



## VERTICILLIUM WILT OF STRAWBERRY

Verticillium wilt of strawberry is caused by the fungi *Verticillium albo-atrum* and *V. dahliae*. When a strawberry plant is severely infected, the probability of it surviving to produce a crop is greatly reduced.

The *Verticillium* species infects over 300 host plants, including many fruits, vegetables, trees, shrubs, and flowers as well as numerous weeds and some field crops.

Once the fungus becomes established in a field or garden, it may remain alive in the soil for 25 years or longer, surviving between cultivated crops on susceptible weeds. The pathogen is introduced into new areas on seed, tools, farm machinery, and in the soil and roots of transplants.

### SYMPTOMS

Verticillium wilt often appears in new strawberry plantings as runners begin to form (Figure 1). In older plantings, the symptoms usually appear just prior to picking. The aboveground symptoms vary with the susceptibility of the cultivar and cannot be easily differentiated from those for red stele, black root rot, or winter injury. A laboratory culture is necessary for positive identification.

On infected strawberry plants, outer and older strawberry leaves droop, wilt, turn dry, and become reddish yellow or dark brown at the margins and between the veins. Few, if any, new leaves develop.

New leaves that do form are stunted and may wilt and curl up along the mid vein. Infected plants are often stunted and flattened with small yellowish leaves and appear to be suffering from lack of water (Figure 2). Brownish to bluish black streaks or blotches may appear on the runners and leaf petioles. New roots that grow from the crown are often dwarfed with blackened tips. Brownish streaks may occur within the decaying crown and roots (Figure 3).



Figure 1. *Verticillium* wilt, causing browning of the outer leaves (courtesy S. Wilhelm).



Figure 2. First-year strawberry plants just coming into production. Most of the plants are collapsing from verticillium wilt (courtesy S. Wilhelm).

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For further information concerning fruit crop diseases, contact Mohammad Babadoost, Extension Specialist in Vegetable and Fruit Diseases, Department of Crop Sciences, University of Illinois at Urbana-Champaign (217/333-1523; [email:babadoos@uiuc.edu](mailto:babadoos@uiuc.edu)).

If the disease is serious, large numbers of plants may wilt and die rapidly. When the disease is not very serious, an occasional plant may wither and die, or several plants scattered over a patch may die, particularly during stressful conditions such as heat, drought, or excess water. Occasionally, a mother plant will die, but one or more of the daughter (runner) plants will survive and be symptomless.

## DISEASE CYCLE

The *Verticillium* fungi overwinters in the soil and plant debris as dormant mycelium or black, speck-sized bodies (microsclerotia). Those bodies remain viable for many years. When suitable conditions occur, these microsclerotia germinate by putting forth one or more threadlike hyphae. These hyphae may penetrate the root hairs directly, but more infection is aided by breaks or wounds in rootlets caused by insects, cultivating or transplanting equipment, frost injury, or root-feeding nematodes. Once inside the root, the fungus invades the water-conducting tissue (xylem). Runner plants may become infected by the movement of the fungus into the stolons from the diseased mother plant. Older mycelia produce microsclerotia in host tissues, completing the disease cycle.



Figure 3. *Verticillium* wilt in extremely susceptible and moderately resistant cultivars (left and center). The two plants on the right are highly resistant (courtesy J.L. Maas).

Cool and overcast days interspersed with warm and bright days is most conducive to development of *Verticillium* wilt disease. Infection and disease development occur when the soil temperatures are between 53° and 86°F (12° and 30°C), with an optimum of 70° to 75°F (21° to 24° C). *Verticillium* wilt is found mostly in the temperate climate zone. In Illinois, the disease is particularly severe during cool seasons.

## CONTROL

1. **Plant in fertile well drained soil. Avoid low, wet spots. Fertilize (based on a soil test) and water, where possible, to encourage vigorous growth.** Avoid fertilizers with high nitrogen content. Extremely vigorous growth should **not** be encouraged. Such growth may lead to an overabundance of plants and that can be detrimental because it encourages the development of other diseases.
2. **Do not plant susceptible strawberry cultivars in soil where tomato, pepper, potato, eggplant, melon, okra, mint, bush or bramble fruits, stone fruits, chrysanthemum, roses, or related susceptible crops have grown for the past five years.**
3. **In *Verticillium* infested soil, set out only certified, disease-free strawberry plants of tolerant or resistant cultivars.** Several old and new cultivars have resistance to this disease. The reaction of strawberry cultivars commonly grown in the Midwest to *Verticillium* wilt and four other diseases are shown in Table 1.

4. **If economically feasible, and if available, use soil fumigation as a preplant treatment.** When properly done, fumigation kills soil insects and weed seeds as well as disease-causing fungi and nematodes. Fumigation is usually done by commercial applicators who are licensed to handle restricted (dangerous) chemicals, and not by the grower. The soil fumigants that are most effective against *Verticillium* include chloropicrin, chloropicrin-methyl bromide mixtures, chloropicrin-chlorinated C hydrocarbon (DD) mixtures, Vapam, and Vorlex. These broad spectrum soil fumigants are costly to apply. This cost is offset by larger yields of better quality fruit, control of soil pests (primarily weeds), and extended life of the planting. Soil fumigation should permit the growing of *Verticillium*-susceptible cultivars.

Many soil fumigants require treated soil to be covered with gas-proof sheeting (polyethylene or vinyl) for at least 24 to 48 hours after treatment. Planting cannot take place for an additional 2 to 3 weeks. When using a soil fumigant, follow **all** of the manufacturer's directions and precautions **carefully**.

Planting stock should be obtained from a reputable source that follows strict disease control practices. The fungus may be reintroduced into fumigated soil if infected, symptomless plants are used.

5. **Control all weeds by timely cultivations and the use of selective herbicides** currently recommended by University of Illinois Extension Fruit Specialists. Common weed hosts include ground cherries, lamb's quarter, pigweed, horse nettles, and velvet leaf.
6. **Control soil insects by crop rotation and the use of insecticides** currently recommended by University of Illinois Extension Entomologists.

For more information on *Verticillium* wilt of strawberry, refer to the "Midwest Small Fruit Pest Management Handbook" (website: <http://www.ag.ohio-state.edu/~ohioline/b861/index.html>), "Illinois Commercial Small Fruit and Grape Spray Guide" (website: <http://www.hort.purdue.edu/hort/ext/sfg/>), and "Compendium of Strawberry Diseases", published by the American Phytopathological Society, St. Paul, Minnesota.

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*The above mentioned publications are available from University of Illinois, Ag Services, P345, 1917 S. Wright St., Champaign, IL 61820 (1-800-345-6087).*

**Table 1. Disease Resistance of Strawberry Cultivars Grown in the Midwest**

Cultivar	Red stele	Verticillium wilt	Leaf spot	Leaf scorch	Powdery mildew
<u>Junebearing</u>					
Allstar	VR <sup>1</sup>	R	R	R	R
Annapolis	S	I	S	S	–
Blomidon	–	–	–	–	–
Canoga	I	I	R	R	–
Cardinal	S	S	R	R	R
Catskill	S	VR	S	R	R
Cavendish	R	I	–	–	S
Delite	R <sup>2</sup>	R	R	S-R	S
Earliglow	R <sup>2</sup>	T-R	S-R	R	I
Guardian	R <sup>2</sup>	T-R	S-R	R	S-R
Honeoye	S	S	R	R	–
Jewel	S	S	R	R	–
Kent	S	S	–	–	–
Lateglow	R	R	T	T	T
Lester	R	R	T	T	T
Midway	R <sup>2</sup>	S-I	S	S	I
Pocahontas	S	S	S-R	S-I	R
Raritan	S	S	S	S	I
Redchief	R <sup>2</sup>	R	S-R	R	S-R
Scott	R	R	I-R	S-R	R
Seneca	S	S	–	–	–
Sparkle	S-R	S	S	S-I	R
Sunrise	R <sup>2</sup>	R	VS	R	R
Surecrop	R <sup>2</sup>	VR	S-R	S-R	–
Tennessee Beauty	S	R	R	S-R	S
Veestar	S	T	T	T	–
<u>Everbearing</u>					
Tribute	VR	T-R	T	T	R
Tristar	R	R	T	T	R

VS = very susceptible; S = susceptible; I = intermediate; T = tolerant; R = resistant; VR = very resistant; – = unknown.

<sup>1</sup> Resistant characteristics of the cultivar usually preclude the need for other controls.

<sup>2</sup> Resistant to several races of the red stele pathogen.