



# Verticillium Wilt of Shade Trees and Woody Ornamentals

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## Introduction

Verticillium wilt is a serious vascular wilt disease affecting many shade tree species and over 80 tree genera, as well as many woody ornamental landscape plants, and herbaceous and vegetable plants. Verticillium wilt most commonly occurs in nursery, orchard and landscape locations. Maple (*Acer* spp.) are a tree genus commonly associated with the disease, but Verticillium wilt occurs on many other trees and woody ornamentals used in landscapes. Verticillium wilt more commonly occurs in locations with colder climates than Virginia; however, Verticillium wilt does cause disease on trees and woody ornamentals in Virginia.

## The Pathogen

Two soilborne fungi, *Verticillium alboatrum* and *Verticillium dahliae*, can cause Verticillium wilt, but in North America, *V. dahliae* is the most common cause of the disease. The Verticillium pathogen infects trees via roots and can become systemic in the tree by traveling in the sap as it flows upward in the tree. This leads to fungal colonization of the vascular (water- and nutrient-conducting) tissue, causing tissue death and failure of the tissue to transport water and nutrients in the tree. Both *V. dahlia* and *V. alboatrum* produce survival structures in the soil that persist and can cause new infections in healthy host plants.

## Symptoms

Symptoms of Verticillium wilt include wilted, shriveled, scorched or browning leaves; off-color foliage; stunting; defoliation; dieback and death (figures 1-3). Symptoms may occur only on part of the tree, such as an individual

branch or branches (figure 4), or occur on the whole tree (figure 5). Young trees are more likely to decline rapidly compared to mature trees, which are typically slow in progression of dieback (figure 6). Symptoms of Verticillium wilt may be more pronounced in one year than another.



Figure 1. A Verticillium-wilt diseased Japanese maple (*Acer palmatum*) showing off-color foliage, wilt, thinning and dieback on a portion of the tree. (Note that this cultivar normally exhibits reddish foliage.) (Photo by Purdue Plant and Pest Diagnostic Lab, Purdue University)

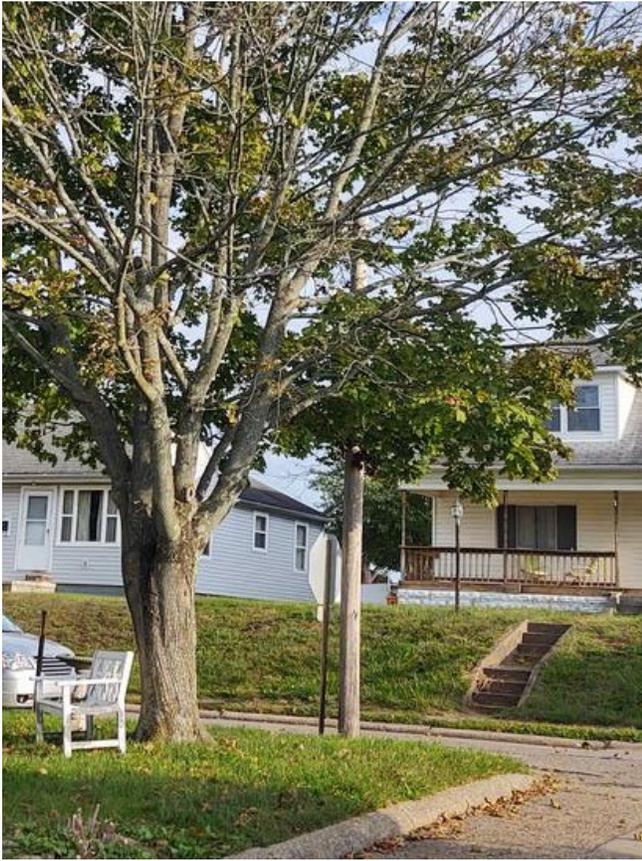


Figure 2. A maple (*Acer* sp.) afflicted with *Verticillium* wilt shows stunted leaves and dieback on a large section of the crown. (Photo by Mahfuz Rahman, West Virginia University)



Figure 4. A *Verticillium*-wilt diseased smoke tree (*Cotinus* sp.) showing browning, wilting leaves on several branches. (Note that this is a cultivar that normally exhibits pale foliage, so the overall yellowing is not caused by *Verticillium* wilt.) (Photo by Michelle Grabowski)



Figure 3. Field nursery maples with browning foliage on branches that have died as a result of *Verticillium* wilt. (Photo by Michelle Grabowski)



Figure 5. Two *Verticillium* wilt-diseased maples (*Acer* sp.) in serious decline and near death. (Photo by John Obermeyer, Purdue University)

Internal symptoms of *Verticillium* wilt may be visible in a cross-section of symptomatic branches (or the main stem or trunk) (figure 6). These appear as a dark discoloration of the sapwood (woody tissue just beneath the bark) (figure 7) or deeper vascular tissue within the branch or trunk or main stem. The discoloration

may be apparent in cross-sections of branches or main stems as discolored ring(s) or arc(s) in the vascular tissue, which follow the pattern of growth rings (figure 8). Discolored vascular tissue will not occur uniformly throughout a *Verticillium*-diseased tree and the color of the discoloration may vary (e.g. gray-green, green, reddish-brown, light tan, etc.) by tree species. Recently infected trees may not show any discoloration and some tree species, such as *Fraxinus pennsylvanica* (green ash), rarely develop discoloration in the vascular tissue or sapwood. Locating discoloration in the vascular tissue is helpful for diagnostic purposes and it may take some time to find such locations on a tree, but the best approach is to cut cross-sections through symptomatic branches.



Figure 6. Internal symptoms of *Verticillium* wilt are visible in this cross-section of a symptomatic sugar maple (*Acer saccharum*) branch as a ring of discoloration in the vascular tissue. (Photo by Elizabeth Bush, Virginia Tech)



Figure 7. After removing bark from a symptomatic sugar maple (*Acer saccharum*) branch, discolored streaking in the vascular tissue, caused by *Verticillium dahliae*, is visible. (Photo by Elizabeth Bush, Virginia Tech)



Figure 8. Vascular discoloration, caused by *Verticillium dahliae*, is apparent in a cross-section of a Japanese maple (*Acer palmatum*) branch as discolored rings/arcs in the vascular tissue, which follow the pattern of growth rings. (Photo by Purdue Plant and Pest Diagnostic Lab, Purdue University)

## Management

Stressed trees are more susceptible to *Verticillium* wilt than trees not subjected to stress (e.g. compacted soil conditions, drought, etc.). Stressed trees will also generally succumb more quickly to *Verticillium* wilt than non-stressed trees, so ensuring optimal cultural conditions and minimizing environmental stress is recommended. Do not apply excessive nitrogen fertilizer and apply fertilizer only as recommended by a soil test.

There is no cure for *Verticillium*-infected trees and woody ornamentals. Since the disease may cause significant dieback, decline, and death, the use of *Verticillium* wilt-resistant trees or woody ornamentals is recommended in locations where the disease has been diagnosed.

For *Verticillium*-diseased trees showing relatively minor symptoms (e.g. little impact to the overall crown of the tree, few symptomatic branches), ensuring adequate irrigation throughout the growing season may slow the progression of the disease. Prune out any dead branches back to healthy tissue and disinfect pruning tools between cuts using 10% household bleach solution or a commercial disinfectant. Remove pruned branches from the location (i.e. destroy or place in the landfill). Trees with significant dieback should be removed. *Verticillium*-infected wood should not be chipped for mulch or composted. Be aware that the *Verticillium* pathogens are soilborne and can be moved to new locations via movement of infested soil or wood, including wood chips or hardwood mulch, and via equipment or tools contaminated with infested soil.

Therefore, in locations where *Verticillium* wilt has been diagnosed, planting *Verticillium*-resistant or immune trees or woody ornamentals is strongly recommended (table 1). Gymnosperms (e.g. conifer trees, cycads, and Ginkgo) are immune or resistant to *Verticillium* wilt. Many dicots (i.e. flowering trees) are susceptible to *Verticillium* wilt (table 2); however, some dicots are resistant to the disease (table 1).

**Table 1.** Some genera of dicot trees and woody ornamentals reported resistant or immune to *Verticillium* wilt. Note that this list is not exhaustive and resistance is not immunity, so trees with resistance could possibly develop *Verticillium* wilt. However, the chance of *Verticillium* wilt is greatly minimized by using resistant plants in locations where *Verticillium* is present (Berlanger and Powelson, 2000; Sinclair and Lyon, 2005)<sup>1</sup>.

Common	Genus
Beech	<i>Fagus</i>
Birch	<i>Betula</i>
Butternut, walnut	<i>Juglans</i>
Chestnut	<i>Castanea</i>
Dogwood	<i>Cornus</i>
Firethorn	<i>Pyracantha</i>
Flowering quince	<i>Chaenomeles</i>
Hackberry	<i>Celtis</i>
Hawthorn	<i>Crataegus</i>
Hickory, pecan	<i>Carya</i>
Holly	<i>Ilex</i>
Honeylocust	<i>Gleditsia</i>
Hornbeam	<i>Carpinus</i>
Katsura tree	<i>Cercidiphyllum</i>
Mountain ash	<i>Sorbus</i>
Mulberry	<i>Morus</i>
Planetree, sycamore	<i>Platanus</i>
Quince	<i>Cydonia</i>
Rhododendron (other than azalea)	<i>Rhododendron</i>
Sweetgum	<i>Liquidambar</i>
Willow	<i>Salix</i>
Zelkova	<i>Zelkova serrata</i>

**Table 2.** Some trees and woody ornamentals reported susceptible to *Verticillium* wilt. Note that this table is not an exhaustive list of *Verticillium* wilt-susceptible trees and shrubs. For susceptible genera listed, there may be cultivars or individual trees with resistance to *Verticillium*. (Berlanger and Powelson, 2000; Sinclair and Lyon, 2005)<sup>1</sup>.

Common Name	Genus
Ash	<i>Fraxinus</i>
Aucuba	<i>Aucuba</i>
Azalea	<i>Rhododendron</i>
Barberry	<i>Berberis</i>
Buckeye, horse-chestnut	<i>Aesculus</i>
Camellia	<i>Camellia</i>
Catalpa	<i>Catalpa</i>
Cherry, plum, ornamental cherry & plum	<i>Prunus</i>
Coffeetree	<i>Gymnocladus</i>
Elderberry	<i>Sambucus</i>
Elm	<i>Ulmus</i>
English ivy	<i>Hedera</i>
Fig	<i>Ficus</i>
Fringe tree	<i>Chionanthus</i>
Golden-rain tree	<i>Koelreuteria</i>
Grapevine	<i>Vitis</i>
Hibiscus	<i>Hibiscus</i>
Horse chestnut	<i>Aesculus</i>
Japanese pagoda tree	<i>Styphnolobium</i>
Lilac	<i>Syringa</i>
Linden	<i>Tilia</i>
Locust	<i>Robinia</i>
Magnolia	<i>Magnolia</i>
Maple, boxelder	<i>Acer</i>

<sup>1</sup> Genera that have been reported as both resistant and susceptible to *Verticillium* wilt have intentionally been omitted from tables 1 and 2. This situation could occur as a result of variation in virulence of *Verticillium* isolates, environmental factors and/or genetic variation among species/cultivars/individuals in genera.

Common Name (continued)	Genus
Mimosa	<i>Albizia</i>
Nandina	<i>Nandina</i>
Osage orange	<i>Maclura</i>
Osmanthus	<i>Osmanthus</i>
Pear and ornamental pear	<i>Pyrus</i>
Persimmon	<i>Diospyros</i>
Photinia	<i>Photinia</i>
Pittosporum	<i>Pittosporum</i>
Privet	<i>Ligustrum</i>
Redbud	<i>Cercis</i>
Rose	<i>Rosa</i>
Russian olive	<i>Elaeagnus</i>
Sassafras	<i>Sassafras</i>
Serviceberry	<i>Amelanchier</i>
Smoketree	<i>Cotinus</i>
Spiraea	<i>Spiraea</i>
Sumac	<i>Rhus</i>
Tree of heaven	<i>Ailanthus</i>
Tuliptree	<i>Liriodendron</i>
Tupelo	<i>Nyssa</i>
Viburnum	<i>Viburnum</i>
Walnut	<i>Juglans</i>
Weigela	<i>Weigela</i>
Yellowwood	<i>Cladrastis</i>

## Diagnosing the Disease

The Virginia Tech Plant Disease Clinic can diagnose this disease and other plant diseases. Refer to the [Plant Disease Clinic website](https://bit.ly/VTplantclinic) (<https://bit.ly/VTplantclinic>) for the current diagnostic form, fees, and instructions on collecting an appropriate diagnostic sample and submitting samples to the Plant Disease Clinic. For diagnosis of vascular diseases, it is best to submit several branch samples that show vascular discoloration; however, do not remove all the bark from such samples—that must be removed in the diagnostic lab just before culture assays are performed. Also include branches with leaves that show foliar symptoms. Completely dead branches are not useful for diagnosis, nor are completely healthy branches.

## References

- Berlanger, I. and M.L. Powelson. 2000. Verticillium wilt. *The Plant Health Instructor*. DOI: 10.1094/PHI-I-2000-0801-01. Accessed 11/30/23 <https://www.apsnet.org/edcenter/disandpath/fungalasco/pdlessons/Pages/VerticilliumWilt.aspx>
- Sinclair, W.A. and H.H. Lyon. 2005. *Diseases of Trees and Shrubs*, 2nd ed. Ithaca, N.Y.: Cornell University Press.



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