

Verticillium Wilt in Almonds

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Verticillium wilt can be seen in many young almond orchards this year. The cool wet spring has increased disease incidence. The symptoms show up in orchards in the late spring when the weather changes from cool to hot. The most visual symptom is dry yellow/brown leaves still hanging from one or two scaffolds of a young tree. At first look this disease gives the appearance of killing the trees but few trees are actually killed. The collapsed scaffolds often leaf out later in the year with the only loss being the tender tips of scaffolds that are too desiccated to regrow. It has been shown that affected trees can have reduced yields in subsequent years mainly due to smaller tree size.

Disease Development: Verticillium wilt (also known as blackheart) is caused by the fungus *Verticillium dahliae*. This soilborne fungus can be found in bare soil as microsclerotia or in plant debris that remains in the field. Microsclerotia are hard coated compacted fragments of fungus that can withstand harsh environmental conditions staying quiescent in the soil for years until roots of a host plant are in the vicinity. When a host plant is near, the fungus infects the roots and grows in the xylem (water conducting tissue) of the plant. The xylem becomes plugged with the fungus making it nonfunctional for water transport causing the plant to wilt. Cool wet springs are favorable for the growth of the fungus promoting the development of the disease. The fungus's growth is slowed or terminated by the hot dry summer conditions allowing the affected scaffolds to recover. In following years, re-infection can occur from new root infections or surviving fungus within the tree's roots and wood.

Many plants are hosts for Verticillium including all of the *Prunus* tree species, many row crops commonly grown in California (tomatoes, melons, potatoes, safflower, strawberry, eggplant, cotton) and many weed species (nightshade, groundsel, lambsquarter, dandelion, pigweed). Verticillium microsclerotia numbers can increase up to 60 per gram of soil where host plants have been grown. Yet, the disease can be a problem in new orchards planted where only 2-3 microsclerotia per gram of soil are found. The majority of the microsclerotia are found in the top layer of soil.

Diagnosing the Disease: Almonds are most susceptible to the disease from 1-5 years of age with most of the disease showing in the 2nd to 4th years. The following symptoms will help diagnose the disease.

- Flagging or wilting of one or two whole scaffolds often starting at the top of the scaffold and progressing downward. The rest of the tree may remain healthy. (photo 1)
- Leaves turn yellow/brown and adhere to the affected branches. Some leaf drop occurs lower on the scaffold.
- Scaffold shoot tips desiccate creating a 'shepherd's hook' appearance.
- Cutting into the wood or making a cut across the wood will show a darkening and streaking of the xylem tissue. (photo 2 & 3)

What to Do After Verticillium Strikes: When you find verticillium affected trees the current recommendation is to be patient and not prune prematurely. The summer heat will slow the growth of the fungus and allow the tree to push new growth from the surviving tissue. I have already seen early infections this year begin to re-leaf. Do not prune out dead wood until you can tell how much of the tree will have made a full recovery. Often you'll find that only the tips of affected scaffolds have died. In 1st and 2nd leaf orchards, in extreme cases some trees may die and will need to be replaced.

How to Avoid or Minimize the Disease:

- Avoid planting new orchards following cultivation of susceptible host crops or weed infestations.
- Don't intercrop with Verticillium susceptible hosts in new orchards.
- Take soil samples from the top 12 inches to determine amount of microsclerotia present before planting.
- If Verticillium is a risk, in the year(s) prior to planting reduce the microsclerotia survival by flooding during the heat of summer, solarization using clear plastic tarps, fumigation with chloropicrin or a combination that contains chloropicrin, or grow a non-host cover crop like sudan grass.
- Use Marianna 2624 rootstock if you are planting compatible almond varieties. Nonpareil is not compatible. M2624 comes with other negative issues such as suckering and possibly Union Mild Etch problems so all risks need to be considered in choosing this rootstock.
- If the orchard is already planted, black plastic mulch the first year can reduce infection or the use of a non-host cover crop (grasses) has been reported to help.



Photo 1. Verticillium wilt in a young almond tree (C.DeBuse)



Photo 2&3. Xylem darkening in verticillium affected almond tree. (C.DeBuse)

