PPP35

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Disease Control for Florida Tomatoes [1]

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Introduction

Fresh-market tomato is the most valuable vegetable crop in Florida. In the 2000-2001 season, 43,000 acres of tomatoes were commercially harvested in the state with a gross sales value of over 588 million dollars.

Tomatoes are grown throughout the state, but commercial production is centered in five locations: Miami-Dade County (Homestead), Palm Beach/St. Lucie counties, southwest Florida (Immokalee/Naples), Manatee/Hillsborough counties (Ruskin), and northwest Florida (Quincy). Most of these tomatoes are produced from November to May and are destined for northern U.S. markets and Canada.

Successful management of diseases has always been a vital necessity in Florida tomato farming; indeed, improvements in state tomato production have paralleled advances in disease control.

Tomato Pathogens

The great majority of plant problems that we call diseases are caused by pathogenic microorganisms. These extremely tiny disease agents cause losses by attacking the tomato fruit directly, rendering them unfit for consumption or sufficiently detracting from the appearance to reduce consumer preference; they also affect other plant parts, reducing plant vigor and carbohydrate production, with subsequent yield and monetary losses.

The pathogens attacking tomato can be classified into three major groups: fungi and fungal-like microbes (hereafter referred to as fungi), bacteria, and viruses.

Fungi

Fungi are microscopic organisms that are commonly classified as resembling plants. However, they are sufficiently different from plants that experts now classify fungi in a unique category . They have no true leaves, roots or stems. Instead, they appear as hyphae (microscopic threads) that absorb food and

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water into their cells. Although fungi have cell walls like plants, the chemicals composing the wall are not predominantly cellulose as in higher plants. Because fungi have no chlorophyll, they must depend on outside sources of food, including living plants.

Many of the fungi attacking tomato reproduce by creating large numbers of spores. Some spores are borne by wind or moisture and spread readily within and between fields. Some fungi, especially those causing wilt and root diseases, can survive one or more years between susceptible crops, with the aid of thick walled spores or sclerotia (aggregates of hyphae).

Fungi may enter plants through wounds or natural openings (e.g., the stomates that allow normal exchange of oxygen and carbon dioxide between the plant cells and the atmosphere). Some can also penetrate directly through the cuticle and cell walls.

Bacteria

Bacteria are smaller microorganisms than fungi and are not at all plant-like. They are one-celled, lack chlorophyll, and the ones that cause plant disease do not form spores. The main known type of reproduction for plant pathogenic bacteria is by simple cell division. They can not penetrate the plant directly but must have a wound or natural opening to get inside a potential host plant. Bacteria cause some of the most serious diseases of Florida tomatoes.

Viruses

Viruses should not be considered "organisms". They are simply molecules made of a nucleic acid (DNA or RNA) with a "wrapping" of protein, and have no cellular structures. New virus particles can only be synthesized within living plant cells. They are much smaller than bacteria and normally require the high magnification of an electron microscope to be seen. Most of the important tomato viruses are transmitted from tomato and wild hosts (such as black nightshade) to tomato by aphids, whiteflies, and thrips. A few viruses are spread mechanically.

Basic characteristics of tomato diseases

For disease to occur in tomato plants all three components of the "**disease triangle**" are required: a virulent pathogen, a susceptible variety, and weather conditions favorable for the disease. If any one of these components is missing, plants will not become diseased.

Effective control of tomato disease is based on **understanding** the biology of the casual organism, the response of the host to this pathogen, and the interplay of outside physical forces, such as temperature and soil type on the living systems involved. A brief outline of the characteristics of the major Florida tomato diseases is listed in Table 1.

With this background information we can proceed to a reasonable, sequential disease control program for Florida field-grown tomatoes.

Suggested Sequential Program for Disease Control

Fumigation of Soil

Most Florida tomatoes are now produced using the full-bed fumigation, plastic-mulch system. Increased land constraints in recent years have made it more difficult to find "new land" on which to plant tomatoes. Rapid buildup of plant pathogens and other pests in these soils has made fumigation economically expedient on most farms.

Fumigants are volatile broad-spectrum biocides that can be applied to the soil, and during a period of exposure will kill many of the potentially harmful disease agents, especially fungi. Most of the organisms that survive well in the soil (Table 1) can be managed if fumigants are properly applied prior to planting. In addition, broad spectrum fumigants can destroy other pests, including nematodes, soil insects, and weed seed.

The fumigants must thoroughly penetrate the spaces between soil particles. Since crop residues can interfere with fumigant penetration, they must be worked into the soil and allowed to decompose before fumigation.

The fumigant methyl bromide is due to be taken from the marketplace in the next few years. Alternatives for management of soilborne pests are currently under investigation.

Host Resistance

Choose varieties with disease resistance. The use of disease resistant plants can reduce the amount of pesticides required to produce quality fruit and economic returns. Knowledge of diseases present in production areas or a history of diseases within a particular field can help determine the resistance needed. This method makes it possible to attain practical control of many of our diseases. Disease resistance must be considered as important a factor in selection of a variety as fruit quality, yield, and other horticultural traits if a farmer is to be successful growing tomatoes in Florida.

Specific Cultural Control Measures

The use of **plastic mulch** is a very important cultural control for fruit rots in the field. Soil rot (*Rhizoctonia solani*) and buckeye rot (*Phytophthora parasitica*) are two soilborne fungi that caused great losses before plastic mulch was used to prevent contact between fruit and the soil. Staking plants has also reduced losses from fruit rots.

Production of transplants free of disease is a very important measure for control of many serious problems, especially early blight, late blight, bacterial spot, and several viruses. Use of certified "pathogen-free" seed is also important for some diseases such as tomato mosaic and bacterial spot.

Destruction of volunteer plants is an important practice in the control of several diseases, because it prevents large populations of pathogens from surviving from one cop to another. Crop rotation also works to prevent crop to crop survival of specific tomato pathogens.

Upward adjustment of soil pH by liming is an effective management strategy for Botrytis gray mold on sandy soils. A pH of 6.5 - 7.0 is recommended for suppression of Fusarium wilt.

Choice of planting date continues to be a largely economic decision based on anticipated market "windows" for a given production region. However, control of a disease by planting date may be considered if a particular problem does not lend itself well to other control measures. Late blight, Sclerotinia stem rot, and leaf mold are "cool" weather diseases, while others, such as bacterial spot, southern blight, and bacterial wilt occur primarily in warm weather. If the actual planting dates can't be used as a primary control strategy, the grower should be aware of the relationship between environmental conditions and certain diseases and apply measures in accord with the prevailing conditions.

Excessive handling of plants--such as thinning, pruning and tying--may help spread some diseases, including bacterial spot, tomato mosaic, and bacterial speck. Whenever possible, plants should be handled and moved when they are driest. If used, stakes should be decontaminated. Farm equipment should also be periodically decontaminated to reduce between-field spread of pathogens.

Several experiments have also shown that **overhead irrigation aggravates disease problems**, especially those caused by bacteria. Well water is preferred for spraying.

Rapid crop destruction at the end of the season is crucial for managing tomato yellow leaf curl. It is extremely important that the crops be destroyed immediately after harvest, because this reduces areas where whiteflies can build up and move to new crops.

Application of Foliar Fungicides and Stylet Oil

Periodic fungicide application is an important component of current tomato disease control programs. Either aircraft or ground application can be used, but the latter is preferred because it allows for superior penetration of the canopy and coverage of leaf under-surfaces. Attention to application techniques is as important as choice of material for achieving adequate disease control. A "typical" tomato spray application uses a tractor-mounted, boom sprayer at 200 to 275 psi pressure and 100 gal/acre of finished spray on mature plants. Proper application calibration should result in tractor speed of about 3 miles/hour. **At this speed an observer should be able to walk behind the tractor at a**

comfortable pace. If the tractor speed is properly adjusted, most diseases can be adequately controlled with one application of fungicide per week. In some small plot tests, bacterial spot control was better with two weekly applications rather than one. Faster tractor speeds can lead to poor control and may make more frequent sprayings necessary. Care must be taken to ensure that nozzles work properly, strainers are clear, and nozzle arrangement allows for adequate coverage. Tomato growers should start adding drop nozzles early (certainly by first bloom). The air in the tomato canopy must be completely displaced by a fine mist of fungicide to prevent disease outbreaks that can begin from deep inside.

Fungicides are primarily preventative: they must be applied before the pathogen arrives on the foliage to have effective disease control. Timing of the sprays is very important. If fungicide sprays are started after the disease is discovered, it may be impossible to curb an epidemic. This is particularly true for late blight. Experiments have shown that even when fields are scouted closely on a regular basis, spray programs initiated after the first detection of late blight will not prevent severe economic loss.

Chlorothalonil, mancozeb, or maneb offer the most broad spectrum activity against the common foliar fungal diseases of tomato: late blight, early blight and target spot. The strobilurins are new materials with a broad spectrum of activity.

There are new fungicide choices for control of late blight because several products were recently relabeled. When choosing a fungicide, resistance management guidelines on the label should be followed.

A formulation of mefanoxam can be applied for control of damping-off caused by *Pythium* spp. and under-vine applications can be made 4-12 weeks before harvest to reduce fruit and root rot caused by *Pythium* spp. and *Phytophthora* spp.

Recent tests have supported the traditional extension service recommendation of copper and maneb or mancozeb for bacterial spot control. When the weather conditions favor bacterial spot, growers may have to use this tank mix as their primary "fungicide". Realistically, chemical control cannot be expected to be as effective for bacterial diseases as it is for fungal diseases. In fact, if conditions are particularly favorable, frequent sprayings may not be sufficient to maintain bacterial disease below damaging levels. When used excessively, copper compounds may also retard plant growth and cause copper "stain" on fruit.

While a tank mix of copper and maneb or mancozeb has more bactericidal activity than copper alone, this tank mix is less effective than mancozeb alone against several fungal pathogens. This presents particular problems when late blight or target spot is a threat at the same time as a bacterial disease (as occurs during occasional bacterial speck epidemics). In such cases separate trips over the field with copper/mancozeb or chlorothalonil alone may have to be made. Alternatively, sprays of chlorothalonil and copper may be used, because copper apparently has no effect on the fungicidal efficacy of chlorothalonil. Early blight is one foliar fungal disease that is quite adequately controlled by applications of copper/mancozeb tank mixes.

Management of aphid-transmitted virus diseases (including potato virus Y, tobacco etch virus, and tomato yellows virus) by insecticide alone is generally poor. All these viruses are carried on the stylet (feeding probe) of the aphid and are transmitted to the tomato plants at the same time that a lethal dose of insecticide is being ingested by the aphid.

JMS stylet oil, a high-grade petroleum oil, has shown promise in protection of several vegetables, including tomato, from aphid-transmitted virus diseases. A thin layer of this oil on the plant surface apparently serves to inactivate the virus as the aphid probes through the cuticle.

Whitefly-transmitted viruses

In recent years, devastating outbreaks of a group of viruses--the "gemini" viruses, and begomoviruses--have occurred in most Florida tomato-growing areas. The major virus problems in their group have been identified as tomato yellow leaf curl virus (TYLCV) and tomato mottle virus (TMoV). These viruses are transmitted to healthy plants by the silverleaf whitefly (SLW). Great

progress has been made in the control of these diseases through a sound integrated management program. It is extremely important that the crops be destroyed immediately after harvest, as this reduces areas where whiteflies can build up and move to new crops. Weeds and volunteer tomato plants that can serve as hosts for whiteflies should be eliminated. Symptomatic plants within a field should be rogued immediately. A systemic insecticide, imidacloprid (Admire®), can be applied prior to planting and gives good early-season control of SLW.

Another virus, tomato spotted wilt virus, is transmitted by thrips. This can be a damaging disease and very difficult to manage. Attempts to manage tomato spotted wilt by controlling the thrips vector have met with limited success.

Growers should consult the University of Florida Plant Disease Guide for current, specific fungicide recommendations. Also, see the plant pathology fact sheets listed in Appendix I for information on correct diagnosis of several tomato diseases.

Further Resources

1. Kucharek, T., Rhizoctonia seedling blights of vegetables and field crops. Univ. of Fla. Coop. Ext. Serv. Fact Sheet (Plant Pathology) No. PP http://plantpath.ifas.ufl.edu/takextpub/FactSheets/pp0001.pdf.

2. Kucharek, T., Bacterial spot of tomato and pepper. Univ. of Fla. Coop. Ext. Serv. Fact Sheet (Plant Pathology) No. PP-3 http://plantpath.ifas.ufl.edu/takextpub/FactSheets/pp0003.pdf.

3. Kucharek, T. , Stem rot of agronomic crops and vegetables (southern blight, white mold). Univ. of Fla. Coop. Ext. Serv. Fact Sheet (Plant Pathology) No.PP-4 http://plantpath.ifas.ufl.edu/takextpub/FactSheets/pp0004.pdf.

4. Kucharek, T., Late blight on potatoes and tomatoes. Univ. of Fla. Coop. Ext. Serv. Fact Sheet (Plant Pathology) No. PP-6 http://plantpath.ifas.ufl.edu/takextpub/FactSheets/pp0006.pdf.

5. Kucharek, T., Early blight on tomatoes and potatoes. Univ. of Fla. Coop. Ext. Serv. Fact Sheet (Plant Pathology) No. PP-7 http://plantpath.ifas.ufl.edu/takextpub/FactSheets/pp0007.pdf.

6. Kucharek, T., Brown, L., Johnson, F., and Funderburk, J. Tomato Spotted Wilt Virus of Agronomic, Vegetable and Ornamental Crops. Plant Pathology Fact Sheet Circ-914 http://plantpath.ifas.ufl.edu/takextpub/FactSheets/circ0914.pdf.

7. Pernezny, K., and R. B. Volin. Bacterial speck of tomato. Univ. of Fla. Coop. Ext. Serv. Fact Sheet (Plant Pathology) No. PP-10 http://plantpath.ifas.ufl.edu/takextpub/FactSheets/pp0010.pdf.

8. Kucharek, T., and J. Bartz. Bacterial soft rots of vegetables and agronomic crops. Univ. of Fla. Coop. Ext. Serv. Fact Sheet (Plant Pathology) No. PP-12 http://plantpath.ifas.ufl.edu/takextpub/FactSheets/pp0012.pdf.

9. Pernezny, K., and L. H. Purdy. Sclerotinia diseases of vegetables and field crops in Florida. Univ. of Fla. Coop. Ext. Serv. Fact Sheet (Plant Pathology) No. PP-22 http://plantpath.ifas.ufl.edu/takextpub/FactSheets/pp0022.pdf.

10. Pernezny, K. and G. W. Simone. Target spot of several vegetable crops. Univ. of Fla. Coop. Ext. Serv. Fact Sheet (Plant Pathology) No. PP-39 http://plantpath.ifas.ufl.edu/takextpub/FactSheets/pp0039.pdf.

Table 1. Some characteristics of principal tomato diseases in Florida[1]

Diseases	Pathogen	Organism	Seed Trans-mission	Soil Survival	Insect Trans-mission	Available Resistance	Favorable Conditions[2]	Areas Most Likely To Occur
Bacterial Speck	*Pseudomonas syringae* pv. *tomato*	Bacterium	++	+	-	-	C,R	ALL
Bacterial Spot	*Xanthomonas vesicatoria* and *X. perforans*	Bacterium	+	+	-	-	H,R	ALL
Botrytis gray mold	*Botrytis cinerea*	Fungus	-	+	+	-	C,R	Sandlands
Buckeye rot	*Phytophthora nicotiane* and *P. capsici*	Fungal-like	-	++	-	-	H,R	ALL
Damping-off	*Pythium* spp., *Rhizoctonia* spp., *Phytophthora* spp.	Fungal-like	-	++	-	-	H,R	ALL
Early blight	*Alternaria solani*	Fungus	-	-	-	+	H,R	ALL
Fusarium wilt	*Fusarium oxysporum* f. sp. *lycopersici*	Fungus	-	++	-	++	H	Sandlands
Fusarium crown rot	*Fusarium oxysporum* f. sp. *radicis-lycopersici*	Fungus	-	+	-	+	C	Sandlands
Gray leaf spot	*Stemphyllium solani*	Fungus	-	+	-	++	R	ALL
Sclerotinia stem rot (white mold)	*Sclerotinia sclerotiorum*	Fungus	-	++	-	-	C,R	Miami-Dade
Soil rot	*Rhizoctonia solani*	Fungus	-	++	-	-	H,R	ALL
Southern bacterial wilt	*Ralstonia solanacearum*	Bacterium	-	++	-	-	H	Sandlands
Southern blight	*Sclerotium rolfsii*	Fungus	-	++	-	-	H	Sandlands
Target spot	*Corynespora cassiicola*	Fungus	-	-	-	-	R	Sandlands
Tomato pith necrosis	*Pseudomonas corrugata*	Bacterium	-	+	-	-	C	ALL-Heavy N rates contribute to disease
Verticillium wilt	*Verticillium albo-atrum* and *V. dahliae*	Fungus	-	++	-	++	C	Miami-Dade
Double virus streak	*Potato virus X* plus *tobacco mosaic virus*	Viruses	+	+	-	+	C	ALL

Table 1. Some characteristics of principal tomato diseases in Florida[1]

Pseudocurly top	*Pseudocurly top virus*	Virus	-	-	++	-	H	ALL
Tomato mosaic	*Tobacco mosaic virus*	Virus	+	+	+*	+	-	ALL
Potato virus Y (vein-banding virus)	*Potato virus Y*	Virus	-	-	++	-	C	East Coast
Tobacco etch	*Tobacco etch virus*	Virus	-	-	++	-	C	East Coast
Tomato spotted wilt	*TSWV*	Virus	-	-	++	-	H	North Florida

[1]+ = may occur occasionally, of some importance.
++= occurs often, important to know for proper control.
- = not known to occur or relatively unimportant.
[2]H = warm weather; C = cool weather; R = favored by extended rainfall.
*Possibly transmitted by insects with chewing mouthparts.