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# Canker diseases of almond

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# 2014-15: 25 Farm Calls in almond orchard with Farm Advisors



- Trunk and Scaffold cankers: 18
- Wood decay – Heart rot: 4
- Lower limb dieback: 2
- Abiotic: 1

Elizabeth Fichtner: Tulare County

Gurreet Brar: Fresno and Madera Counties

Roger Duncan: Stanislaus County

David Doll: Merced County

**Trees are dying young: 8-9 years-old**

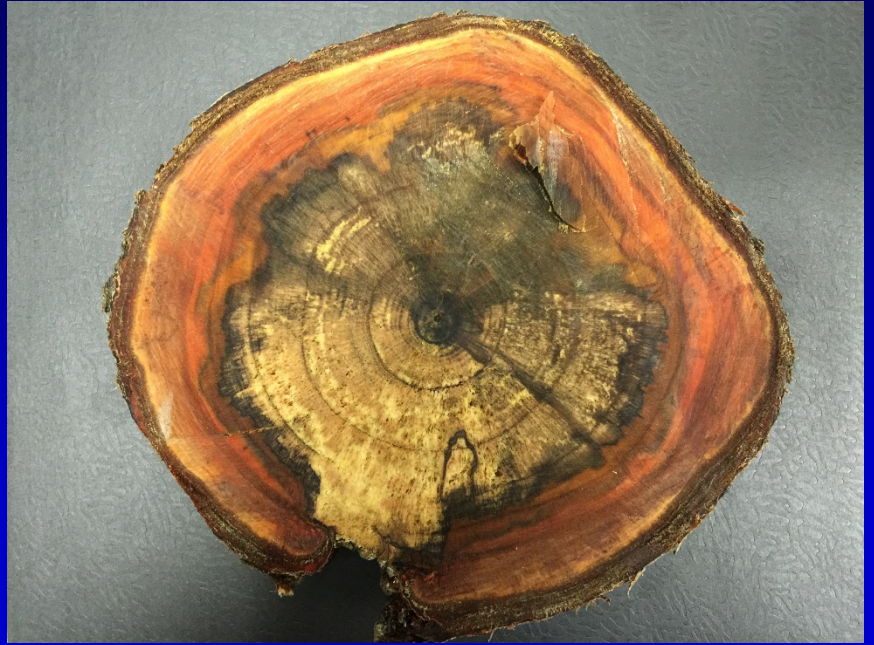


# Almond canker diseases:





# Wood decay, Heart rot diseases: Bracket fungi, Secondary?





# Bacterial canker:

- *Pseudomonas syringae* pv. *syringae*
- Symptoms usually found late winter into spring
- Can be very destructive to trees 2-8 years old
- Islands of necrotic tissue (flecks), which coalesce into large cankers
- Cankers do not extend into the soil
- Very unique sour smell





# Bacterial canker:





# Bacterial canker:

## Complex disease that is poorly understood

- All *Prunus* species are susceptible
- Usually associated with stressed/weak trees – heat, cold, nematodes...
- Highly correlated with the presence of ring nematode in soil
- Sandy soil or sandy spot in the orchard
- Favored by high moisture and low temperatures in spring
- Marianna 2624 and peach-almond hybrid rootstocks are more susceptible (Brights, Hansen, etc..)
- Pathogen is present on plant surfaces (epiphytes) and invades through openings (lenticels, stomates, leaf scars, etc.)
- Pathogen spread by rain splash



# Bacterial canker:

## Management

- Improve tree vigor
- Foliar application of Nitrogen (low-biuret urea) in the fall
- Viking the best rootstock for site prone to bacterial canker
- Post-plant nematicide
- Remove branch and trees that have been killed
- In soils that have exhibited the disease, with several generation of *Prunus* spp: pre-plant fumigation (last resort)



# Ceratocystis canker:



Caused by the fungus *Ceratocystis fimbriata*

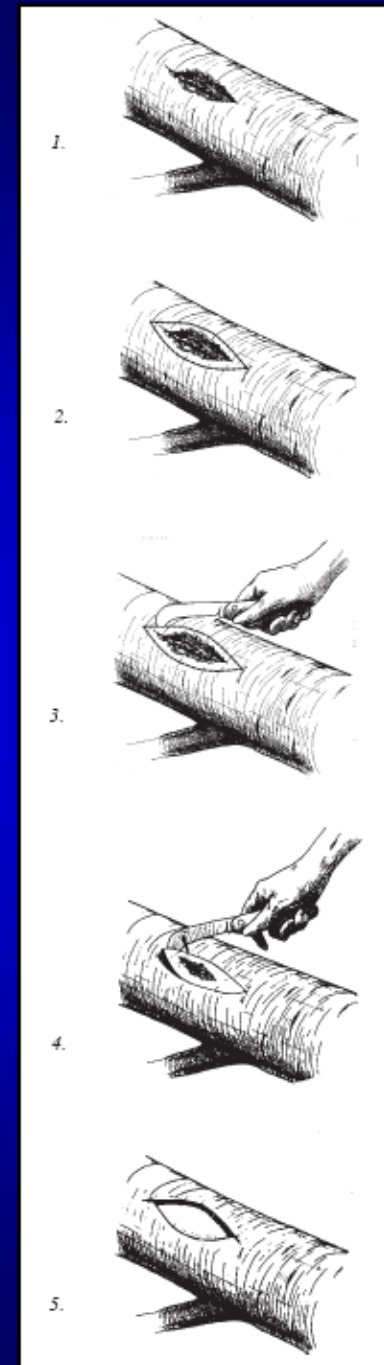
- Infections occur in bruise type injuries that expose the cambium in trunk and scaffold branches
- Usually associated with mechanical-harvest injury and pruning wounds
- Cankers are most active during the growing season.
- Amber gum at the canker margin
- Disease spread by sap-feeding insects and fruit flies
- Bark injuries and pruning wounds are susceptible for up to 14 days



# Management of Ceratocystis canker:

## Non-chemical control

- Avoid shaker injuries to trunks and scaffolds
- Insure orchards are relatively dry prior to harvest
- Avoid wounds on small twigs and branches which can also be infected
- You can perform surgery (and this can be repeated in the following year)
- Surgery in the winter when insects are not active (1" from canker margins)
- Cut away the diseased bark tissue
- Protect wound after clean up





# Aerial Phytophthora:

Caused by the fungus *P. syringae*, *P. citricola*, *P. cactorum*,

- Usually associated with pruning wounds or scaffold crotch pocket
- Cankers are fast growing but will stop as the pathogen dies out in hot weather
- Gum balls occur throughout the disease area
- Inoculum blown onto trees during harvest





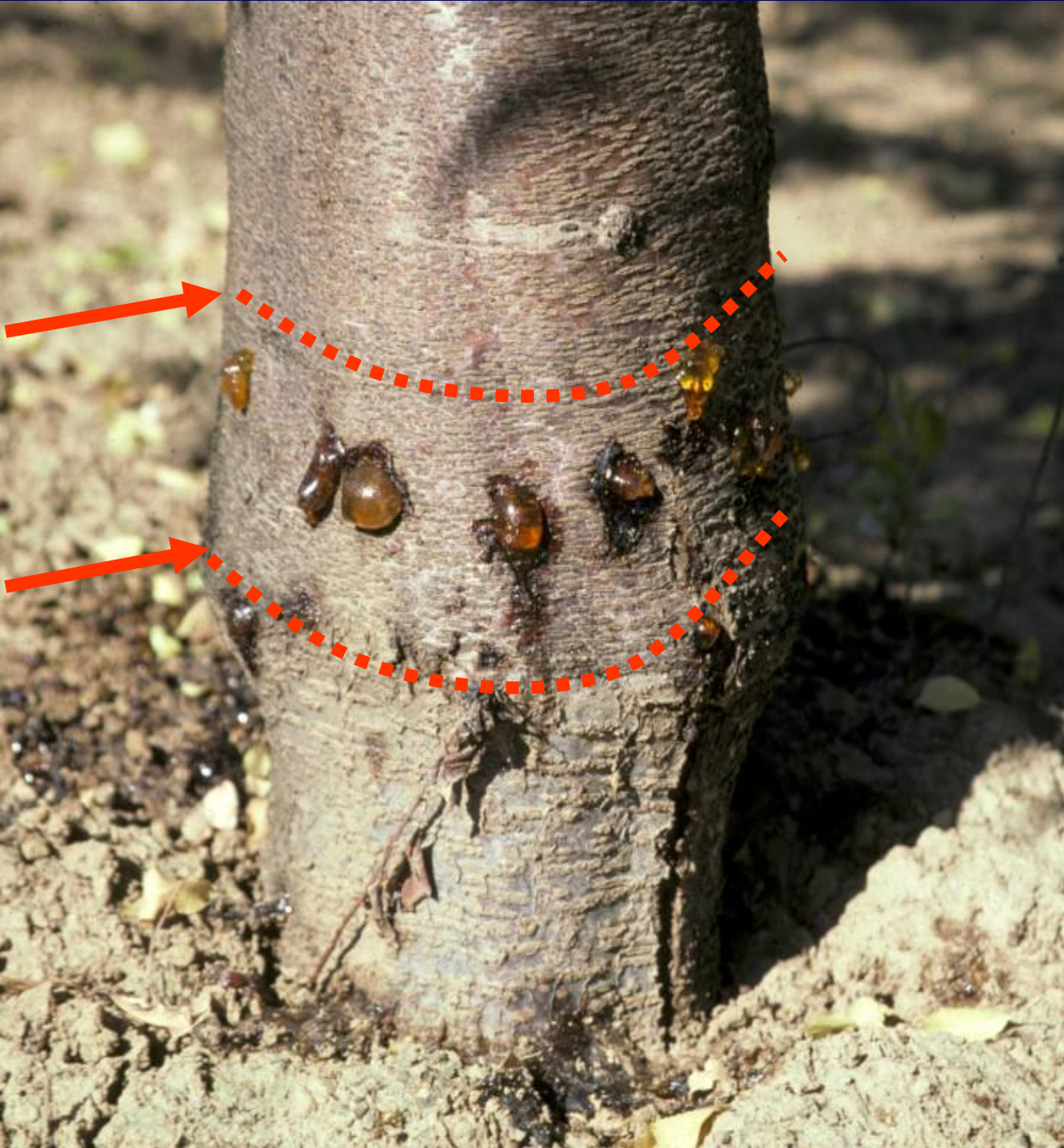
# Botryosphaeria canker:





# Band canker

initial "band"  
canker  
symptoms





# Band canker

growth cracks





## Band canker can occur on:

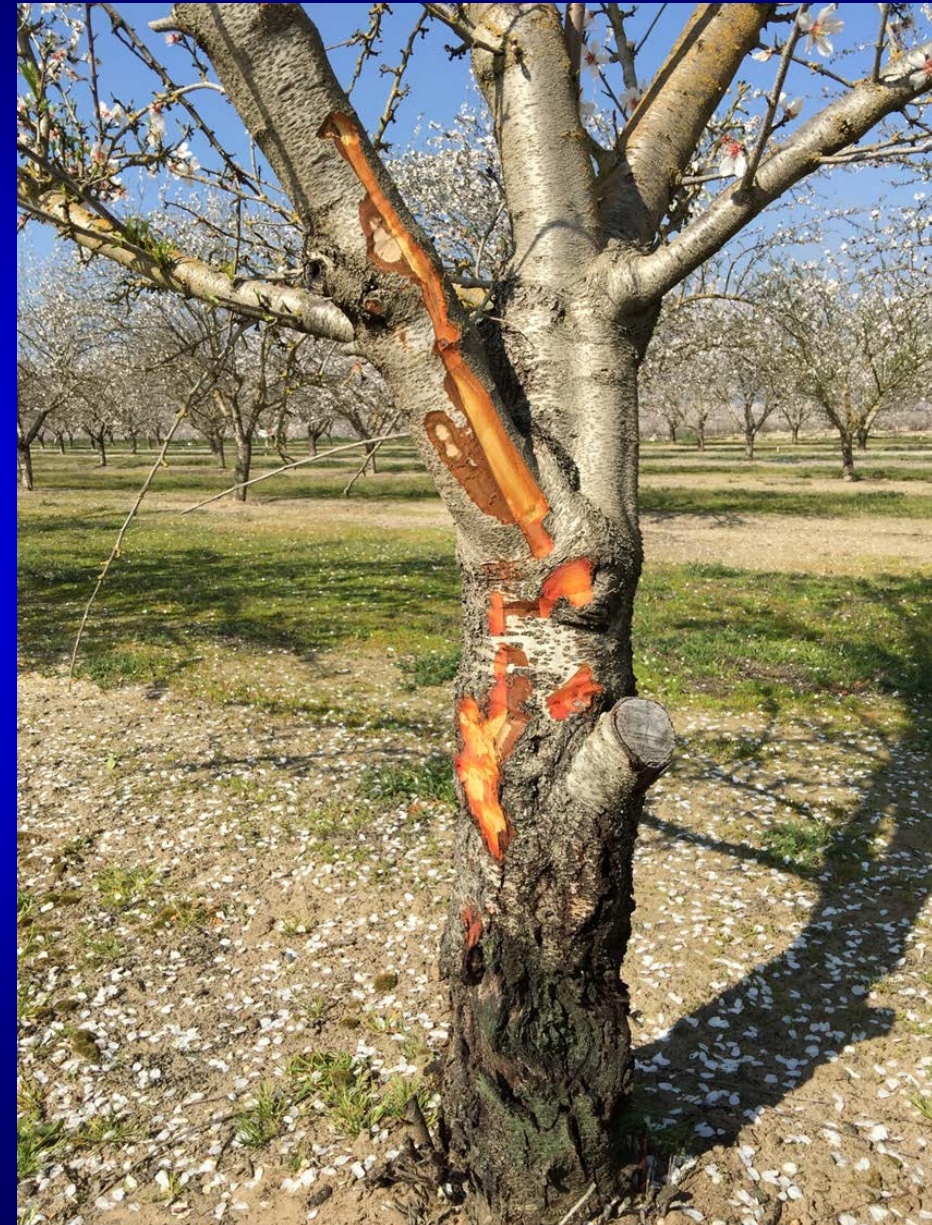
- Vigorously growing varieties
- 3 to 6-years-old trees

## Varieties affected by band canker

- Nonpareil
- Carmel
- Padre
- Butte



# Botryosphaeria canker



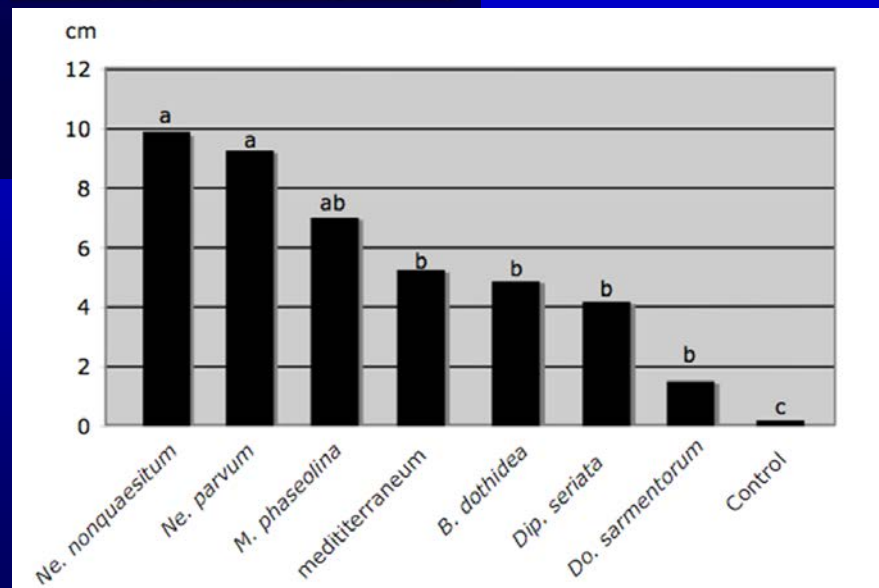
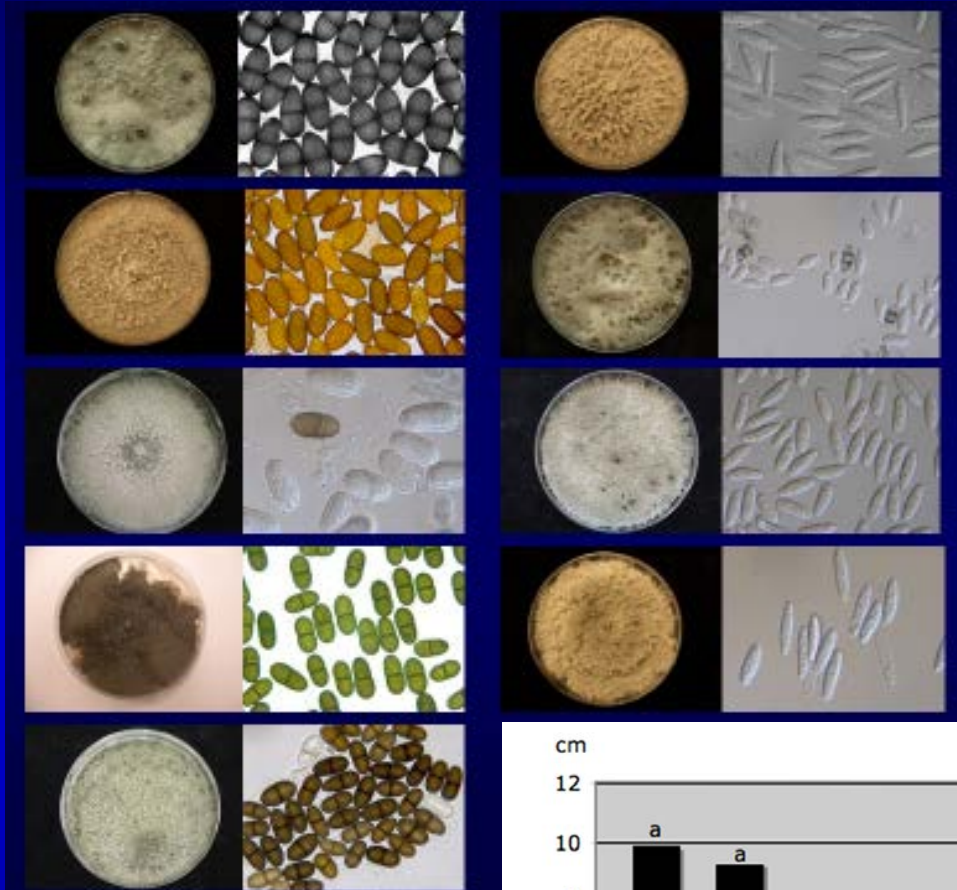


# Botryosphaeria canker





# Disease etiology: 9 species of Botryosphaeria in almond



Canker size caused by different Bot species in almond



## Disease epidemiology:

- Ways of infection: growth cracks, lenticels, fruit stems, pruning wounds
- Sources of inoculum were identified inside the orchards (tree stumps) and outside of orchards (riparian areas)

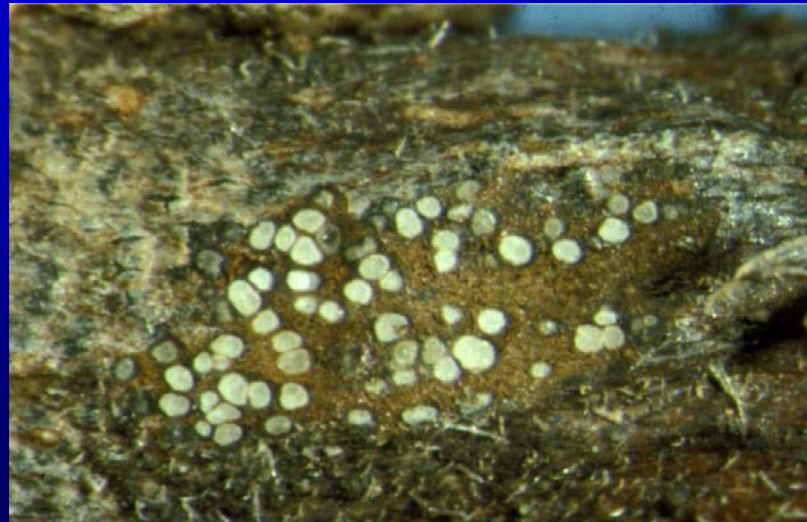
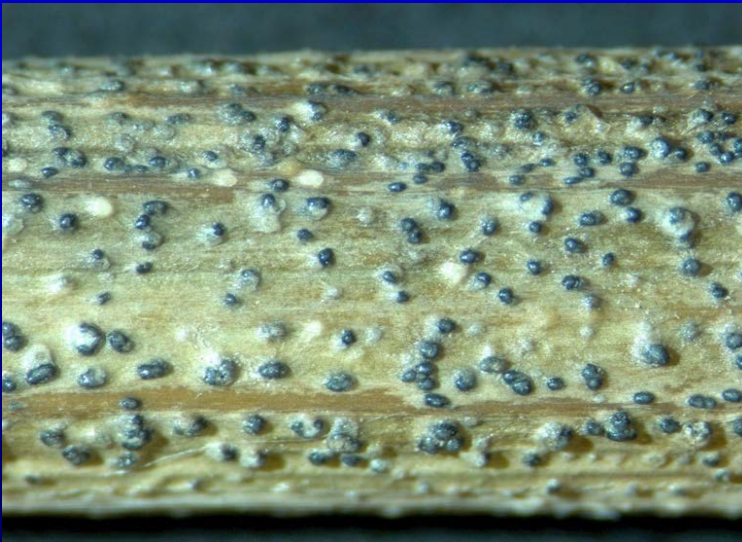
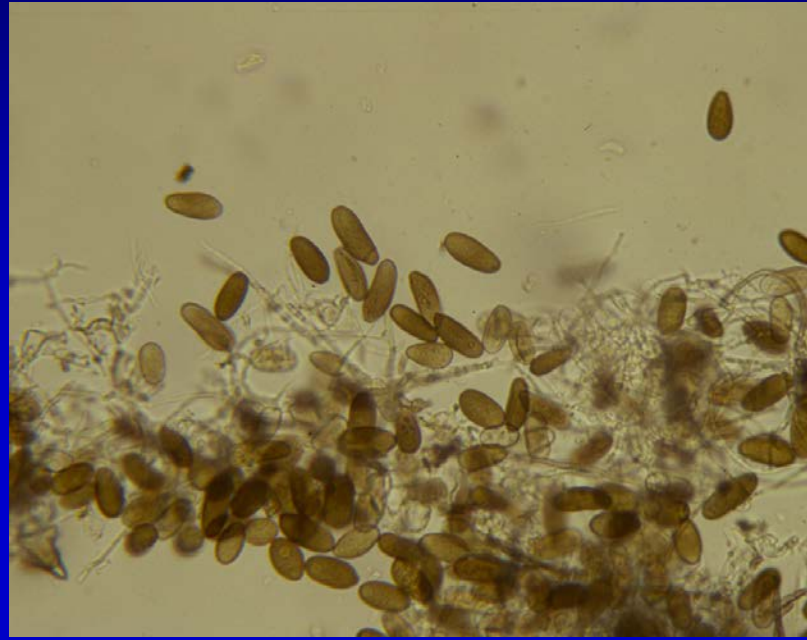
## Broad host range:

- Walnut
- Pistachio
- Grapevine
- Prune
- Olive
- Oak trees
- Blackberry
- Willow
- Cottonwood
- Bay laurel
- Etc...



# Disease epidemiology:

Inoculum sources: dead wood

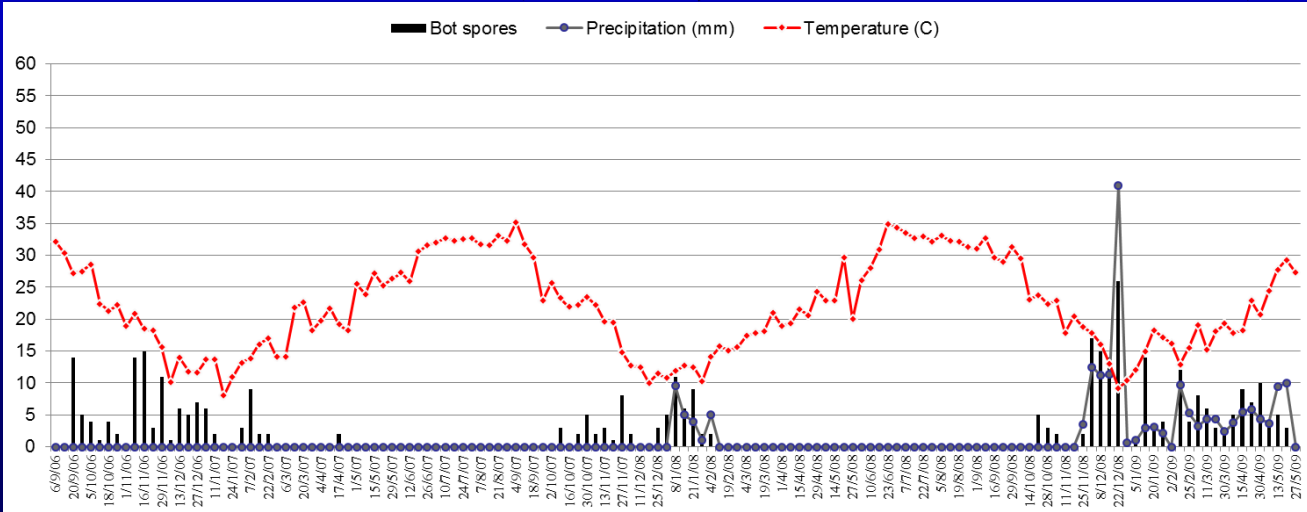
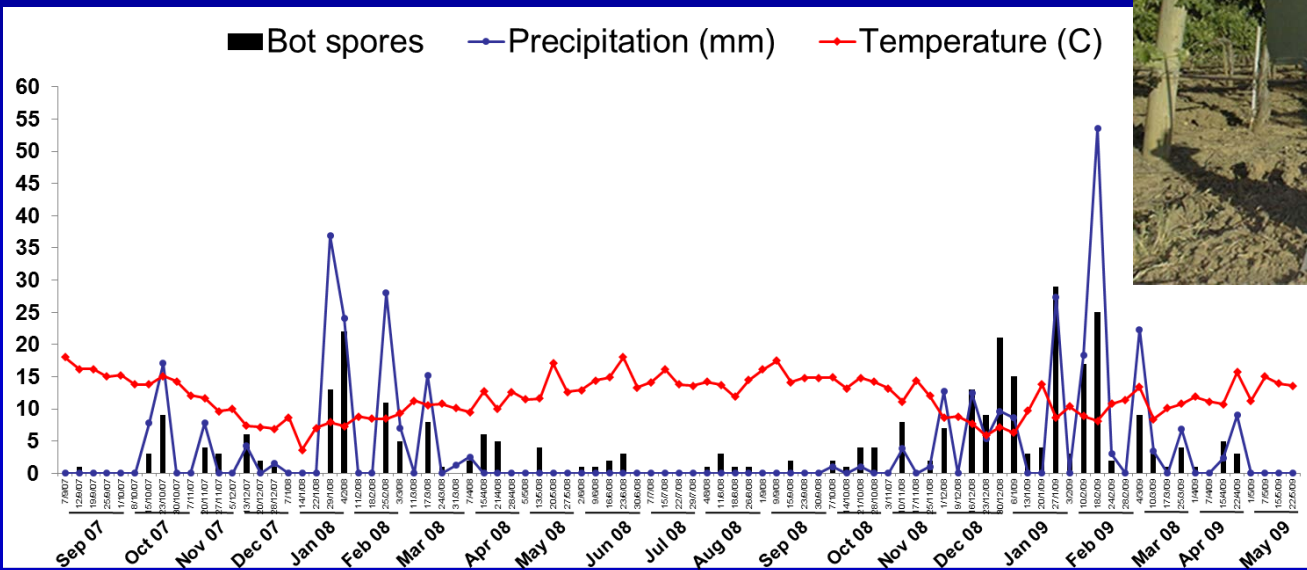




# Disease epidemiology:

## Spore trapping studies for Botryosphaeria in vineyards:

Monitor the yearly pattern of spore release/dispersal to detect low risk period for pruning wound infections



# Almond canker diseases: Fungal diseases

## Ceratocystis:

Moller, Devay, English 1968

Beth Teviotdale 1996-1998

## Wood Decay fungi:

Adaskaveg 1990

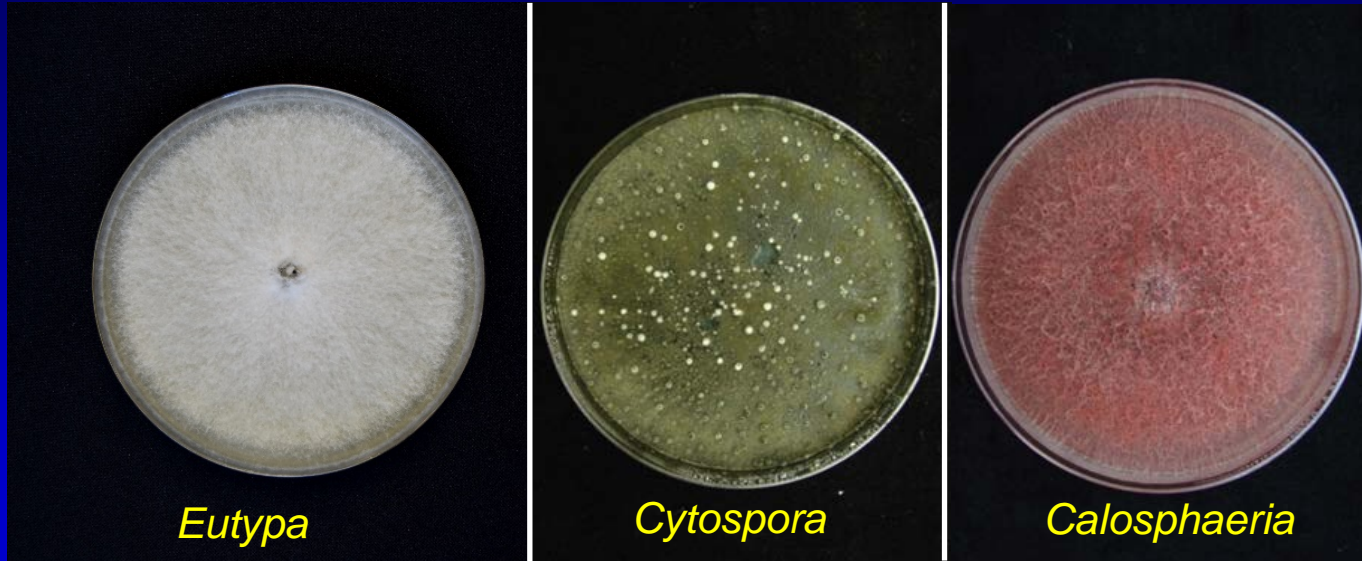
## Botryosphaeria dieback and canker diseases:

English 1966, 1975

Michailides 2010



# New canker pathogens of Almonds



Fresno, Merced,  
Stanislaus,  
Yolo Co

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Merced,  
Stanislaus Co

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Elizabeth Fichtner: Tulare County

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**Canker diseases**: complex disease or disease complex

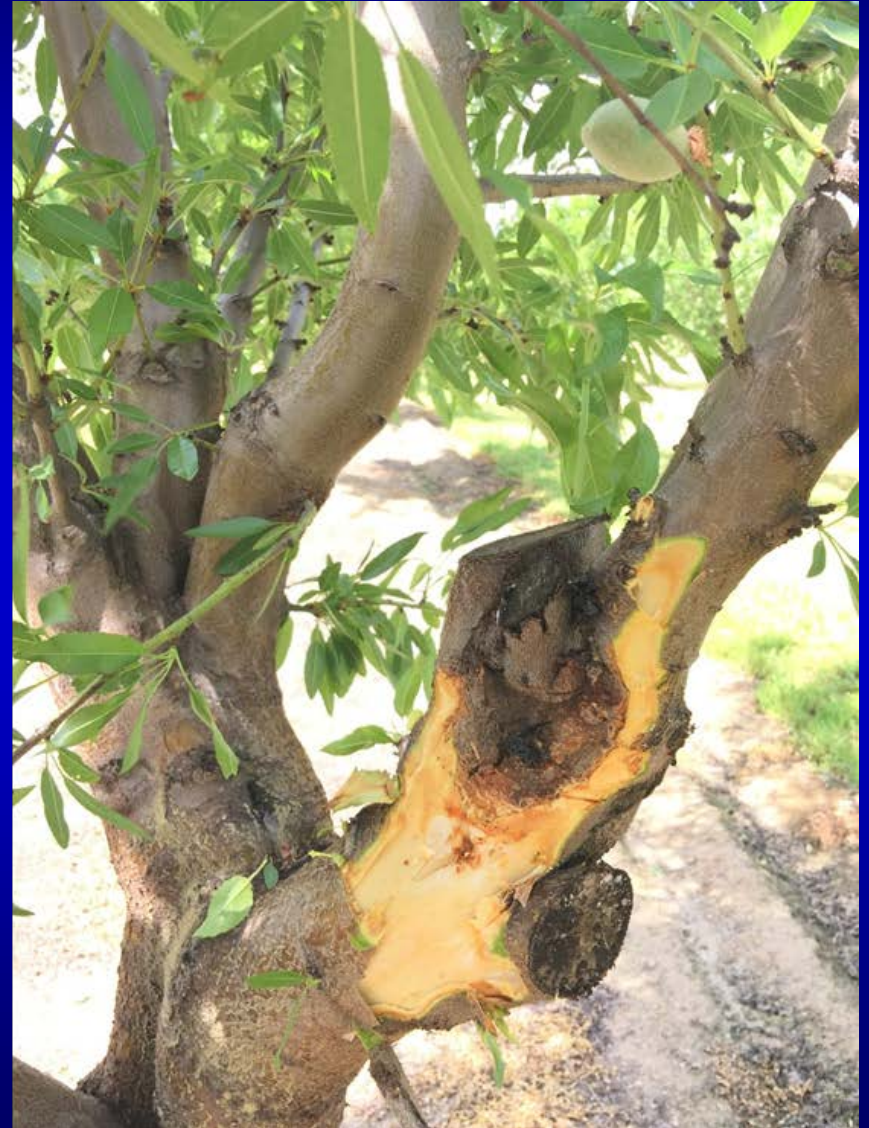


# Eutypa dieback of Almond:



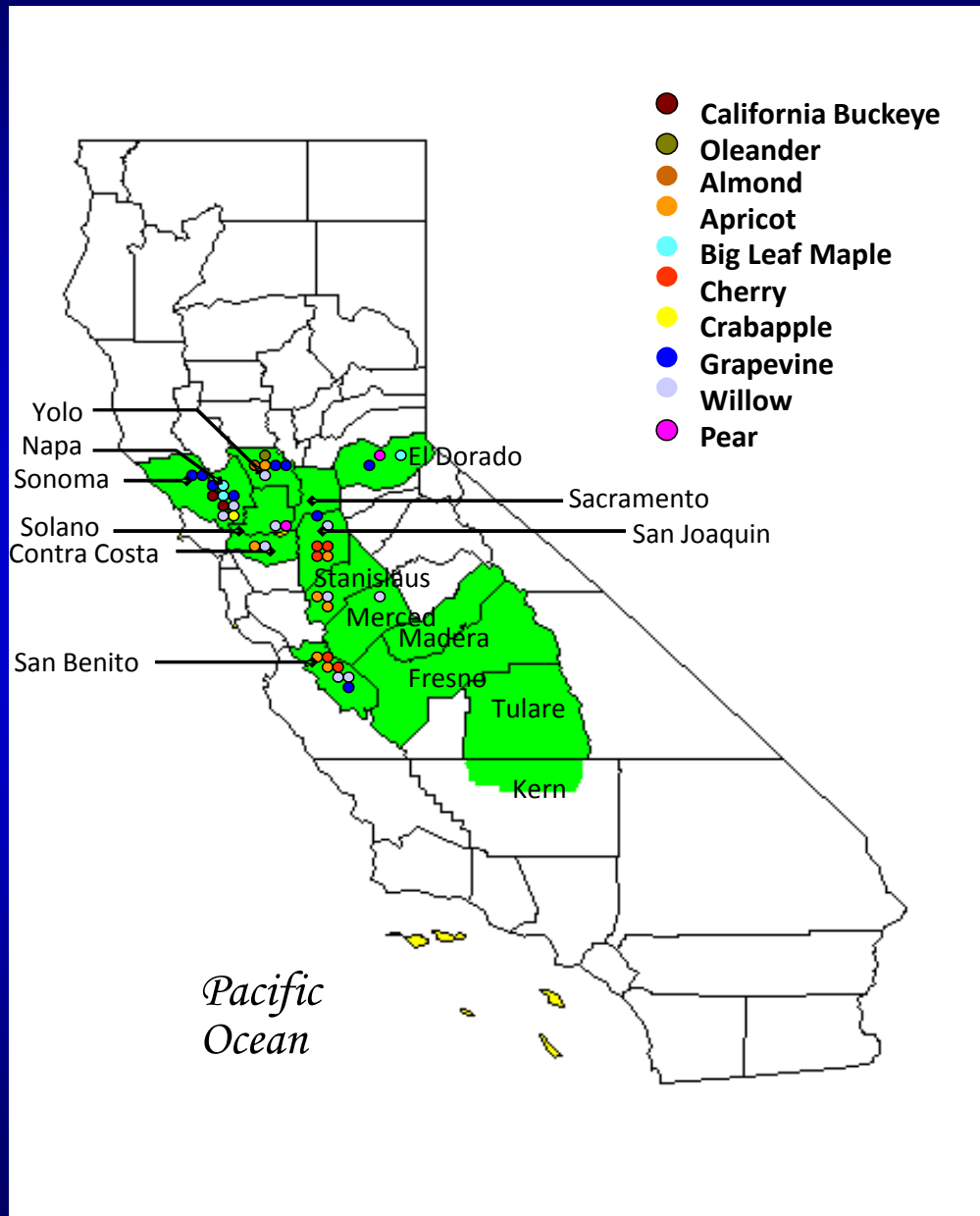


# Eutypa dieback of Almond:





# Disease epidemiology:



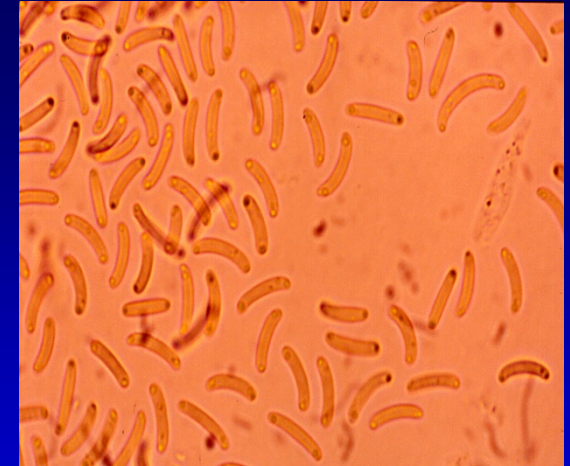
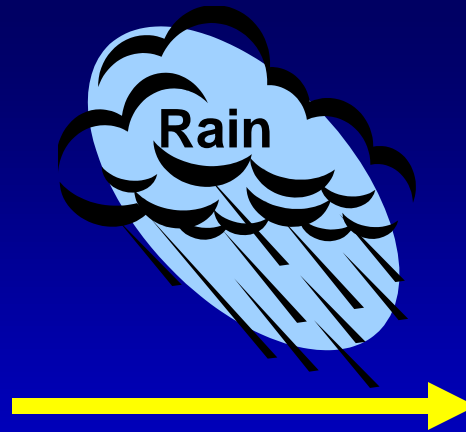
## Geographical distribution and host range of the perithecial stage of the pathogen *E. lata* in California.

Survey was realized in 2002. Areas represented in green color correspond to the areas that were visited.





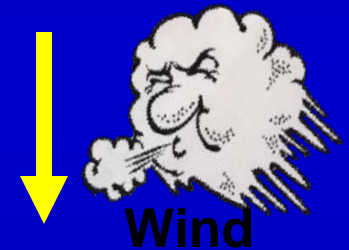
Stroma with perithecia on dead trunk



Ascospores Release

## Disease cycle

for *Eutypa dieback*



Wind

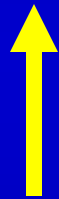
Fresh pruning wounds



Several Years After Infection



Canker





# Calosphaeria canker:

*Calosphaeria* canker of almond caused by *Calosphaeria pulchella* in Iran

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(Received 18 September 2012; final version received 29 September 2012)





# Calosphaeria canker:





# Cytospora:





# Cytospora:





# Cytospora:





# Management of canker diseases:

- Appropriate tree training and scaffold selection
- Remove dead wood, stumps and dead trees from the orchard
- Burn dead wood or protect from rain
- Protect at least large pruning wound
- Favor drip irrigation or micro-sprinklers
- Avoid wetting the tree trunks with sprinklers
- Prune mature orchards in early fall to avoid cool, rainy weather
- Prune nonbearing trees late to avoid rainy periods



*An Ounce of Prevention Is Worth a Pound of Cure ...*



# Management of canker diseases:

Prevent disease establishment in young trees

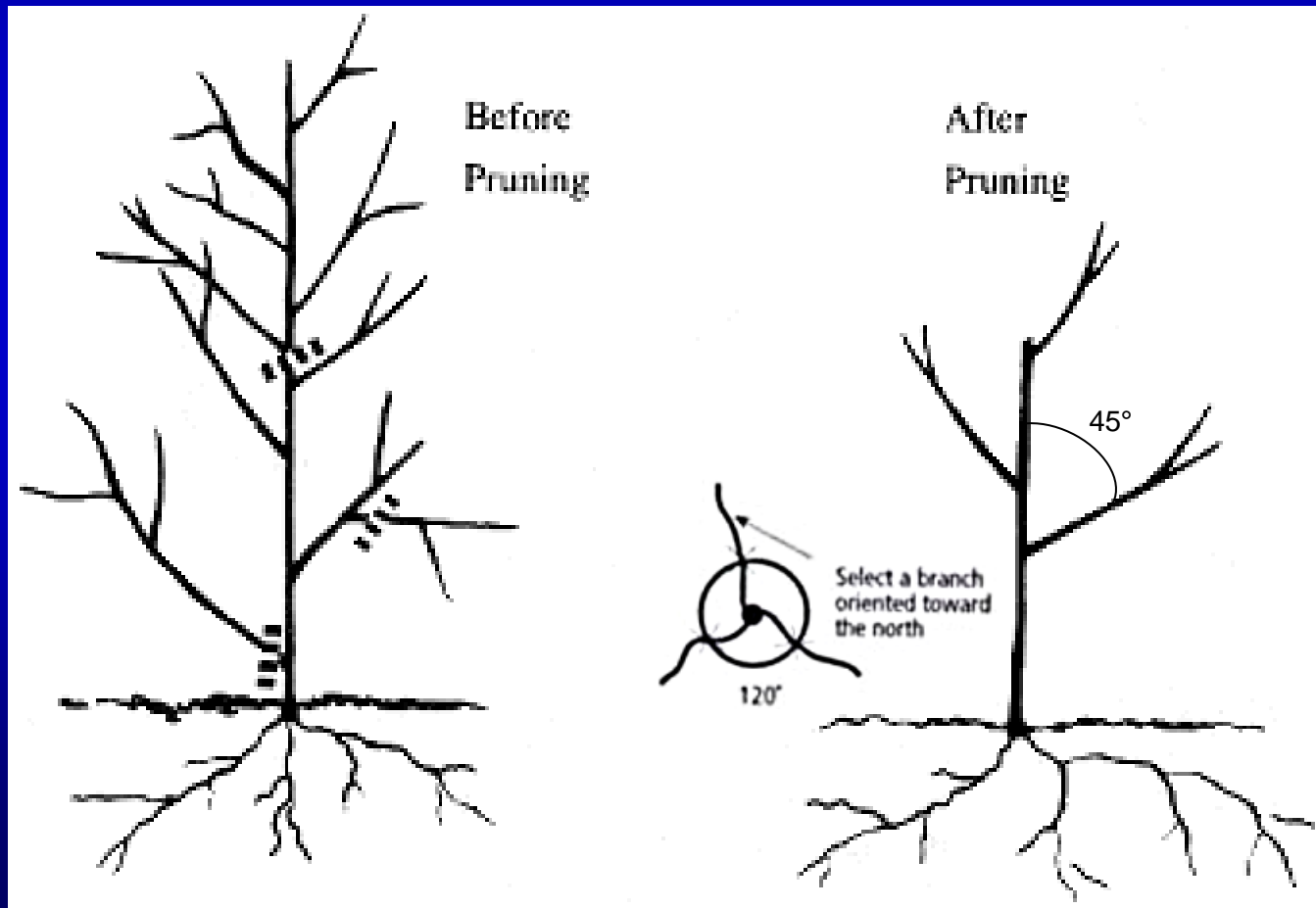




# Management of canker diseases:

## Tree training and Scaffold selection:

- Vertical spacing
- Primary scaffolds equally spaced
- Angle of branch attachment:  $45^\circ$





# Management of canker diseases: Physical barrier





# Management of canker diseases:

Maintenance pruning:





# Other diseases: Almond





# Other diseases: Pistachio

