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**73. An aversion to *Verticillium*: with proper attention, *Verticillium* wilt disease can be managed.** Weiland, J. Digger 57(2):33-36. 2013.

# An aversion to verticillium

With proper attention, verticillium wilt disease can be managed



JERRY WEILAND

*Verticillium dahliae* is a fungus affecting certain susceptible plants, mostly when they are field grown. It starts in the roots and can work its way up through the vascular system, where infested plants will show discoloration.

*By Jerry Weiland*

Verticillium wilt is one of the most serious diseases affecting field production of ornamental trees and shrubs.

The disease is caused by the soil-borne fungus, *Verticillium dahliae*. (Note: *V. dahliae* was first isolated from dahlias, which gave rise to part of the scientific name for this pathogen.)

It is rarely a problem in containerized plants unless the potting media

becomes contaminated (by soil or infested hardwood mulch) or if roots grow from the container into infested soil.

The pathogen is very common in agricultural fields and has an extremely wide host range. *Verticillium dahliae* infects hundreds of economically important plant species, including ornamental flowers (coneflower, dahlia), vegetables (potato, lettuce), fiber crops (cotton), crops for essential oils and flavorings (mint, bay), fruit crops (raspberry, strawberry), nut trees (pistachio), and ornamental trees and shrubs (maple, smokebush), among many others.

Most knowledge about *V. dahliae* comes from the agricultural food and fiber crop industries for plant hosts such as potato, mint, strawberry, and cotton. Very little is known about how the pathogen affects woody plant species and, as a consequence, disease management options for nurseries are limited.

Nevertheless, we do know some basic aspects of the pathogen's biology that dictate which disease control measures will be effective.

The next few sections discuss important points about the *V. dahliae* life cycle, its host range, and include a

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description of common verticillium wilt symptoms. The final section addresses disease management strategies that can help minimize the damage caused by this destructive pathogen.

### Life cycle

*Verticillium dahliae* is extremely well-built for survival. Once it is in the soil, the fungus can endure for years in the absence of a suitable host.

It survives as tiny fungal structures called microsclerotia. These are dark, microscopic, thick-walled cell masses that are resistant to drying, flooding, and temperature extremes.

Microsclerotia germinate and produce hyphae (filamentous fungal strands) when roots of a host plant grow nearby. The hyphae then penetrate into the root system and begin to spread slowly, causing the fine roots

and then larger roots to die.

Once inside, the fungus may also colonize the plant's water-conducting tissues and produce tiny spores that can quickly move up through the plant in the sap stream. These spores lodge in other parts of the tree or shrub. There, they plug the water-conducting vessels, thereby initializing the wilt symptoms that give rise to the name of the disease.

As the plants begin to die, microsclerotia are produced in the leaves, stems, seeds, and roots. These infected parts are then important sources of inoculum for new infections. Infected leaves or seeds may blow into new areas, thus spreading the pathogen into previously clean field soils. Infected wood chips can also transmit the fungus.

### A tale of two verticilliums

Historically, *V. dahliae* has often been confused with a different species of *Verticillium* called *V. albo-atrum*. As a result, many older articles incorrectly listed *V. albo-atrum* as the causal agent of verticillium wilt in many woody plant species. However, the two pathogens are now officially recognized as distinct species with different host ranges.

*Verticillium dahliae* is the most common species isolated from ornamental and shade trees, and has a huge host range. Some of the most susceptible woody plant genera grown in the region include ash (*Fraxinus*), goldenrain tree (*Koelreuteria*), maple (*Acer*), redbud (*Cercis*), and smokebush (*Cotinus*).

All conifers (pine, spruce, yews, firs, and others) and grasses are considered resistant or immune, as well as birch (*Betula*), boxwood (*Buxus*), hackberry (*Celtis*), katsura tree (*Cercidiphyllum*), dogwood (*Cornus*), beech (*Fagus*), honeylocust (*Gleditsia*), sweetgum (*Liquidambar*), and sycamore (*Platanus*). A more complete listing of resistant and susceptible species should be consulted if you suspect *V. dahliae* is a problem in your fields.

*Diseases of Trees and Shrubs* by Sinclair



Acute and chronic symptoms of verticillium wilt in sugar maple: leaf scorch and stunting (left), premature fall coloration and stunting (middle), healthy plant (right).



This magnified image shows a single microsclerotium produced by the soilborne fungus *Verticillium dahliae*. The organism is 20 micrometers wide, which equals 2 hundredths of a millimeter.

and Lyon offers one such guide.

In contrast to *V. dahliae*, *V. albo-atrum* has a much more limited host range and has been mainly isolated from hops (*Humulus lupulus*), tree-of-heaven (*Ailanthus altissima*), potato, and alfalfa. Therefore, if you have any soil analyses conducted for the presence of *Verticillium* in tree or shrub production fields, make sure that the results are based on *V. dahliae* and not *V. albo-atrum*.

**Symptoms**

Symptoms of verticillium wilt usually begin to appear on trees and shrubs in mid-to-late summer, and may occur more quickly on plants experiencing water or transplant stress. Therefore, the best time to scout for the disease is from summer to early autumn when symptoms of wilting and dieback are most apparent.

There are two phases of symptoms: acute and chronic. Acute symptoms occur in a relatively short time span (days or a few weeks) and include wilting, leaf curling, premature fall coloration, leaf loss, branch dieback, and death. Chronic symptoms occur over a longer period of time (over a single growing season or across multiple years) and are typified by slow-growing, stunted plants with sparse or undersized leaves and twigs.

In some cases, leaf scorch (browning of leaf margins) or abundant seed production is observed. Both acute

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and chronic symptoms may occur on the same plant and the symptoms may either affect the entire plant or occur on only a few scattered branches.

If you cut into infected branches or stems, the sapwood may show a dark greenish-black or reddish-brown streaking along the direction of the grain. This will appear as a circular or semicircular pattern in cross section.

### Management

Avoidance is the best management strategy. Before planting a new field with susceptible plant species, be sure to send soil samples to a private or public laboratory to test for the presence of *V. dahliae*.

As little as 1 microsclerotia per gram of soil (1 CFU/g or 1 ppg) has been associated with disease. Therefore,

any detection of the pathogen in field soils should be considered a risk.

It may also pay to know the prior cropping history of the field. Fields with a history of mint, raspberry, strawberry, potato or other vegetable (squash, tomato, cabbage, etc.) should be used with caution as these crops are also hosts for *V. dahliae* and can leave behind substantial amounts of the fungus.

In order to minimize the accidental introduction of the pathogen, never move infested stock into fields where the pathogen is absent and inspect all incoming stock for symptoms of the disease. If possible, all equipment moved from infested fields to clean fields should be cleaned and/or disinfested.

Once *V. dahliae* is present in a particular field, the most practical option is to plant resistant tree and shrub species. Susceptible plants should never be planted in soils where the pathogen is found. In some cases, resistant cultivars of normally susceptible tree species are available, and these may also be a good option.

Infested nursery stock (including the root system) should be culled and burned to destroy any potential inoculum. Do not chip infected trees for mulch, as infested mulch can spread the pathogen to other locations.

Fumigation is effective at significantly knocking back soil populations and thereby reducing disease incidence. However, *V. dahliae* is unlikely to be completely eradicated. As the soil populations build back up over time, the infested fields will need to be periodically refumigated.

Fungicides are largely ineffective, and do not cure infected plants. Crop rotation does not work because of the pathogen's ability to survive in the soil for long periods of time as microsclerotia. The fungus can afford to wait for the next suitable host to be planted. In addition, *V. dahliae* is sometimes able to persist on the roots of some weed species and resistant hosts without causing symptoms, thereby sustaining its population in the soil in the absence of

a susceptible host.

Finally, soil solarization has shown some success in western Oregon at reducing *V. dahliae* populations. However, given that solarization is most effective in the upper soil profile and that it does not completely eradicate the pathogen, solarization may not be an effective option for the production of susceptible tree and shrub species.

### Summary

*Verticillium dahliae* is a challenging pathogen for many ornamental nurseries to deal with because it is widespread, has a large host range, and survives for years in the soil. In fields where the pathogen is absent, avoidance is key and all attempts should be made to prevent the pathogen from being introduced. In locations where the pathogen is present, resistant plant species should be used. ©

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