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report on
PLANT
DISEASE

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FUSARIUM WILT OR "YELLOWS" OF TOMATO

Fusarium wilt, caused by the soilborne fungus *Fusarium oxysporum* f. sp. *lycopersici*, was formerly the most prevalent and damaging disease of both field and greenhouse tomatoes in Illinois, especially in the southern half of the state. Only the cultivated tomato (*Lycopersicon esculentum*), certain wild species of *Lycopersicon*, and eggplant are affected. The fungus, however, can colonize the roots of a number of weeds. Illinois now has over 4,000 acres of Fusarium-wilt-infested soil. If suitable resistant or immune varieties were not widely available, wilt would undoubtedly be the most damaging disease of tomatoes in this state.

Figure 1. Tomato plant susceptible to Fusarium wilt.

The Fusarium fungus is present in all important tomato-growing regions of the world. It is most damaging in the southern United States and in northern states during excessively hot, dry seasons.

SYMPTOMS

The first symptom of Fusarium wilt in gardens and fields is usually the golden yellowing of a single leaflet or shoot, or a slight wilting and drooping of the lower leaves on a single stem. As the fungus develops inside the stem, plants show progressive yellowing, wilting, and withering starting generally with the lowermost foliage (Figure 1). Yellowed and wilted leaflets drop early. Often the symptoms appear first only on one side of the stem. Affected plants turn a bright yellow, wilt, dry up, and usually die before maturity, producing few, if any, fruit.

When the epidermis and cortical tissues (bark) on a section of the main stem close to the base of the plant is cut and peeled back, a distinct chocolate-brown discoloration of the water- and food-conducting (vascular) tissue is evident (Figure 2). The streaks extend from the roots up through the branches and into the petioles.

In damp weather, the pinkish-white masses of Fusarium spores may be seen on dead vines or in wounds and leaf scars of severely infected plants. A black rotting of the side roots hastens wilting and dying of the foliage. Seedbed infections commonly cause severe losses. Affected seedlings are stunted. The older leaves droop and curve inward, the veinlets are cleared, and the leaves commonly droop, later wilt, and die. Fruit infection may occur and can be detected by the brown discoloration of the vascular tissue within the fruit.

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Symptoms of Fusarium wilt may be confused with those of Verticillium wilt, caused by a common soil fungus *Verticillium albo-atrum (V. Dahliae).* The two tomato wilts usually cannot be distinguished except by culturing the fungus in the laboratory. The Verticillium fungus, unlike Fusarium, also attacks brambles, eggplant, okra, pepper, potato, strawberries, and 300 or more other herbaceous and woody plants. The Verticillium fungus thrives best in cool, moist soil (60° to 75°F or 15° to 23°C), and this wilt is therefore more serious in the northern half of Illinois in most seasons. Control measures are the same as those given below for Fusarium wilt.

Figure 2. Cut tomato stem showing brown vascular discoloration typical of Fusarium wilt.

DISEASE CYCLE

The causal fungus usually enters plants of all ages through uninjured feeding roots, through wounds in the roots made during transplanting and cultivating, or through wounds made by nematodes (such as burrowing, lesion, root-knot, sheath, sting, stubby-root, and stunt). After preparation, the fungus grows into and multiplies in the water- and food-conducting tissues of the roots and stems. These tissues later become partly plugged or killed. Toxic substances are believed to be secreted by interaction of the fungus and tomato plant. These materials apparently cause the wilting and death of the plant.

Fusarium wilt is most serious during hot weather, when air and soil temperatures are 78° to 90°F (25° to 32°C) with an optimum at about 82°F (27°C). The first symptoms generally appear about the time of bloom or soon after the set of the crown-cluster fruit, but infections may occur at any time during the life of the plant.

The causal fungus may be introduced into uninfested gardens and fields with a small percentage of the seed, by transplants grown in wilt-infested soil, by windborne or water-spread soil, or by garden implements, farm equipment, contaminated tomato stakes and cages, or any other agency carrying small amounts of infested soil.

Once the fungus is introduced, it may survive and persist in most soils indefinitely, especially if the soil is warm, as in the greenhouse, even when no tomato crops are grown. The fungus can also survive in the fibrous root systems of many plants including common weeds such as species of crabgrass, mallow, and pigweed. Transplants grown in infested soil usually do not show typical wilt symptoms until they have been transplanted for some time and soil temperatures reach 75°F (23°C).

The Fusarium fungus produces three types of microscopic, asexual spores (Figure 3). Macroconidia are colorless, slightly curved, and contain up to six cells.

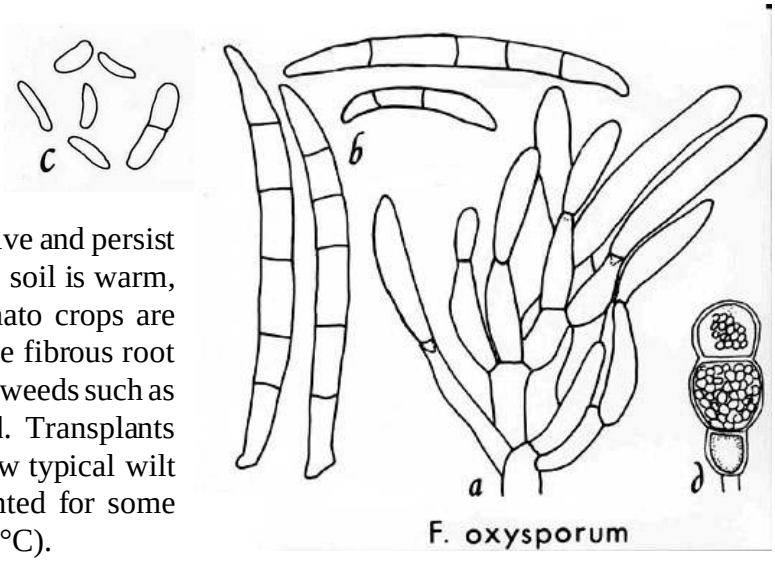

Figure 3. Fusarium oxysporum f. sp. lycopersici, the cause of Fusarium wilt of tomato as you would see the fungus under a high-power, laboratory microscope: (a) conidiophores bearing immature macroconidia at their tips; (b) macroconidia; (c) microconidia; (d) chlamydospores (drawing by Lenore Gray).

Microconidia are small, colorless, and one-celled. Chlamydospores are roundish, thick-walled, and may form on or in mycelium or macroconidia cells.

At least three physiologic races of the fungus have been reported. Race 1 is the predominate race in most areas including Illinois. Race 2 is now present in Arkansas, Florida, New Jersey, and Ohio as well as Australia, Brazil, Iraq, Israel, and Morocco. Race 3 has not been reported to occur in the United States. A new race has been reported in Florida causing 50 to 80 percent plant loss in some fields.

CONTROL

1. Plant only certified, disease-free seed and transplants in fertile, well-drained, wilt-free soil. Tomato seed treated properly with hot water is free of the Fusarium fungus.

2. Disinfest greenhouse and seedbed soil before planting, using steam or a soil fumigant (e.g., chloropicrin, Vorlex, methyl bromide, etc.) that is effective against soilborne fungi. Greenhouse structures, benches, containers, used stakes, and tools should be disinfested and pathogen-free.

3. In infested soil, grow only tomato varieties that are highly resistant or immune to Fusarium and Verticillium wilts (labeled VFN) and suitable for growing in Illinois. For information on resistant varieties see Illinois Circular 1373, Midwest Vegetable Production Guide for Commercial Growers and C1354, Illinois Homeowners' Guide to Pest Management. Also consult current seed catalogs and trade publications. Practically all of the newer tomato varieties are resistant to race 1 and many are also resistant to race 2. When seed catalogs report resistance to Fusarium wilt without reference to race, the resistance is to race 1. Race 2 resistance is usually specified as such when present. We suggest that race 2-resistant varieties be grown only where it is needed. This will minimize selection pressure for development of race 2. No commercial tomato varieties are known to be resistant to the new race reported in Florida.

4. Grow tomatoes in the same field area no more than once in four years. Lightly infested soil may become heavily infested by too-frequent cropping of tomatoes..

5. In home gardens, pull up and burn wilt-infested plants when they become severely diseased.

6. Spraying or dusting–useful in controlling tomato blights, leaf spots, and fruit rots–is not effective in controlling Fusarium wilt.

Publications mentioned above should be available at your nearest Extension office or ITCS, P345 University of Illinois, 1917 S. Wright St., Urbana, IL 61801.