



Level of Adoption of IPM in New York Greenhouses

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Level of Adoption of IPM Practices in New York Greenhouses

Floriculture is an important and growing industry that contributes to the local economy and enhances community quality of life. The floriculture industry in New York ranked 6th among the states with production sales in the year 2000 of \$316.4 million. Greenhouse area increased 16.9% from 1999 to 26.2 million square feet in 2000 (2002 Outlook Handbook, Chapter 11, W. L. Uva). The greenhouse operations produce a wide variety of crops, including bedding plants, flowering potted plants, cut flowers, vegetable transplants, and herbs.

Among the many challenges faced by New York growers are high costs of heating and labor, and management of diseases and insects. Education by the New York State Integrated Pest Management Program in partnership with Cornell Cooperative Extension began more than 20 years ago to provide

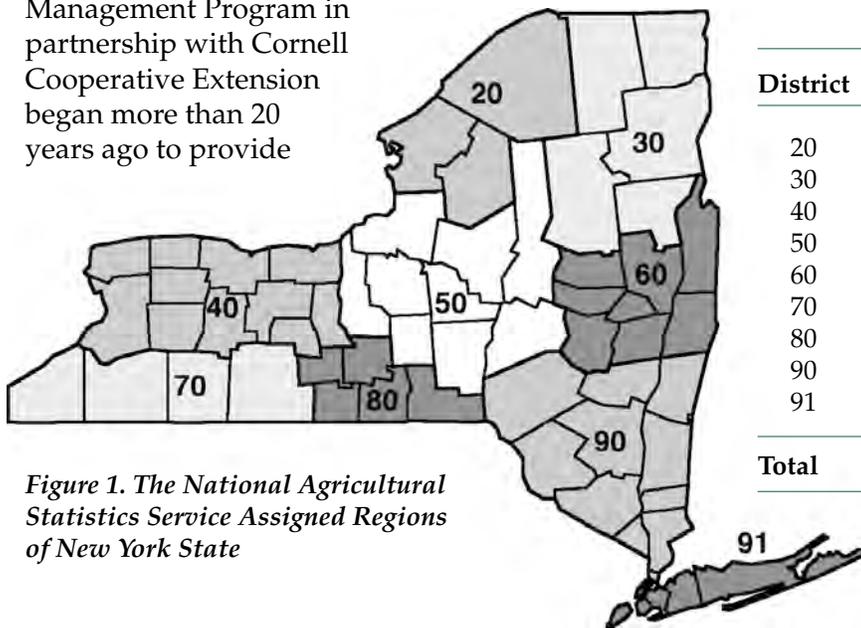


Figure 1. The National Agricultural Statistics Service Assigned Regions of New York State

educational assistance. Growers also take advantage of programs such as the Ohio Short Course and the New England Greenhouse Conference.

The NYS IPM Program and the New York Agricultural Statistics Service conducted a survey of registered greenhouse operators in 2000. The objectives of the survey were to evaluate progress in the implementation of greenhouse IPM, to determine

any regional strengths and weaknesses, and to compare the implementation of IPM practices adopted by different sized operations. The survey instrument was written with the advice of S. Keating and B. Blackson of the New York State Agricultural Statistics Service, Albany. The IPM survey was mailed Jan. 6, 2000 by the NYS Department of Agriculture and Markets along with the annual floriculture survey. Out of 875 surveys mailed, 247 growers sent the completed survey back voluntarily. NASS conducted follow-ups by telephone (170) and personal interview (90), achieving balance in sampling the nine districts in the state and the different sized operations. A total of 507 responses were tabulated.

TABLE 1. Response Summary

| District | Mail | Phone | Interview | Total Reports |
|--------------|------------|------------|-----------|---------------|
| 20 | 3 | 7 | 5 | 15 |
| 30 | 7 | 4 | 5 | 16 |
| 40 | 54 | 32 | 22 | 108 |
| 50 | 28 | 28 | 7 | 63 |
| 60 | 36 | 25 | 17 | 78 |
| 70 | 15 | 9 | 2 | 26 |
| 80 | 14 | 12 | 4 | 30 |
| 90 | 49 | 25 | 14 | 88 |
| 91 | 41 | 28 | 14 | 83 |
| Total | 247 | 170 | 90 | 507 |

TABLE 2. Total Protected and Covered Growing Area of Respondent Firms

| | Number of Firms | Percent |
|----------------------------------|-----------------|------------|
| Less than 10,000 ft ² | 206 | 41 |
| 10,000 to 43,560 ft ² | 226 | 45 |
| Greater than 1 acre | 75 | 14 |
| Total | 507 | 100 |

TABLE 3. Crops Grown by the Respondents to the Survey

| | Number of Firms | Square Footage | Average Square Footage |
|-------------------------------|-----------------|----------------|------------------------|
| Bedding plants (flowers) | 433 | 8,864,193 | 20,472 |
| Vegetable transplants | 292 | 6,094,358 | 20,871 |
| Herbaceous perennials | 214 | 2,432,407 | 11,366 |
| Lilies or other bulbs | 112 | 378,851 | 3,383 |
| Poinsettia | 140 | 3,308,947 | 23,635 |
| Chrysanthemum (indoors) | 75 | 683,067 | 9,108 |
| Chrysanthemum (outdoors) | 196 | 4,817,099 | 24,577 |
| Other flowering potted plants | 199 | 2,646,602 | 13,300 |
| Foliage plants | 94 | 275,534 | 2,931 |
| Herbs | 161 | 232,145 | 1,442 |
| Greenhouse vegetables | 37 | 143,071 | 3,867 |
| Cut flowers (indoors) | 29 | 558,441 | 19,257 |
| Cut flowers (outdoors) | 52 | 3,759,664 | 72,301 |

The Diversity of IPM Adoption Levels

The results of the survey indicate that all respondents employ some IPM practices and a majority would appreciate an opportunity to learn more. Advanced IPM practices, such as the use of microbials and beneficials for insect management, hiring a professional scout, and monitoring electrical conductivity of nutrient solutions, are routine in some operations. Almost all operations remove weeds from their greenhouses during the crop season, but a few do not. Only about one third of growers keep written records of scouting data. Management practices were assigned points that reflected degree of IPM adoption and allowed us to graph the IPM adoption continuum (the number of growers at each level of implementation). Survey questions focused on practices affecting pest management, including sanitation, cultural practices, basic IPM elements, disease management, and insect management. The survey point system, questions, and answers are described in detail in the last section of this report.

Preseason sanitation practices

Growers generally take the opportunity to clean up

between crops. About two-thirds of growers allow a one-month fallow period. 90% of growers surveyed remove all organic debris, and 97% start their crops in a weed-free greenhouse.

Recording cultural practices

Horticultural practices are critical to the management of diseases and arthropod pests. Recording information such as changes in environment and nutrient solution allows the grower to develop the site history and to communicate with employees, consultants, and educators. Life cycles and reproductive rates fluctuate according to the environment, and keeping track of pest life stages can help to determine spray frequencies and timing the release of predators. About 40% of growers record maximum/minimum temperatures. Monitoring water quality is extremely important, since municipal and well water can change pH and alkalinity during the summer. About 40% of growers monitor pH; only 27% monitor electrical conductivity (EC), the saltiness of water and nutrient solutions.

Basic IPM practices

The basic elements of IPM include scouting, record keeping, weed management, correct pest identification, and sprayer calibration. Most

TABLE 4. Greenhouse IPM Practices, Average Score by Questionnaire Subject and Region

| Survey Subject | Max. Score | Average Score by Region | | | | | | | | | State Average |
|----------------|------------|-------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|---------------|
| | | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 91 | |
| Sanitation | 16 | 12.0 | 10.4 | 10.8 | 11.0 | 11.3 | 10.4 | 10.0 | 9.8 | 10.6 | 10.7 |
| Culture | 10 | 3.5 | 3.3 | 2.3 | 2.4 | 2.6 | 1.7 | 3.0 | 2.3 | 2.1 | 3.1 |
| Basic IPM | 18 | 10.2 | 9.4 | 9.4 | 9.9 | 9.6 | 9.8 | 9.1 | 9.8 | 9.6 | 9.6 |
| Disease mgmt | 11 | 6.9 | 5.8 | 6.5 | 6.4 | 6.4 | 6.6 | 6.2 | 6.3 | 6.6 | 6.5 |
| Insect mgmt | 15 | 7.4 | 8.5 | 7.1 | 7.1 | 8.0 | 7.2 | 7.0 | 7.6 | 7.5 | 7.5 |
| Total | 70 | 39.9 | 37.3 | 36.1 | 36.8 | 37.8 | 35.6 | 35.4 | 35.9 | 36.5 | 36.6 |

greenhouses are scouted regularly: 88% of growers scout weekly or more often. Most greenhouse operators scout themselves (81%). Designated employees (9.5%), the person watering (6.1%), and professional scouts (2.2%) monitor in the other operations. Scouting has an impact on decision making: 40% of growers always base their management tactics on scouting results, and another 25% sometimes do. The remaining 35% of growers are not basing their sprays on actual observed pest populations. We hope to work with this group in the future to explain the advantages associated with scouting. Without scouting records, growers lose the opportunity to communicate easily with employees and to predict future pest outbreaks based on experience. Weeds harbor insects and disease beneath the benches. 96% of growers reported that they weed during crop production. 48% of growers sent pest samples to Cornell Cooperative Extension or to clinics for identification. 48% calibrated their sprayers at least once per year; the others need training about effective application.

Disease management

Most growers demonstrated awareness of the principles of disease management: 94% inspect new shipments of plants and 98% remove infected leaves and flowers during the growing season. About 48% remove diseased prunings in a covered garbage can; we should teach the other growers about dispersing fungal spores while moving debris through the greenhouse. Half of the responding growers ventilate based on temperature; 45% manage humidity. 70% disinfect their cutting tools.

Insect management

Of the 68% of growers who use yellow or blue sticky cards, about 29% change the cards weekly. Microbial products are being used for insect control by 38% of growers. About 13% are releasing predators or parasites for biological control. 97% identify insects before making a pesticide application.

The IPM Continuum for Five Subject Areas

The concept of an IPM continuum is based on an increased knowledge base over time as growers accumulate experience. The reliance on pesticides to solve crop problems will decrease when growers understand pest biology and pest prevention. Instead of calendar-based applications, they will monitor pest levels and spray at the most effective time. The survey responses for basic IPM and insect

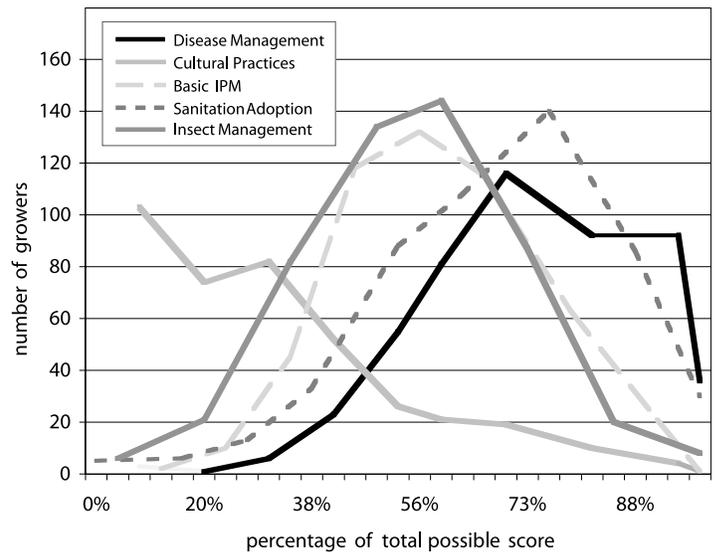


Figure 2. The IPM Continuum for Five Subject Areas

management appear as a normal distribution curve, with most growers' scores clustering around 55% of total possible points (Figure 2). Disease management and preseason sanitation peaked to the right, suggesting greater adoption of these practices. The lowest scores are observed in recording cultural practices, suggesting that this area offers the greatest opportunity for teaching. The relevance of fertility, water quality, and environmental parameters to pest population biology and disease progression can be illustrated with specific examples. Hands-on training can increase familiarity with equipment and promote wise selection of monitoring instruments.

IPM Adoption in Greenhouse Operations of the New York Regions

There is a trend of stronger IPM implementation at larger operations, perhaps because it makes sense in larger companies to define the role of IPM scout or pest manager and focus more dollars on education and resources. This is particularly evident in the graphs of cultural practices and of basic IPM (Figure 3). The trend for better IPM adoption in larger businesses is not so strong in sanitation, insect, and disease management. Surprisingly, the level of IPM adoption across the state clusters around the state average, with no particular region displaying a prominent lack of IPM adoption. On Long Island (Region 91), the larger operations scored higher in all five aspects of IPM. In central New York (Region 50), the larger operations scored higher than the smaller operations in four out of five aspects. These results combined suggest that we should focus on trying to meet the needs of operations with fewer resources, but should not ignore any regions of the state.

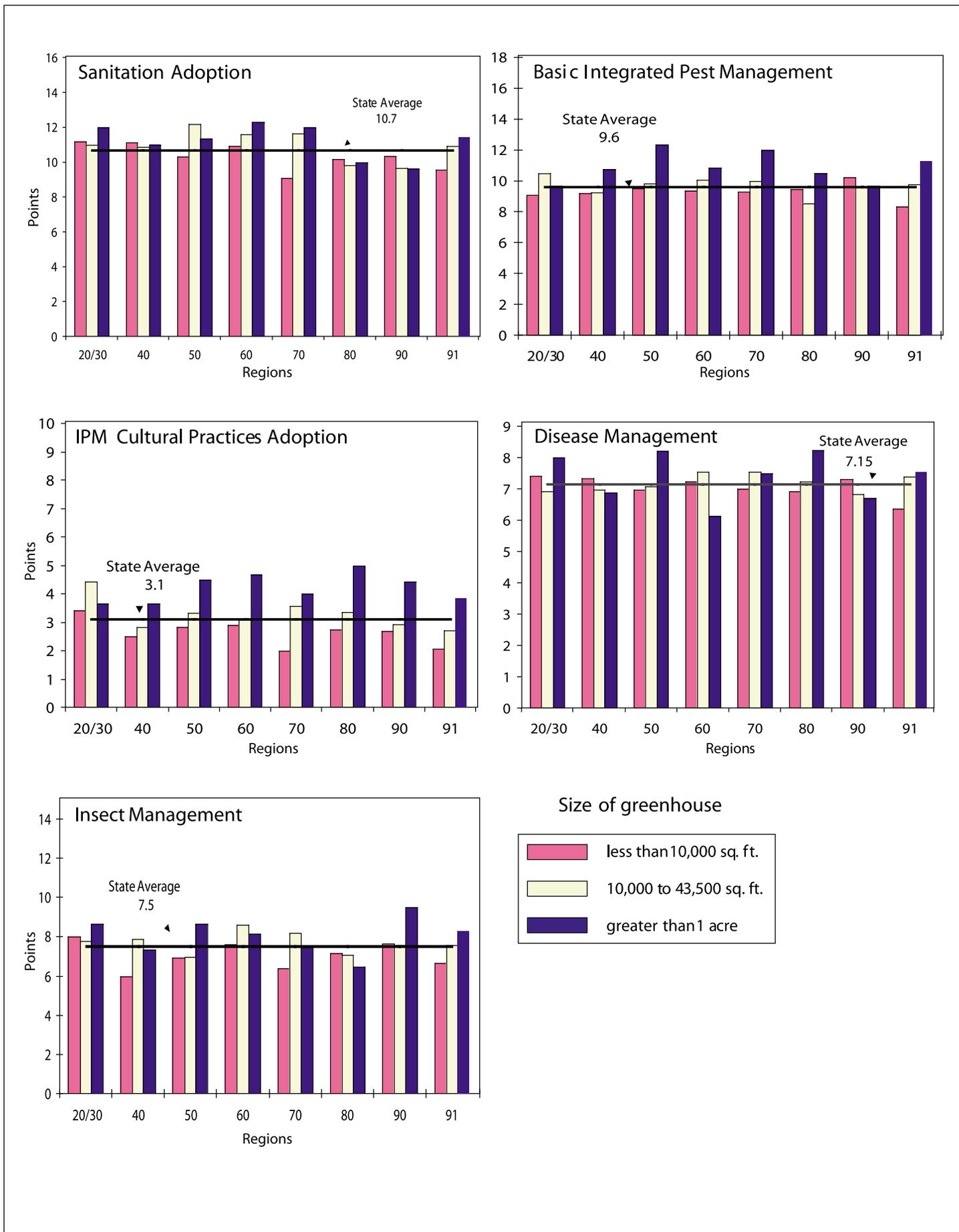


Figure 3. Scores for IPM Practices, by Region and Size of Operation.

Survey Questions and Answers on Greenhouse IPM Practices

The statisticians at the New York Agricultural Statistics Service analyzed the results of the survey in a report that included for each question the number of respondents who did not answer, as well as those who answered yes or no. A copy of that report is available on request. In the following report, “number of growers” represents the number of growers who gave a particular response to or answered “yes” to the question; “percent” is the “number of growers” written as a percentage of the total number of respondents (507).

The point system parallels that used in the development of the elements of vegetable production IPM for the purposes of IPM labeling (<http://www.nysipm.cornell.edu/elements/index.html>. see greenhouse tomato elements). Individual practices were assigned points to give credit for activities that have the potential to reduce pest populations or symptom development, thereby reducing reliance on pesticides.

Preseason sanitation practices. Maximum 16 points

| | number of growers | percent |
|---|-------------------|---------|
| <i>Which of the following are your customary practices?</i> | | |
| disinfect used pots and flats (2 points) | 278 | 54.8 |
| use only new pots, flats (2 points) | 265 | 52.3 |
| remove all organic debris from greenhouse floor, benches (2 points) | 451 | 90.0 |
| treat floors, walls, benches with disinfectant (2 points) (such as GreenShield, Physan 20, ZeroTol) | 306 | 60.3 |
| disinfect irrigation system (2 points) | 127 | 25.0 |
| allow a fallow period (of at least one month) (2 points) | 337 | 66.5 |
| remove weeds from greenhouse (2 points) | 490 | 96.6 |
| remove weeds around greenhouse exterior (2 points) | 441 | 87.0 |

Routine cultural practices. Maximum 10 points

| | number of growers | percent |
|--|-------------------|---------|
| <i>Do you keep records of fertilizer product, frequency, and rate?</i> (1 point) | 292 | 57.6 |
| <i>Do you keep records of maximum and minimum temperatures? If yes, how often?</i> | | |
| weekly (1 point) | 41 | 8.1 |
| daily (2 points) | 128 | 25.2 |
| other (1 point) | 38 | 7.5 |
| <i>Do you keep records of water test results?</i> (for carbonates, pH) (1 point) | 205 | 40.4 |
| <i>Do you keep records of electrical conductivity (EC) of water or nutrient solution? If yes, how often?</i> | | |
| annually (1 point) | 37 | 7.3 |
| monthly (2 points) | 25 | 4.9 |
| weekly (3 points) | 44 | 8.7 |
| other (1 point) | 31 | 6.1 |

| | | |
|--|----|------|
| <i>Do you keep records of foliage analysis results? If yes, how often?</i> | | |
| annually (1 point) | 54 | 10.1 |
| monthly (2 points) | 25 | 4.9 |
| more frequently (3 points) | 24 | 4.7 |

Basic Integrated Pest Management. Maximum 18 points

| | number of growers | percent |
|--|-------------------|---------|
| <i>Do you remove weeds during the growing season?</i> (2 points) | 489 | 96.4 |
| <i>Do you scout regularly for insects and diseases? If yes, how often?</i> | | |
| monthly (1 point) | 26 | 5.1 |
| every two weeks (2 points) | 28 | 5.5 |
| weekly (3 points) | 222 | 43.8 |
| more frequently (4 points) | 225 | 44.4 |
| <i>Who does the scouting?</i> | | |
| I do it myself (2 points) | 411 | 81.1 |
| a designated employee scouts (2 points) | 48 | 9.5 |
| the person who waters (1 points) | 31 | 6.1 |
| a professional consultant (3 points) | 11 | 2.2 |
| <i>Do you record scouting results?</i> (1 point) | 161 | 31.8 |
| <i>Do you base pest management tactics, including chemical sprays, on scouting records? If yes, how often?</i> | | |
| sometimes (1 point) | 126 | 24.9 |
| always (2 points) | 201 | 39.6 |
| <i>Do you use last year's records to predict problems?</i> (1 point) | 189 | 37.3 |
| <i>Do you use cooperative extension or diagnostic labs to diagnose your pest problems? If yes, how many times in the past year (1999)?</i> | | |
| one to three (1 point) | 202 | 39.8 |
| 4 or more (2 points) | 40 | 7.9 |
| <i>Do you calibrate your sprayers? If yes, how often?</i> | | |
| Less often than annually (1 point) | 46 | 9.1 |
| annually (2 points) | 159 | 31.4 |
| monthly (3 points) | 50 | 9.9 |
| more often than monthly (4 points) | 34 | 6.7 |

Disease management. Maximum 11 points

| | number of growers | percent |
|---|-------------------|---------|
| <i>Do you inspect plants upon arrival for signs of infection?</i> (1 point) | 476 | 93.9 |
| <i>Do you remove diseased leaves and flowers periodically to reduce infection?</i> (1 point) | 498 | 98.2 |
| <i>Where are diseased plant prunings discarded for short-term disposal?</i> | | |
| on the floor (0 points) | 12 | 2.4 |
| in an open bucket (1 point) | 242 | 47.7 |
| in a covered garbage can (2 points) | 245 | 48.3 |

| | | |
|---|-----|------|
| <i>Where are diseased plant prunings discarded for long-term disposal?</i> | | |
| in a compost pile far from any intake vents (1 point) | 256 | 50.5 |
| buried (1 point) | 38 | 7.5 |
| municipal garbage (1 point) | 205 | 40.4 |
| <i>How frequently is the air exchanged with outside air?</i> | | |
| whenever the greenhouse is too hot (1 point) | 255 | 50.3 |
| when my glasses fog up (1 point) | 5 | 1.0 |
| when the humidity reaches a specific level (2 points) | 52 | 10.2 |
| <i>Do you disinfest cutting tools? (1 point)</i> | 355 | 70.0 |
| <i>When do you apply fungicides/bactericides?</i> | | |
| before I see symptoms (0 points) | 190 | 37.5 |
| whenever I see symptoms (1 point) | 234 | 46.1 |
| on a calendar basis (0 points) | 30 | 5.9 |
| after obtaining lab diagnosis (2 points) | 4 | 0.8 |

Insect management. Maximum 15 points

| | number of growers | percent |
|--|-------------------|---------|
| <i>Do you use yellow (or blue) sticky cards to monitor insect pests?</i> (1 point) | 346 | 68.2 |
| <i>If yes, How often do you replace them?</i> | | |
| every 6 months (0 points) | 42 | 8.3 |
| monthly (1 point) | 159 | 31.4 |
| weekly (3 points) | 127 | 25.0 |
| more often than weekly (4 points) | 18 | 3.6 |
| <i>Do you use a microbial product for insect control ? (1 point)</i> | 192 | 37.9 |
| <i>If yes, which of the following:</i> | | |
| NaturalisO or BotaniGard (beneficial fungus) | 125 | 24.7 |
| Gnatrol (beneficial bacteria) | 117 | 23.1 |
| Nemasys or ScanMask (beneficial nematodes) | 29 | 5.7 |
| <i>Do you use beneficial predators or parasites for biological control? (1 point)</i> | 65 | 12.8 |
| <i>If yes, how often:</i> | | |
| weekly (2 points) | 17 | 3.4 |
| monthly (2 points) | 15 | 3.0 |
| three to four times a year (2 points) | 12 | 2.4 |
| twice a year (0 points) | 8 | 1.6 |
| once a year (0 points) | 13 | 2.6 |
| <i>Do you identify insects before applying pesticide?</i> (1 point) | 491 | 96.8 |
| <i>If yes, how often:</i> | | |
| sometimes (0 points) | 30 | 5.9 |
| usually (2 points) | 66 | 13.0 |
| always (3 points) | 395 | 77.9 |
| <i>Would you like to learn more about integrated pest management?</i> (2 points) | 335 | 66.0 |