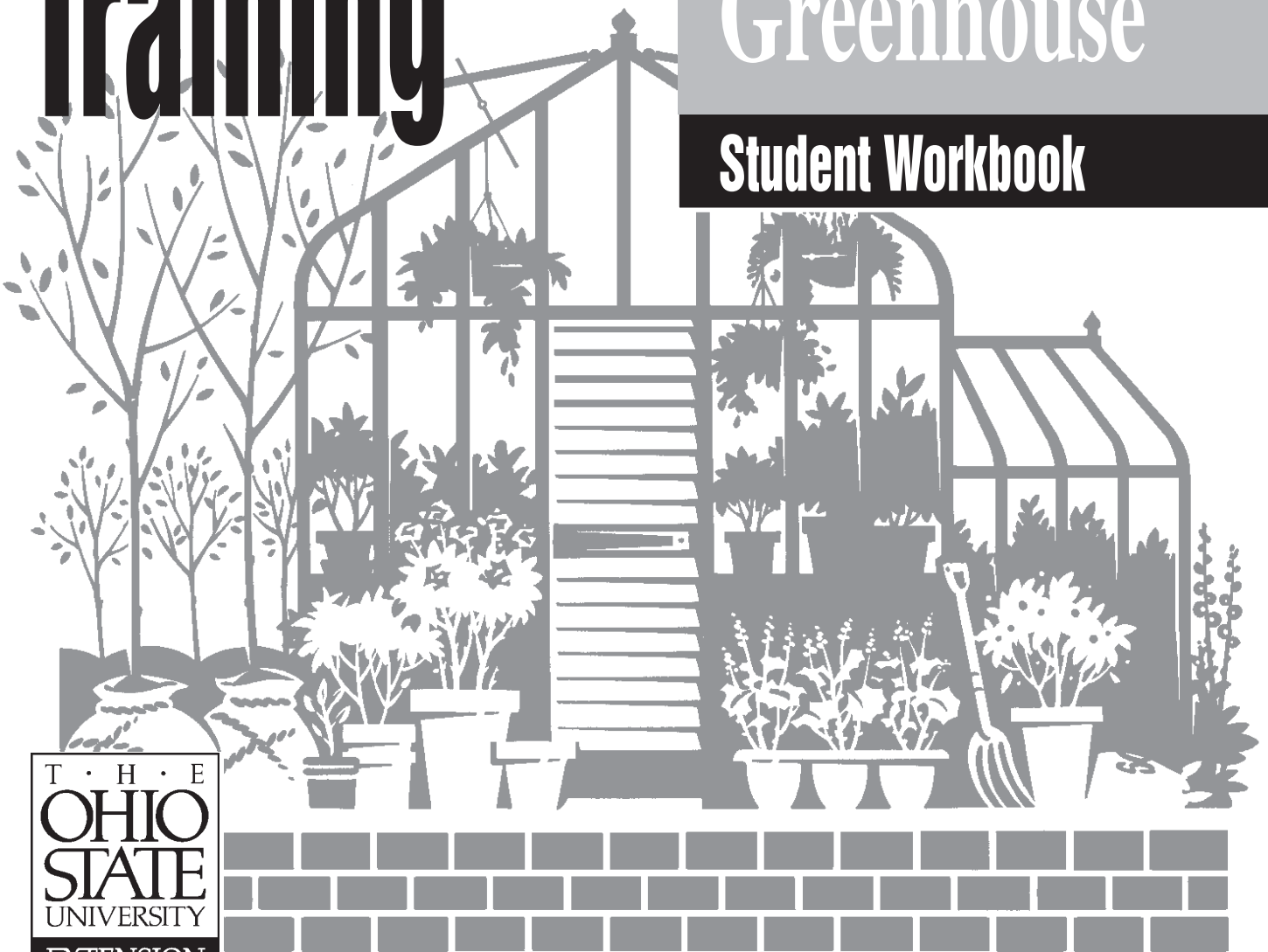


Ohio Pesticide Applicator Training

Greenhouse

Student Workbook



 For Sale Publication

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Ohio Pesticide Applicator Training

Greenhouse

Student Workbook

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Preface

This workbook was prepared by the Ohio State University Extension for use as a self-study guide or in combination with an educational program. It has been developed to assist pesticide applicators in better preparing themselves for taking the exams required for certification in the greenhouse category. The sample questions presented in this manual will help the reader obtain a general understanding of green-

house pest problems, approaches to control, and general information needed to apply and use pesticides safely.

Your comments and suggestions to improve this study tool for future users would be appreciated. Comments should be directed to Pesticide Applicator Training 249 Howlett Hall, 2001 Fyffe Ct., Columbus, OH 43210-1096.

How to Use This Workbook

This workbook is designed to serve as a supplementary study guide to the following bulletins published by the Ohio State University Extension and the Ohio Florists' Association. Extension publications are available through county offices of Ohio State University Extension.

Bulletin 538 *Insect, Mite and Disease Control on Commercial Floral Crops*

HYG 3038-95 *Using Fungicide Sprays Effectively*

Ento-003 *Protecting Our Groundwater*

HYG 3065-95 *Virus Diseases of Greenhouse Floral Crops*

HYG 3066-95 *Black Root Rot of Greenhouse Floral Crops*

HYG 3070-95 *Botrytis Gray Mold of Greenhouse Floral Crops*

Ohio Florists' Association *Tips on the use of and Safety of Chemicals, Biologicals and the Environment on Floriculture Crops*
Available from: Ohio Florists' Association, 2130 Stella Court, Suite 200 Columbus, OH 43215
Phone (614) 487- 1117

When completing this workbook, use the flap on the back cover to conceal the answers while answering the questions on the left-hand page. Once all the questions for a section are answered, the user should check to see if the responses are correct, mark those incorrect, and read the explanation for each question. If the explanation is confusing or if you disagree with the answer or explanation, refer to the section indicated in the reference.

General Knowledge

1. Pesticide recommendations given in university publications can be relied upon to be current, legal uses.

- A. True
- B. False

2. Which of the following sprayers will produce large spray droplets.

- A. Mechanical aerosol generator
- B. Electrostatic applicator
- C. High-volume (hydraulic) sprayer

3. An applicator that applies pesticide products evenly over the top leaf surface will get good control of all pests.

- A. True
- B. False

4. The use of trapping and scouting for pest detection as well as cultural, physical, environmental, chemical, and biological controls is said to be:

- A. MPI
- B. PMI
- C. IPM

5. Sticky traps can be used as a total management tool to detect insect pests in the greenhouse.

- A. True
- B. False

6. Growers often “keep over” a few plants after a crop. This is a good practice.

- A. True
- B. False

7. The method of using living organisms to control or manage other living organisms is called:

- A. Mechanical control
- B. Environmental control
- C. Biological control
- D. IPM

8. Pesticides can easily be used in conjunction with biological pest control programs.

- A. True
- B. False

1. **Correct Answer: B** *Tips* (Ohio Florists' Association)
Explanation: Labels can change after a university publication goes to press. It is the responsibility of the pesticide user to make certain that he or she is following the currently labeled product instructions. Labels should be checked before purchase to confirm if the labeled uses are consistent with their practices. Plant use should also be checked. The label - not the research publication—is the law.

2. **Correct Answer: C** *Tips* (Ohio Florists' Association)
Explanation: Primarily large droplets are generated by high-volume sprayers, but some smaller droplets will also be produced. Based on droplet size, only two percent to six percent of the pesticide applied by high-volume spray actually reaches its intended target, and the rest is lost. Many pesticide labels still call for high volume sprays even though they are less efficient. When making future purchases of a sprayer, the ones that produce small droplets would be more efficient.

3. **Correct Answer: B** *Tips* (Ohio Florists' Association)
Explanation: It's good to get even application of pesticides, but to get proper control both the top and bottom leaf surfaces must have even coverage. Insects and disease can occur on both surfaces of plant leaves.

4. **Correct Answer: C** *Tips* (Ohio Florists' Association)
Explanation: IPM stands for Integrated Pest Management and should be an acronym in every grower's vocabulary. Many management techniques used in the greenhouse can provide pest control if used with understanding

5. **Correct Answer: B** Bulletin 538
Explanation: Sticky traps will aid in early detection of insect pests, but do not replace early visual detection by the grower. The growers should inspect plants that come from propagators or plants exchanged between growers. The grower should be trained along with employees to recognize various greenhouse pests and what healthy plant material should look like.

6. **Correct Answer: B** *Tips* (Ohio Florists' Association)
Explanation: Crop residues, whether pot plants or plant refuse, should be destroyed immediately after harvest. The longer the residues remain nearby, the better the chances for pest populations to increase. Do not dump plants out the back door as insects will fly back into the greenhouse through open doors and vents. Do not plant a vegetable or flower garden adjacent to the greenhouse.

7. **Correct Answer: C** *Tips* (Ohio Florists' Association)
Explanation: Biological control employs other living organisms such as parasites, predators, fungi, nematodes, and viruses to control or manage other pests. Careful monitoring of pests and management of control strategies are necessary.

8. **Correct Answer: B** *Tips* (Ohio Florists' Association)
Explanation: Most insecticides and some fungicides are harmful to parasites and predators. Some pesticides may be effective for several weeks. Wait at least 30 days before beginning a biological control program.

9. Insect pests can gain entrance into the greenhouse in many ways. Some of these entrance ways include:

- A. Open greenhouse vents and doors
- B. Exchange of plant materials between growers
- C. Bringing in mulching materials, soil, or equipment from outdoors
- D. All of the above

10. Chemicals are not always needed for disease control in the greenhouse.

- A. True
- B. False

11. Sanitation is one of the most important means of managing plant health and controlling disease. Ways to achieve sanitation include:

- A. Cleaning up and controlling weeds
- B. Using clean soil mixes
- C. Sweeping up and disposing of plant debris
- D. Disinfecting equipment and greenhouse surfaces from time to time
- E. Quarantining newly arrived plant material
- F. All of the above

12. Most pesticides are designed to stay active for a given period of time. A properly stored product can be expected to last:

- A. 1 year
- B. 6 months
- C. 2 years

13. A greenhouse owner has four greenhouses with inside floor dimensions of 25 feet by 100 feet. How many total square feet of area need to be covered when spraying?

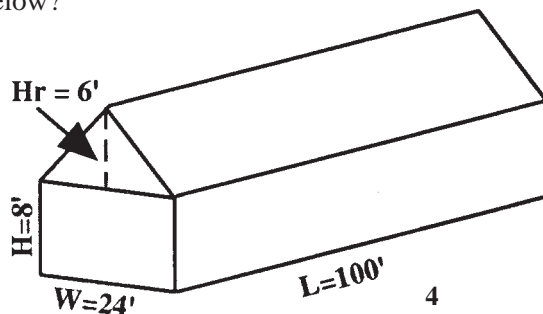
- A. 250 square feet
- B. 2,500 square feet
- C. 10,000 square feet
- D. 12,500 square feet

14. A grower has 10,000 square feet of bench area to drench. The label calls for 4 oz. chemical per 50 gallons applied per 500 square feet. How many gallons of material need to be made up?

- A. 200 gallons
- B. 1,000 gallons
- C. 575 gallons

15. A grower has an insect problem. The spray aerosol generator insecticide label says one aerosol spray can should be applied to 5,000 cubic feet. How many aerosol spray cans must the grower use to treat the greenhouse illustrated below?

- A. 1 can
- B. 5 cans
- C. 30 cans
- D. 16 cans



9. **Correct Answer:** D Bulletin 538

Explanation: Pests can gain entrance in many ways, and growers and assistants should be alert to pests coming through open vents and doors. Soils, mulches, plant materials coming from suppliers, and equipment from the outdoors should also be considered as ways of introducing pests. Customers can also introduce pests into the greenhouse.

10. **Correct Answer:** A Bulletin 538

Explanation: Preventive health management involves more than chemicals. Growers need to use early detection and identification of diseases. Optimum growing conditions, and manipulation of the greenhouse environment reduces or retards the spread of disease. Sanitation is an important disease control method by using synthetic potting mixes, clean containers, steam sterilization and proper handling of clean potting soil.

11. **Correct Answer:** F Bulletin 538

Explanation: Sanitation involves many activities. Controlling weeds inside and outside the greenhouse, using “clean” or soilless mixes, keeping plant waste picked up, disinfecting equipment and benches, inspecting and quarantining plant material from other growers or suppliers, all can help control disease in the greenhouse.

12. **Correct Answer:** C Bulletin 538

Explanation: Most pesticides are designed to last for about 2 years or longer when cared for properly. Keep products away from high humidity, extreme temperatures, and direct sunlight. Remember, some products may have a shorter life. Check the label.

13. **Correct Answer:** C

Explanation: Each house is 25 feet by 100 feet, which equals 2,500 square feet. The grower has four houses, so multiply as follows: $2,500 \times 4 = 10,000$ square feet.

14. **Correct Answer:** B

Explanation: The grower would want to make up 1,000 gallons of material to drench the soil. To calculate this: 10,000 square feet of bench area . 500 square feet of treated area equals 20 units x 50 gallons/unit, which equals 1,000 gallons. The grower would use 20 units x 4 oz. per unit, or 80 oz. of chemical, in the 1,000 gallons.

15. **Correct Answer:** B

Explanation: One must figure the cubic feet in this greenhouse. The formula is:

$$[(W \times H) + \frac{W \times Hr \times L}{2}] \quad \text{or} \quad \frac{[(24' \times 8') + \frac{24' \times 6' \times 100'}{2}]}{2} = 26,400 \text{ cu. ft.}$$

or $[192 \text{ sq. ft.} + 72 \text{ sq. ft.}] \times 100 = 26,400 \text{ cu. ft.}$

Then, take $\frac{26,400 \text{ cu. ft.}}{5,000 \text{ cu. ft./can}} = 5.28 \text{ cans (round off to 5 cans)}$

Space the 5 cans evenly throughout the greenhouse to obtain good dispersion of the product. Note that this problem requires seeking cubic feet, not square feet. Many aerosol generators rely on enough product to fill cubic feet of space.

16. The Worker Protection Standard (WPS) covers employees when they are involved in any step in the production of plants.

- A. True
- B. False

17. When a “handler” is applying or otherwise handling a fumigant in a greenhouse, the employer must ensure that someone maintains constant visual or voice contact.

- A. True
- B. False

18. New pesticide labels will have Worker Protection Standards (WPS) information listed in the front part of the label.

- A. True
- B. False

19. The Restricted Entry Interval (REI) is the time you feel like waiting before you or your employees can enter a pesticide treated area.

- A. True
- B. False

20. Control of green house insects and disease starts with a very important first step:

- A. Early detection and correct identification of pest
- B. Spraying everything that comes into the greenhouse
- C. Raising your own cuttings or seeds

21. Water quality issues relating to pesticide application should be of concern to growers because:

- A. Pesticide runoff could percolate down through the soil or along well casings to contaminate groundwater
- B. Emptying spray tank rinseates near storm sewers will contaminate streams or surface waters
- C. Pesticides can contaminate well water or city water supplies if check valves are not in use when filling spray tanks
- D. All of the above

16. **Correct Answer: A** Bulletin 538

Explanation: Employers are classified as either workers or handlers based on the tasks they are performing. Say for example, Bill, your employee, pots plants in the morning as a greenhouse “worker”, then later in the day he applies pesticides to the greenhouse crops, he is considered a “handler”. In each case the WPS applies and as the employer you must do certain things according to the WPS.

17. **Correct Answer: A** Bulletin 538

Explanation: Employers must insure someone does maintain visual or voice contact with any “handler” who is applying or otherwise handling a fumigant in the greenhouse. This also includes handlers who enter the greenhouse during fumigation to operate ventilation systems, adjust tarps and other coverings used in the fumigation or check air concentration levels. In the event of an emergency, the appointed monitor must be prepared to enter the greenhouse with proper personal protective equipment (PPE).

18. **Correct Answer: B** Bulletin 538

Explanation: Pesticide manufactures are changing labels on new products to include the WPS requirements. All pesticide products affected by WPS will eventually carry a statement under the new “Agricultural Use Directions” section of the labeling. This may be located somewhere other than on the front of the label. This statement will instruct users to comply with all provisions of WPS. A newly labeled product will have required personal protective equipment (PPE) and the restricted entry interval (REI) listed too.

19. **Correct Answer: B** Bulletin 538

Explanation: The Restricted Entry Interval (REI) is the time immediately after pesticide application when entry into the treated area is limited. REI’s are listed on each label and are set by the Environmental Protection Agency. The re-entry time determination cannot be set by the grower. Read the label each time as REI intervals can be changed by the E.P.A.

20. **Correct Answer: A** Bulletin 538

Explanation: Pests gain entrance to greenhouses in many ways such as by open vents, doors, soil, mulching material, and the purchase or exchange of plant materials. Early detection by use of traps, direct observation, and pest knowledge will help only if you get the correct identification of the pest, once you have detected it.

21. **Correct Answer: D** *Protecting Our Groundwater*

Explanation: All the answers are correct. Pesticide applicators always need to be aware that pesticide products can percolate down through the soil beneath the benches or move along well casings to contaminate growers. Spray tanks should never be emptied into storm sewers as the drains may terminate at a stream, pond, or surface water area. Check valves should be in place to prevent back-siphoning of pesticides into water lines. Make it a practice to keep the end of the fill hose above the water level in the spray tank.

Pesticides

22. When some pesticides are mixed in water that is alkaline (basic), they will break down. Which of the following water pH readings is alkaline (basic)?

- A. pH 4.5 - pH 6.5
- B. pH 7.0
- C. pH 7.1 - pH 9.5

23. All pesticides are toxic to some degree. Some are more toxic than others. The most toxic pesticides have the following signal on the label:

- A. Warning
- B. Danger
- C. Caution

24. Which personal-protection precautions should be observed when growers use pesticides in a greenhouse?

- A. Wear natural rubber gloves or unlined neoprene gloves
- B. Smoke and eat while applying
- C. Use any kind of respirator when applying pesticides
- D. Try to spray when conditions are cooler
- E. Wear eye protection
- F. A, D, & E

25. After a greenhouse has been sprayed, it is permissible for workers to re-enter within 1 hour or after leaves are dry.

- A. True
- B. False

26. After sterilizing a potting soil, it is correct to add a systemic insecticide to the pile of mix to prevent insects from entering it or attacking the plant.

- A. True
- B. False

27. Pentac is effective against all species of insects.

- A. True
- B. False

28. Which of the following are plant growth regulating chemicals?

- A. A-Rest
- B. Bonzi
- C. B-Nine
- D. Cycocel
- E. All of the above

22. **Correct Answer: C**

Explanation: Water pH can have a dramatic effect on pesticides, especially insecticides. The pH scale goes from 0 - 14, and 7 is neutral. In the range 7 - 14, the solution is considered alkaline (basic).

23. **Correct Answer: B**

Explanation: Growers should be especially aware of the “Danger Poison” sign on the label as being extremely poisonous. Other warning statements should be noted and protection worn.

24. **Correct Answer: F**

Explanation: There are a number of rules to follow, but adequate protection of hands and wrists with natural rubber or neoprene gloves is necessary when handling pesticides. Other safety concerns should be observed, such as a NIOSH/MESA respirator or face shields to protect eyes, nose, and mouth. Choose the correct respirator for the job, and replace filters regularly. Check the label for the personal protective equipment required for any product. Launder clothing properly, and do not smoke or eat when spraying or handling pesticides.

25. **Correct Answer: B**

Explanation: New federal regulation under the Worker Protection Standard (WPS) require the area be posted so no one enters before the re-entry interval (REI) has expired. If one must enter to adjust equipment, full pesticide protection must be worn as stated on the pesticide label.

26. **Correct Answer: B**

Explanation: Mixing in insecticides after sterilizing potting soil exposes a worker handling the soil to excessive pesticide residues on hands. When filling containers, follow label directions of systemic insecticide for correct application.

27. **Correct Answer: B** *Tips (Ohio Florists’ Association)*

Explanation: Pentac is a miticide, not an insecticide. Pentac is slow-acting. Spray as recommended during warm weather as mite populations build rapidly over a few days.

28. **Correct Answer: E** *Tips (Ohio Florists’ Association)*

Explanation: All products listed are plant growth regulators. Products listed work on height control or induce early flowering. Some products require precise application to get desired results, while others are more forgiving if misapplied. Consult the label for correct dilution.

29. Growth regulating chemicals have labels that cover all crops, including vegetable transplants.
- A. True
 - B. False
30. When using a plant growth hormone regulator as a drench, be certain to apply it uniformly by thoroughly soaking the growing medium mass when drenching.
- A. True
 - B. False
31. When using herbicides labeled for use in the greenhouse, it is important to:
- A. Spray between crops or when crops are out of the greenhouse
 - B. Use low-drift, large-droplet sizes
 - C. Avoid steam pipes
 - D. Turn off circulation fans before spraying
 - E. Apply on days when greenhouse temperatures are lower
 - F. All of the above
32. Which of the following are greenhouse sanitizing agents?
- A. Diazinon
 - B. Dursban
 - C. Chlorine bleach
 - D. Q-salts (Physan 20, Consan 20, Greenshield)
 - E. All of the above
 - F. C&D
33. Growth regulators can have a dramatic effect on plant growth. But to get good results, one should:
- A. Spray when you feel like it
 - B. Apply the proper chemical growth regulator to the proper plant at the proper time and at the proper application rate
 - C. Spray on a weekly basis
34. This bacterial insecticide works against several caterpillar species, but must be eaten by the pests to be effective.
- A. *Bacillus thuringiensis v. Kurstaki* (Dipel)
 - B. Clandosan
 - C. Margosan
35. What is true about the following insecticides, Citation (cyromazine), Adept (diflubenzuron), Precision (fenoxycarb), Enstar II (s-kinoprene)?
- A. All are botanical insecticides derived from plants
 - B. All are insecticides
 - C. All are a form of an insect growth regulator
 - D. All of the above
 - E. Only B and C

29. **Correct Answer: B** *Tips* (Ohio Florists' Association)
Explanation: Many articles and recommendations have been written for non-registered uses of growth regulators on crops in the popular press. It is the responsibility of the applicator to read the labeled uses of the material and use them accordingly. **Remember the label is the law.**
30. **Correct Answer: A** *Tips* (Ohio Florists' Association)
Explanation: It is important when using growth regulators as a drench that you get the correct amount of chemical into the growing medium. Actual volume will vary with pot size, growing medium, and/or plant size. One wants to moisten the medium without leaching. If possible, use 2 split applications of half strength one week apart, rather than one application at full strength. This is especially true when using A-Rest or Cycocel.
31. **Correct Answer: F** *Tips* (Ohio Florists' Association)
Explanation: A limited number of herbicides are labeled for greenhouses. Extreme care must be taken when using labeled herbicide products in a greenhouse, as crop injury can occur. Desirable vegetation such as vegetable and flower crops must be out of the greenhouse before spraying. Fans must be turned off to avoid moving herbicide spray droplets around the greenhouse. Weeds are often overlooked as a source of insects and disease both inside and outside the greenhouse. Avoid spraying pipes because herbicides may volatilize when the pipes are heated.
32. **Correct Answer: F** *Tips* (Ohio Florists' Association); Bulletin 538
Explanation: Diluted chlorine bleach and Q-salts are among the traditional sanitizing agents. Other compounds include formaldehyde and phenolics, which are not widely used. Occasionally, 70 percent alcohol is used on cutting tools. Chlorine products are unstable in organic matter and they degrade rapidly.
33. **Correct Answer: B** *Tips* (Ohio Florists' Association)
Explanation: Growth regulators must be applied to the proper plants at the proper time and at the proper application rate to obtain desired results. Be sure the plants are well-established with a good root system and are not wilted.
34. **Correct Answer: A** Bulletin 538
Explanation: Caterpillar species are controlled by *Bacillus thuringiensis* bacterial products only by eating the material. Thorough coverage of plant parts is essential for control of caterpillars. The other products, while biological, do not kill caterpillars. Margosan is extracted from a plant and is used for control of white flies. Clandosan is a chitin-based nematicide.
35. **Correct Answer: E** Bulletin 538
Explanation: All the products are insecticides and they also control insects by acting as an insect growth regulator when applied. It must be remembered that insect growth regulators work slowly.

36. Horticultural oils are registered for use on many greenhouse and outdoor ornamentals. Oils kill insects by:
- A. Direct contact
 - B. Suffocation
 - C. Both A & B
37. Which of the following insecticides are synthetic pyrethroids?
- A. Dursban, Diazinon, Orthene
 - B. Talstar, Sumithrin, Resmethrin
 - C. Vendex, Kelthane, Pentac
38. Insecticides such as Acephate, Dursban, Diazinon, Malathion, and Sulfotep are all considered:
- A. Carbamates
 - B. Pyrethroids
 - C. Organophosphates
 - D. Chlorinated hydrocarbons
39. Pesticides are often available in several different formulations, each having advantages and disadvantages. Emulsifiable concentrations (EC) can cause:
- A. A white residue on plant foilage.
 - B. No visible residue but plant injury is possible due to solvent formulation.
 - C. Corrosion to equipment.
40. Methyl bromide is a common fumigant used by greenhouse and outdoor growers. Growers must be aware that:
- A. Methyl bromide is very volatile and must be injected under plastic tarps
 - B. The quality of many vegetable and floriculture crops can be affected by bromine residues
 - C. Rubber gloves and clothing that traps methyl bromide next to the skin should not be worn
 - D. Both A&B
 - E. All of the above
41. Soil moisture that is 20 percent to 30 percent of field capacity is suitable for fumigation.
- A. True
 - B. False
42. Successful soil fumigation requires that soil temperatures be within certain ranges at a 6-inch depth. These ranges are:
- A. 32 F to 40 F
 - B. 45 F to 55 F
 - C. 60 F to 80 F

Insects

43. Aphids attack greenhouse crops by chewing plant tissue.
- A. True
 - B. False

36. **Correct Answer: B** Bulletin 538
Explanation: Horticultural spray oils are used to control many pest groups including spider mites, aphids, mealybugs, scale and whitefly. The product works by suffocating the insect thus there is no known resistance as with other chemical insecticides. The oil then volatilizes off. Plant injury sometimes occurs when more than three applications are made in sequence. Oils are often tank mixed with other products to increase efficacy.
37. **Correct Answer: B** Bulletin 538
Explanation: Talstar (bifenthrin), Sumithrin (d-phenothrin), and Resmethrin (SBP1382) are all synthetic pyrethroids. Others include Mavrik and Astro. Use care in mixing and applying pyrethroid products as skin irritation may occur. Kelthane, Vendex, and Pentac are miticides, not insecticides.
38. **Correct Answer: C** Bulletin 763
Explanation: The organophosphate group of insecticides includes Acephate, Dursban, Diazinon, Dichlorvos, Malathion, Naled, and Sulfotep. When spraying, one should rotate between chemical classes of insecticides to reduce the occurrence of insect resistance.
39. **Correct Answer: B**
Explanation: Emulsifiable concentrates (EC) applications do not leave a visible residue but generally cause more plant injury because of solvent materials added to the formulation. Residues may be visible with dust, wettable powders and flowables. If two E.C. materials are mixed it may cause problems because of excess solvent. Be sure to check the label.
40. **Correct Answer: E**
Explanation: Fumigation is covered on the ODA pesticide exam even though many products have or will soon be taken off the market. If methyl bromide is used because of its volatility it must be injected under a plastic tarp. Bromide residues can affect growth of carnation, salvia, onion, snapdragons, garlic, alyssum, calendula, chrysanthemum, coleus and others. Allow for adequate aeration of the soil after application. Avoid wearing clothing that could trap methyl bromide against the skin. Vapam or Metam-sodium is sometime used as a soil fumigant to control weeds, soil fungi, and nematodes. Vapam must be soil incorporated with water to increase effectiveness.
41. **Correct Answer: B**
Explanation: At 20 percent to 30 percent field capacity, the soil is on the dry side and the fumigant will leave the soil too rapidly. Also, the organism to be killed may be in a resistant resting stage and not affected by the fumigant. Soil moisture should be at least 50 percent to 75 percent of field capacity for proper fumigation. With any product used, label directions will point out proper moisture levels.
42. **Correct Answer: C**
Explanation: Most soil fumigants work best when soil temperatures range between 60 F to 80 F at a 6-inch depth. When soil temperatures are lower, the chemicals volatilize more slowly and concentrations of fumigant high enough to control pests may not be reached. At low temperatures, phytotoxic concentrations can be retained and delay planting. Above 80 F, the fumigant gas may leave the soil too rapidly to give effective control.
43. **Correct Answer: B** Bulletin 538
Explanation: Aphids have piercing, sucking mouthparts that are inserted into plant tissue to extract plant fluids. This feeding habit also transmits plant virus diseases that can weaken plants.

44. Aphids can and often do produce live daughter insects without going through the egg stage of development.
- A. True
 - B. False
45. When searching for greenhouse whiteflies, a grower should:
- A. Check top sides of leaves
 - B. Look at foliage in lower part of plant
 - C. Specifically check undersides of younger foliage
46. Honeydew is a sticky substance excreted by several insect species in the greenhouse. They are:
- A. Leafminers, cabbage loopers, cutworms
 - B. Aphid, greenhouse whitefly, mealybug, scale
 - C. Fungus gnats, shore flies
47. When spraying for whiteflies, it is best to spray:
- A. The egg stage
 - B. The newly emerged nymph (crawler)
 - C. Pupa stage
 - D. Adult stage
 - E. Both B&D
48. Thrips damage can appear in distinct ways on plant foliage and flowers. This can be seen as:
- A. Loss of color pigment in flower petals and a silver-gray appearance on leaves
 - B. Chewed holes in the foliage
 - C. Darkened green spots on leaves
49. Thrips are considered important greenhouse pests because:
- A. They are so tiny
 - B. They move about quickly
 - C. They can transmit virus diseases and distort foliage and flowers
50. Western flower thrips damage is best described as:
- A. Eating large holes in foliage and bacterial wilt
 - B Notching leaf edges and fusarium wilt fungus
 - C Direct feeding on foliage and flower parts and transmission of tomato spotted wilt virus (TSWV) or impatiens necrotic spot virus (INWV).
51. Damage that appears as an irregular mine between the upper and lower leaf surfaces on a flower or vegetable crop is a clue to look for:
- A. Thrips
 - B. Leafminers
 - C. Cutworms

44. **Correct Answer: A** Bulletin 538
Explanation: The female aphid will produce some 50 or more live daughters during her lifespan under average greenhouse conditions. Each of the daughter aphids can begin to reproduce more daughters in about 7 days.
45. **Correct Answer: C** Bulletin 538
Explanation: Growers should be aware that whiteflies like to feed on undersides of top foliage leaves. Eggs are also laid in this area. One should also place yellow sticky traps in the upper plant level to monitor properly for whiteflies.
46. **Correct Answer: B** Bulletin 538
Explanation: Honeydew is excreted by insects such as whitefly, scale, mealybug, and aphid, and can often be seen as a clear sticky substance on plant leaves. Later, a black fungus, sooty mold, often grows on the honeydew.
47. **Correct Answer: E** Bulletin 538
Explanation: The young nymph (crawler) and adult stages of the whitefly are the most susceptible to insecticide sprays. The egg and pupa stages of growth are resting stages that current insecticides do not affect. In the nymph or crawler stage, they move a short distance before settling down to feed. Knowing the pest stage of development is often critical to effective control.
48. **Correct Answer: A** Bulletin 538
Explanation: Thrips feed by rasping plant tissue with their mouthparts and sucking plant juices. This feeding results in a silver-gray appearance on leaves. On pigmented petals, the color is absent where feeding occurred. Black dots of excrement on plant tissue are also a clue to thrips.
49. **Correct Answer: C** Bulletin 538
Explanation: Thrips, because of their small size, often go undetected until damage occurs. Typical damage appears as distorted growth and damaged flower petals. In the process of feeding, thrips can transmit tomato spotted wilt virus (TSWV) and cause further losses.
50. **Correct Answer: C**
Explanation: Western flower thrips are serious pests of flowers. While thrips scar the petals and foliage, the underlying serious problems are transmission of tomato spotted wilt virus (TSWV) and impatiens necrotic spot virus (INWV). Thrips are difficult to control and many tactics must be used such as monitoring and inspecting new crops coming into the greenhouse, using thrips resistant screening on vents, monitoring with sticky cards, and alternating different classes of insecticides on a regular basis.
51. **Correct Answer: B** Bulletin 538
Explanation: Irregular leaf mines is a clue that some species of leafminer larva is attacking a crop. Other clues are sting marks on the foliage and frass between the upper and lower leaf surfaces. Since the larva are protected by two leaf surfaces contact sprays don't kill them. So, by the time leafminers are detected, it is often too late to control them. Leafminers can survive transport of cuttings in the egg, larvae and pupal stage. Susceptible crops include chrysanthemum, carnation, columbine, tomatoes and cucumbers.

52. Cyclamen mites often go undetected because of their small size. A grower should watch for what type of damage?
- A. Red spots on leaves
 - B. Curled stunted and deformed growth of new leaves and buds
 - C. Green leaves with horizontal lines
53. Under the general environmental conditions of high humidity and cool greenhouse temperatures, one would expect which mite population to occur?
- A. Two-spotted mite
 - B. Cyclamen mite
54. Places to inspect for mealybugs include:
- A. The flowers
 - B. Foliage
 - C. Stems, foliage, and root areas
55. Mealy bugs are an oval sluggish scale-like insect about 1/8 inch long with waxy spines on the body margin and a white waxy covering . They have piercing-sucking mouthparts and can reduce plant vigor. Growers should be aware that:
- A. Honeydew is excreted by mealybugs upon which black sooty mold fungus grow
 - B. Some species can feed on root systems and stunt growth
 - C. Infestations often start by placing infected plants into the greenhouse and forgetting that plant inspection is necessary
 - D. All of the above
56. Which insect is often found in large numbers concealed under a hard shell?
- A. Mealybugs
 - B. Aphids
 - C. Scale insects
 - D. Whitefly
57. Two-spotted spider mite populations can be expected to “explode” under certain conditions. These conditions are:
- A. Cool, moist
 - B. Hot, dry
 - C. Hot, humid
58. Spider mite damage occurs as:
- A. Chewed plant leaves
 - B. Torn plant leaves and flowers
 - C. Spotted, mottled appearance to leaves (often with webbing)
59. These small, fragile dark-gray or black flies are often seen running over wet soil surfaces. Larvae often feed on root systems.
- A. Fungus gnats
 - B. Mealybug
 - C. Shore flies

52. **Correct Answer: B** Bulletin 538
Explanation: Because of their extremely small size (1/100 of an inch) cyclamen mites are never seen without magnification. They feed in developing buds. The curling and stunting of new growth is the first clue that cyclamen mites are present. Webbing is not seen.
53. **Correct Answer: B** Bulletin 538
Explanation: Cyclamen mites are extremely small (1/100 inch) and are difficult to see without microscopic magnification. Cyclamen mites like cool greenhouse temperatures with high relative humidity. The species feed on developing leaf and flower buds, causing curling, stunting and deformities in these areas. Two spotted spider mites prefer warm temperatures and low humidity to reproduce rapidly on plants.
54. **Correct Answer: C** Bulletin 538
Explanation: Mealybugs can be found all over a plant, even on the roots, when not evident on above-ground plant parts. Watch for stunted plant growth as a clue to mealybugs along with white, fluffy waxy masses on stems and leaves.
55. **Correct Answer: D**
Explanation: All the above facts are true about mealy bugs. They are small, they have piercing sucking mouthparts and when they feed, exude honeydew upon which black sooty mold fungus grows. Some feed on root systems and often go undetected. It is important to check stems and roots of plants when getting new plant material into your greenhouse.
56. **Correct Answer: C** Bulletin 538
Explanation: Several species of soft and armored scale insects can occur on greenhouse and interior plants. Most scales are brought into the greenhouse on infested plants. Honeydew is often a clue that scale insects may be present. Since the scales are small and blend in with the bark of the plants, they are difficult to detect until the population is out of control.
57. **Correct Answer: B** Bulletin 538
Explanation: During hot, dry weather, the egg to adult cycle may be completed in about 7 days. Because each female can produce 100 or more eggs, there is potential for rapid population explosion under hot, dry, conditions.
58. **Correct Answer: C** Bulletin 538
Explanation: Spider mites remove sap from plant leaves and in the process give the upper leaf surfaces a characteristic spotted or lightly mottled appearance. Silky webbing is formed in heavy infestations.
59. **Correct Answer: A** Bulletin 538
Explanation: Fungus gnat adults are often seen scurrying on the soil surface. The larvae feed on root hairs. Very large numbers can be found in flower pots that are kept moist.

60. When high amounts of algae build up on mats or floor areas, what insect can be expected to be around?

- A. Fungus gnats
- B. Shore flies
- C. Whiteflies

61. Viruses can be transmitted by what insects?

- A. Aphids, leafhoppers, thrips
- B. Mealybugs, scales
- C. Cabbage loopers, fungus gnats

62. Growers who see damage on plants that have large irregular holes in the leaves and shiny slime trails should look for:

- A. Caterpillars
- B. Slugs
- C. Spring tails

Diseases

63. When fungi destroy seeds or seedlings in the soil, this problem is called:

- A. Post-emergent damping off
- B. Pre-emergent damping off
- C. Excess soluble salts

64. When soil fungicide drenches are called for, it is important to apply the correct amount in a stated volume of water.

- A. True
- B. False

65. Powdery mildew is a fungal disease that attacks many greenhouse crops and is favored by the following conditions:

- A. Hot, dry
- B. Freezing
- C. Moist, with leaf wetness and stagnant air
- D. Cool conditions
- E. C&D

66. Some groups of common bacterial diseases in greenhouse crops include:

- A. Soft rot of corms and bulb cuttings, bacterial leaf spot, bacterial stem rot
- B. Nematodes
- C. Water molds, rusts, mildews

60. **Correct Answer: B** Bulletin 538

Explanation: The larvae of the shorefly feed on algae in the greenhouse environment. The adults may be mistaken for fungus gnats, so proper identification is necessary.

61. **Correct Answer: A** Bulletin 538

Explanation: Aphids, leafhoppers, and thrips are often the vectors of plant viruses. Thus, their reduction in the greenhouse is necessary to reduce the spread of virus problems.

62. **Correct Answer: B**

Explanation: Slugs often eat extensive holes in plant foliage. A silvery slime trail often is left on foliage, pots, and trays as they search for food. Mollusk baits are often used in control. Slugs are not insects, but mollusks, so insecticides will not be effective.

63. **Correct Answer: B**

Explanation: Pre-emergent damping off results from fungi that attack seeds or seedlings before emerging from the germination medium. Pythium fungi probably account for most damage.

64. **Correct Answer: A**

Explanation: The drench takes the place of an irrigation. Thus, if the pesticide label calls for 50 gallons of prepared drench over 400 square feet, these directions should be followed to adequately apply the drench product.

65. **Correct Answer: E** Bulletin 538

Explanation: Powdery mildew fungi are very host- specific. Only one plant species may be affected in a greenhouse situation. Stagnant, moist, cool air favors development of powdery mildew. Environmental control of powdery mildews can be quite successful. Reduce the high humidity that often occurs at night by venting and heating at sundown. Use fans to circulate air. Avoid drafts such as those caused by doors that are not kept closed. If possible plant resistant cultivars.

66. **Correct Answer: A** Bulletin 538

Explanation: Bacterial diseases comprise a diverse group of single cell microbes. Common diseases include bacterial blight and leaf spot of geranium, soft rot of cuttings, corms, bulbs, and bacterial leaf spot. Control centers around cultural control measures. Begin with clean plant material, make sure cuttings are optimum hardness for rapid rooting. If bacterial diseases start, be careful not to splash water about when watering space plants, harden the crop by running temperatures cool and dry with reduced fertilization. Copper based compounds may be needed in severe cases.

67. The root knot nematode can be detected visually by what symptoms?
- A. Leaves show red to orange spotting
 - B. Nodules or tiny swellings often form on the root system, causing plant stunting
 - C. Plant stems and flowers often fall off
68. Control of virus problems in plants can be difficult. Control plans might include:
- A. Discarding infected plants
 - B. Use cultured stock plants, control insect problems, and avoid unnecessary handling of plants
 - C. Both A&B
69. Greenhouse environmental practices of improving the drainage or air-filled space of planting media, keeping clean the areas under benches, and keeping watering hoses off the ground help to prevent:
- A. Rust diseases
 - B. Powdery mildew
 - C. Leaf spotting fungi
 - D. Water mold fungi
70. Many leaf and flower spotting fungi such as Botrytis, Septoria, and Alternaria require certain environmental conditions for disease infection to start. These general conditions are:
- A. Dry, sunny conditions with good air movement
 - B. High relative humidity, wet leaf surfaces, and perhaps injured tissue
 - C. High air movement and early-morning watering on a well-drained soil
71. Which common greenhouse disease produces abundant gray or brown spores on blighted tissues? Water on plant surfaces, along with lower temperatures, makes this disease spread rapidly.
- A. Powdery mildew
 - B. Botrytis
 - C. Rust
 - D. Root rot
72. Fungicides that are taken up by the plant to combat disease are said to be:
- A. Systemic
 - B. Hyperaggressive
 - C. Contact
 - D. Phytotoxic
73. Several fungicides are considered to be systemic. These are:
- A. Captan (Orthocide), chlorothalanyl (Exotherm Temil), dicloran (Botran), sulfur
 - B. Triadimefon (Bayleton), fenarimol (Rubigan), metalaxyl (Subdue), Zyban
74. When controlling algae in the greenhouse, any fungicide can be used.
- A. True
 - B. False

67. **Correct Answer: B** Bulletin 538
Explanation: The root knot nematode, as its name implies, is found on the roots as swellings or nodules. Impaired root function leads to stunted plants.
68. **Correct Answer: C** Bulletin 538
Explanation: Because viruses live and multiply only within living cells, they are hard to control. Sanitation, cultured stock, insect control, and avoidance of unnecessary plant handling all reduce virus movement in plants.
69. **Correct Answer: D** Bulletin 538
Explanation: Pythium and Phytophthora are called water molds because they have a spore stage that spreads by swimming in water. Improving pore space, keeping benches clean, and keeping water hoses off the ground will help prevent these diseases.
70. **Correct Answer: B** Bulletin 538
Explanation: The leaf and flower spotting fungi are spread by spores. Splashing water, high relative humidity, and poor air circulation all contribute to disease spread. Avoid late-afternoon watering, provide adequate ventilation, and remove infected plant materials. Growers should also understand when disease conditions are present and scout for evidence of disease activity.
71. **Correct Answer: B** Bulletin 538
Explanation: The most common flower and foliage disease is Botrytis. Botrytis occurs over a wide host range. The abundance of gray or brown spores on the blighted tissue characterizes most Botrytis diseases. Generally cool, wet, and humid weather conditions favor spore production and infection of the plant. Predisposing factors include watering late in the day, poor air circulation, crop shading, dense crop spacing, and injured plant tissue.
72. **Correct Answer: A** Bulletin 538
Explanation: Some fungicides provide a protective barrier on the surface of plants against disease. Others are taken up by the plant and transported within it. These are considered to be systemic in action.
73. **Correct Answer: B** Bulletin 538
Explanation: Bayleton, Rubigan, Subdue, and Zyban are considered to be systemic fungi. Label rates must be followed **exactly** to avoid problems with plants.
74. **Correct Answer: B** *Tips* (Ohio Florists' Association)
Explanation: Fungicides generally do not work on algae. The labeled products (at the time of publication) include Agribrom soluble granules and Physan 20L. Both have registered use for specific applications.

Greenhouse Pest Control

Score Card

No. of Questions Answered Correctly	% Correct	Evaluation
67-74	>90%	Excellent- You have a very good understanding of greenhouse pests and their control.
59-66	>80%	Good- Be sure you understand the questions you missed. It may help to read the references again and re-answer the questions you missed.
52-58	>70%	Needs Improvement- Your score indicates a borderline level of expertise. Be sure to read the cited references again and re-answer the questions you missed.
0-51	<70%	Re-read the recommended references and work through the workbook again.