

Verticillium Wilt of Woody Plants

Introduction

Trees and shrubs are an integral part of our landscape. Verticillium wilt is a disease affecting a wide range of trees and woody shrubs, as well as herbaceous plants. In Iowa, it is especially common on maple, catalpa, ash, viburnum, lilac, and smoke tree. Planting resistant species and keeping plants in good vigor are the only ways to effectively manage this disease.

Fig 1. Interveinal yellowing caused by a chronic infection of *Verticillium* on maple. Photo by Paula Flynn.



Symptoms

Verticillium wilt is caused by either of two related fungi, *Verticillium albo-atrum* and *V. dahliae*, although *V. dahliae* is more common on woody plants. Both species cause similar symptoms.

Affected plants or branches may wilt and die suddenly (acute disease) or may decline slowly over several years (chronic infection). Symptoms of acute infection include wilting of individual branches or groups of branches, leaf curling and drying, defoliation, abnormal yellow or red coloration between veins of leaves, and death of branches. Wilting may occur anytime during the growing season, but is most likely to appear in July and August. Cutting into the wood of wilted branches sometimes reveals dark discoloration under the bark. In cross section this discoloration may appear as rings following the growth rings of the plant. Color of the discoloration varies with the plant species affected. Discoloration in maples is light to dark green or black while that in catalpa is purplish pink to bluish brown. Ash trees generally show only faint, light tan discoloration. Acute symptoms indicate infection of the current season's water-conducting tissue, the sapwood. Plants may have acute symptoms in consecutive years or may skip one or more years, appearing normal or stunted in the interim. Younger trees showing acute symptoms usually die within one year.

Fig 2. Mature maple showing branch death caused by acute *Verticillium* disease. Photo by Cindy Ash.



Symptoms of chronic infection include stunted, yellowed leaves, marginal browning of leaves, stunted branch growth, heavy seed crops, and death of branches. Chronic symptoms indicate stress caused by infection of the previous year's sapwood. Trees with chronic infections typically decline slowly over time.

Symptoms of acute or chronic infection may be confused with those caused by herbicide damage and stressful environmental conditions such as drought.

How the fungus causes disease

More than 300 woody and herbaceous plants can be infected by *Verticillium*. The *Verticillium* fungi live in the soil and enter plants through the roots, entering the water-conducting vessels (xylem) of the plant. The fungus enters through wounds in the roots, or, in stressed trees, it can penetrate the roots directly. The fungus develops at its point of entry, and may produce tiny reproductive structures, spores, that travel through the xylem up the plant, rapidly increasing the infected area. The fungus also produces toxins that travel through the vascular system and poison the plant tissue. The fungus causes the xylem cells to form gums and plugs called tyloses, the plant's attempt at closing off the vascular system to prevent spread of the infection. Eventually this may cause the plant to wilt because it cannot transport water to its leaves. In some instances the plant is able to contain the infection and symptoms may be in remission.

The fungus survives in the soil as a thread-like body called a mycelium, or as small, resistant structures called microsclerotia. Microsclerotia may develop in infected plant tissues and may persist in the soil for 10 years.

Fig 3. Vascular streaking in a maple branch infected with *Verticillium*. Photo by Paula Flynn.



Management

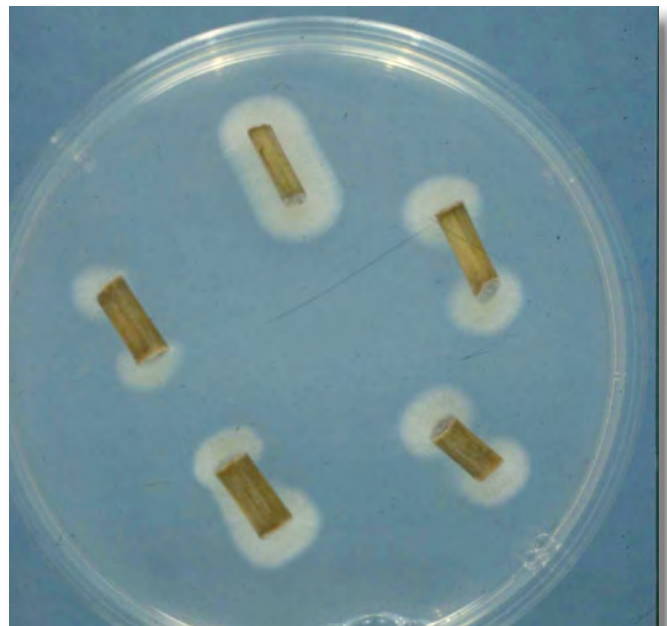
There are no treatments available to remove the fungus from the soil where it survives. Management relies on keeping trees in good vigor by mulching, watering when dry, keeping dead limbs pruned out, and avoiding stresses. Trees with recent wilt symptoms may be able to compartmentalize the infection and recover. Dead branches should be pruned out to prevent infection by other fungi. Moderately fertile soil with nutrient levels of slightly high potassium and low nitrogen and adequate moisture increase resistance to infection.

Trees that have died from *Verticillium* wilt should be replaced with resistant species. The lists on the next page give species resistant and susceptible to *Verticillium* wilt. Some species appear on both lists because susceptibility depends on the variety of the plant and the particular type of *Verticillium* found at a certain site.

Collecting a sample to test for *Verticillium* wilt

Verticillium wilt is diagnosed in the lab by culturing the *Verticillium* fungus from wood from a branch showing symptoms. A sample for testing should include branch segments pencil-thick to an inch in diameter, 8 inches long, taken from several branches showing recent symptoms (not completely dead and dried). Avoid exposing the sample to extreme heat, such as in a hot car. It can take 2-3 weeks to grow the *Verticillium* fungus in culture. Sometimes *Verticillium* cannot be isolated from symptomatic plant tissue. Samples may be sent to the Iowa State University Plant and Insect Diagnostic Clinic, 351 Bessey Hall, Ames, IA 50011. Visit the clinic website for current fees and submission forms at clinic.ipm.iastate.edu.

Fig 4. Laboratory culture of the *Verticillium* fungus growing from infected twigs. Photo by Paula Flynn.



Susceptible species

Ash	Cork tree	Linden*	Rose
Azaela	Currant and gooseberry	Locust, black	Russian olive
Barberry	Dogwood*	Magnolia	Serviceberry*
Boxwood	Elder	Maple	Smoke tree
Buckeye, Ohio	Elm	Oak, pin and red	Spirea
Catalpa	Honeysuckle	Pawpaw*	Sumac
Cherry and other stone fruits	Horsechestnut	Plum	Viburnum
Coffee tree, Kentucky	Lilac	Redbud	Wigela

Resistant species

Apple	Ginkgo	Linden*	Serviceberry*
Arborvitae	Hackberry	Mountain ash	Spruce
Beech	Hawthorn	Mulberry	Sycamore
Birch	Hickory	Oak, white and bur	Walnut
Butternut	Honeylocust	Pawpaw*	Willow
Crabapple	Hophornbeam	Pear	
Dogwood*	Juniper	Pine	
Fir	Larch	Poplar	

*Susceptibility depends on cultivar of plant and strain of *Verticillium* present.

Fig 5. Linden tree showing symptoms of acute infection by *Verticillium*. Photo by Mark Gleason.



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