Sampling for Whitefly Nymphs on Poinsettias

Scouting for whiteflies on poinsettia usually isn't free; however, growers who scout their crop typically report that because of scouting they spray less, their plants are cleaner, and they gain a lot of peace of mind because they know the status of the whitefly infestation on their crop. To reduce scouting costs, we have developed a new, more efficient sampling plan for whiteflies on poinsettia, called a sequential sampling plan. Sequential sampling plans do not directly estimate population levels but are designed to provide control decisions based on specific pest thresholds. In other words, this type of sampling plan indicates whether a whitefly population is above or below a given level. Sequential sampling plans can provide information to make control decisions with minimal scouting costs because a decision can usually be reached after inspecting relatively few plants. The plan is called "sequential" because you continue to inspect plants in sequence until you can classify an infestation as above or below the threshold. The number of plants that are inspected is variable. This sampling plan is designed to be used in conjunction with the IPM tactics outlined in *IPM for Poinsettias in New York: A Scouting and Pest Management Guide* (New York State IPM Program Publ. No. 403, 1993, Cornell Cooperative Extension).

We have identified two tentative thresholds from the results of a statewide survey of whitefly nymphs on finished poinsettias at time of sale in New York. The survey, conducted annually from 1989 to 1992, revealed that it was rare to find a completely uninfested poinsettia crop, although the whitefly levels were often very low. The average percentage of plants that had at least one whitefly of any life stage at time of sale among growers in the IPM program in 1991 was approximately 10 percent, whereas the statewide average among non-IPM growers was approximately 30 percent. Somewhat higher end-of-season whitefly levels (~50 percent infested plants) may be more common in warmer areas of the United States, where season-long whitefly migration into greenhouses is more likely. In the future, other thresholds may be more appropriate at certain periods of crop growth or perhaps when natural enemies are used. The sequential sampling plan can be modified to incorporate such thresholds as they become available. We have calculated the relationship between the average number of whitefly nymphs per leaf and per plant, and the percentage of infested plants. Based on a sampling unit of six leaves per plant, the thresholds become an average of 0.1 nymph per plant ("low" threshold), 0.6 nymph per plant ("moderate" threshold), or 3.0 nymphs per plant ("high" threshold) (see Table 1). You can choose which threshold(s) would be most appropriate for your crop.

Validation studies. We used actual scouting reports from commercial greenhouses to validate the sampling plans for the "low" and "moderate" thresholds. The sequential sampling plans worked well for both whitefly species. Appropriate treatment decisions were made between 94 and 100 percent of the time for the two thresholds. The average number of pots that had to be inspected to make a decision was 12 to 13. The previous sampling procedure in the New York Poinsettia IPM Program required the inspection of 20 pots per every 2,000 pots. This sequential sampling plan will reduce sampling costs by about 40 percent.

Instructions for Sequential Sampling Plans

1. Sample from groups of about 2,000 pots. These groups are called pest management units (PMUs). A PMU could be all the plants in a small (<4,000 sq. ft.) greenhouse, in a bay of a gutter-connected greenhouse, etc. Each PMU should be scouted separately.
2. Select plants to sample at random from throughout the entire PMU. Sample different plants each week. Random sampling is important for this plan to be accurate and to detect hot spots.
3. Inspect six leaves on each plant. As the canopy grows, inspect two leaves from the top, middle, and bottom part of the canopy, for a total of six leaves per plant.

4. Record the total number of nymphs in each life stage (i.e., small [first and second instars], medium [third instars], or large [fourth instars, pupae]) for each plant on a scouting form. Scouting forms that are used in the New York Poinsettia IPM Program can be found in *IPM for Poinsettias in New York: A Scouting and Pest Management Guide*. Categorizing the nymphs into instars can be used for timing insecticide applications or perhaps natural enemy releases against appropriate instars.
5. Keep a running total of the number of nymphs that you have found as you inspect the plants. Record this cumulative number of nymphs on the scouting form. Compare this number with the numbers in Table 1 after you inspect each plant. Continue to sample plants until you can make a control decision from Table 1.
6. To use Table 1, first decide on the threshold you want to use. (Three thresholds are provided: a "low" threshold of 0.1 nymph per plant, a "moderate" threshold of 0.6 nymph per plant, and a "high" threshold of 3.0 nymphs per plant. These thresholds were derived from surveys of end-of-season whitefly levels on poinsettias in New York and anecdotal information from other states.) If the cumulative number of nymphs is above the upper limit, then the number of whiteflies on the crop is above the threshold, and you should consider a control measure. If the cumulative number of nymphs is below the lower limit, then the number of whiteflies is below the threshold, and control is not needed. (Note from Table 1 that you must inspect at least 14 plants to determine if you are below the lower limit for the "low" threshold, at least 10 plants for the "moderate" threshold, and at least six plants for the "high" threshold.) If the cumulative number of nymphs is between the upper and lower limit, then you must continue inspecting additional plants until the cumulative number of nymphs goes above or below the limits. See examples below.
7. Continue to sample each PMU weekly. Follow the general scouting guidelines outlined in *IPM for Poinsettias in New York: A Scouting and Pest Management Guide*.

Examples

1. After sampling seven plants randomly in a PMU, a scout has found no nymphs. On the eighth plant, two nymphs are found. If the "low" threshold is used, a total of two nymphs found after inspecting eight plants is above the threshold of one nymph in Table 1. No more sampling is needed for this week. A control measure should be considered in this PMU.
2. In another PMU, the scout has randomly looked at 14 plants and has found no nymphs. Using the "low" threshold, Table 1 indicates that unless at least one nymph is found after inspecting 14 plants, the whiteflies are below the threshold. No more sampling is needed until the next week.
3. Another grower prefers to use the "moderate" threshold at the beginning of his crop. After randomly inspecting 10 plants, the scout has found a total of three nymphs, which is between the upper limit of 11 nymphs and the lower limit of one nymph. A decision cannot be made, so the scout continues to inspect more plants randomly. No more nymphs are found after inspecting six more plants, giving a total of three nymphs found on 16 plants. This lies below the lower limit of four nymphs in Table 1. Sampling can now stop; the whiteflies are below the threshold.

Chemical Control

Many insecticides can provide good whitefly control. Marathon (granular or drench) continues to give excellent long-term control when used properly. Several new insect growth regulator (IGR) insecticides also show excellent activity against nymphs. These IGRs provide important new insecticide options for pesticide rotation schemes. They are also very compatible with parasitic wasps for whitefly biological control, as discussed later. All whitefly insecticides must be used carefully, according to label directions, or resistance problems are likely to occur.

Eggs and the older nymphal stages are the most immune to many insecticides. When using foliar sprays, remember that thorough coverage is easier to achieve early in the crop before the canopy

becomes dense. Plants should be spaced so as to maximize spray coverage. In addition, better coverage will probably be achieved on plants grown on benches than on the ground. A spray wand or spray technique that directs the spray to the undersides of leaves will kill many more whiteflies per application. Nymphs occur on the undersides of leaves and are generally covered more thoroughly with well-aimed hydraulic or electrostatic sprayers. Adults can be controlled with aerosols, smokes, various types of low- or ultralow-volume sprayers, or hydraulic sprayers. But adults should be killed before they are able to lay eggs—about three to four days under northeastern United States poinsettia production temperatures. Thus aerosol or ULV applications should be applied every three to four days as long as new adults are emerging.

Biological Control

Whitefly biological control could include the release of parasitoids, predators, fungal pathogens, or all three. For biological control to be successful, rely on releases of the natural enemies and use selected insecticides as a backup. Growers interested in biological control must learn about the natural enemies as well as the whiteflies and have established a successful whitefly monitoring plan.

Encarsia formosa is the most commonly used natural enemy for GHWF on greenhouse tomatoes. But this parasitoid species is not as effective against SLWF on ornamentals. When compared with the commercial strain of *E. formosa*, another parasitoid, called *Eretmocerus eremicus*, provides better SLWF control on poinsettia. *E. eremicus* will also control GHWF on poinsettia. For successful SLWF management with parasitoids alone, *E. eremicus* should be released weekly at three female wasps per pot per week. Such a release regime is expensive, however. Our recent research has indicated that a less expensive approach may be to release *E. eremicus* at one female wasp per pot per week, coupled with an IGR applied once, just before bract coloration. Detailed information on the use of parasitic wasps for whitefly biological control on poinsettia can be found in *A Grower's Guide to Using Biological Control for Silverleaf Whitefly on Poinsettias in the Northeast United States*, by M. Hoddle, R. Van Driesche, and J. Sanderson, UMass Floral Facts, U. Mass Extension, Stockbridge Hall, University of Massachusetts, Amherst, Mass. 01003.

Some growers have reported successful use of parasitoids on the Christmas crop until late October, when smokes and aerosols were used for final cleanup.

BotaniGard (ES and WP formulations) (Mycotech) and Naturalis-L (Troy Biosciences) contain the insect fungal pathogen *Beauveria bassiana*. This pathogen should be used while whitefly levels are still low. Three to five weekly sprays should be applied, then carefully evaluate the degree of control to determine the need for additional sprays. Tank mixes with most conventional insecticides can be used to reduce pest levels, but do not mix with any fungicides, and be sure that the spray tank is clean of all fungicide residues. Do not use 48 hours before or after a fungicide application on the crop. Another fungal pathogen, PFR-97 (*Paecilomyces fumosoroseus*), is registered by Olympic and is expected to be available soon.

Combinations of natural enemies, such as *Beauveria bassiana* plus *E. eremicus, E. eremicus* plus the tiny predatory beetle *Delphastus pusillus*, or other combinations, may also provide good whitefly biological control.

Table 1. Upper and lower boundaries for sequential sampling plans for whitefly nymphs on poinsettias at three threshold levels

	Cumulative No. Whitefly Nymphs		
No. plants	"Low" Threshold[a]	"Moderate" Threshold[b]	"High" Threshold[c]

sampled

	Upper limit[d]	Lower limit[e]	Upper limit[d]	Lower limit[e]	Upper limit[d]	Lower limit[e]
2	0	–	3	15	–	
4	1	–	5	25	–	
6	1	–	7	34	2	
8	1	–	9	–	42	6
10	2	–	11	1	50	10
12	2	–	12	2	58	14
14	2	1	14	3	66	18
16	3	1	16	4	74	22
18	3	1	17	4	81	27
20	3	1	19	5	89	31
22	3	1	20	6	96	36
24	4	1	22	7	104	40
26	4	1	23	8	111	45
28	4	1	25	9	118	50
30	4	2	27	9	125	55
35	5	2	30	12	143	67
40	6	2	34	14	161	79
45	6	3	38	16	179	91
50	7	3	41	19	196	104
55	8	3	45	21	213	117

[a]"Low" threshold = 0.1 nymph/sample unit

[b]"Moderate" threshold = 0.6 nymph/sample unit

[c]"High" threshold = 3.0 nymphs/sample unit

[d]Classify sample as "above threshold" if cumulative counts exceed the upper limit

[e]Classify sample as "below threshold" if cumulative counts are less than the lower limit