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Verticillium Wilt of Trees in Idaho

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Contents

- 1 Introduction
- 2 Diagnosis
- 3 Disease Management
- 3 Further Reading

Introduction

VERTICILLIUM WILT IS A DEVASTATING DISEASE to many plants worldwide. It affects over three hundred plants species, including trees, shrubs, fruits, and vegetables. The causal agent of verticillium wilt in trees is primarily *Verticillium dahliae*, although *V. albo-atrum* and *V. nonalfalfae* have also been implicated in certain situations. Trees infected with *Verticillium* cannot be cured and eventually die. The rate of tree death ranges from weeks to years. Good disease management can considerably prolong the life of the tree and limit further spread of the pathogen. In Idaho, maple and ash are particularly vulnerable to infection, especially in locations where susceptible field crops, such as mint and potatoes, have been grown previously.

Verticillium is soilborne; once introduced to a field or garden it survives in the soil. The fungus spreads via wind, rain, irrigation water, humans, animals, and agricultural tools and machines. In the soil, *V. dahliae* survives as microsclerotia, which are small, dark structures. The microsclerotia germinate when susceptible plants grow nearby. The fungus infects the roots through wounds or natural openings. In some situations, nematode-caused wounds on plant roots exacerbate infection. The fungus then spreads through the vascular system; occlusions of the xylem occur as a result of the buildup of fungal hyphae and other aggregates associated with xylem vessel damage. The occlusions impede water flow and water-stress symptoms subsequently develop.

Microsclerotia persist in soil for up to fourteen years in the absence of a host, enabling the pathogen to attack new plantings. The pathogen infects common weed species asymptotically, such as common lambsquarters (*Chenopodium album*), common purslane (*Portulaca oleracea*), and black nightshade (*Solanum nigrum*), which increases the inoculum present in the soil.



Figure 1. Maple tree, showing the characteristic symptoms associated with *Verticillium* infection.



Figure 2. An infected ash tree, showing defoliation and dieback on one side.

Diagnosis

Symptoms can vary because of the host, tree age, and stage of infection. For example, ash trees rarely produce the wilting and sapwood discoloration that is commonly seen with maple. Nevertheless, typical symptoms of *verticillium* wilt include wilting in one or more branches followed suddenly by dieback. The effect typically occurs on just one side of the tree (Figures 1 and 2).

Sometimes a slow decline in new twig growth is observed. Dead shoots, twigs, and branches typically appear in July, sometimes emerging as early as May. Sapwood infected with *Verticillium* also might have brown staining or that of dark olive green in maples (Figure 3) or yellow green in other hosts. Staining is difficult to see in young twigs and may be very patchy in an individual tree.

Discoloration can occur in leaves as well. Some might turn an abnormal yellow or red color before wilting



Figure 3. Vascular discoloration in maple associated with *verticillium* wilt.

or the leaf margins may turn brown and appear scorched. Smaller-than-normal leaf development can occur in infected trees, along with defoliation. The rate of death of a tree is unpredictable, particularly in young ones.

Only laboratory testing accurately diagnoses the disease. Real-time polymerase chain reaction (PCR), a DNA test, confirms the presence of *V. dahliae* in plant and soil material. When collecting a plant sample for PCR, secure at least three branch pieces, taken from recently wilted branches. Completely dried-out and dead branches are not suitable. Branch pieces should measure at least ½–2 inches in diameter and approximately 8 inches long. Other plant sample types that work are leaf petioles, which have recently proven useful for PCR testing.

Gather soil samples using a trowel or soil probe. Brush aside the top half inch of the soil and collect to a 12-inch depth. To make sure the sample more accurately represents an area, gather multiple subsamples in a grid pattern. Place the subsamples in a bucket or large bag for mixing, then transfer at least 500 g (18 oz) to a labeled plastic bag or special soil test bag for submission to the lab. Do not expose the soil bags to direct sunlight. Submit the plant and soil samples immediately after collecting them or keep them refrigerated until you can send them in. Because of the complexity of this process, discussing site-specific sampling strategies with the diagnostic lab prior to sampling is recommended.

Disease Management

Disease management should focus on avoiding the introduction of *Verticillium* into an area, preventing the buildup and spread of *Verticillium* inoculum, and maintaining optimum tree health. To avoid the introduction of the pathogen, test planting stock for the presence of *Verticillium*. Also test the soil, and, if *Verticillium* is present or there is a known history of *Verticillium* in the area, planting resistant tree species is a helpful strategy (Sinclair and Lyon 2005). Alternatively, consider fumigation to reduce inoculum levels in the soil. Also, do not plant high-value tree crops next to fields with verticillium-susceptible crops.

To help prevent the buildup and spread of inoculum, carry out the following strategies:

- Prune and either burn infected limbs or remove and place them in plastic bags and deposit them in a landfill (preferably before the leaves fall and before new inoculum incorporates into the ground). Do not compost infected material.
- Keep soils weed-free as much as possible, particularly weeds that are known hosts of *Verticillium*.
- Avoid overwatering, because it spreads propagules of the pathogen.
- Clean work boots, machinery, and tools when moving from infested areas to clean areas. Disinfect pruning tools between trees, using a 70% alcohol solution. A 10% bleach solution is acceptable, but it can be corrosive to metal tools and it damages clothing.

Note that a tree infected with *Verticillium* can never be cured and will eventually die. However, maintaining optimum tree health significantly extends its life. This can be done by keeping nitrogenous fertilizers to a minimum: using only enough fertilizer to produce normal, healthy growth, not succulent growth; testing the soil for existing nutrient levels, then using the results to determine optimum fertilization rates; and irrigating regularly, avoiding under- or overirrigation. Indeed, underirrigating amplifies wilt symptoms, while overirrigating increases tree stress and the chances of spreading the disease to surrounding and thus susceptible trees. Finally, prune trees appropriately—avoid wounding tree roots and bark.

Further Reading

- Keykhasaber, M., B. P. H. J. Thomma, and J. A. Hiemstra. 2018. "Verticillium Wilt Caused by *Verticillium dahliae* in Woody Plants with Emphasis on Olive and Shade Trees." *European Journal of Plant Pathology* 150: 21–37.
- Sinclair, W. A., and H. H. Lyon. 2005. *Diseases of Trees and Shrubs*. 2nd edition. Ithaca, NY: Cornell University Press.

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