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PLANT DISEASE

VERTICILLIUM WILT

Verticillium wilt, a disease of a plant's vascular system, occurs worldwide, but is most important in temperate regions. In the Pacific Northwest, 50 genera of plants have been reported as susceptible to this disease, which is caused by a fungus. In Washington State, verticillium wilt is especially common in irrigated areas and is particularly severe on mint, potato, cherry, eggplant, melon, and such ornamentals as rose and catalpa. Mint wilt is especially devastating; if a mint planting becomes infected, production may become uneconomic within 3 to 5 years. In the late 1940s, growers moved most of the mint production from midwestern to western states in an effort to escape from Verticillium wilt. Unfortunately, they carried it with them on infected mint roots.

Symptoms. The fungus invades plant roots and plugs the water-conducting tissues, which prevents water from reaching the leaves. Symptoms may vary from one host plant to another, but commonly, the leaves wilt, drop (Figure 1), eventually turn yellow, and die prematurely. Wilting usually begins with the lower leaves and spreads upward. For most types of plants, severe disease may darken the water-conducting tissues, especially in the lower stem. This can be seen by cutting the stem lengthwise.

Figure 1. Verticillium wilt on cherry.

Cankers and bleeding are not usually associated with Verticillium wilt, but on Russian olive and cherry there may be considerable gum production on the trunk and larger branches.

Certain plants develop additional symptoms:

- *Alfalfa.* V-shaped necrotic lesions develop at the apex of the leaflets and shoots die without prominent crooking.
- *Cherry.* The spurs may die and the leaves drop. Generally, one side of the tree

Figure 2. Verticillium wilt on mint.

becomes infected and the leaves eventually turn a flame or yellow color. In addition, the woody tissue may have spots or extensive brown discoloration.

- *Melons.* A portion or all of the plant yellows and usually wilts just before the fruit is mature.
- *Mint.* There is a characteristic bronzing and twisting of the top leaves, which gives them a half-moon appearance (Figure 2).
- *Raspberry.* Especially in black raspberry, the lower portion of diseased canes may have a blue or purple color. The disease is often called "blue stem" in this case.

Pathogens. Verticillium wilt is caused primarily by two species of *Verticillium.*

(1) *Verticillium dahliae* is the most common species and attacks a wide range of plants. It is a major problem in many ornamentals in addition to many crop plants including mint, potato, cherry, and strawberry. It can also attack hops, but is usually only serious when the hop plants are grown in soil treated with the insecticide heptachlor. This chemical seems to predispose hops to more serious damage. *V. dahliae* readily infects potato and causes potato early dying (PED), which is a serious problem in the Midwest and Pacific Northwest. PED is marked by premature vine death and reduction in tuber yield by as much as 30 percent. Commercial certified seed tubers are commonly infected with *V. dahliae* and spread the pathogen.

V. dahliae produces small, black, resting structures called microsclerotia. Under favorable conditions, the microsclerotia sprout to produce small, thread-like strands (hyphae) that invade the roots of susceptible plants. These infection threads invade the water-conducting cells of the plant and cause wilt symptoms by destroying the ability of the plant cells to conduct water. Microsclerotia can be produced in large numbers in some host plants, such as potato, and can survive in the soil for up to fifteen years. This makes crop rotation both a high-risk practice and an ineffective control measure. For example, heavy damage can occur on susceptible hosts, such as cherry and strawberry, when they are planted in soil previously cropped to potato.

There are at least four groups, or strains, of *V. dahliae* that can vary from each other in many characteristics including pathogenicity and aggressiveness. These strains are called vegetative compatibility groups (VCGs). VCGs are genetically isolated from each other, meaning that an individual from one group (for example, VCG 2) can fuse with another individual from the same group (VCG 2), but not with an individual from a different group (for example, VCG 4). Isolates of *V. dahliae* can be identified in the laboratory by pairing known and unknown isolates.

Until recently, *V. dahliae* isolates were thought to have a wide variety of hosts, but recent research showed that certain isolates differ in aggressiveness on various hosts. Isolates of *V. dahliae* obtained from mint plants were significantly more aggressive on mint than isolates obtained from other host plants. Also, certain isolates (VCG 4A) from mint and potato were more aggressive on potato than were other isolates (VCG 2B and VCG 4B). Further evidence for host adaptation or specificity comes from studies regarding synergistic associations between *V. dahliae* isolates and nematodes. When a mint or potato plant becomes infected with both *Verticillium dahliae* and the root-lesion nematode *Pratylenchus penetrans,* the plant may develop earlier and more severe symptoms of verticillium wilt than a plant infected only by *V. dahliae.* This happened on potato with *V. dahliae* isolates from VCG 4A and on mint with isolates from VCG 2B, but not vice versa, and isolates from VCG 4B showed weak or no interaction on potato with the nematode. Currently, isolates of the following groups of *V. dahliae* are considered to be host-adapted: VCG 4A (potato), 2B (mint). Research on host adaptation and aggressiveness is being conducted to develop better disease management practices.

(2) *Verticillium albo-atrum* is most notable for causing alfalfa wilt and is less common than *V. dahliae* in relatively warm temperate climates. It is further

distinguished because it does not produce microsclerotia and its threadlike strands (hyphae) have thick, dark walls. It is called the "dark mycelial type."

Disease control. Controlling verticillium wilt is difficult and can be expensive, but several means of avoiding the disease and reducing losses are available:

- *Avoid planting susceptible trees and other plants* in soil previously cropped to susceptible herbaceous plants such as potato, tomato, eggplant, etc.
- *Eliminate susceptible weed hosts* such as pigweed, nightshade, and lamb's-quarter from plantings. These are hosts of the fungus and will enable it to build up in the soil and potentially infect new plantings.
- *Maintain a balanced fertilizer* schedule to avoid excessive succulent growth in young plants.
- *Provide adequate water during warm weather* to prevent or delay the onset of wilt symptoms.
- *Always use planting stock certified to be verticillium-free and to have been grown in verticillium-free soil* when planting susceptible crops in soil known to be free from the fungus. Keep in mind the accidental introduction of verticillium wilt to the Pacific Northwest when infected mint plants from the Midwest were brought here.
- *Prevent movement of soil from infested fields into clean fields* since *V. dahliae* can survive in the soil for up to 15 years as microsclerotia.
- *Prune infected and diseased limbs of cherry and ornamental trees.* Cherry trees usually recover from wilt.

Additional tips:

- Soil fumigation can reduce the amount of fungus present, but this method of control is expensive and recontamination is always possible.
- Disease-resistant cultivars are not available for most crop plants, but some plant species are more resistant or tolerant than others and should be considered when the disease is known to be a serious problem.
- Crop rotation is of little value because, once again, the fungus can survive in the soil for many years.

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