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2006 Florida Plant Disease Management Guide: Tomato [1]

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Specific Common Diseases

Anthracnose (*Colletotrichum coccodes*, *C. gloeosporoides*, *C. dematium*)

Symptoms: This is primarily a disease of ripe to overripe fruit that can cause serious losses in home gardening but seldom in commercial fields due to the mature green harvest nature of Florida's industry.

Fruit infection may occur during green stages but disease development is linked to ripening. Small lesions are circular and depressed, but can enlarge to greater than 12 mm in diameter with zonate markings. The lesion surface may appear salmon-colored due to spore production and be dotted with black specks (microsclerotia). Infected fruit have a short shelf life.

Cultural Controls: Home growers should rotate the location of tomatoes in the garden whenever possible to avoid soil survival of the causal fungi. Avoid stress on tomatoes from nematodes, insects, and other diseases that will predispose plants to fruit rot. Collect and destroy infected fruit as they appear. Avoid overhead irrigation where possible. Staking plants and mulching helps to reduce losses to anthracnose.

Chemical Controls: Use of a fungicide to control other diseases will reduce incidence of anthracnose. Specific fungicides for anthracnose must be used **before** fruit ripen. See PPP-6.

Bacterial Soft Rot and Hollow Stem (*Erwinia carotovora* pv. *carotovora*)

Symptoms: The most important aspect of this disease is post-harvest infection of the fruit. Symptoms are soft watery decay of fruit, starting at one or more points, as very small spots. These spots enlarge, often very rapidly until the entire fruit may become a soft watery mass. Usually leakage occurs as the decay develops.

The causal bacterium may infect stems, petioles and pedicels producing a dark green-to-black, water-soaked canker. Affected stem areas become soft and hollow.

Cultural Controls: Tomato varieties differ in their resistance to bacterial soft rot disease of fruit.

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To reduce disease incidence and severity, avoid harvesting plants while they are wet. Avoid wounding fruit and avoid exposing harvested fruit to the sun. Use chlorine in the first water immersion in the packinghouse. Avoid deep or prolonged immersion of tomato fruit in water. Fruit should not be packed with wet stem ends nor should green fruit be chilled below 55° F. See Plant Pathology Fact Sheet PP-12.

Chemical Controls: See PPP-6.

Bacterial Speck (*Pseudomonas syringae* pv. *tomato*)

Symptoms: Foliar infection due to this disease is difficult to distinguish from leaf spots caused by bacterial spot. Fruit infection caused by bacterial speck appears as numerous, tiny, dark brown lesions less than one-sixteenth of an inch in diameter, and sunken. Speck lesions do not usually extend deeper than the epidermis of the fruit.

Large speck lesions may be mistaken for those of bacterial spot since both diseases can occur on the same fruit. Speck lesions are more restricted in size on the fruit and do not exhibit the raised, scab-like appearance or cause the epidermis to rupture as with bacterial spot-infected fruit. This bacterial pathogen is seedborne and is apt to be more severe during particularly cool, wet growing seasons that favor plant-to-plant spread. See Plant Pathology Fact Sheet PP-10.

Cultural Controls: Start with clean, disease-free seed or transplants. This disease, like bacterial spot, is very difficult to control once it is established in a field situation.

Chemical Controls: See PPP-6.

Bacterial Spot (*Xanthomonas axonopodis* pv. *vesicatoria*)

Symptoms: Spots on the leaves and fruit spurs are brown, water-soaked circular and rarely more than 1/8 inch in diameter. They can be confused with young early blight, gray leaf spot and target spot lesions on the leaves. Later, spots may coalesce and large blighted areas appear. Lesions caused by the race T3 of the pathogen often tear out leaving a "shot hole" appearance. However, the bacterial spot lesions usually lack the concentric zones of early blight and usually they are darker and less uniformly distributed on a leaflet than gray leaf spot lesions. Often the lesions tend to be elongated on the leaf margins; occasionally, after a heavy rain during which the leaves have become saturated with water, entire interveinal areas will become infected.

On the fruit, the early symptom is a very minute black speck surrounded by a slightly lighter area. As the spot enlarges it becomes brownish in color, scab-like, slightly raised on the edges, and sunken in the center. The epidermis of the fruit finally ruptures and curls back from the center of the spot. This is the most characteristic symptom of the disease on the fruit. The bacterial spots are very seldom deeper than half way through the outer fleshy layer of the tomato.

Cultural Controls: Do not place seedbeds in the area of an abandoned field where bacterial spot was present the previous season. Set only disease-free transplants. This disease is difficult to control once it is established. Protect against mechanical transmission by frequent hand washing with a bactericidal soap.

Biological Controls: Bacteriophages (phages) have been found as an effective biocontrol agent for the management of bacterial spot on tomato. Phages are viruses that infect bacteria. Recently, protective formulations were developed to increase longevity of phages on plant surfaces in the field conditions. A Powdered Skim milk formulation may be recommended for field application because it is easy to prepare and apply. Evening (before sunset) application of phages resulted in better bacterial spot control compared to morning application. Formulated phages could be applied twice a week at sunset for the management of bacterial spot. As for any new product, first test on a limited acreage.

Chemical Controls: See PPP-6. Recently, alternative chemical control approaches have been investigated in which chemicals are applied that activate plant defense responses. Plants can activate protective mechanisms upon detection of invading pathogens. It is a similar concept to immunity in animals. If this protection is expressed locally at the site of primary inoculation and also systemically in

tissues remote from the initial treatment, it is called systemic acquired resistance (SAR). Chemical SAR inducers are active against a broad range of pathogens, including fungi, bacteria, and viruses. Acibenzolar-S-methyl (Actigard 50WG, Syngenta), an SAR inducer, has now been registered for commercial use in Florida against bacterial spot of tomato.

Bacterial Wilt (*Ralstonia solanacearum*)

Symptoms: A diseased plant is characterized by rapid wilting with the foliage remaining green. Affected plants rapidly wilt and die without appreciable yellowing of the lower leaves. Plants that are attacked by this pathogen frequently appear stunted before wilting occurs. The pith near ground level is dark colored and has a water-soaked appearance. If the stem is cut near the base, a slimy, gray material may exude from the cut.

In later stages, the pith decays and the stem becomes hollow. The vascular tissue becomes brown, and adventitious root formation may be enhanced. The rapidity of wilting and death, the lack of foliage yellowing, and the pith decay and hollowness distinguish this wilt disease from the Fusarium and Verticillium wilts. This is a hot-weather and wet-soil disease.

Rapid diagnosis can be made in the field. Cut the lower three-inch stem section from soil line upwards. Suspend this section in water for 15-30 seconds. Observe immersed stem end for streams of bacteria that will be extruded into the water. Visibility of bacteria is enhanced when viewed in front of a strong source of light.

Cultural Controls: Bacterial wilt is a very difficult disease to control. The only way to totally control bacterial wilt is to not plant in fields infested with the pathogen. Do not plant seedbeds on land where this disease has been a problem. Infested fields should be rotated to non-susceptible crops (long term rotation might reduce pathogen populations). Avoid movement of water, equipment, or soil from infested fields to non-infested ones. In south Florida, late fall planting (October in the Ft. Pierce area) reduces the incidence of this disease. Fields should not be over-irrigated, because excess soil moisture favors disease build-up. Increase of soil pH and available calcium might reduce the disease incidence.

Chemical Controls: See PPP-6. Please note that these broad spectrum soil fumigants (chloropicrin) will contribute to the management of this disease either through reduced disease incidence or the delay of the initial disease onset.

Black Shoulder (Undetermined)

Symptoms: Fruit approaching maturity appear most susceptible. Dark gray to blue-black areas develop on the shoulders of fruit. Those areas are irregular in size and shape. The discolored areas may undergo tissue collapse with the subsequent production of sunken lesions. The affected tissue in these lesions will harden and shrivel but further lesion enlargement normally does not occur.

Cool, rainy weather that occurs, especially when fruit are mature, has been associated with the incidence of this problem.

Cultural Controls: Choose varieties that are more tolerant of this disorder.

Blossom-end Rot (Calcium deficiency)

Symptoms: The blossom ends of fruit turn pale green to brown. These affected areas enlarge into sunken spots. The discolored fruit portion will shrivel into a dry rot unless the tissue is invaded by secondary organisms that often extend the area of rot throughout the fruit.

This condition can result from a number of situations that limit available calcium to the plant. Poorly limed, sandy soils may suffer from a deficiency of calcium in the soil. Calcareous soils seldom have this problem. Extremes in soil moisture can limit calcium availability to roots regardless of the amount present in the soil. Since calcium is not freely mobile in the plant, short periods of calcium deficit will affect rapidly growing fruit tissues. Competition from other cations (e.g. Mg) can lead to and exacerbate blossom-end rot.

Cultural Controls: Follow a program of soil testing and liming according to soil test results. Soil should contain adequate calcium (=> 300 ppm).

Supplement erratic rainfall with irrigation during fruit development to avoid blossom-end rot problems.

Buckeye Rot (*Phytophthora nicotianae* var. *parasitica*)

Symptoms: On fruit that are touching soil, the fungus enters at the point of contact, causing a slight brownish spot. As the fungus develops and the spot enlarges, a series of irregular, brown-to-light-colored concentric bands are produced, forming a typical buckeye effect. Fruits decay very rapidly and break down in a soft-rot.

All stages in the growth of the tomato fruit can be infected by the fungus. In some instances when the fruit remain damp and moist for a day or two, the concentric zoning effect may be indistinct and invasion of the fruit by the fungus exceedingly rapid. Under these conditions the invaded areas become dull brown, and the fruit collapse without the production of the marked concentric zones. In some cases where the epidermis is ruptured the mycelium of the fungus can be distinguished.

Cultural Controls: Drain fields well. Stake plants. Use of full-bed plastic mulch will limit fruit contact with the ground and therefore limit disease incidence.

Chemical Controls: See PPP-6.

Cucumber Mosaic (*Cucumber Mosaic Virus*)

Symptoms: This aphid-vectored virus has a wide host range within Florida that includes many plant species among agronomic, vegetable, ornamental crops as well as weeds. Plants in the Solanaceae and Cucurbitaceae are particularly susceptible. The virus is not seed-transmitted. Infection results in a 'shoestring' like symptom on leaves as the interveinal tissue is reduced. Infected plant appears stunted and bushy while fruits may exhibit ring or line patterns during ripening.

Cultural Controls: Sanitize surrounding crop fields to prevent over-seasoning of the virus and/or the aphid vector. Eliminate stands of dayflower in and around the tomato field.

Chemical Controls: Manage aphid populations according to the latest recommendations in the Insect Management Guide.

Damping-off (Various fungi, species of *Pythium and Rhizoctonia* often implicated)

Symptoms: Dying or poor growth of seedlings in seedbed. Seedling death may also occur after plants are set in the field.

Chemical Controls: Plant only fungicide-treated seed.

Employ an appropriate soil fumigant for seedbed treatment as well as in-row treatment in the field depending on previous disease history and other production practices. See PPP-6.

Early Blight (*Alternaria solani*)

Symptoms: Early blight is first observed in the field as small brownish-black lesions on the older foliage. The spots enlarge rapidly, and by the time they are 1/4 inch in diameter or larger, concentric rings may be distinguished on the dark brownish portion of the spots. The tissue surrounding the spots may become yellow in color, and when spotting is abundant the entire leaf may yellow.

Stem lesions on seedlings are small, dark, and slightly sunken. These lesions enlarge, forming circular or elongated lesions with concentric rings and light centers. If stem-infected seedlings are set in the field, the lesions continue to enlarge at the ground line and partially girdle the plants. These plants often die, but if they do survive, their growth and yields are reduced.

The fruit become infected, generally through the calyx or stem attachment, either in the green or ripe stage. The fruit lesions attain considerable size, often involving nearly the entire fruit, and usually show concentric ringing. The diseased areas appear leathery and may be covered by a velvety mass of black spores. Infected fruit frequently drop, and losses of 50% of the immature fruit may occur.

Chemical Controls: Pursue fungicide applications as needed in the transplant production system as well as in the field. See PPP-6.

Fusarium Crown Rot (*Fusarium oxysporum* f.sp. *radicis-lycopersici*)

Symptoms: Disease first appears during cool seasonal periods when fruit are setting or sizing. Symptoms indicate lower leaf marginal yellowing and a slow-to-rapid wilt syndrome that kills the plant. The lower stem at soil line exhibits vascular discoloration and pith necrosis for a variable distance upward in the stem.

Cultural Controls: As the pathogen is soilborne, incidence tends to increase with the direction of movement of infested soil. Several cultivars with resistance are now available.

Chemical Controls: Use of soil fumigation will aid in pathogen suppression.

Fusarium Wilt (*Fusarium oxysporum* f. sp. *lycopersici* races 1-3)

Symptoms: Infected seedling plants are stunted, the older leaves droop and curve downward, and the plants frequently wilt and die. Symptoms on older plants generally become apparent during the interval from blossoming to fruit maturation. The earliest symptom is the yellowing of the older, lower leaves. These yellow leaves often develop on only one side of the plant, and the leaflets on one side of the petiole frequently turn yellow before those on the other side. The yellowing process gradually includes more and more of the foliage and is accompanied by wilting of the plant during the hottest part of the day.

The wilting becomes more extensive from day to day until the plant collapses and dries up. The vascular tissue of a diseased plant is dark brown in color. This browning often extends far up the stem and is especially noticeable in a petiole scar. This browning of the vascular system is characteristic of the disease and generally can be used for its identification. Fruit infection occasionally occurs and can be detected by the vascular tissue discoloration within the fruit.

Cultural Controls: Use resistant varieties where available for Race 1 or 2. A 5-7 year crop rotation will greatly reduce losses on infested land.

Prevent the movement of infected plants and/or infested soil clinging to machinery, hand tools, vehicles, trellising and staking implements, and field crates into areas free of this pathogen.

Do not flood land, since this will spread fungus. Do not overhead irrigate with ditch water that may be contaminated with the fungus. Do not use infested land for seedbeds.

Chemical Controls: Use pre-plant soil fumigants.

Gray Leaf Spot (*Stemphylium solani*)

Symptoms: Gray leaf spot first appears as minute, brownish-black specks on the lower leaves. The spots are circular to oblong. Occasionally the spots are marginal and in such cases are somewhat elongated or irregular in outline. The spots enlarge to about 1/12 inch in diameter, turn in color from a brownish-black to a grayish-brown, and become somewhat shiny and glazed. By this time, a definite yellow area may be apparent around the spots.

Lesions rarely exceed 1/12 inch in diameter, although on the very oldest leaves near the base of the plant individual spots may obtain a diameter of 1/6 inch or more. On the older leaves the spots may coalesce, killing large areas of the leaf blade. As the centers of the spots dry out, they often crack with a yellowing of the entire leaf. The leaves then die rapidly, become brown, and drop. Serious infections in the seedbeds result in marked defoliation without conspicuous yellowing. Most globe tomatoes developed for Florida are resistant to this disease. Commercially, most gray leaf spot outbreaks have been noted in cherry tomatoes. Homeowners may experience problems if older, “up-north” cultivars or heirlooms are planted.

Cultural Controls: Plant resistant varieties.

Chemical Controls: See PPP-6.

Gray Mold (*Botrytis cinerea*)

Symptoms: On the stems, gray mold is characterized by large, elliptically shaped, water-soaked lesions that during cool, wet weather

soon become covered with the grayish-brown mycelium and spores of the fungus.

The lesion produced on the fruit is a watery area with a light brown or tan-colored central region. The decay develops rapidly, and the fruit is converted into a soft, watery mass within a few days. If the skin is broken, the grayish mycelium and spore clusters develop within a few hours.

Occasionally, following abortive infections, small whitish rings approximately 1/6 inch in diameter develop on young green fruit. These "ghost spots" are usually single rings but may be solid white spots; the center of which contain dark-brown specks. The spots are superficial on the pericarp of the fruit, do not increase in size, and do not affect fruit eating quality. Infected leaves, which develop gray lesions that are often wedge-shaped, soon wither and die. During cool, wet weather the diseased leaves become covered with the gray mycelium and spores of the fungus.

Cultural Controls: To avoid gray mold, crop tomatoes on soil limed to pH = 6.5 or higher.

Chemical Controls: See PPP-6.

Gray Wall (undetermined)

Symptoms: Dark-brown tissue develops around the vascular bundles of the outer fruit wall. Sometimes this browning also occurs in the middle column and septa of the fruit. Outward appearance of the fruit shows blotchy gray (sometimes yellow) areas with indistinct margins. Occasionally the tissue of the gray areas shrinks and sunken spots develop. On green immature fruit, symptoms are more difficult to see, but by careful examination the dark areas and streaks can be seen through the translucent skin. Plants infected with *Tobacco Mosaic Virus* (TMV) have higher incidence of gray wall. However, plants free of TMV and those resistant to the virus can also develop gray wall.

Cultural Controls: Use resistant varieties.

Late Blight (*Phytophthora infestans*)

Symptoms: The lesions produced on the leaves are rather large, irregular, greenish, water-soaked areas. These areas enlarge rapidly and become brown and paper-like. During moist weather or periods of heavy dew, a fine, white mold may develop near the margin of the diseased tissue on the lower surface of the leaf.

Stem lesions may occur anywhere on the stem, and appear as water-soaked brown to gray areas that may girdle and kill the plant. Severely diseased plants often appear to have been frozen.

Fruit lesions appear as large, green to mahogany colored, irregular water-soaked blotches. These lesions most commonly appear on the upper half of the fruit, are firm in texture, and may occasionally become zonate. Often soft rot organisms invade blighted fruit and cause rapid deterioration of the fruit.

Chemical Controls: Apply fungicides preventively. See PPP-6. See Plant Pathology Fact Sheet PPP-6.

Leaf Mold (*Fulvia fulvum*)

Symptoms: Leaf mold is usually first observed on the oldest leaves closest to the ground where ventilation is poorest and the period of excessive moisture is most uniform. It is detected on a leaf by the appearance of small, light-colored spots which turn to a distinct light yellow color followed by the browning, drying, and death of the cells in the area. Often when the infection is severe these spots coalesce, and the foliage is rapidly killed.

The causal fungus sporulates on the lower surface of the leaf but very rarely is found producing spores on the upper surface. Careful examination of a yellow-spotted leaf will reveal an olive-green mold on the lower surface almost exactly coinciding with the yellow area. Traditionally, this disease has been more of a problem on greenhouse crops.

Cultural Controls: Choose resistant varieties where possible. The practice of staking and pruning plants, along with proper plant spacing, will ensure

adequate ventilation and discourage disease development.

Chemical Controls: Apply fungicides when needed. See PPP-6.

Phoma Rot (*Phoma destructiva*)

Symptoms: On the foliage, small black spots first appear on either surface of the leaf. These spots are round or irregular in shape, slightly sunken, and as they rapidly enlarge, become typically zonate as in early blight. They enlarge and often coalesce, causing the leaves to become yellow and curl upward. The pycnidia, or fruiting bodies, which are produced in these spots on the foliage, are imbedded or sunken in the leaf tissue with only a small opening to the outside. Thus, they are very difficult to observe, and without a hand lens it is almost impossible to make a definite diagnosis.

On the stems the lesions are black, elongate, and zonate. The damage to young seedlings may be extremely severe, since they are often completely girdled by the stem lesions. Plants are attacked from the seedling stage to maturity.

On the fruit, the spotting takes place only where the fruit have been injured, and in most cases the fungus enters through growth cracks, the stem scar, and other mechanical injuries around the stem end, although in some cases it enters through punctures made by insects. When it enters any skin rupture it produces a distinctly sunken spot almost black in color which enlarges rapidly and involves large portions of the fruit.

The disease is readily distinguished from other rots by the black color of this spot which is speckled with small, black, pimple-like eruptions. These specks are the pycnidia or fruiting bodies of the fungus.

Chemical Controls: Use only fungicide-treated seed. Apply fungicides in the seedbed or field as needed. Use of chlorothalonil to control other diseases will aid in control of Phoma rot. See PPP-6.

Potato Y Disease (*Potato virus Y*)

Symptoms: The young leaflets cup inward slightly and curl downward. The petioles also curl downward and give the plant a drooping appearance. The vein areas of the leaflets are banded with yellow. Dark-brown necrotic areas develop on the young leaves, especially on the terminal leaflets. The stem tips and petioles are usually streaked with purple. Entire shoots may be killed. Infected plants are stunted, unthrifty, and yield poorly, but the fruit do not show symptoms. Laboratory assays are required to accurately diagnose this disease.

This virus is transmitted to tomato plants by aphids during feeding. A number of weed hosts of this virus occur in Florida and include the ground cherries and nightshades.

Cultural Controls: Eradicate wild host plants and volunteer tomato plants **before** the crop is planted. Avoid planting subsequent crops next to diseased early plantings until after the early plantings have been destroyed. Avoid tomatoes in close proximity to potatoes. Applications of JMS Stylet Oil, exactly as the label directs, will reduce virus spread by aphids in the field.

Chemical Controls: See PPP-6.

Pseudo-curly Top (*Pseudo-curly top virus*)

Symptoms: Primarily a disease of young plants, but fruiting-sized plants can become infected. The first symptom is severe upward rolling and curling of leaflets. Later the plant turns rather yellow and becomes brittle and often the veins of the leaflets turn purple. Branches and stems are stiff and erect and the entire plant stunted. After infection, little or no fruit is set.

Cultural Controls: Destroy nightshade and ragweed growing in and around the field before planting the crop. If the disease appears in the field, spray the margin of the field with an approved insecticide to kill the treehoppers that transmit the virus. Consult the Insect Control Guide for recommendations.

Sclerotinia Stem Rot (*Sclerotinia sclerotiorum*) (White mold)

Symptoms: The seedling disease occasionally caused by this fungus is a typical damping-off, resulting in a quick, wilting death of the seedlings. The fungus usually attacks older plants at or slightly above the soil line.

The grayish-white mycelium covers the surface of infected tissues and the plant shows a marked wilted condition and eventually withers and dies. An examination at this time will show a large canker at the base of the plant, which girdles the stem and causes the softer tissue to disintegrate. Stems are generally quite soft, later turning to a white "dried bone" appearance. This disease is most prevalent in Miami-Dade County.

Splitting of the stem will reveal cavities filled with the black, large, hard sclerotia and the grayish-white fungal growth characteristic of this fungus. Infected fruit may develop a watery soft rot. Occasionally the leaves are affected; however, if petioles become infected the fungus generally grows into the stem. See Plant Pathology Fact Sheet PP-22.

Cultural Controls: Flooding fields for five to six weeks during summer months will reduce the number of sclerotia in the soil. However, flooding may spread other soilborne pathogens such as those causing Fusarium wilt and bacterial wilt. Adequate drainage, sanitation and crop rotation are important in the control of this disease. Plant tomatoes in well-drained fields. Do not plant tomatoes immediately following Sclerotinia-diseased crops of beans, cabbage, celery, lettuce, potato, or any other susceptible crop.

Chemical Controls: Apply fungicides to the transplant production system or field as needed when disease occurs. See PPP-6.

Soil Rot (*Rhizoctonia solani*)

Symptoms: This fungus causes the fruit to decay in all stages of development. It penetrates the fruit through wounds or the unbroken epidermis and invades the tissue, causing numerous small, brown, sunken spots on the side of the fruit that is in contact with the soil.

Usually there is a single point of invasion by the fungus, and as this spot enlarges it becomes zonate with concentric brown rings, somewhat typical of buckeye rot. This marking may be distinguished from buckeye rot in most instances by the narrowness of the concentric zones. With this disease, the zoning is extremely definite and more pronounced than in buckeye rot. In most cases, the epidermis is ruptured at the center of the spot in soil rot, whereas in buckeye rot the epidermis is very seldom broken. See Plant Pathology Fact Sheet PP-41.

Cultural Controls: This disease is seldom of importance in fields where the plants are staked, pruned and/or grown on plastic mulch. Fruit losses in transit can be controlled by careful grading.

Chemical Controls: See PPP-6.

Southern Blight (*Sclerotium rolfsii*)

Symptoms: Mature plants are attacked just below the soil surface and are completely girdled. The tops wilt and die rapidly. The mycelium often grows over the diseased tissue and surrounding soil forming a white mat of mycelial threads with the typical tan-to-brown, mustard-seed-sized sclerotia. Often the entire root system is destroyed. This is a hot weather disease.

The fungus is exceedingly destructive on ground crops and attacks the fruit where they contact the soil. Slightly sunken, yellow spots develop on invaded fruit, which rapidly decay, collapse, and become covered by a white fungal mass with numerous sclerotia.

Seedling invasion occurs rapidly, and the seedlings die quickly. As the plants grow older they become more woody and more resistant to attack.

Cultural Controls: Sanitation will provide good protection against southern blight. Whenever diseased fruit or plants are found in a field they should be collected and disposed of, preferably by burying 2 or 3 feet deep or by burning. In this way, the distribution of the sclerotia throughout the field will be prevented, and to a large extent the disease will be controlled.

Since these sclerotia are so large that they are not carried by the wind and since their numbers are comparatively small, sanitation is an effective control measure.

The careful regulation of water by means of a well-designed irrigation-drainage system to prevent excessive soil moisture will help prevent the occurrence of the disease.

Plants in a field where the disease has been prevalent should be staked. This will keep the fruit from touching the ground and thus prevent infection of the fruit. Also, turn soil at least 6 inches deep when plowing.

Chemical Controls: Use of preplant soil fumigation will aid in the control of this disease.

Target Spot (*Corynespora cassiicola*)

Symptoms: Leaf spots start as small brown spots and as each increases in size, a sunken area, dull green in color, surrounds the spot. In older leaves the center of the spot is white.

Fruit rot is most often on the shoulder or sides and starts as small white, circular spots with a definite border. Later the spots enlarge or coalesce up to 1/2 inch, become noticeably sunken, and are brown to black.

Chemical Controls: See PPP-6.

Tobacco Etch Disease (*Tobacco etch virus*)

Symptoms: Effects of this virus on tomatoes is somewhat like those of *potato virus Y,* except plants are more stunted by *tobacco etch virus*. Leaves of the terminal shoots are cupped and petioles are bent downward. Fruits are not mottled or deformed. Spread of this virus is somewhat slower than *potato virus Y*. Laboratory assays are required to accurately diagnose this disease.

This virus is transmitted by aphids during feeding. A number of weed hosts (ground cherry, nightshade) serve to overseason the virus in Florida.

Cultural Controls: Eradicate wild host plants and volunteer tomatoes **before** the crop is planted. Avoid planting subsequent crops next to diseased early plantings until after the early plantings have been destroyed. Control aphids as needed. Applications of JMS Stylet Oil will reduce virus spread by aphids in the field.

Chemical Controls: See PPP-6.

Tomato Chlorosis Disease (*Tomato Chlorosis Closterovirus*)

Symptoms: This virus has been fairly restricted to the acreage of greenhouse tomato production. The virus is vectored by four whiteflies: the sweet potato, silverleaf, cotton and greenhouse species. Host range information is being researched along with important weed hosts in Florida. Onset of disease appears to occur during the short day-length period of late December-February. Lower leaves develop a progressive, interveinal chlorosis, often with necrotic flecking. Symptoms resemble these caused by magnesium deficiency in tomato but are less uniform within a leaflet or among leaflets on a leaf. No fruit abnormalities have been observed. Fruit size and number appear reduced by virus infection.

Cultural Controls: Raise clean transplants in a whitefly-free production site. Tighten greenhouse facilities to prevent ingress of whiteflies from the field. Use of insect screening can dramatically reduce virus incidence but will seriously limit cooling capabilities, unless houses are structurally redesigned.

Chemical Controls: Judicious vector control with legally available insecticides will slow disease onset and reduce severity. See the latest recommendation in the Insect Management Guide.

Tomato Little Leaf Syndrome (physiological disorder)

Symptoms: Interveinal chlorosis in the young leaves could be the first sign of this disorder. Subsequent top growth could become severely distorted with leaflets along the midrib failing to expand properly, resulting in a “little-leaf” appearance. In addition, these symptoms may include cessation of terminal growth, leaflets with twisted and brittle midribs and auxillary buds with distorted growth. Fruits that set in mildly affected plants are

distorted with radial cracks extending from the calyx to the blossom scar. In more severely affected plants, blossoms are distorted and fail to set fruit. Affected plants can resume normal growth and set marketable fruit, if conditions no longer support the development of this syndrome.

Cultural Controls: Avoid waterlogged situations

Tomato Mottle (*Tomato mottle virus*)

Symptoms: *Tomato mottle virus* was the first begomovirus known to infect tomato in Florida. It was first found in 1989 and is widespread throughout the state. The virus is transmitted by the silverleaf whitefly, *Bemesia argentifolii*. Once the whitefly acquires the virus, it is retained for the remainder of its life. These viruses are not seedborne and are not mechanically transmitted in the field.

Virus symptoms on tomato have been variable but all varieties observed have been susceptible. One symptom type (least common) is a bright golden mosaic accompanied by leaf curling and plant stunting. The more widespread appearance is an interveinal chlorosis and mottle that is accompanied by a downward arching of leaves, leaflet curl, and plant stunting. Damage to yield appears to be a reduction in fruit numbers and size.

Cultural Controls: See *Tomato Yellow Leaf Curl Virus*.

Chemical Controls: See *Tomato Yellow Leaf Curl Virus.*

Tomato Mosaic (*Tomato mosaic virus*)

Symptoms: The ordinary green strains of *tomato mosaic virus* cause mottled areas of light and dark green on the leaves. The dark green areas are usually raised and crinkled.

Plants may be somewhat stunted and yields reduced if infected while small, but little harm is incurred if the plants are not infected until after one or two clusters of fruit have set.

There may be no fruit symptoms, or fruit may be deformed or marked with spots or streaks. Certain strains of *tomato mosaic virus* cause a yellow mottling of the leaves and occasionally a mottling of the stems and fruit.

The yellow mosaic is more severe than the green and may cause pronounced stunting of the plants and large yield reductions.

Cultural Controls: Before handling plants and during staking, pruning, or tying operations, wash hands thoroughly in soap and running water or in 70% alcohol. This will wash off or inactivate the virus. Do not use tobacco when working with tomato plants. If seedbeds are used, periodically remove diseased plants. Do not carry diseased plants to the field. Eliminate all volunteer tomato plants. Sterilize equipment before each growing season.

Tomato Pith Necrosis (*Pseudomonas corrugata*)

Symptoms: This is a sporadic bacterial disease that was first reported in greenhouses in Europe, but has now been found in greenhouses in North America and in several field situations in Florida.

Initial symptoms include chlorosis of young leaves, followed by wilting of plants. A brown discoloration of the surface of the lower stem may be evident. The most diagnostic characteristic is the appearance of a hollow or chambered ("laddered") pith in the lower stem evident when lower stems are cut open longitudinally. The intact pith tissue is often a dark-brown color. Proliferation of adventitious roots is common.

Cultural Controls: Little can be done for this disease once it appears in fields. It appears to be worse when nighttime temperatures are low, nitrogen fertilization is excessive, and humidity and rainfall are high.

Tomato Spotted Wilt (*Tomato Spotted Wilt Virus*)

Symptoms: *Tomato spotted wilt virus* (TSWV) (genus Tospovirus), has a large host range and is vectored by thrips. The western flower thrips (*Frankliniella occidentalis*) is the main vector although the tobacco thrips (*F. fusca*), and other thrips can also vector this virus. The immature insect stages acquire the virus, the virus multiplies in its

vector, and the insect remains infective throughout its life cycle. TSWV can infect some 35-plant families including the Solanaceae, Asteraceae, Leguminaceae, Brassicaceae, and Bromiliaceae. This virus is not easily mechanically transmitted in the field.

Symptoms on tomato include chlorotic and necrotic ringspots, leaf bronzing, stem necrosis, stunting, meristem necrosis, and fruit spotting. Distinctive circular patterns often appear on the fruit and leaves. These symptoms vary with the strain of virus involved, time of year, and whether other viruses exist in a plant.

Cultural Controls: Use virus-free transplants. Weed control in and around production field is encouraged. Use of UV-reflective plastic mulch (metalized mulch) will reduce TSW incidence. In north Florida, UV-reflective mulch could be used in spring and fall seasons, except early plantings in the spring. Cut infected plants as they appear in the field before secondary spread. Avoid overlapping crop (peanut, pepper, tobacco) acreage nearby that can act as both a virus and vector reservoir. Monitor for thrips and manage populations with recommended insecticides. In north Florida, integration of metalized mulch with Actigard and insecticides reduced TSW incidence up to 75 % compared to black plastic mulch untreated plots.

Tomato Yellows (*Tomato yellows virus*)

Symptoms: Infected plants develop a stunted appearance with a general foliar chlorosis. There have been no typical viral symptoms of mosaic associated with this disease. Fruit do not express symptoms. It traditionally has been more of a problem in Southwest Florida.

The virus is transmitted by aphids to the tomato crop. Aphids pick up the virus from such wild hosts as nightshade, ground cherry, and *Datura* spp.

Cultural Controls: Maintain weed control as well as control of volunteer tomatoes prior to setting the next crop. Avoid planting subsequent crops next to diseased earlier plantings until these earlier plantings have been destroyed. Control aphids as needed.

Tomato Yellow Leaf Curl (*Tomato yellow leaf curl virus*)

Symptoms: *Tomato yellow leaf curl virus* (TYLCV-Is) is a whitefly-transmitted begomovirus virus that is native to the eastern Mediterranean. It was discovered in the eastern Caribbean in the early 1990s and was identified in Florida in July 1997. TYLCV-Is has been found throughout Florida. The disease is difficult to control, and management of whitefly populations at both the beginning and end of seasons is critical.

Two or three weeks after infection, mottling and distortion can be seen on the newest leaves. At this stage TYLCV symptoms are difficult to distinguish from TMoV. However, subsequently emerging leaves will be markedly reduced in size, upwardly cupped, mottled and have yellow margins. Infected plants are severely stunted. Flowers drop prematurely, leading to poor fruit set. Fruit production after infection may be reduced 90%.

Cultural Controls: Promptly remove sources of TYLCV and whiteflies. Do not locate new fields near infested crops. Promptly destroy fields. Keep fields clean of volunteers and resprouts during off-seasons. Create as long a crop-free period as economically practical. Use virus-free transplants. Reflective mulches will disorient whitefly adults, reducing numbers of infected plants. Rogue infected plants at first sign of disease. Scout fields for whiteflies and apply insecticides accordingly.

Chemical Controls: Chemical controls are centered on management of the whitefly vector. Use imidacloprid (Admire®) in the transplant water. Rates recommended are Admire®, 16 oz/A. See the insect control guide for suggestions for spray treatment of whiteflies if population becomes high later in the season. Do NOT use Pravado® if plants were treated with imidacloprid or similar insecticide at transplanting. Insect growth regulator insecticides can be applied when scouts find nymphal densities to exceed 5 to 10 per leaflet by standard sampling procedures. Repellants (e.g. crop oil, UV-reflective mulch) can be used to interfere with secondary virus spread.

Verticillium Wilt (*Verticillium albo-atrum*)

Symptoms: The first symptoms generally do not occur until the beginning of fruit set, and consist of the diurnal wilting and recovery of the lower leaves. Initially, the leaves are green, but yellow areas develop along the margins or between veins of the leaflets. Fan-shaped necrotic lesions develop as the yellowing progresses, and the affected leaves gradually wither. The wilting and yellowing may involve only a few terminal leaflets, or it may occur on most of the bottom leaves, sometimes causing a 50% loss of foliage. Diseased plants, although not killed by the fungus, are stunted, do not respond to fertilizer, and produce only small fruit.

A lengthwise cut of an infected plant near the base reveals a light tan discoloration of the vascular tissue. The discoloration, in Florida, is typically lighter than that of Fusarium wilt and usually does not extend far up the stem before fruit are mature. There is no decay of the pith typical of bacterial wilt, nor dark-colored vascular bundles at the base of the petiole typical of Fusarium wilt.

Cultural Controls: Choose varieties with resistance or tolerance to this disease. Locate seedbeds on soil free of the Verticillium fungus. Practice sanitation and crop rotation.

Chemical Controls: Employ soil fumigants to assist in control of Verticillium wilt in the seedbed and in the field.