Epidemiology and Management of Phytophthora Root and Crown Rot of Almond

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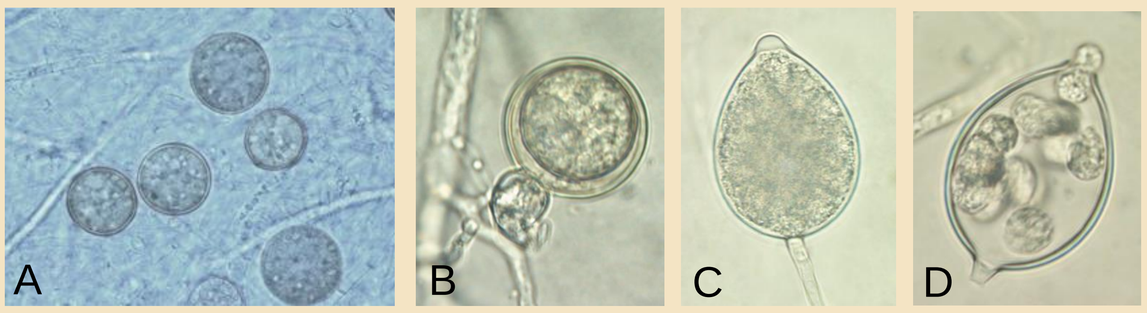
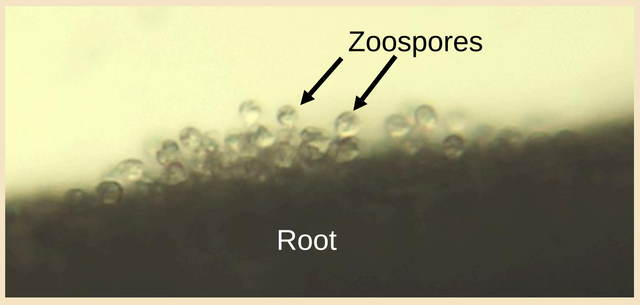
Phytophthora root and crown rot of almond

Phytophthora root rot and crown rot of almond can be caused by several species of *Phytophthora* including *P. cactorum, P. cryptogea*, *P. megasperma*, *P. niederhauseri*. Depending on the species, *Phytophthora species* survive as chlamydospores, oospores, and/or hyphae in plant debris in the soil.



A) Chlamydospores of *P. parasitica*. B) Oospore of *P. cactorum*. C) Sporangium of *P. cactorum*. D) Sporangium of *P. cactorum* releasing zoospores.

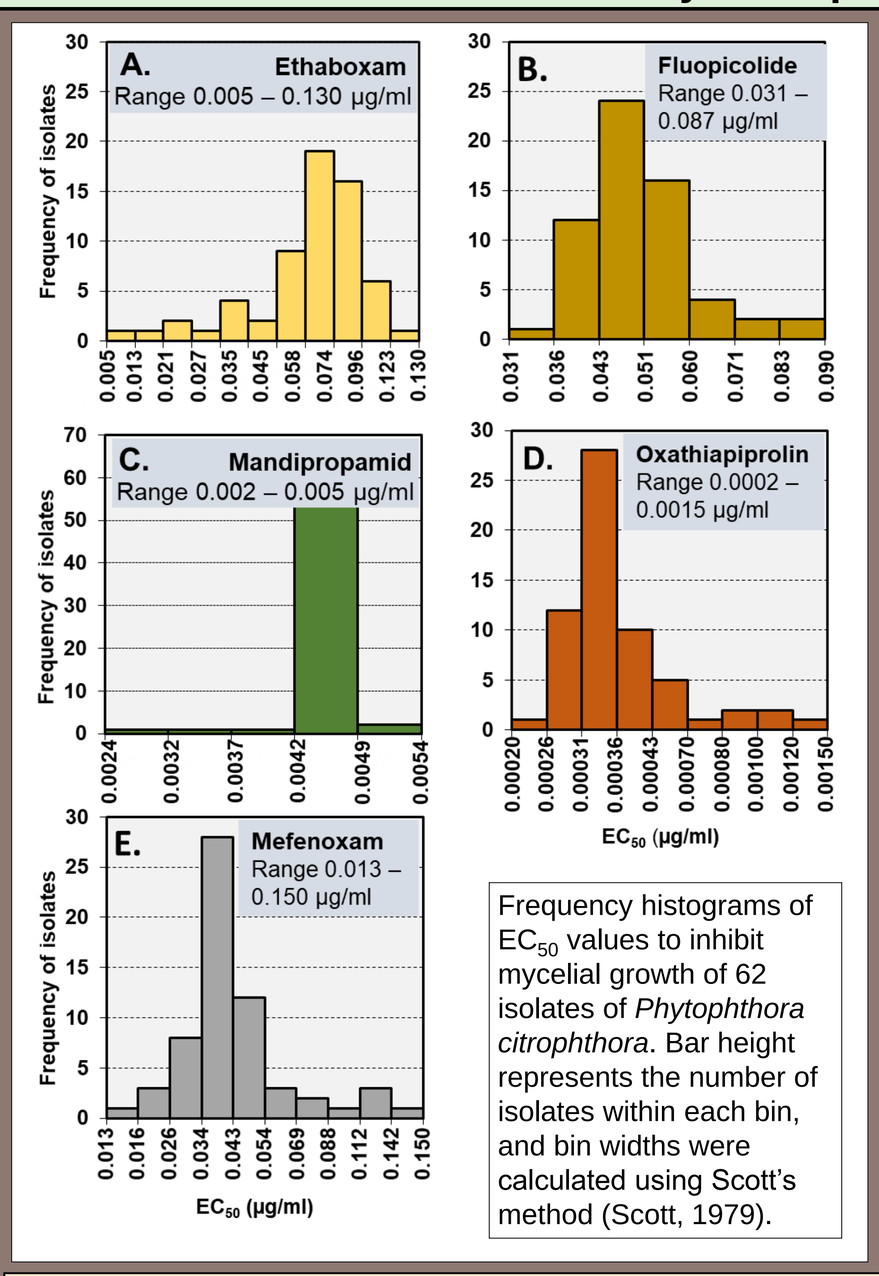


Under proper conditions (wetness and favorable temperatures), hyphae start growing or chlamydospores and oospores germinate to produce sporangia that contain zoospores - the main infective propagules. Zoospores are attracted to roots by root exudates (left).

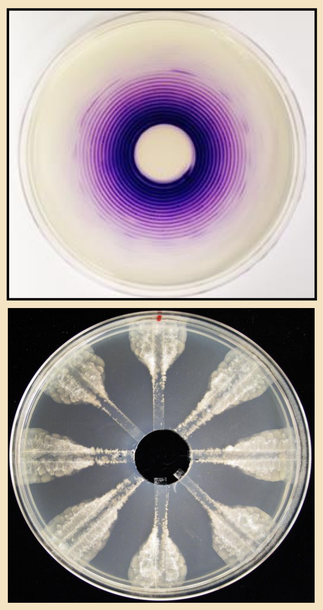
Currently registered and new fungicides for managing Phytophthora Root and Crown Rot diseases

Common Name	Trade Name	Class	FRAC
metalaxyl, mefenoxam	Ridomil Gold	Phenylamides	4
fosetyl-Al, phosphorous acid	Various	Phosphonates	33
mandipropamid	Revus	CAAs	40
fluopicolide	Presidio	Benzamides	43
ethaboxam	Intego	Thiazole carboxamide	U5
oxathiapiprolin	Orondis	Piperidinyl thiazole isoxazolines	49

In vitro sensitivities of new Oomycota-specific fungicides



Frequency histograms of EC_{50} values to inhibit mycelial growth of 62 isolates of *Phytophthora citrophthora*. Bar height represents the number of isolates within each bin, and bin widths were calculated using Scott's method (Scott, 1979).



Spiral gradient dilution assay with dye demonstrating concentration gradient (top) and growth response of 8 isolates of *Phytophthora* on a fungicide concentration gradient (bottom). High concentrations in the center inhibit growth.

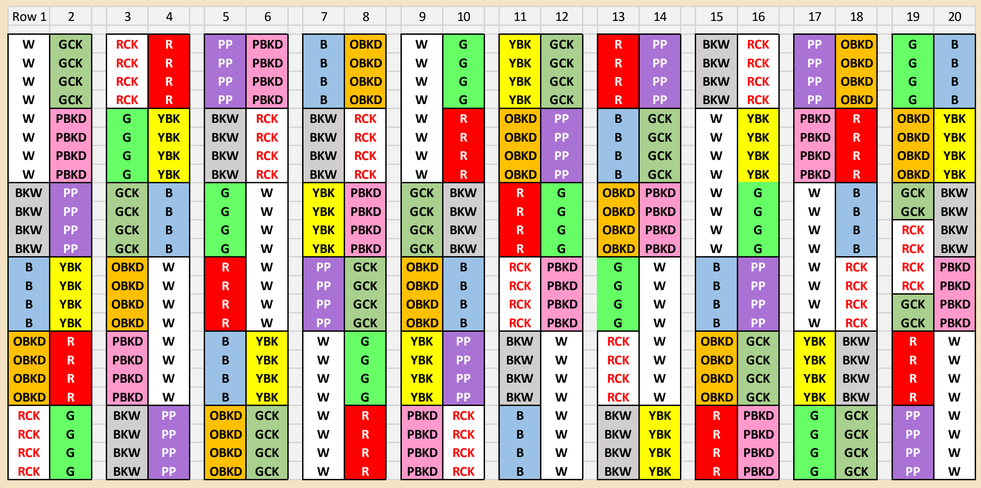
- Similar sensitivity ranges were determined for several other *Phytophthora* species.
- Oxathiapiprolin is the most active compound ever evaluated.
  - It was also highly effective against other life stages of the pathogens: chlamydospore and oospore formation, sporangia production, and cyst germination.

Field trials on the management of Phytophthora root and crown rot of almond

Procedures

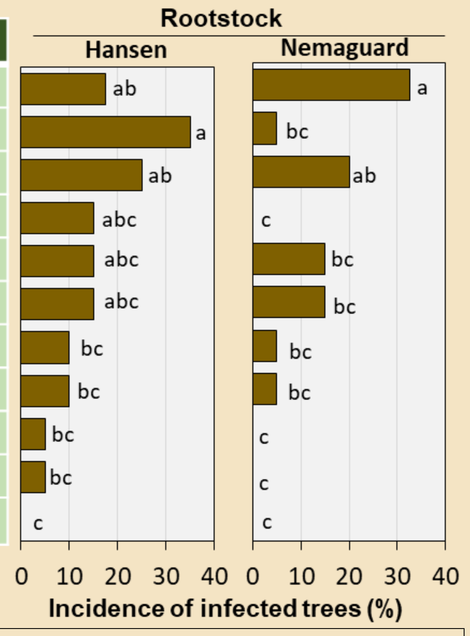
- May 2016: Nonpareil trees on Nemaguard and Hansen rootstocks planted at UC Davis. 10 replications with two trees of each rootstock.
- July and Oct 2016: Inoculated soil with *P. cactorum,* March 2017: *P. cactorum, P. citrophthora*, *P. cambivora*
- July 2016 (after planting) and July 2017: Treatments – 0.5 L fungicide solution/tree.
- July 2017: Trees with crown rot were first observed, evaluation in September..

Field trial at UC Davis with a randomized complete block design.



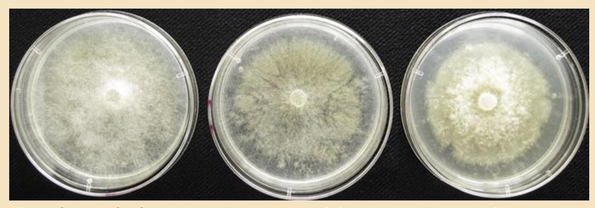
Results:

Treatment	Rate(/A)
Control	---
Ridomil Gold 480SL	1 pt
Intego	10 fl oz
Prophyt	64 fl oz
Presidio	6 fl oz
Presidio + Intego	6 + 10 fl oz
Prophyt + Ridomil Gold	64 + 16 fl oz
Revus 250SC	8 fl oz
Orondis 100 OD	9.6 fl oz
Orondis 100 OD	19.2 fl oz
Orondis 100 OD	4.8 fl oz

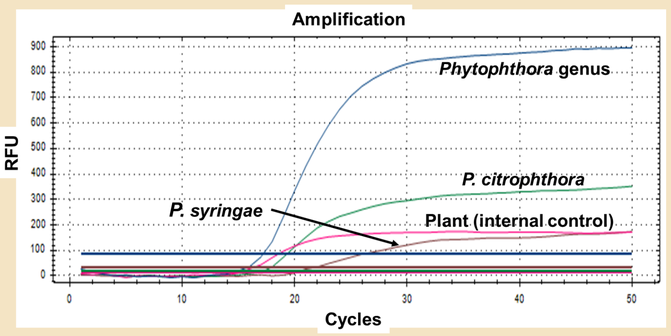


Efficacy data identified Orondis and Revus as highly effective on both rootstocks for managing Phytophthora crown rot on almond. Presidio and Intego were previously shown to have efficacy against Phytophthora root rot on other crops.

Phytophthora crown rot with canker expanding up the trunk of 'Nonpareil' almond. Gumming is a typical host response to infection.



P. citrophthora *P. parasitica* *P. syringae*



Identification of *Phytophthora* species by TaqMan qPCR

Project Summary

Several new Oomycota-specific fungicides including mandipropamid, fluopicolide, ethaboxam, and oxathiapiprolin have recently become available. These fungicides:

- All have high toxicity to *Phytophthora* spp in vitro.
- All have different modes of action (different FRAC groups).
- Resistance management strategies can be developed.
- Orondis and Revus were highly effective in preventing Phytophthora crown rot and were compared to mefenoxam and potassium phosphite in field studies.
- All fungicides will continued to be evaluated for different disease phases such as root rot.
- Respective registrants are supporting almond registration.
- A second field study was initiated in the fall of 2017 at UC Davis.