Kearney Agricultural Research and Extension Center (KARE)

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Etiology and Management of Trunk and Scaffold Canker Diseases in Almond

L.A. Holland*, M. Nouri, M. Crespo, N. Morris, T. Michailides, D.A. Doll, R.A. Duncan, D.M. Lightle, M.A. Yaghmour, F.J.A. Niederholzer, E.J. Fichtner, K.S. Pope, B.A. Holtz., and F.P. Trouillas

**PhD Student, Department of Plant Pathology, University of California, Davis*

ANR University of California

What are trunk and scaffold canker diseases?

- Trunk and scaffold canker diseases (TSCD) of almond cause significant yield and tree losses within orchards, while also reducing orchard life spans
- Common symptoms of TSCD include vascular discolorations, wood necrosis, cankers and extensive gumming. Dieback of scaffold branches can occur and eventually the whole tree may die

Fig 1. Symptoms of trunk and scaffold canker diseases of almond

What causes trunk and scaffold canker diseases?

- Surveys of California almond orchards in 2015 and 2016 revealed a broad diversity of fungal pathogens associated with trunk and scaffold cankers
- The main fungal pathogens associated with canker diseases included **Botryosphaeriaceae spp. (30%) and *Ceratocystis fimbriata* (21%).** Other fungi associated with cankers in California almonds include ***Collophora* spp. (9%), *Cytospora* spp. (17.5%), *Phomopsis* spp. (11%), *Eutypa lata* (7.5%), and *Phytophthora* spp. (4%).**

'Bot' canker
Cankers associated with pruning wounds; or on trunk (band canker) with gumballs in ring

Ceratocystis canker
Cankers associated with pruning wounds; trunk cankers associated with mechanical shaker damage; gumballs delineate margin of canker

How do the pathogens infect trees?

- The primary infection court for canker pathogens are pruning wounds, and in the case of Ceratocystis injuries to bark from mechanical damage during harvest
- Spores of the fungal pathogens can spread during rain events
- Canker pathogens tend to infect pruning wounds during the dormant period which coincides with rain in California; cankers actively expand during the growing season

Fig 2. Pruning wounds left after scaffold selection

What pathogens are most aggressive on almond?

- Pathogenicity tests were carried out on almond branches (2nd to 3rd year wood) in experimental orchards in Colusa and Kern Counties. A total of 17 fungal isolates were tested on three cultivars of almond (Nonpareil, Aldrich and Sonora).
- Fungi from the Botryosphaeriaceae (*Neofusicoccum arbuti*, *N. parvum* and *N. mediterraneum*) were the most aggressive TSCD pathogens on almond

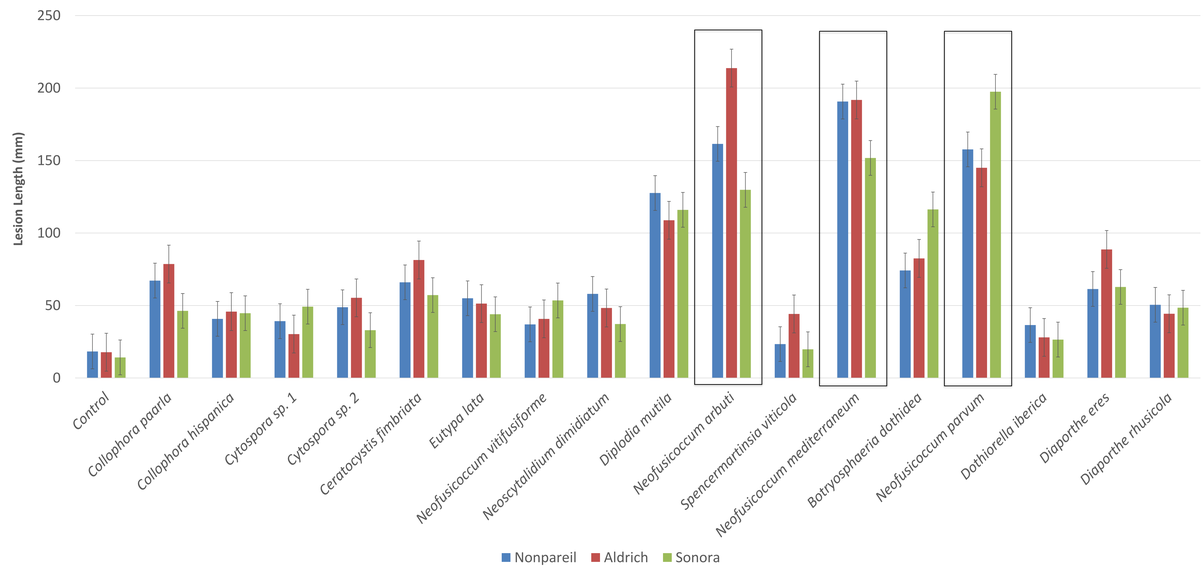

Fig 3. Lesion lengths on almond caused by various TSCD pathogens

How do we manage TSCD of almond?

- Pruning wound protection field trials were established during the dormant season (2016-2017) in experimental orchards to test the efficacy of numerous fungicide products against several TSCD pathogens. Pruning wounds were made on 2nd to 3rd year branches, fungicides were applied to wounds, and fungal spores were used to inoculate treated wounds.

Table 1 . Results from Year 1 pruning wound protection field trial (Colusa County)

	Eutypa	*B. dothidea*	*N. parvum*	*N. mediterraneum*	*Neosc. dimidiatum*	*D. mutila*	Avg. recovery
Control	75	100	50	75	50	50	66. 7
neem oil	100	100	100	100	100	100	100
thyme oil #2	50	100	100	100	100	100	91. 7
Trichoderma	50	50	75	100	50	75	66. 7
metconazole	25	50	50	75	75	75	58. 3
thiophanate-methyl	25	50	50	0	25	0	25
acrylic paint	0	25	75	75	25	25	37.5
natural wound sealant	0	25	25	75	0	75	33.3
myclobutanil	25	25	75	0	75	50	41. 7
fenbuconazole	75	100	75	100	75	50	79.2
penthiopyrad	67	100	50	75	100	75	77.8
difenoconazole/cyprodinil	50	25	75	50	50	50	50
fluopyram/trifloxystrobin	25	0	25	50	25	0	20.8
propiconazole/azoxystrobin	25	0	0	0	75	50	25
tebuconazole/phosphite	25	50	0	25	25	75	33. 3
fluopyram/tebuconazole	0	67	0	100	0	25	32
chlorothalonil	25	50	75	100	25	50	54.2
difenoconazole/azoxystrobin	25	25	50	100	75	67	57
pyraclostrobin/fluxapyroxad	50	0	0	0	25	0	12.5
pyraclostrobin/boscalid	50	25	0	100	50	0	37.5
azoxystrobin	33	67	50	100	50	100	66. 7
ziram	75	100	100	100	75	100	91. 7
Avg. recovery	39.8	51. 5	50	68.2	52.3	54.2	

% of fungal recovery from treated wounds

- 0%
- 25-50%
- 75-100%

Top performing products

- propiconazole/azoxystrobin
- pyraclostrobin/fluxapyroxad
- fluopyram/tebuconazole
- thiophanate-methyl
- fluopyram/trifloxystrobin

- Prevent disease establishment in the early years by appropriate tree training and scaffold selection
- **Avoid** wetting the tree trunks with sprinklers
- Remedial surgery, cut into the clean wood
- A second year of pruning wound protection field trials will be carried out in December 2017

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