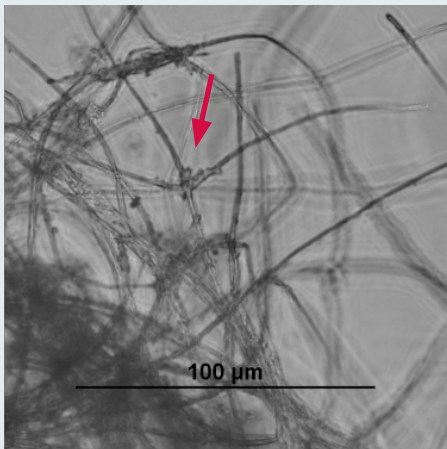




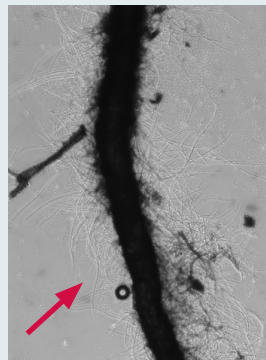
Pistachio Soilborne Diseases

Jiahuai Hu

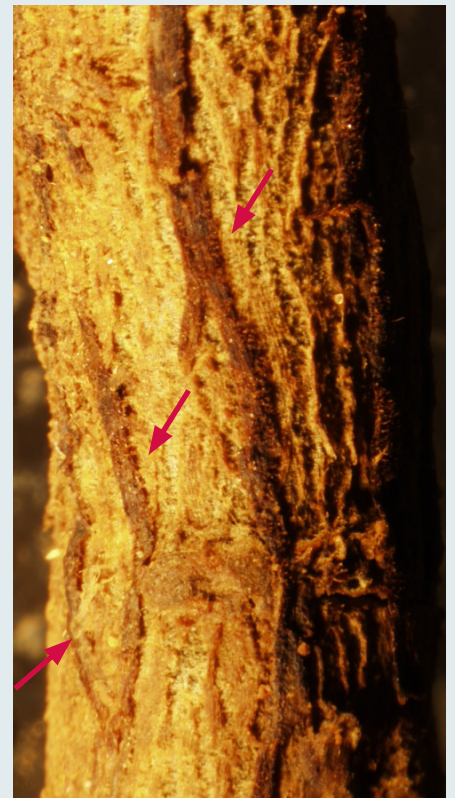
PHYMATOTRICHOPSIS ROOT ROT



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 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); 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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THE UNIVERSITY OF ARIZONA

Cooperative Extension

THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE AND LIFE SCIENCES
TUCSON, ARIZONA 85721

AUTHORS

DR. JIAHUI HU

*Assistant Cooperative Extension Specialist and Plant Pathologist,
School of Plant Sciences*

CONTACT

JIAHUI HU

epp@email.arizona.edu

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