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Considerations for Managing Greenhouse Pests - Florida Greenhouse Vegetable Production Handbook, Vol 3[1]

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The impact of plant pests on the aspiring producer of greenhouse vegetables is direct and significant. The prospective producer must understand that Florida is a paradise for both the crop and the accompanying pests that afflict it. Disease-causing organisms, insects, and nematodes can cause serious problems in greenhouses. Without a real winter period, populations of pests continue to build, and many are sustained throughout the year. With this mild climate comes the adaptability of both temperate and tropical pests to Florida, thus presenting a large number of potential problems for greenhouse crops.

If a person becomes interested in constructing or beginning a greenhouse operation, there are certain important considerations that should be understood concerning pests and their potential to reduce or destroy a greenhouse crop. First, a greenhouse provides a protected environment in which pests can thrive. The very heart of the concept of greenhouse farming is to grow plants by providing a means to protect the crop from extreme heat, cold, rain, and the numerous environmental factors that would otherwise slow down or prevent the crop from being grown at a particular time period. Pests that may inhabit a greenhouse are consequently protected from the very same harsh environmental factors that normally aid in their control when a crop is grown out of doors or under field conditions. For instance, the driving force of rainfall and wind often help to keep mites, aphids, and other insects under economic control. Direct sun and the constant changes in temperature also play an important role in overall natural pest control often obtained under open conditions. The greenhouse literally protects its plants and consequently their respective pests from these environmental conditions. Biological control of insects, however, can be more effective in a protected environment.

One serious problem to consider is the lack of available chemical control measures for the greenhouse. For instance, tomatoes grown under field conditions may have several dozen insecticides and fungicides that can be used on them; not so in the greenhouse. Strict EPA, federal, and state laws reduce the number of pesticides that can be used on greenhouse-grown tomatoes or other vegetables. A material should not be used if it specifically states on the label "not for greenhouse use" with directions for the specific crop.

There are serious legal and liability situations that a greenhouse grower could be faced with when using toxic substances in enclosed areas. This is one of the major reasons why most pesticides used under field conditions cannot be used in greenhouse situations. When comparing greenhouse to field use, pesticides may dry on the plant

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at different rates, become highly volatile and give off toxic vapors either longer or faster under the greenhouse conditions, as well as respond differently in numerous other chemical and physical fashions. The toxic fumes may not escape and become diluted as rapidly as they would under field conditions, and thus are a potential hazard to the grower. There are many considerations that a grower must make when using pesticides in a situation where workers may be exposed daily and/or frequently under the modified and enclosed conditions of the greenhouse.

A greenhouse grower also faces the problem of frequent harvests over a long period of time. Greenhouse tomatoes, for instance, are picked many times and the larger number of harvests frequently prevents the use of many efficacious pesticides that have a longer pre-harvest time limit. The value of growing vegetables under greenhouse conditions is the ability to pick small quantities of ripe fruit every day or so, rather than harvesting great quantities in minimum number of pickings. The growth characteristics of greenhouse fruits demand close and careful handling by harvesters, and pesticide residues are again more of a potential problem under these conditions. Another consideration that a potential greenhouse grower must face is that available equipment to apply pesticides efficiently under greenhouse conditions can be very limited. The field tomato grower, for instance, has a wide range of choices of application equipment such as aircraft, sophisticated tractor equipment and chemigation units for use in their operations. The greenhouse grower frequently only has access to hand or small capacity power equipment units that are severely limited in nozzles, pressure, and spray application flexibility. By not having proper and available equipment, it is difficult to gain control over many pests under greenhouse conditions. In order to utilize valuable and expensive space, the greenhouse grower is frequently not able to use large pieces of spray equipment that are needed to accomplish a specific task. The grower, therefore, must be extra careful in the long range planning, selection, use, and application of pesticides.

Insect Management

Because of all the problems associated with the use of chemicals in the greenhouse environment, growers need to use exclusion as their first line of defense. Thus, insect management needs to be considered when designing the greenhouse. Insect-proof screening is available for vents and other openings, but because of greater resistance to air flow, the surface area of screened areas must be increased to compensate. For greenhouses that are covered with plastic, the use of ultraviolet-absorbing plastics can reduce insect problems. The UV-free light inside the greenhouse alters insects landing and feeding behavior and can greatly reduce the spread of insect-vectored viruses as well as discourage the establishment of aphids, whiteflies, and thrips. UV-reflective mulches used on the ground around the greenhouse can also help limit the entry of these pests.

The protected environment of the greenhouse promotes survival of beneficial insects as well as pests, so biological control is another tactic worth exploring. Much of the research on how best to use natural enemies in greenhouse vegetables production is still in progress, but growers are already experimenting with the use of lady beetles, lacewing larvae, pirate bugs, and predacious mites. This approach can be expensive. Predacious mites are particularly effective for controlling spider mites under greenhouse conditions. Suppliers of natural enemies can recommend the proper species for release.

Nematode Management

In addition to traditional insects and diseases in greenhouses, nematodes can present an additional type of problem. Nematodes are among the pest/disease problems that can be especially troublesome in greenhouse production systems. These relatively microscopic worms feed on or in plant roots, disrupting plant root growth and function. Some redirect significant amounts of plant energy to their own growth and support, reducing quantity and quality of yield and often delaying crop maturity. They reproduce well at 80-90°F and cause significant problems on many of the crops most popular in greenhouse production systems. Nematodes are easily spread in contaminated water, soil or growing media, and plant tissues. They can be especially troublesome in greenhouse systems because, among other things:

- Nematodes are easily introduced into greenhouse operations, and very difficult to get out of them. Any of several serious vegetable nematodes are commonly found in most native soils. They can get into a greenhouse crop whenever the barrier between the crop and the native soil beneath the house is broken. A single root penetrating through the plastic, concrete, or other flooring material can provide a route of entry. Infested transplants are another especially common means of introducing nematodes into a greenhouse. Any component of the growing medium that was never sterilized or was exposed to contamination during storage or handling can introduce nematodes. Even the water, if obtained from a shallow or surface source, may carry nematodes into the greenhouse.

- Nematodes are aquatic animals, so are spread especially easily in water. Recirculating hydroponic systems are vulnerable to nematodes, for the entire system can become uniformly infested as soon as nematodes in or on roots anywhere in the system begin reproducing and get into the water. Of course, any movement of soil or roots from an infested area to other parts of a house is also likely to spread a nematode infestation.
- Once a greenhouse crop in infested, there is no pesticide or other treatment that can cure the problem in that crop. Only by destroying the crop and sterilizing every component of the growing system that was contaminated can the problem be eliminated. Since that is very difficult, perhaps nearly impossible in some systems, careful sanitation to prevent introduction of nematodes into the operation is by far the best means of nematode management.

Disease Management

Currently, major greenhouse crops in Florida include cucumbers, lettuce, tomatoes, and various herbs. As an example of the seriousness of the pest situation, the following represents an approximate list of the number of diseases that potentially could affect these crops in the greenhouse:

- *Cucumber*- 9 fungal and viral diseases
- *Lettuce*- 7 bacterial, fungal, and viral diseases
- *Tomatoes*- 21 bacterial, fungal, and viral diseases
- *Herbs*- various plant-specific diseases

Some of these diseases are yearly problems, other appear with less frequency depending upon season, variety, production conditions, etc. For example, hydroponic production systems can have entire crops affected by root or vascular wilt diseases since the root zone is continuously in a nutrient film. There are no legal disease control products for either herb or lettuce production in the greenhouse and only one for cucumber production. Tomato production has access to seven distinct products with collective use for ten diseases only. Of these seven products, none are effective against diseases caused by bacteria or viruses. In addition, normal field use of multipurpose fumigants for control of soilborne pathogens is not adaptable to greenhouse production due to design of these facilities. Thus, hydroponic or ground systems where root or wilt diseases occur are often difficult to impossible to disinfest.

For the successful management of plant diseases in greenhouses, the crop production system needs to be closely associated with goals of disease and insect management practices. Some insects, such as whiteflies and thrips, are vectors of viral diseases.

Pest Management Considerations

The planning stage for the production system should include the following considerations:

a) Greenhouse construction design (especially height, heating, insect screens, and ventilation components) and an irrigation system that minimizes leaf wetness and humidity at the plant canopy level.

b) Selection of available pest resistant varieties.

c) Pest-free and healthy transplants that minimize introduction of plant pathogens, nematodes, and insects.

d) Optimum fertilizer programs that result in healthy growth as opposed to maximum growth.

e) Scouting for diseases, nematodes and insects during the growing season.

f) Sanitation practices that minimize microorganism movement from diseased plants to healthy ones, including removal of all plant materials after final harvest.

g) Harvest and shipping practices that maximize product quality.

Application of such integrated practices will ensure economically and environmentally acceptable greenhouse vegetable crops.

More Information in the

Volume 1: Introduction • Financial Considerations • Pre-Construction Considerations • Crop Production • Considerations for Managing Greenhouse Pests • Summary

Volume 2: Physical Greenhouse Design Considerations • Production Systems • Other Design Information Resources

Volume 3: Preface • General Aspects of Plant Growth • Production Systems • Irrigation of Greenhouse Vegetables • Fertilizer Management for Greenhouse Vegetables • Production of Greenhouse Tomatoes • Greenhouse Cucumber Production • Greenhouse Nematode Management • Alternative Greenhouse Crops • Vegetable Insect Identification and Management