdery mildew on verbena does not infect poinsettia.

Inspection of the incoming poinsettia cuttings is an important prevention strategy. Powdery mildew may remain undetected in the greenhouse at very low levels and then suddenly develop into an epidemic. Favorable conditions for spore germination include warm temperatures (68°F - 78°F) and high humidity levels (85% and higher).

Inspect at least 10 poinsettias per 1000 sq. ft. Randomly select plants throughout the greenhouse. Inspect plants both at hanging basket and bench levels (See Table 4c). All poinsettia cultivars are susceptible to this disease.

To minimize disease spread, remove infected leaves or plants by placing them directly in a plastic bag. Do not carry infected plants through the greenhouse because the fungal spores are easily airborne and may spread to healthy plants. Begin a fungicide spray program immediately after first detecting powdery mildew. After removing an infected leaf with fungal mycelium, the infected plant should be tagged and used as an “indicator plant” to evaluate the effectiveness of the fungicide applications.

LESS COMMON DISEASES

BACTERIAL SOFT ROT

Bacterial soft rot is caused by the bacteria Erwinia chrysanthemi and Erwinia carotovora. This disease often occurs during periods of hot weather when cuttings are propagated. Infected cuttings may have a slimy texture and a “fishy” odor. Immediately remove the infected cuttings. Strict sanitation is essential to limit losses during and immediately after propagation.

POINSETTIA SCAB

Poinsettia scab is caused by the fungus, Sphaceloma poinsettiae. Look for raised, purple-rimmed tan cankers along the stem and leaf midribs. Small leaf spots surrounded by a yellow halo may be seen. Affected plants may have one or two branches with abnormally tall growth.

RHIZOPUS STEM ROT AND BLIGHT

Rhizopus stem rot and blight are caused by the fungus, Rhizopus stolonifer. Look for a soft, mushy brown rot with white fungal strands or black fruiting bodies. Also, watch for sudden death of an otherwise healthy plant. Usually, the infected plant has a well-developed root system. Wilting is the first noticeable symptom in many cases (See Table 4d).

<table>
<thead>
<tr>
<th>Table 4c: Scouting for Powdery Mildew.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production Phase</td>
</tr>
<tr>
<td>On Incoming Cuttings</td>
</tr>
<tr>
<td>During Crop</td>
</tr>
<tr>
<td>Production</td>
</tr>
</tbody>
</table>

Look on the underside of leaves for the small, circular colonies while inspecting cuttings for immature whiteflies. Active colonies are white and “fluffy.”

Look on the upper and lower leaf surface of the lowest leaves for white, talcum-like patches (1/2”). With a 10x hand lens, look for the fungal mycelium radiating out from the center. Do not confuse with white spray residues that tend to be more variable in shape.

<table>
<thead>
<tr>
<th>Table 4d: Scouting for Less Common Diseases.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease</td>
</tr>
<tr>
<td>Bacterial soft rot</td>
</tr>
<tr>
<td>Poinsettia scab</td>
</tr>
<tr>
<td>Rhizopus stem rot</td>
</tr>
</tbody>
</table>

Look for a soft, mushy rot on the basal end of cuttings. Look for raised, purple-rimmed, tan cankers along the stem or leaf midribs and abnormally tall growth of a few branches.

Look for a soft, mushy rot with white fungal strands or black fruiting bodies. Wilting and sudden death may also occur.
NUTRITIONAL DISORDERS

Management of poinsettia nutrition with routine (monthly) submission of both soil and tissue samples is a vital step in developing an effective integrated crop management program. In addition, weekly in-house testing of both electrical conductivity (EC) and pH (See Table 2c for sources of EC and pH meters) allows prompt adjustment of a nutritional program increasing plant health.

In spite of routine monitoring, growers may occasionally see symptoms of nutrient deficiencies or toxicities. Poinsettias are unique in their nutritional requirements. They need relatively high levels of both nitrogen and molybdenum, and calcium uptake may be of concern during production. Growers may also observe interveinal leaf chlorosis, margin necrosis or misshapen leaves or bracts. Three of the more common disorders are molybdenum deficiency, magnesium deficiency and ammonium toxicity (See Table 4e).

Nutritional disorders are often difficult to diagnose. A careful review of your fertilizer program, combined with regular, testing of both soil and tissue analysis, and consultation with an extension specialist will help to identify the problem. (See insert for testing guidelines and laboratories in New England.)

Table 4e: A Guide to Nutritional Disorders, Deficiencies and Toxicities.

<table>
<thead>
<tr>
<th>Deficient Element</th>
<th>Symptom Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>Cupping, crinkling or chlorosis of young leaves; roots may be stunted, thickened and bunched.</td>
</tr>
<tr>
<td>Iron</td>
<td>Intereival chlorosis of younger leaves, especially when the bracts begin to color.</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Intereival chlorosis of older leaves.</td>
</tr>
<tr>
<td>Manganese</td>
<td>Intereival chlorosis of young mature leaves.</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>Chlorotic band around the leaf margin of young mature leaves. Leaves may become distorted with a upward leaf roll.</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>General foliar yellowing, especially on the older leaves.</td>
</tr>
<tr>
<td>Potassium</td>
<td>Necrotic spots on the older leaves near the margins. Margins becoming chlorotic then browning.</td>
</tr>
<tr>
<td>Sulfur</td>
<td>Young leaves may yellow.</td>
</tr>
<tr>
<td>Zinc</td>
<td>Chlorosis and stunting of new developing leaves.</td>
</tr>
<tr>
<td>Toxic Element</td>
<td>Symptom</td>
</tr>
<tr>
<td>Ammonium</td>
<td>V-shaped chlorotic bands starting at the leaf tip, downward leaf cupping, leaf drop, and poor root development.</td>
</tr>
<tr>
<td>Boron</td>
<td>Foliar edge burn on the oldest leaves.</td>
</tr>
</tbody>
</table>

PHYSIOLOGICAL DISORDERS

Physiological disorders are caused by non-infectious agents. Some of the more commonly seen disorders on poinsettias include leaf distortion, ethylene injury and bract necrosis.

Leaf distortion

Symptoms of leaf distortion are extremely variable and may include puckering, v-shaped margins and tip distortion. Damage frequently occurs from late September to October. At the time of sale, the damage is usually not evident. Plants under stress from high temperature, bright light or wind damage may have more leaf distortion. Some injury may be associated with pinching, especially on certain cultivars, during high temperatures. Thrips injury, spray or fertilizer injury may also damage young leaf tissue.

Ethylene injury

In the greenhouse, various gases, including ethylene, may accumulate causing plant injury. Sources of ethylene include the incomplete combustion of fossil fuels, smokestacks that are too short resulting in downdrafts, cracks in the heat exchanger or exhaust fumes from delivery trucks running just outside of the greenhouse. Plant injury may be more common in airtight polyethylene-covered greenhouses than in glass houses that have more air exchange. Look for a downward bending or twisting of the leaves and yellowing and leaf drop of the lower foliage.

Bract necrosis

Bract necrosis is not a serious problem during poinsettia production. It may be of concern for the retail grower or when poinsettias will be displayed
for an extended period of time and may be “over-mature.” The exact cause is complex and not fully understood. Poinsettia cultivars vary in their susceptibility to this disorder. To prevent bract necrosis, growers may consider the timely use of calcium sprays for the more susceptible cultivars listed (See Table 4f). Many cultivars, including Freedom, Red Sails, Red Success and Sonora, are resistant to bract necrosis.

Symptoms of bract necrosis include small (0.04 inch) light brown spots or pinpoint flecking at the leaf edge. Botrytis blight, pesticide sprays and overhead fertilization can all cause bract damage that can be confused with bract necrosis (See Figure 4a).

**Latex Eruption**

This physiological disorder, known as “crud,” is primarily due to high turgor pressure occurring during periods of high moisture availability and high humidity, which result in high fluid pressure in the cells. Latex may be seen at the young stem tips or on fully expanded leaves.

**Premature Cyathia Drop**

True flowers or cyathia may drop from the center of the inflorescence before the poinsettia flowers reach maturity. The plants then appear “over-mature,” which can reduce their marketability. Low light levels, high forcing temperatures or water stress may contribute to this problem.

**Bilateral Bract Spots (Rabbit Tracks)**

Breakdown of the tissues between the veins on either side of the bract midrib results in the appearance of “rabbit tracks.” Annette Hegg cultivars are particularly sensitive. Conditions which promote the development of rabbit tracks include: high relative humidity or changing humidity levels, high fertilization levels, and high night temperatures (above 70°F) during bract development.
<table>
<thead>
<tr>
<th>Key Pest</th>
<th>How to Scout</th>
<th>Where to Look</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key Insects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fungus gnats</td>
<td>Use sticky cards to monitor for adults. Place cards just above soil surface. Horizontal placement attracts more adults. Use potato chunks to monitor for larvae. On poinsettia cuttings, inspect developing callus for signs of feeding injury. While inspecting roots, look for blunt root tips that are not tapered, showing signs of fungus gnat feeding.</td>
<td>Favorable habitats include areas with standing pools of water and floors with spilled potting media, debris and weeds. Growing mixes with compost less than six months old are more attractive to fungus gnat adults.</td>
</tr>
<tr>
<td>Whiteflies</td>
<td>Use sticky cards to monitor for adults. Rely on plant inspection to detect immature stages. On cuttings and young plants, inspect three leaves per plant. On larger plants, inspect 6 leaves. Use indicator plants to assess treatment effectiveness.</td>
<td>Adults and immatures are found on the underside of leaves. Egg-laying adults are found on the upper leaves. Small immatures are found in the middle canopy. Medium and large immatures are found in the lower canopy.</td>
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<tr>
<td><strong>Key Diseases</strong></td>
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<tr>
<td>Botrytis blight</td>
<td>On cuttings, look for blighted leaves with a light brown, cobwebby mold. On older stems, look for tan sunken cankers. On bracts, look for necrotic tissue at the edge of the bract. Do not confuse with bract necrosis. Spores are easily airborne and develop under conditions of high relative humidity.</td>
<td>Look on tender new growth, freshly injured tissues, or weakened tips of leaves or bracts. Look in areas with poor air circulation, where plants are crowded together, near end walls and where pockets of condensation form.</td>
</tr>
<tr>
<td>Powdery mildew</td>
<td>On cuttings, look on the underside of leaves for small, circular white colonies. White or yellow spots may be seen on the upper leaf surface. Look for white, talcum-like patches, especially on the lower leaves. Do not confuse with spray residue.</td>
<td>Randomly inspect all cultivars throughout the greenhouse. Early infections may be difficult to detect in hanging baskets. Closely inspect plants in drafty locations where there may be more temperature fluctuations between day and night temperatures.</td>
</tr>
<tr>
<td>Pythium root and stem rots</td>
<td>On cuttings, look for a tan to dark brown water-soaked canker on the stem near the soil line. On mature plants, leaves may suddenly wilt and drop. Plants may be stunted. A diagnostic feature is a cortex that &quot;sloughs off&quot; leaving a central core.</td>
<td>Scout incoming plants and plants that may have been stressed by high fertilization, wounding or transplant shock. Inspect plants closely in wet areas (with puddling) or where there are high numbers of shore fly adults or fungus gnat larvae.</td>
</tr>
<tr>
<td>Rhizoctonia root and stem rot</td>
<td>On cuttings, look for dry, brown discoloration at the cutting base. On mature plants, look for dry, brown stem canker at the soil line. Leaves may yellow and drop.</td>
<td>Scout incoming plants and plants that have been weakened or stressed. High ammonium levels in the growing mix can favor the development of Rhizoctonia root and stem rot.</td>
</tr>
</tbody>
</table>
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Agriculture. National Agricultural Statistics
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potential pests in the southeastern United States.
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Management Fact sheet. 4 pp.


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<th>Aphids</th>
<th>Fungus Gnat Adults</th>
<th>Fungus Gnat Larvae (on potatoes)</th>
<th>Shore Flies</th>
<th>Other</th>
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### Greenhouse IPM Scouting Summary Report

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<th>Aphid</th>
<th>F.G.</th>
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#### PLANT INSPECTIONS

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#### PLEASE NOTE

**COMMENTS:**

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This page is for use in your scouting program.
### Poinsettia IPM Program Indicator Plant Scouting Form

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<th>Location in house:</th>
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<th>Eggs</th>
<th>1st + 2nd Instar</th>
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Cooperative Extension System
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