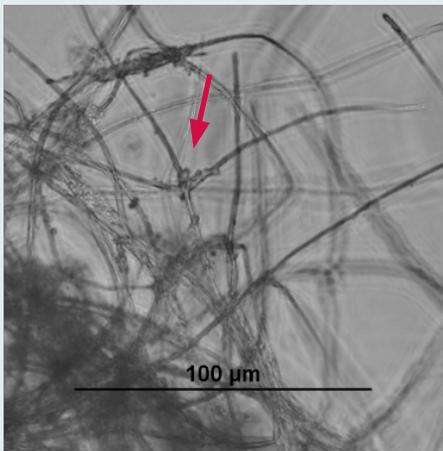




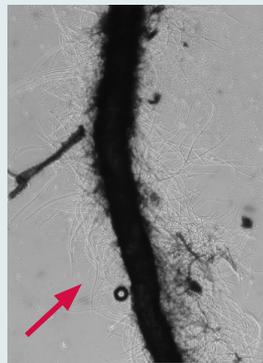
## Pistachio Soilborne Diseases

*Jiahuai Hu*

### PHYMATOTRICHOPSIS ROOT ROT



Cruciform-branched hyphae along mycelial strand



Tapered hyphae network along the mycelial strand



Fungal mycelial strands on root bark surface



Sudden death of an infected young tree with brown leaves remained firmly attached to the tree



A young orchard infested heavily with cotton root rot

## VERTICILLIUM WILT



Scaffold branch death



Bare spot with several tree death



Canopy thinning and defoliation



Staining of vascular and pith in main stem



Vascular streaking of a verticillium infected tree limb

White vascular tissue of a healthy tree limb

## PHYTOPHTHORA ROOT AND CROWN ROT



sucker growth from rootstock, extensive bleeding and gummosis, bark canker



Crown rot and root rot



Crown canker: dark brown cambium with a sharp demarcation line between diseased (reddish to brown) wood and healthy (white) wood



Sudden tree death with leaf firmly attached to the tree

## COMPARISON OF PISTACHIO SOIL BORNE DISEASES

|                                      | PHYMATOTRICHOPSIS ROOT ROT  |   | VERTICILLIUM WILT  |  | PHYTOPHTHORA DISEASES |  |
|--------------------------------------|---|---|--|--|-----------------------|--|
|                                      | PHYMATOTRICHOPSIS ROOT ROT  | VERTICILLIUM WILT   | ROOT ROT   | CROWN ROT  |                       |  |
| Common names                         | Cotton root rot, Texas root rot, Phymatotrichum root rot  | Thin leaf decline   | Phytophthora root rot  | Phytophthora crown rot   |                       |  |
| Pathogen                             | <i>Phymatotrichopsis omnivora</i> (Fungus)  | <i>Verticillium dahliae</i> (Fungus)  | <i>Phytophthora nicotianae</i> and other Phytophthora species (oomycete, fungus-like microorganism, water molds)   | <i>Phytophthora nicotianae</i> and other Phytophthora species  |                       |  |
| Organs invaded by pathogen           | Bark and outer wood tissues of roots and crown  | Vascular systems of root, trunk and branches  | Infections of small roots such as feeder roots which led to reduced uptake of water and nutrients  | Bark and outer wood tissues of crown and lower trunk   |                       |  |
| Tree canopy symptoms                 | Typically rapid death of young tree, branch death on mature trees; sometimes slow decline   | Poor vigor which may be accompanied by slow thinning of canopy  | Reduced tree growth and slow thinning of canopy  | Rapid canopy decline and tree death  |                       |  |
| Leaf symptoms                        | Yellowing and bronzing of leaves with marginal chlorosis or necrosis<br>Dead leaves remain attached to the branches; leaf defoliation on mature trees   | Yellowing of leaves in mid-summer, interveinal patches of yellowing or scorching of the leaves on affected branches   | Early defoliation and senescence   | Affected trees may leaf out in spring, but later die in hot summer.                                      |                       |  |
| Stem, twig or shoot symptoms         | Branch death, bark lesions on tree trunk near soil line   | One or more branch death, Vascular streaking, sudden collapse of branches; flagging and shepherd's crook of new shoots  | Branch dieback with defoliation  | Branch or tree death by canker that girdles the tree, profusely gumming                                  |                       |  |
| When symptoms appear                 | In summer or fall when soil and air temperatures are high   | Late spring and early summer  | Several growing seasons  | Late spring and summer   |                       |  |
| Spread                               | From tree to tree by mycelial strand growing through soil, introduced to new areas through contaminated soils or plant materials  | Within a row through growth of infected roots, introduce to new sites by plant materials or soil contaminated with microsclerotia   | By swimming zoospores that moves through soil water film   | By splash of irrigation water via sprinkler  |                       |  |
| Survival structures                  | Mycelial strands on diseased debris in soil and sclerotia (seed like structure) buried deep in soil   | Microsclerotia in the soil or lives on the roots of alternate hosts or weeds  | Oospores (sexual spores with thick-walled) or chlamydospores (resistant asexual spores)  | Oospores (sexual spores with thick-walled) or chlamydospores (resistant asexual spores)                  |                       |  |
| Factors favoring disease development | Alkaline calcareous clay soil (pH:7 to 8.5), high soil temperature in late spring and summer  | Cool spring temperatures and moist soils, mild summer, over-irrigation  | Soil that is heavy in clay, poorly drained with caliche  | Sprinkler-irrigated orchards   |                       |  |
| Susceptible varieties or rootstocks  | All varieties and rootstocks  | Rootstock <i>P. atlantica</i> , <i>P. terebinthus</i>   | Susceptibility depends on the particular interaction between rootstock and Phytophthora species involved   | Susceptibility depends on the particular interaction between rootstock and Phytophthora species involved |                       |  |
| Management options                   | No effective management methods including resistance are available. Soil modification to increase organic matter and microbial diversity, lower soil pH may reduce disease severity. Rhyme fungicide (flutriafol) is not available on pistachio | the most effective tool is resistant or tolerant rootstocks: Pioneer Gold ( <i>P. integerrima</i> ) PGI or UCB-1 (a <i>P. atlantica</i> x <i>P. integerrima</i> hybrid);<br>Cultural practices include weed control, good fertility, good tree vigor, planting at a site without history of susceptible crops | Limit period of soil saturation by choosing well drained planting site, monitoring irrigation water, and improving soil structure; no fungicides are registered for managing Phytophthora disease on pistachios. | Sprinklers or micro-sprinklers should be set to avoid water hitting the tree                             |                       |  |

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