UT Extension
SP 370-C
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Plant Diseases

Tomato Wilt Problems

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There are many possible causes of wilting of tomato plants. Successful treatment of the problem depends on accurate diagnosis and appropriate preventive measures. Some of the major causes of wilting are discussed below.

Figure 1. Yellowing of leaves caused by Fusarium wilt.

Figure 2. Dark discoloration of the vascular tissue of the stem caused by Fusarium wilt.

Fusarium Wilt

The first symptom of Fusarium wilt is yellowing of the leaves (Figure 1), often on only one side of the plant. The yellowing gradually affects most of the foliage, which may wilt and gradually die. A brown discoloration of the vascular tissue (Figure 2) may be seen by cutting the stem lengthwise with a knife.

Fusarium wilt is caused by a fungus, *Fusarium oxysporum* f. sp. *lycopersici,* that enters the plant through the roots and grows up through the vascular tissue. The fungus destroys cells of the vascular tissue, causing starvation in nearby branches of the plant. Disease development is favored by warm temperatures, dry weather, acidic soil and root-knot nematodes. The Fusarium wilt fungus may be introduced to soils in several ways, such as through wind, water, wildlife or equipment. These fungi become established readily in most soils and can remain in the soil for years.

The most effective means of control is the use of resistant varieties (Table 1). There are three strains (races 1, 2 and 3) of the Fusarium wilt fungus, defined by the host varieties they are able to attack. Regardless of the variety planted, follow good cultural practices for reducing the level of the Fusarium wilt fungus and its effects on the plants. Crop rotation of four to five years effectively reduces the inoculum level. Clean all equipment, tools and stakes used in an infested field before using in a noninfested field. Soil pH between 6.5 and 7.0 and the use of nitrate, rather than ammoniacal, nitrogen fertilizer reduces severity. Soil fumigation is an effective control method for commercial growers, and soil solarization has shown benefits for gardeners.

Verticillium Wilt

Verticillium ("vert") wilt is favored by cool temperatures, so this disease is a threat mainly in East Tennessee. The Verticillium wilt fungus, Verticillium albo-atrum, causes disease in the same manner as the Fusarium wilt fungus. Plants may wilt slightly during the day, and leaf yellowing and necrosis begins on the margins of lower leaves, often in a V-shaped pattern (Figure 3). The symptoms may be confused with those of bacterial canker. The woody vascular tissue in the lower stem is discolored, but this may not extend as far up the plant as with Fusarium wilt.

Crop rotation is helpful in reducing the inoculum level in the soil but is limited by the wide host range of the fungus. Many crop plants and weeds are good hosts. Where possible, infected plants should be pulled and removed. As with Fusarium wilt, soil fumigation and solarization are effective control methods. The most effective method of control is the use of resistant varieties. Examples of resistant varieties can be found in Table 1. In addition, any variety whose name is followed by the letter "v" is resistant to Verticillium wilt, race 1. Desirable varieties that lack resistance to

Fusarium or Verticillium, such as heirloom varieties, can be grafted onto resistant rootstocks (Table 1). Susceptible varieties should not be planted in an infested field unless the field has first been fumigated or placed into a five-year rotation with corn or grasses.

Figure 3. Wedge-shaped leaf symptoms of Verticillium wilt.

Root-Knot

Wilting of tomato plants can result from an impaired root system caused by the root-knot nematode, *Meloidogyne incognita* or *M. hapla*. This is a wormlike microorganism that feeds on the roots, causing galls, loss of feeder roots and induction of fungal root decay. Infected plants may be stunted and off-color (Figure 4).

Figure 4. Stunting caused by the root-knot nematode.

Refer to UT Extension publication, "SP 341-L: Nematode Control in the Home Garden," for additional information on nematodes and their control. Table 1 lists commercial tomato varieties that are resistant to root-knot.

Southern Blight

Southern blight is characterized by rapid wilt and death of the entire plant (Figure 5). The causal fungus, *Sclerotium rolfsii*, attacks many field and vegetable crops and broadleaf weeds. The fungus attacks the stem at the soil line, producing a dry, brown rot. High humidity induces a white, fan-shaped mold, on which small, spherical, seedlike structures (sclerotia) appear (Figure 6). The sclerotia are white initially, turning tan, then brown.

The fungus can survive for years in the upper 2 or 3 inches of soil; it will not survive at greater depths. Spread occurs through movement of soil or infested plant material.

Crop rotation with corn is effective in reducing the fungus if it is accompanied by good control of broadleaf weeds. Most broadleaf crops will support some level of multiplication of the fungus. Deep fall plowing with a moldboard plow will bury the fungus to a depth at which it will not survive. Do not use a rotary tiller and do not plow deeply after burying the fungus. Chemical control is not possible for gardeners, because the fungicides cleared for use in gardens are not effective against southern blight. Certain fungicides are labeled for control of this disease but are available only to commercial growers and do not provide a high level of control. Soil fumigation is an option available to commercial growers. Natural products with activity against southern blight include several microbial disease-control products and a biofumigant consisting of pulverized mustard seed. Because of their cost, however, they are best suited for gardens or organic farms. Resistance to southern blight is available only in rootstock varieties (Table 1). Susceptible varieties can be grown successfully in infested sites by grafting onto resistant rootstock.

Figure 5. Plant wilting caused by the southern blight fungus.

Figure 6. White mold and sclerotia typical of the southern blight fungus.

Bacterial Wilt

Bacterial wilt, also known as southern bacterial wilt, is characterized by rapid collapse and death of the plant (Figure 7). A cut through the stem near the ground reveals darkened vascular tissue. The stem pith and cortex also become brown (Figure 8). Dark, water-soaked areas may develop on the surface of the stem. Roots develop a brown rot.

Infection and disease development are favored by high temperature and high soil moisture. Severity is increased by root injury from cultivation, nematodes or any other physical means. The causal organism, *Ralstonia (Pseudomonas) solanacearum,* can persist on many weeds or even in fallow soil. Spread into uninfested fields can occur through transplants, tools or drainage water from adjacent infested land.

Figure 7. Bacterial wilt.

Figure 8. Internal stem symptoms of bacterial wilt.

Avoidance of infested sites is recommended, as the pathogen is long-lived in the soil and has a wide host range. Tomatoes should not be planted for at least three or four years, and crops other than members of the Solanaceae should be planted in the interim. Soil fumigation increases yields in infested sites. Few resistant varieties are available (Table 1); hence, grafting with resistant rootstocks should be a consideration for control in problem sites. Avoid mechanical root injury and control nematodes.

Walnut Wilt

Wilting of tomato plants may occur when they are planted near walnut or butternut trees. Large amounts of a substance called juglone are released into the soil from roots or leached from leaves and nuts during rains. Symptoms of walnut wilt include vascular discoloration, similar to that of Verticillium and Fusarium wilts.

Avoid planting tomatoes near walnut or butternut trees. Plants should be planted at a distance from the tree greater than the height of the tree.

Fusarium Crown and Root Rot

Fusarium crown and root rot of tomato is caused by the fungus *Fusarium oxysporum* f. sp. *radicis-lycopersici*. It is primarily a greenhouse problem but occasionally occurs in the field in Tennessee (Figure 9). Conditions that favor crown and root rot are the same as those for Fusarium wilt, except that crown and root rot is favored by cool temperatures. Infected plants develop chocolate brown cankers on the surface of the lower stem, and roots are usually discolored or rotting (Figure 10). Symptoms appear during fruiting as yellowing of the oldest leaves, gradually progressing to the younger leaves. Some plants may be stunted and quickly wilt and die. Other plants wilt mainly during the heat of the day and may remain alive. The vascular tissue becomes brown in the roots and main stem, extending up to 10 inches above ground.

Figure 9. Fusarium crown and root rot.

Figure 10. Fusarium crown and root rot.

The fungus enters the plant through the roots. The soil becomes contaminated with the fungus via infested plant debris from previous crops or by the arrival of spores in air currents from nearby infected tomatoes or other hosts. Spread from plant to plant can occur through root contact.

The most effective way to control this disease is to plant varieties resistant to Fusarium crown and root rot (Table 1). No currently registered fungicides have been shown to be effective in reducing this disease, whether applied to the soil or to the plant. The fungus can be reduced in the soil by fumigation or solarization. Infested greenhouses should be cleaned and sanitized. Cultural practices for control of Fusarium wilt are also effective against crown and root rot.

Spotted Wilt

Spotted wilt is caused by the tomato spotted wilt virus (TSWV), which is spread by tiny insects called thrips. Significant problems with spotted wilt occur only in summers following abnormally dry springs. The name “spotted wilt” is a misnomer, because the plants show little to no wilt. Young leaves show bronze to purplish specks and rings and become brown and dry (Figure 11). Initial symptoms appear on the younger leaves, distinguishing

this disease from early blight and Septoria leaf spot, which first appear on older leaves. Brown, corky areas appear on stems. Infected plants may be bordered by healthy ones. Plants infected while young become pale and stunted and show rolled leaves with purple veins. Fruit are marked with yellow rings (Figure 12) and/or a rough, brownish surface.

Infected plants cannot be cured, and efforts to slow spread of the disease via insecticide applications are often unsuccessful. It is recommended that infected plants not be removed, as sometimes plants grow out of the condition and produce normal fruit. Prevent winter weeds or plow them under well in advance of planting tomatoes, so that overwintering thrips do not move into the crop. Many resistant varieties are available (Table 1). Consult your favorite seed catalogs for additional varieties. Spotted wilt resistant varieties are not highly resistant, and additional control measures are needed.

Figure 11. Leaf symptoms caused by the tomato spotted wilt virus.

Figure 12. Fruit symptoms caused by the tomato spotted wilt virus.

Pith Necrosis

Pith necrosis occurs sporadically in fields and greenhouses, usually causing minor losses, although severe cases occur occasionally. The causal agent is the soil-borne bacterium, *Pseudomonas corrugata,* and certain other bacteria can be involved. Pith necrosis is most severe in plants that grow too rapidly. The types of tomato culture most likely to experience pith necrosis are those involving soil fumigation, plastic mulch, frequent drip irrigation and high nitrogen levels. Cool nights and high humidity also favor the disease. The center of the stem (the pith) decays and may become dry and disked or hollow (Figure 13). The outer surface of the stem may develop dark lesions or adventitious roots. The plant may remain alive, or it may wilt and die.

Figure 13. Hollow stem with thin walls caused by pith necrosis.

Disease-resistant Rootstocks

For certain diseases such as bacterial wilt and southern blight, few resistant varieties are available. Grafting onto a resistant rootstock is an effective way of controlling soil-borne diseases without foregoing a desired variety. Rootstocks generally are resistant to more soil-borne diseases than any scion variety. Some of the many rootstocks available are shown in Table 1. Information on tomato grafting can be found in a webinar at http://www.extension.org/pages/25443/grafting-tomatoes-for-organic-open-field-and-high-tunnel-production-webinar.

Table 1. Reactions to Verticillium wilt (V), Fusarium wilt races 1, 2 and 3 (F), root-knot nematode (N), spotted wilt (SW), tomato mosaic (TM), Fusarium crown and root rot (FR), bacterial wilt (BW), and southern blight (SB) in selected tomato varieties.

Variety	V	F (1,2,3)	N	SW	TM	FR	BW	SB
Large-fruited types								
Amelia	X	1,2,3	X	X				
Better Boy	X	1	X					
BHN 585	X	1,2	X			X		
BHN 602	X	1,2,3		X				
BHN 640	X	1,2,3		X				
Big Beef	X	1,2	X		X			
Carolina Gold	X	1,2						
Celebrity	X	1,2	X		X			
Crista	X	1,2,3	X	X				
Fletcher	X	1,2	X	X				
Floralina	X	1,2,3						
Florida 47R	X	1,2						
Florida 91	X	1,2						
Florida 7514	X	1,2					X	
Mountain Fresh Plus	X	1,2	X					
Mountain Glory	X	1,2,3		X				
Mountain Merit	X	1,2,3	X	X				
Park's Whopper	X	1,2	X		X			
Phoenix	X	1,2						
Primo Red	X	1,2		X	X			
Red Defender	X	1,2		X				
Sebring	X	1,2,3				X		
Sunkeeper	X	1,2,3				X		
Roma, cherry, grape, saladette types								
BHN 685	X	1,2,3		X				
Cherry Grande	X	1						
Health Kick	X	1,2		X				
Mariana	X	1,2	X					
Mountain Belle	X	1						
Mountain Magic	X	1,2						
Muriel	X	1,2	X	X				
Plum Crimson	X	1,2,3						
Plum Regal	X	1,2		X				
Pony Express	X	1,2,3	X		X			
Sunoma	X	1,2	X		X			
Rootstocks								
Beaufort	X	1,2	X		X			X
Big Power	X	1,2	X		X			X
Colosus	X	1,2,3	X	X	X	X		
Dai Honmei	X	1	X		X		X	X
Estamino	X	1,2,3	X	X	X	X		
Maxifort	X	1,2	X		X	X		X
TMZQ702	X	1,2	X		X		X	X
RST-04-105-T	X	1,2	X		X		X	X
RST-04-106-T		1,2,3	X		X		X	

Moderate or high levels of resistance indicated by "X" or, for Fusarium wilt, by the race number to which resistance applies. Refer to seed companies' catalogs for the particular level of resistance.
Rootstock information adapted from (1) Rivard, Cary L. and Frank J. Louws. 2011. Tomato grafting for disease resistance and increased productivity. SARE Publication 12AGI2011. (2) Johnny's Selected Seeds Catalog, 2013.

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