



Fungal Diseases

Akif Eskalen, Ph.D.

Plant Pathologist, Cooperative Extension Specialist

Department of Plant Pathology, UC Davis

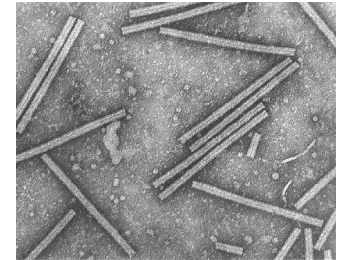
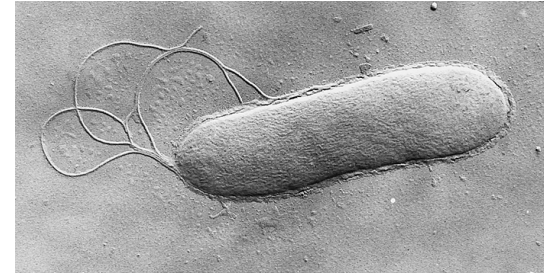
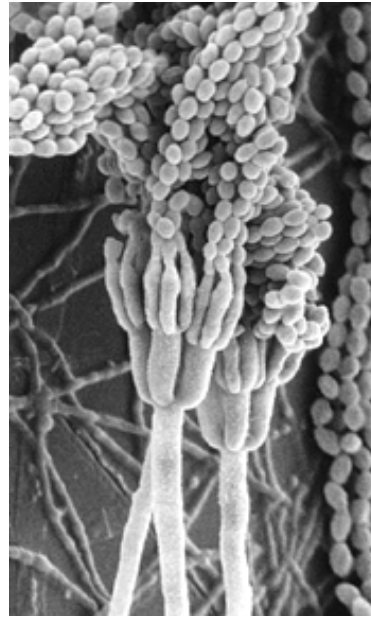
Feb 15, 2019,

Napa, CA

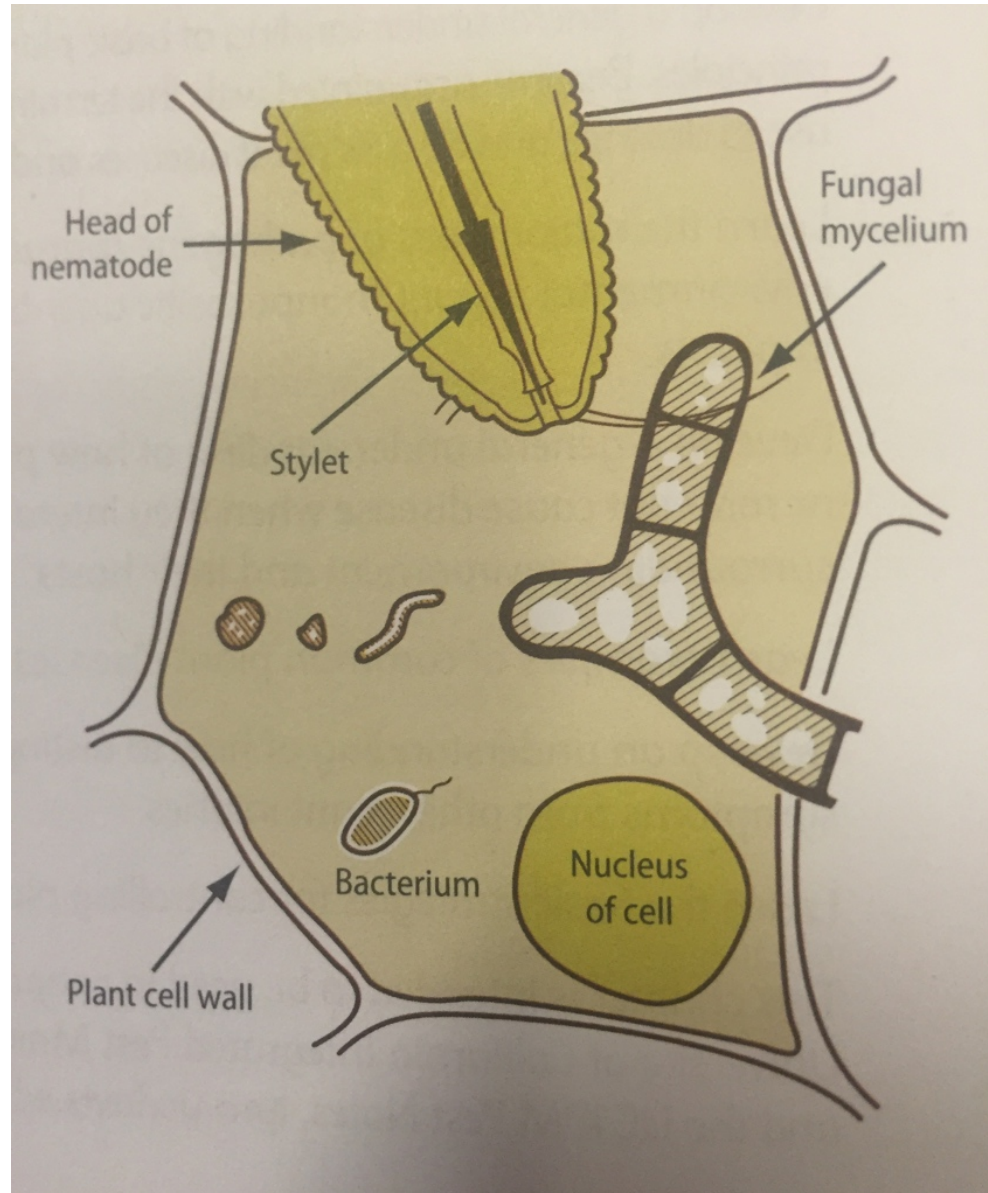
What are the Causes of Plant Disease?

1-Biotic Factors

- Fungus
- Bacteria
- Virus, Viroid
- Nematodes
- Parasitic Flowering Plants
 - Broomrapes - *Orabanche* sp.
 - Dodder - *Cuscuta* spp.
 - Witchweeds – *Striga* spp.
 - Mistletoes – *Phoradendron* spp.



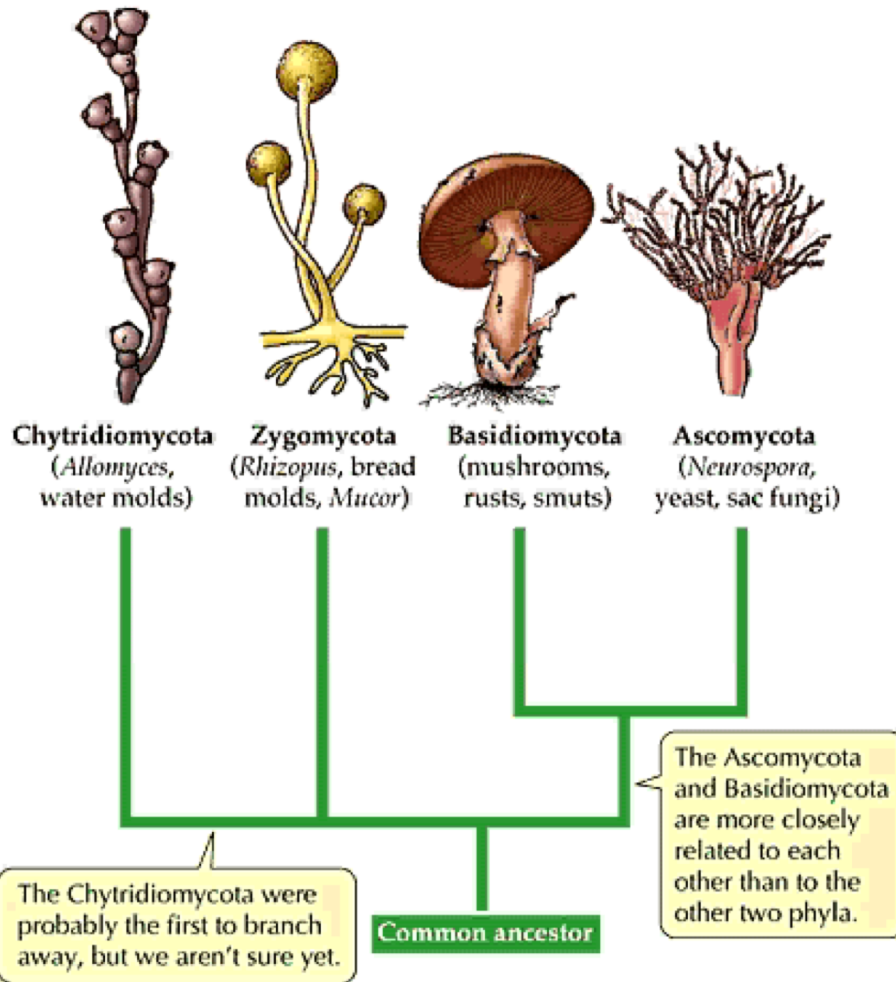
Size comparison of plant pathogens



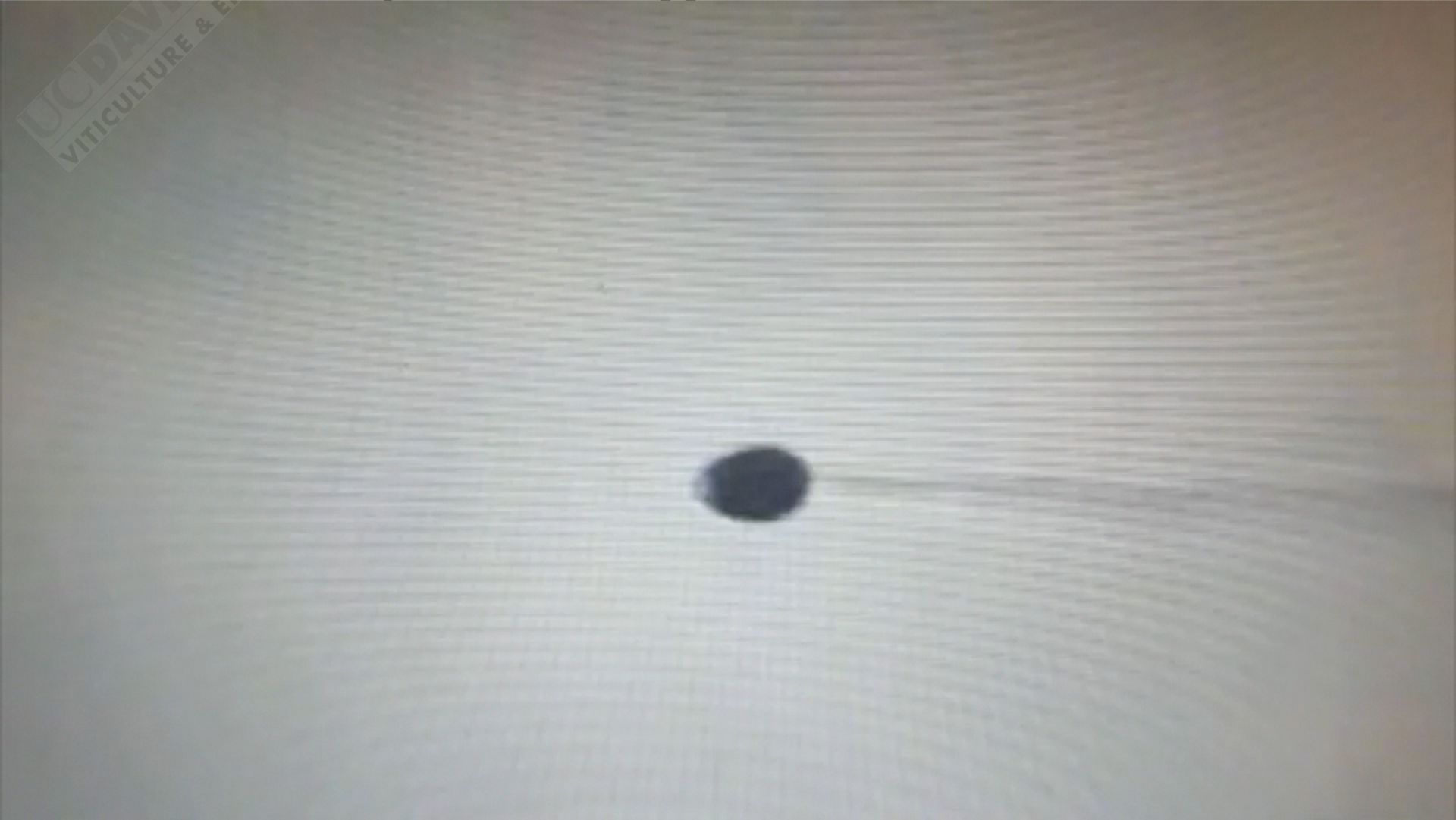
Fungus

- Fungi are spore forming, non-chlorophytic, eukaryotic organisms!
- Over 100,000 species of fungi are saprophytes
- Over 20,000 species of fungi are parasites and causes disease in crops and plants.
- Fungal parasites are by far the most prevalent pathogenic organism.

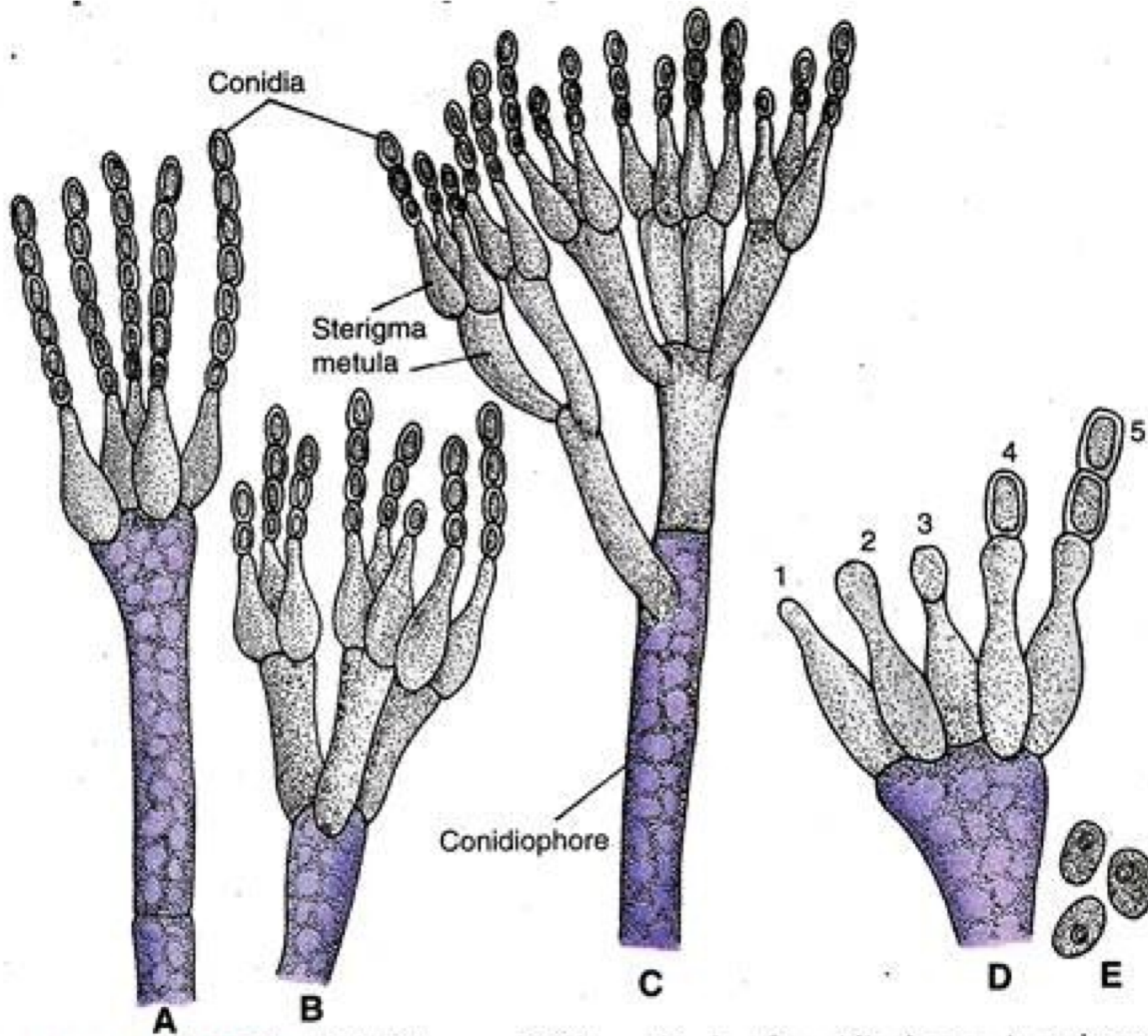
Taxonomy of Fungi



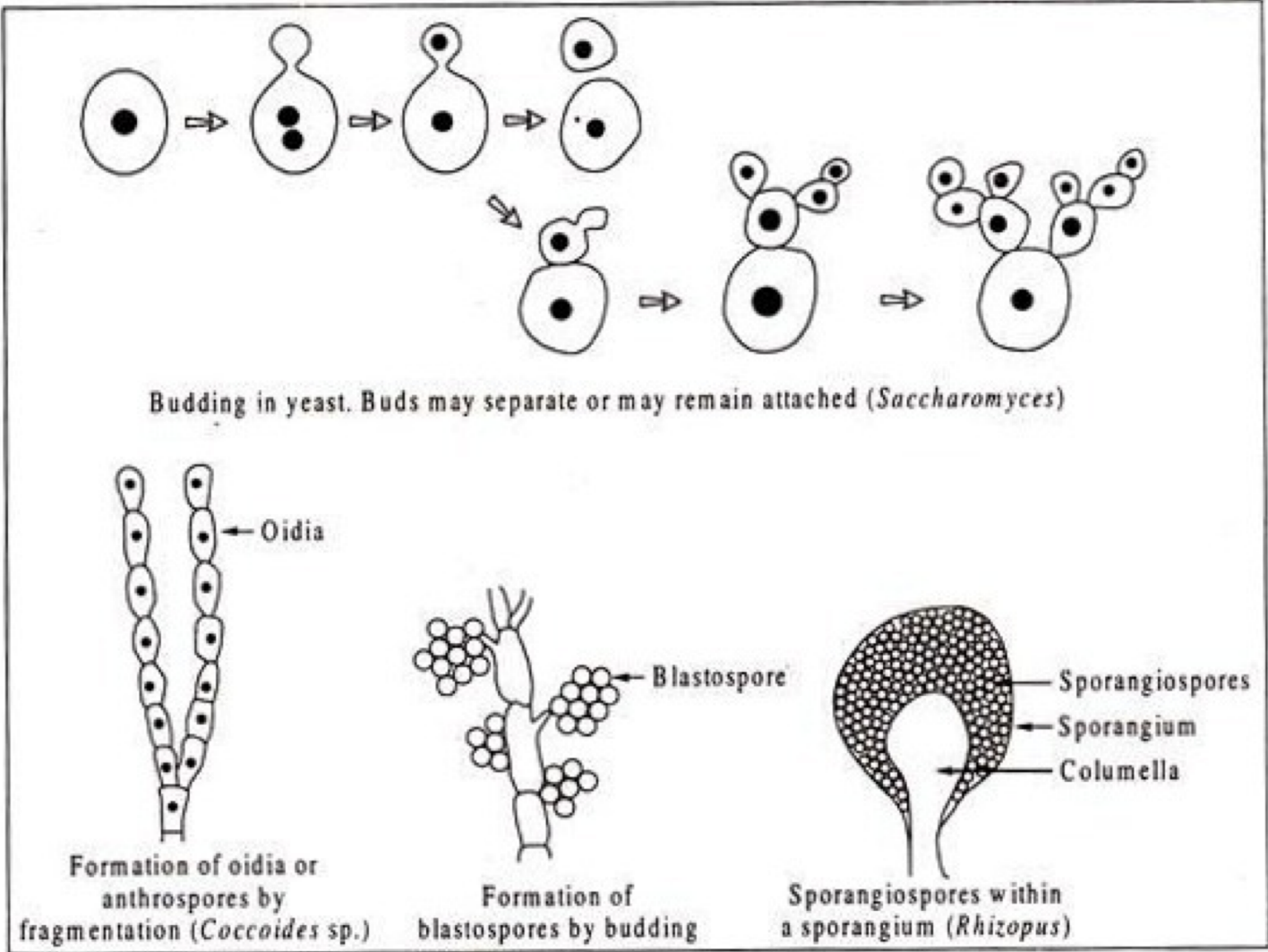
Taxonomy of Fungi



Asexual Fruiting Body



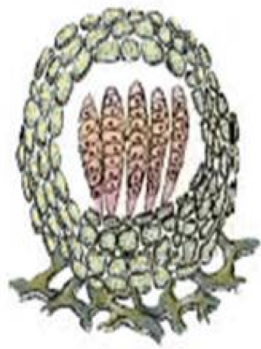
Conidia



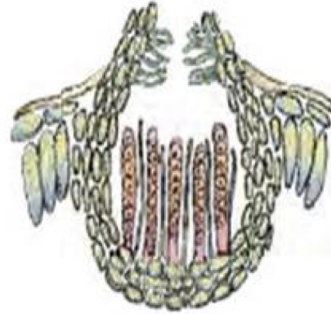
Sexual Fruiting Bodies



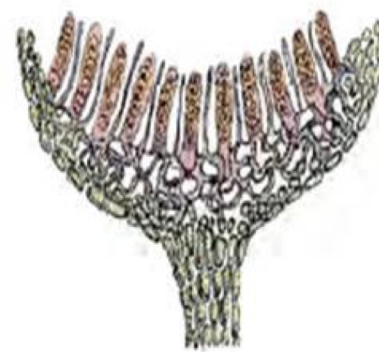
Naked asci



Cleistothecium



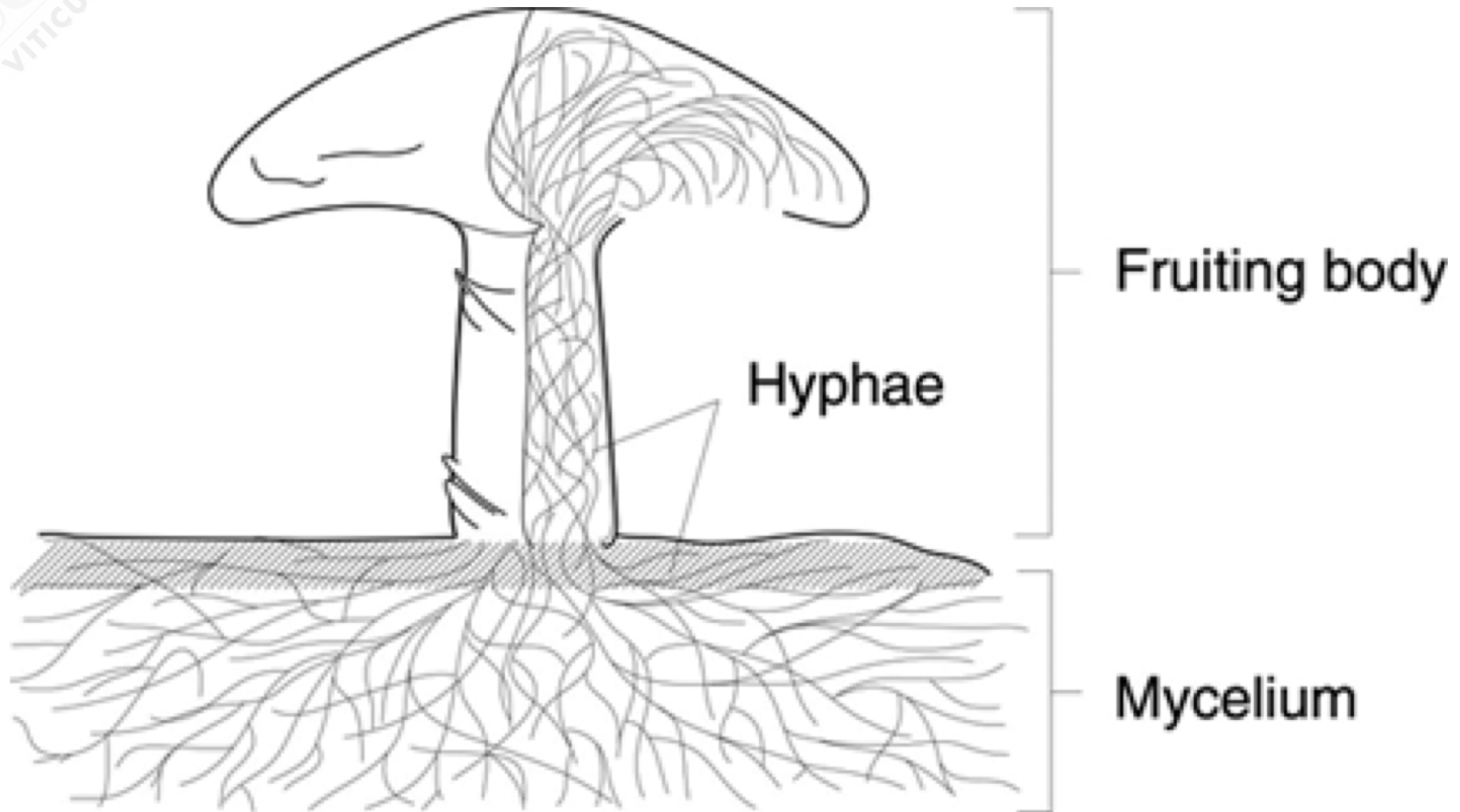
Perithecium



Apothecium

Ascomycetes

Characteristics of Mushroom



Prehistoric Fungi



A giant prehistoric Fungus Fossil

Disease Triangle

Pathogen



Environment

Host

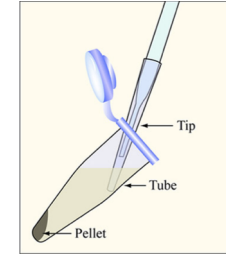
Diagnostic Process



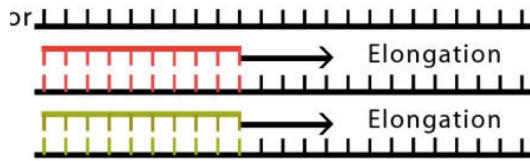
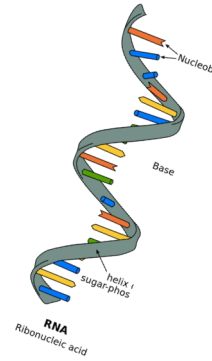
Symptomatic plant tissue



Culture Media



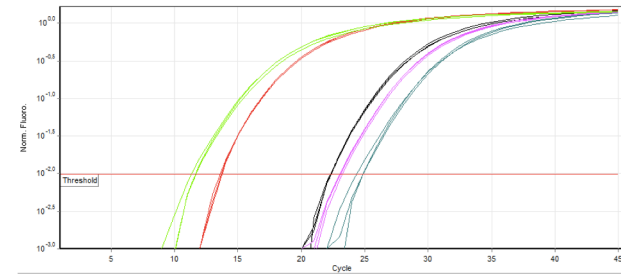
DNA Extraction



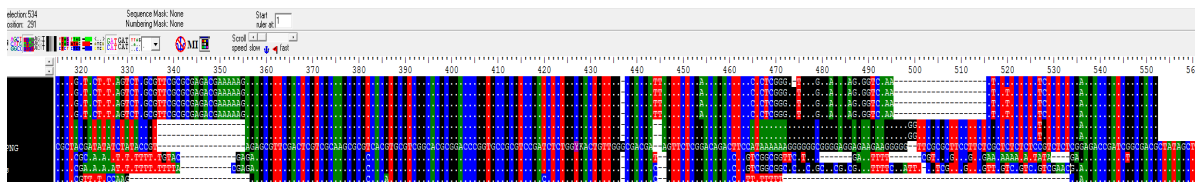
Species Specific Primers



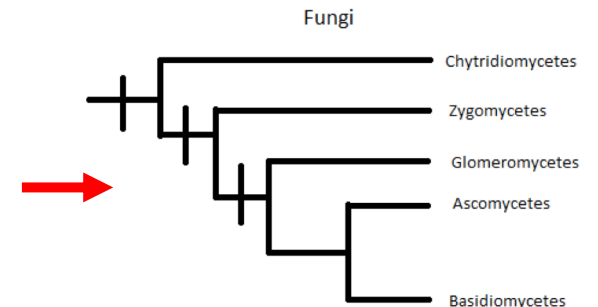
Quantitative Real Time PCR



Identification based on melting curve



Sequencing the DNA Region



Phylogenetic Tree ¹⁴

Fungi

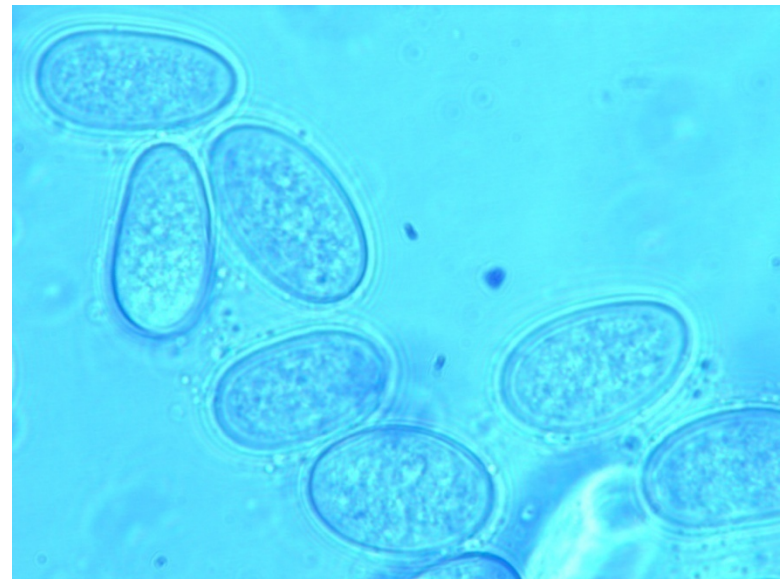
- Chytridiomycetes
- Zygomycetes
- Glomeromycetes
- Ascomycetes
- Basidiomycetes

2) Petri Disease-*Phaeomoniella chlamydospora*

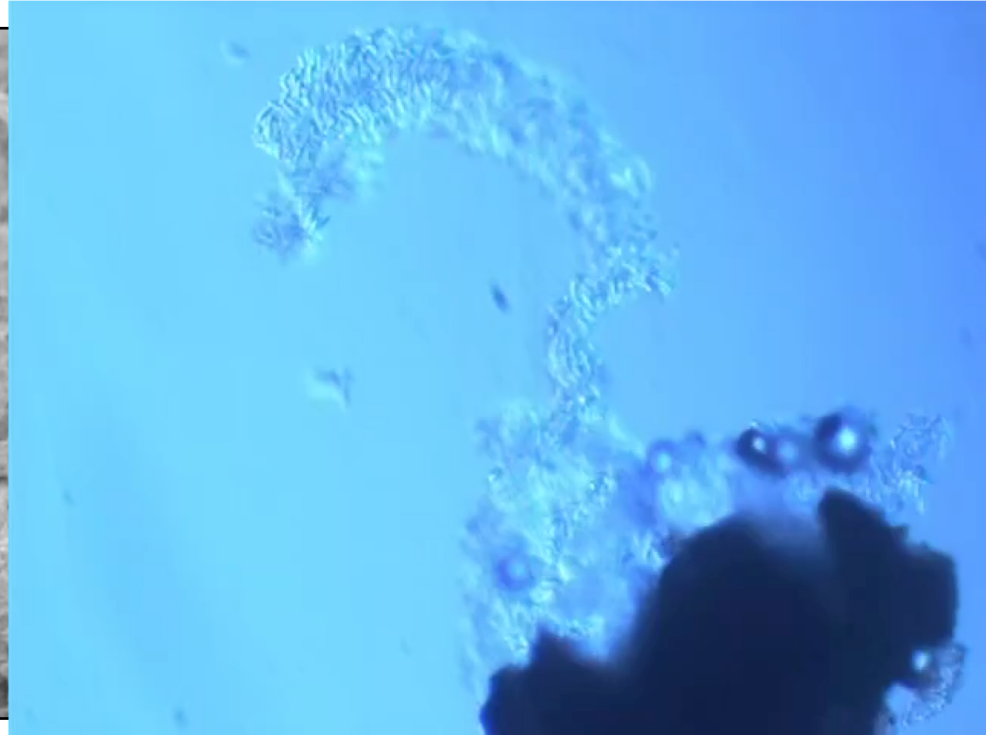
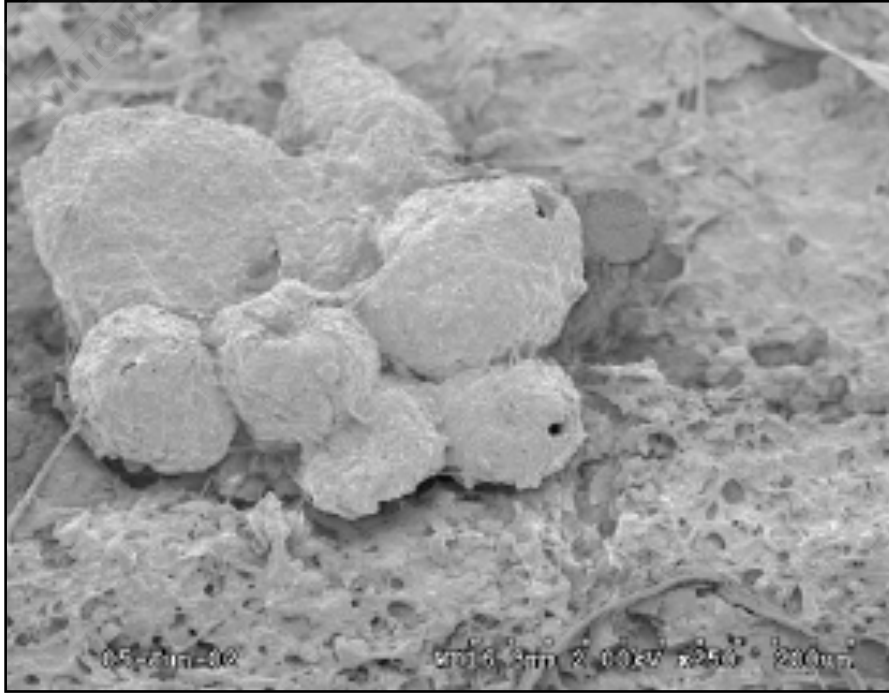


Associated with both young and mature grapevines

Pycnidia of *Botryosphaeria* sp. on dead branches



Pycnidia of *Phaeomonielle chlamydospora*



Eskalen, A., S.N. Rooney, and W.D. Gubler. 2002. Phytopathology 92:S24.

- The survival overwintering structure
- Provides source of primary inoculum for ne infections

Esca (*Togninia* spp.)

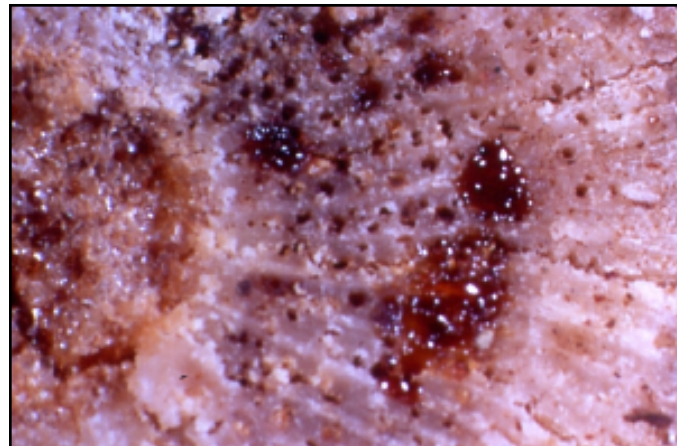


Shoot and tendril dieback on grapevine

Esca Fruit symptoms on table grapes



Esca - *Togninia* spp.

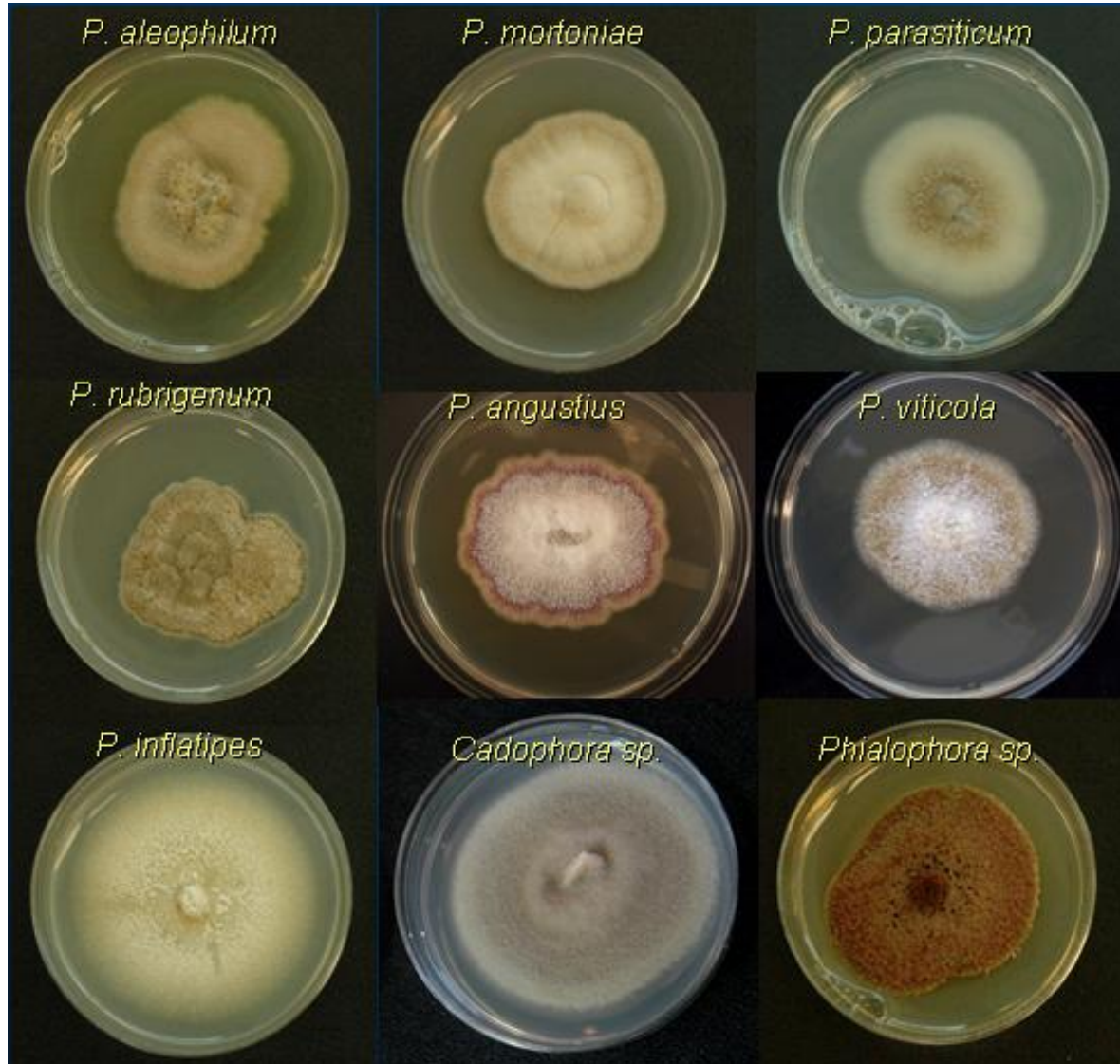


Internal symptoms

Esca – *Fomitiporia* spp.



Colony morphology of *Togninia* spp.

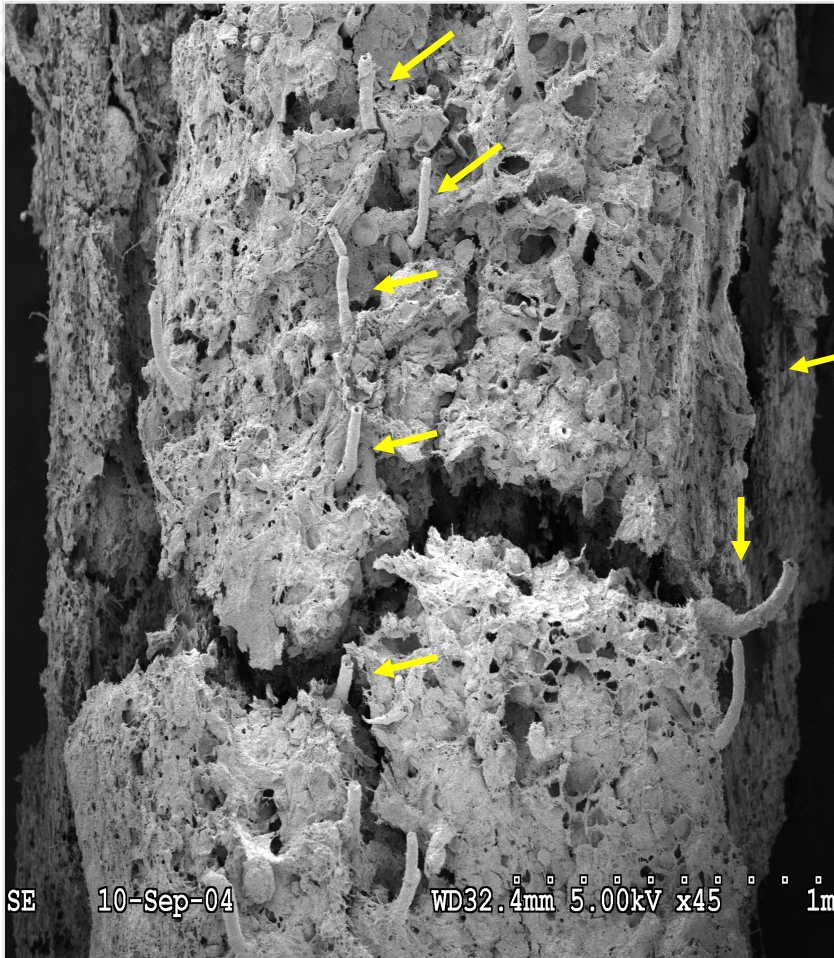


Perithecia of *Togninia minima* on old pruning wounds



Plant Disease/February 2005. Vol.89 No.2

Perithecia of *Togninia minima*



Life Cycle of Esca Pathogens



4) Eutypa dieback (*Eutypella lata*)

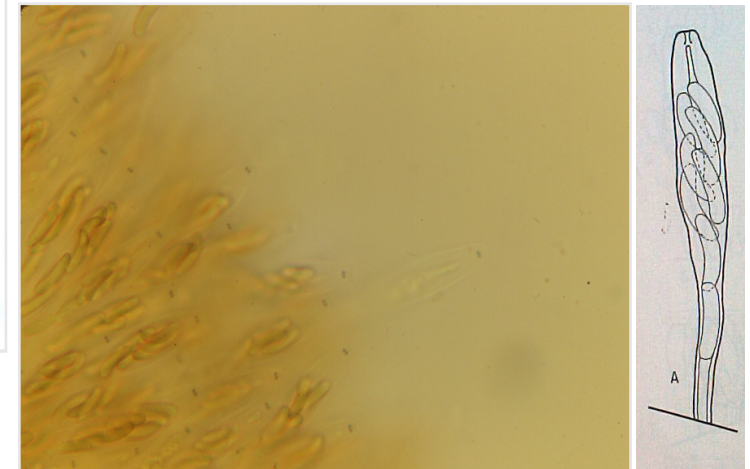
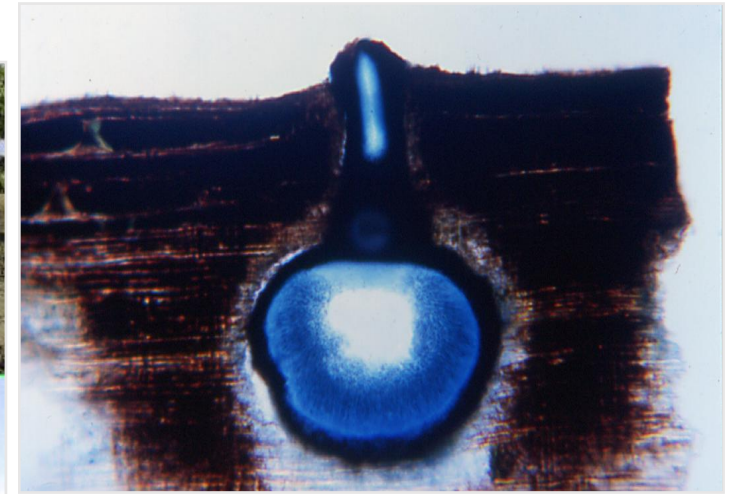


External symptoms
Small shoots, stunted leaves



Internal symptoms
Wedge shape canker

Stroma of *Eutypa lata* with Perithecia



Hosts of *Eutypa lata* in CA

Grapevine



Cherry



Apricot



Native trees



5) Bot Canker - *Botryosphaeria* spp.

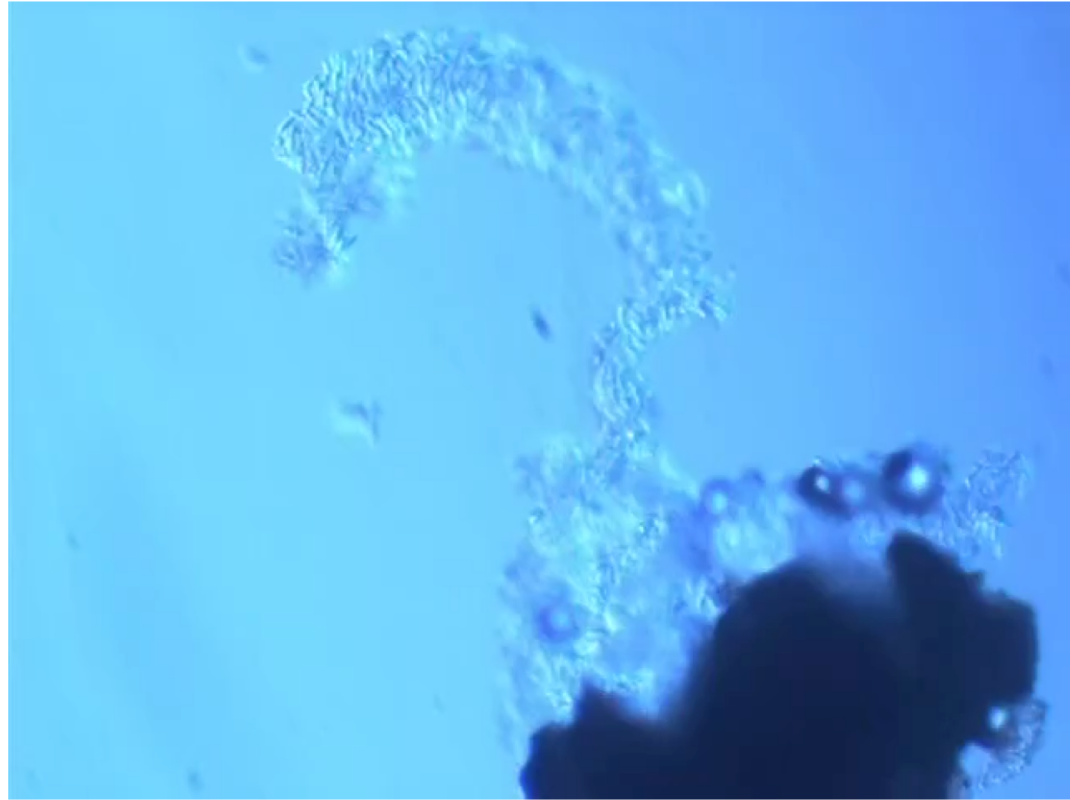
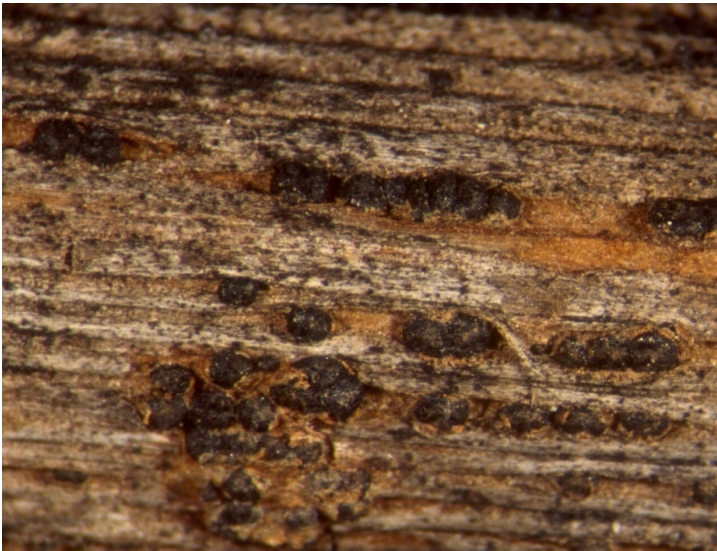


External symptoms



Internal symptoms

Fungal Fruiting Body-Pycnidia of Botryosphaeria

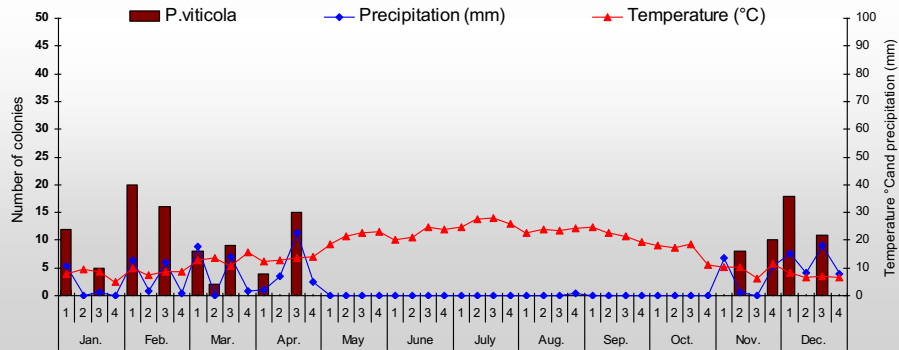


Spore Release from Perithecia of Botryosphaeria

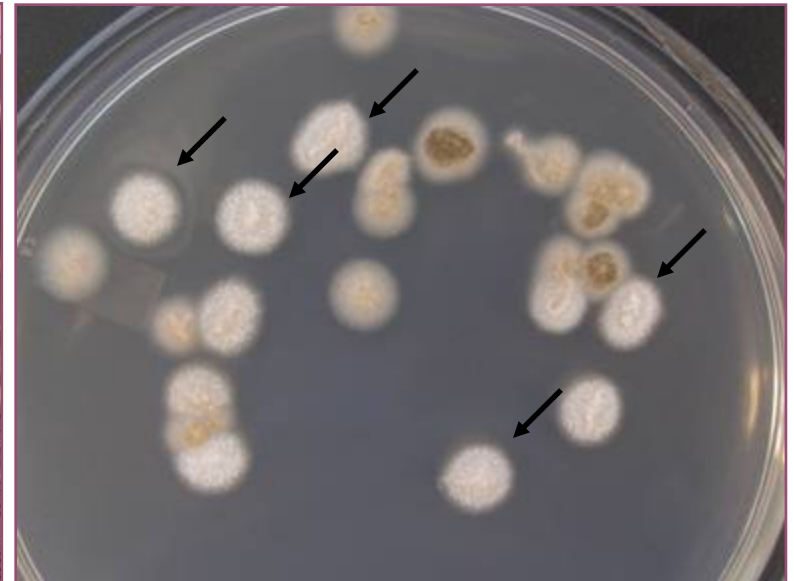
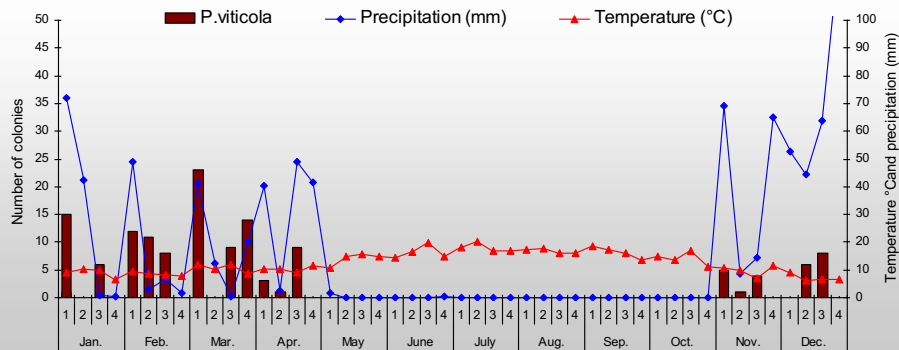


Spores dispersal pattern of Esca pathogens

MADERA 2003



SONOMA 2003



6) Grape Powdery Mildew



***Uncinula necator* (syn *Erysiphe necator*)**

7) Botrytis Bunch Rot

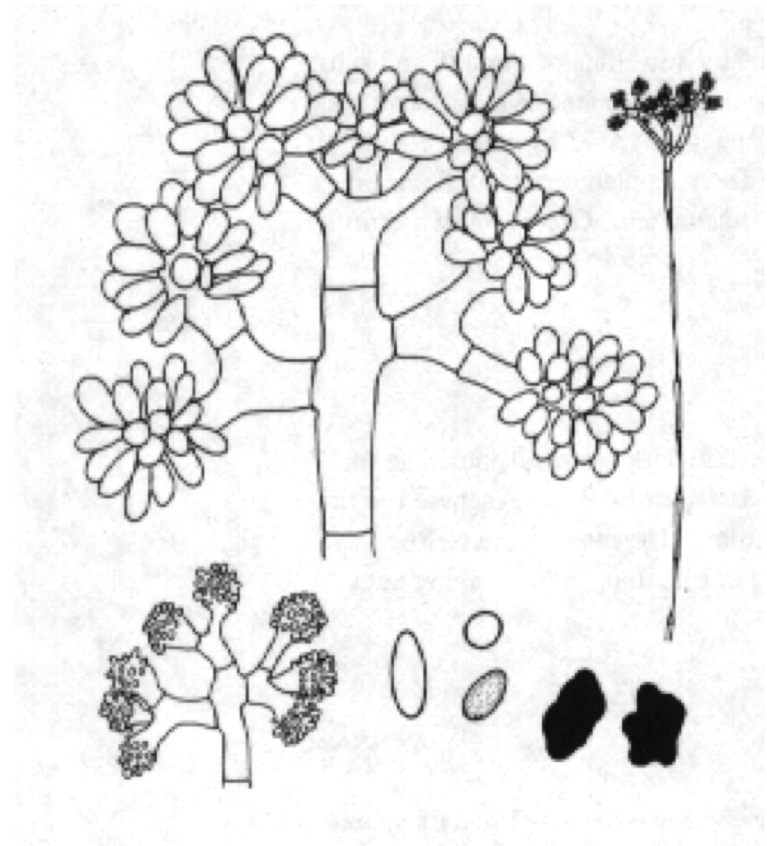
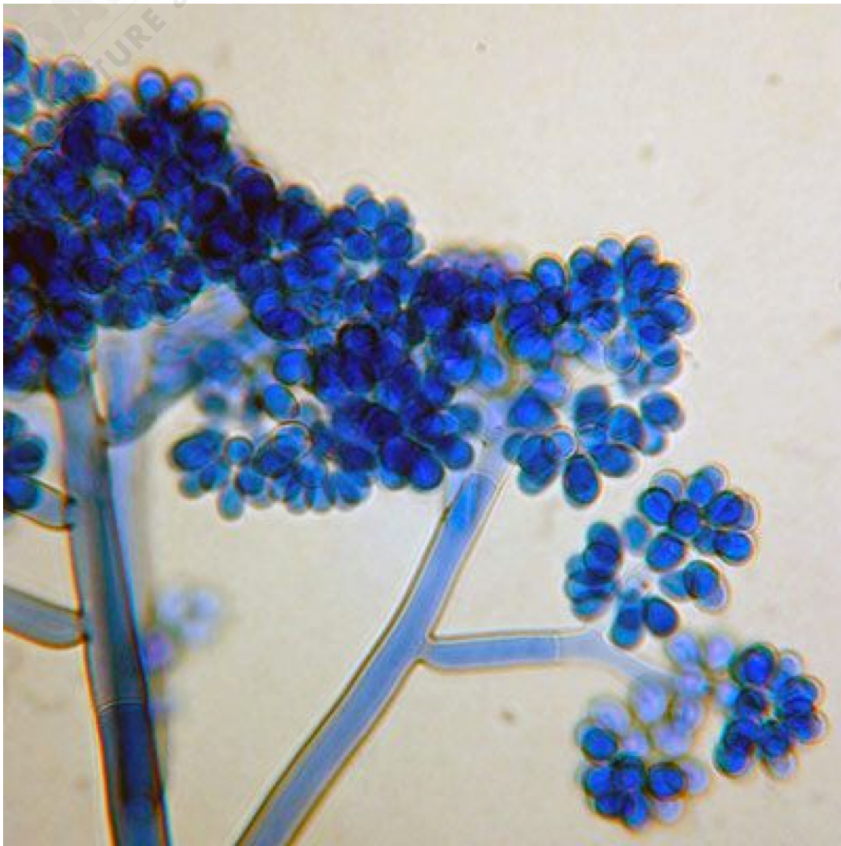


https://www.google.com/search?q=botrytis&tbm=isch&tbs=rimg:CTQK4CYHwipJi6-ubRSCXoSqx1fjQaF0y/Uz-VL5-aic4v0bMpl0letCy5cFQQ2OnkqkmBFEqnuTpFRfOf7BoCoScbr65fJehKEWB49Cuf-JVKhlrHV-NBoU7LsRV7zd3u_1PwlgEgITNukvmsqjzhEvHglskS1VCo5CS_1RsynSV60LEYKxAQOU-DKbKhlLfwVBDY6eQRlnjky4uyrlqEgmsYF8Seqs5BGIS8yT10j5gioCekvF85-3sGgESmjnsI8jWSN&tbo=u&sa=X&ved=2ahUKEwjkw5_Sk77gAhURCwKH0BpAEAQ9C968AgBEs&biw=1383&bih=1166&dpr=1#imgrc=NClglgeG-18qCM

https://en.wikipedia.org/wiki/Noble_rot#/media/File:SemillonBotrytisCinerea.JPG

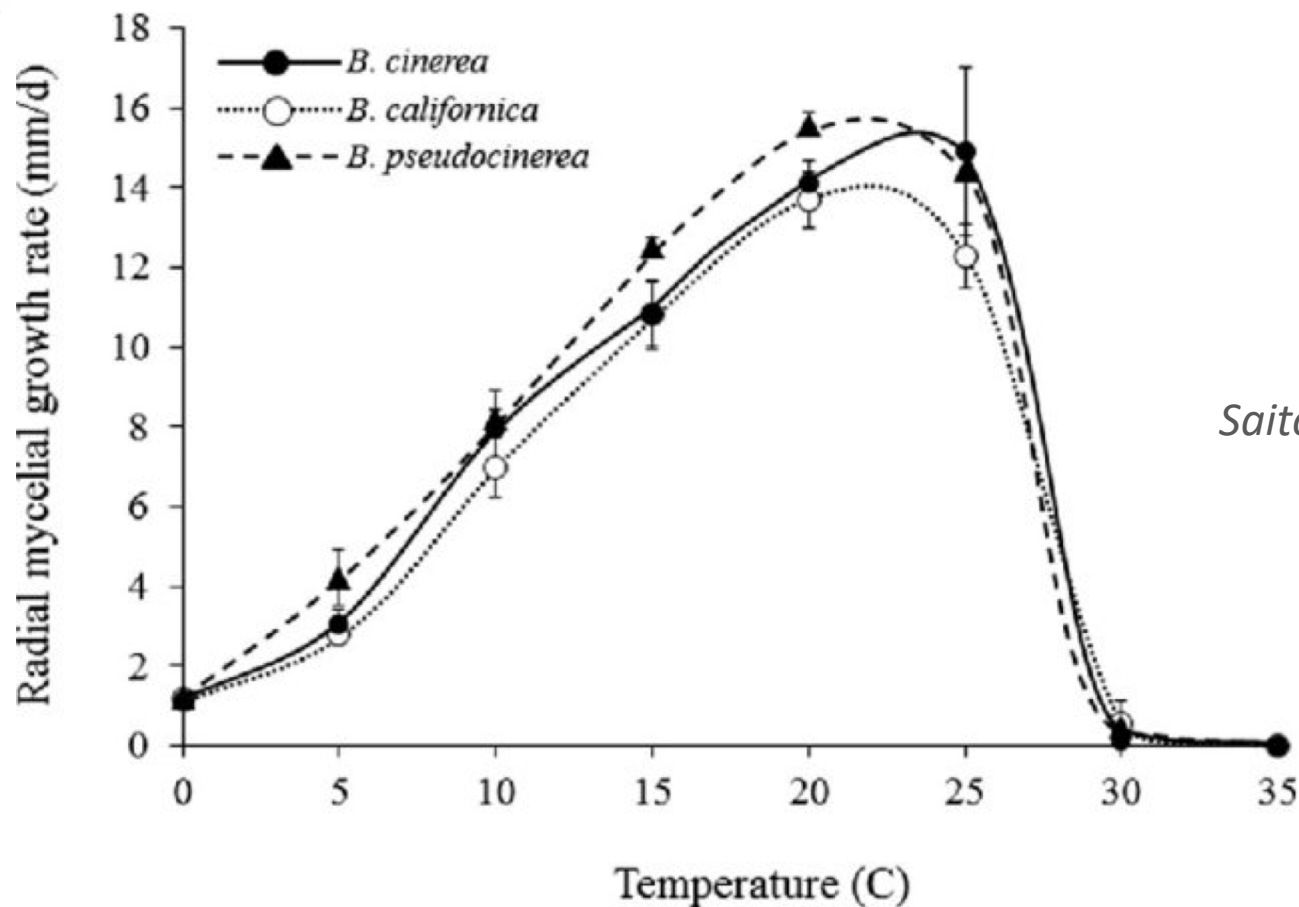
Botrytis cinerea

7) Botrytis Bunch Rot



Botrytis cinerea

7) Botrytis Bunch Rot



Saito et al. 2016.

Effects of temperature on mycelial radial growth!

7) Phomopsis dieback

- *Phomopsis viticola* (teleomorph *Diaporthe*)
- *Diaporthe ambigua*
- *Diaporthe neotheicola*

7) Phomopsis dieback

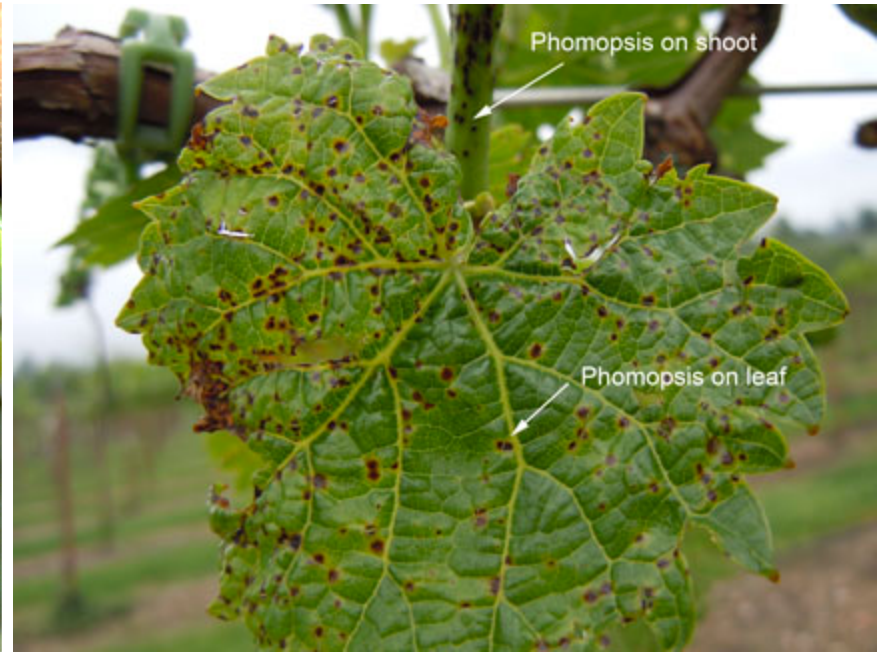


Phomopsis viticola

7 Phomopsis dieback



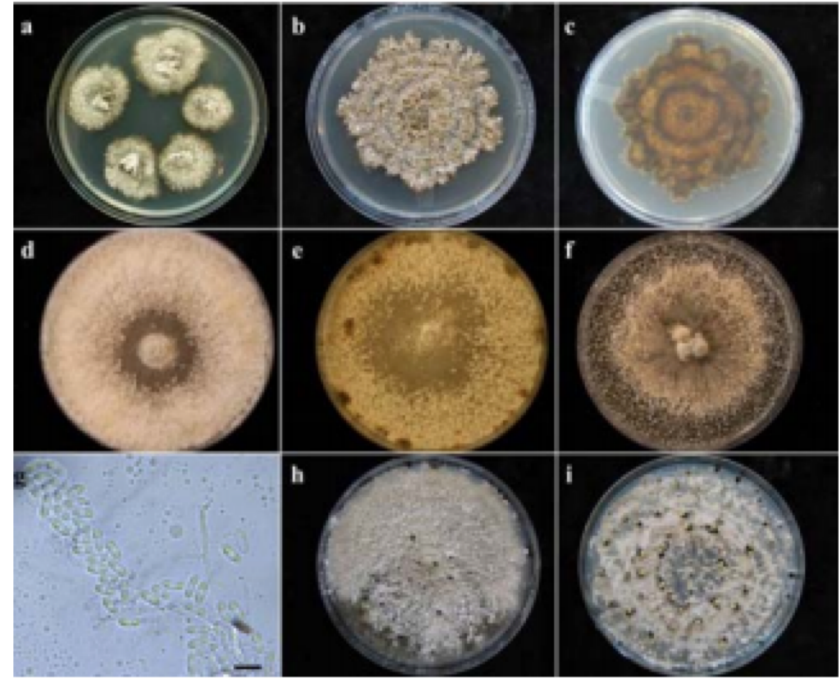
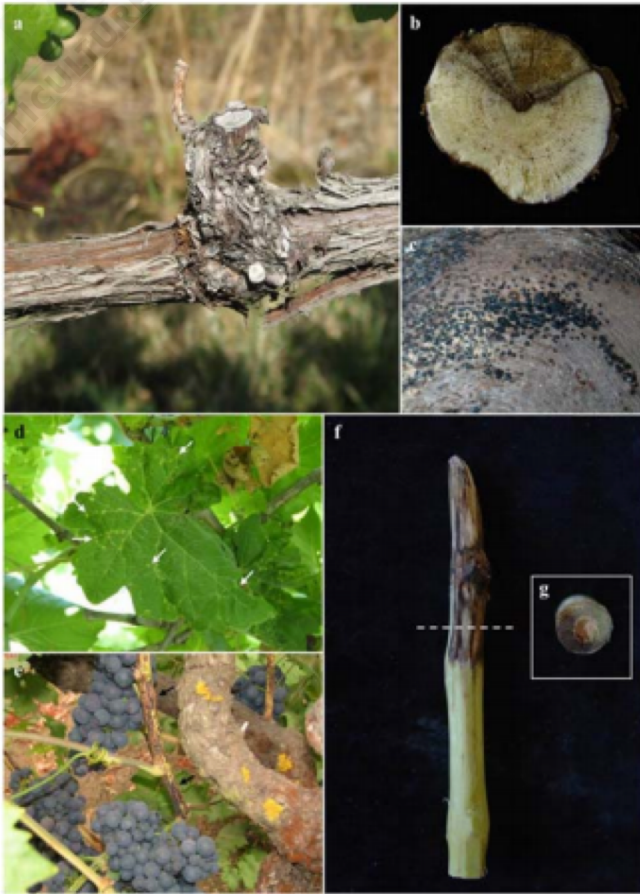
https://www.google.com/search?q=phomopsis+grapevine&source=lnms&tbn=isch&sa=X&ved=0ahUKEwie-_Wpml7gAhUB-58KHSkcCywQ_AUIDigB&biw=1383&bih=1166#imgrc=9dnDKGjYrWDySM:



https://www.google.com/search?q=phomopsis+grapevine&source=lnms&tbn=isch&sa=X&ved=0ahUKEwie-_Wpml7gAhUB-58KHSkcCywQ_AUIDigB&biw=1383&bih=1166#imgrc=QfDB2ZAMbYF8pM:

Phomopsis viticola

7) *Phomopsis dieback*



Urbez-Torres et al 2013

6) Armillaria Root Rot

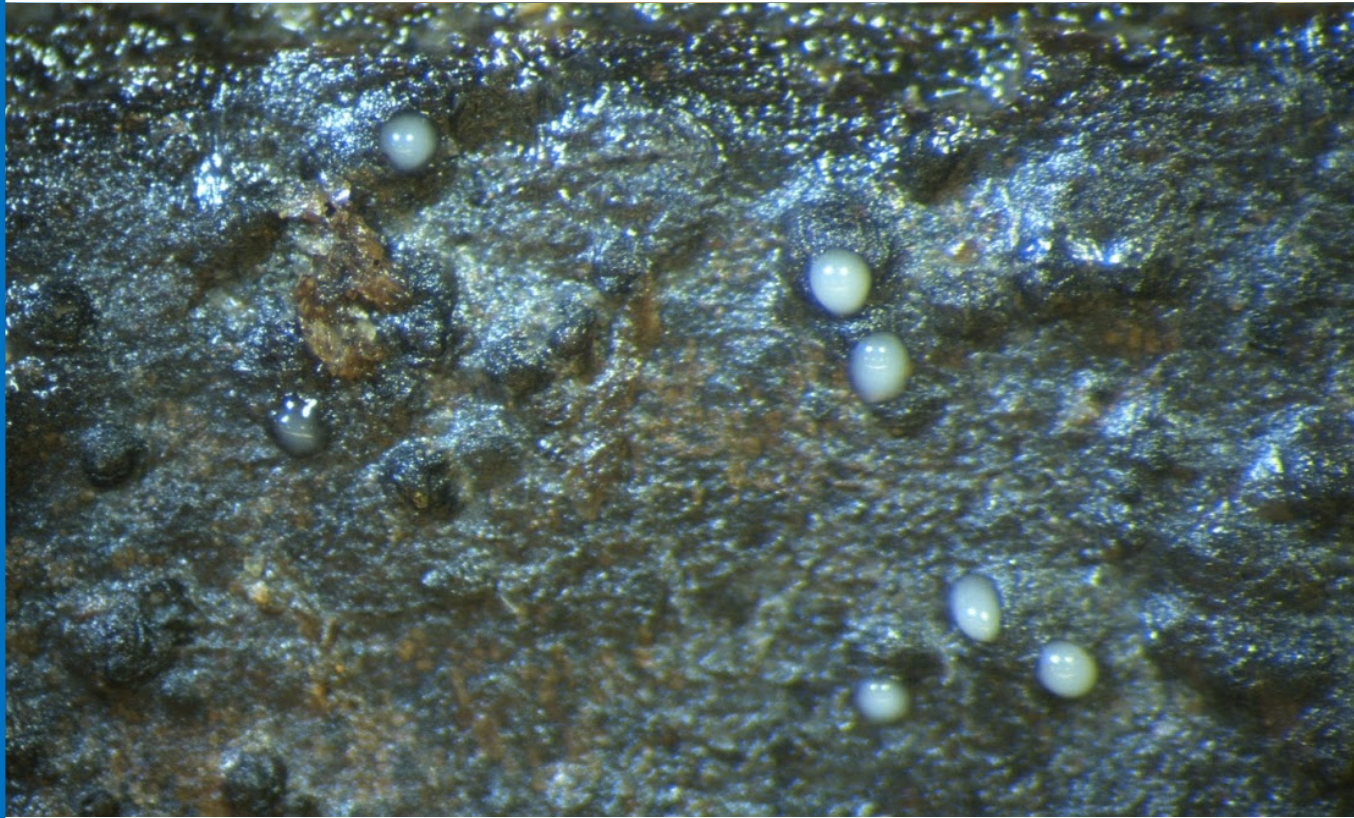


Armillaria melleae

Clean Plant Material



Clean Plant Material



Clean Plant Material



Management in Nurseries

- Treat propagation materials with hot water at 122 °F at 30 min
- Rotate crops in nursery beds periodically
- Treat pruning wounds on mother plants to prevent new infections
- Apply good cultural practices in nursery beds (avoid too much or less irrigation)
- Check nursery beds periodically for potential soilborne pathogen contamination

Management in Vineyards

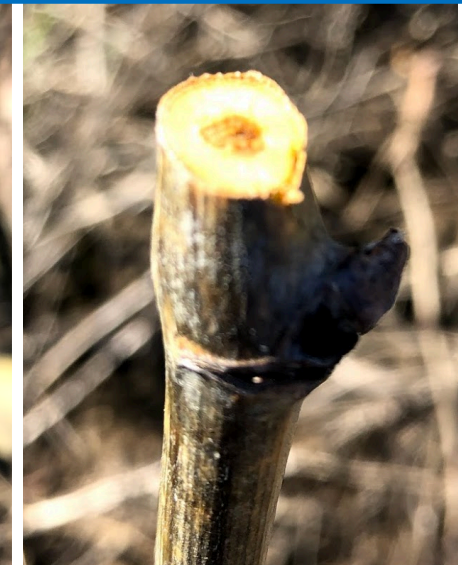
- Use disease free, clean plant materials when establish new vineyards
- Apply good cultural practices to minimize stress on young and mature vines
- Delay dormant pruning to avoid potential pathogen dissemination during winter precipitation and to reduce the susceptibility
- If applicable, consider doing double pruning to reduce fungal spore infection during winter months

Double Pruning (Weber et al. 2007)



1 foot above spur position

Mechanical Pruning



Topsin M and Rally in tank mix with non-ionic spreader (Freeway/Pentra Bark)

UC IPM

Statewide Integrated Pest Management Program



[What is IPM?](#)

[Identify & Manage Pests](#)

[Research](#)

[Publications](#)

[Training & Events](#)

[Links](#)

[About Us](#)

[Contact Us](#)

[Subscribe](#) 

Solve your pest problems with UC's best science

What's New

- **Pest Alert!** [Agriculture: Peach Root-Knot Nematode Pest Alert. New nematode to California.](#)
- [Ag Pest Management: Onion and Garlic and Strawberry revised](#)
- [Pest Notes: Ground Squirrel, Brown Recluse and Other Recluse Spiders, and Asian Citrus Psyllid and Huanglongbing Disease revised](#)
- [Retail Nursery & Garden Center IPM Newsletter: Fall 2018](#)
- [Green Bulletin: Fall 2018](#)

MAKE A GIFT

Support UC IPM's mission to make integrated pest management the way to manage pests

Home, Garden, Turf & Landscape Pests



Agricultural Pests



[Cilantro](#)

[Citrus](#)

[Cole Crops](#)

[Corn](#)

[Cotton](#)

Cucumber (see [Cucurbits](#))

[Cucurbits](#)

[Dry Beans](#)

[Eggplant](#)

[Fig](#)

[Floriculture](#)

Garlic (see [Onion](#))

[Grape](#)

Grapefruit (see [Citrus](#))

[Prune](#)

Pumpkin (see [Cucurbits](#))

Raspberry (see [Caneberries](#))

[Rice](#)

Rye (see [Small Grains](#))

[Small Grains](#)

[Spinach](#)

Squash (see [Cucurbits](#))

[Strawberry](#)

[Sugarbeet](#)

[Tomato](#)

[Turfgrass](#)

[Walnut](#)

Wheat (see [Small Grains](#))

General Information

- [Delayed-Dormant and Bud Break Monitoring \(Wine/Raisin Grapes\) \(7/15\)](#)
 - [Delayed-Dormant And Budbreak Monitoring \(Table Grapes\) \(7/15\)](#)
 - [Pheromone Traps \(7/15\)](#)
 - [Monitoring Insects and Spider Mites \(7/15\)](#)
 - [Monitoring Caterpillars \(7/15\)](#)
 - [Relative Toxicities of Insecticides and Miticides Used in Grapes to Natural Enemies and Honey Bees \(7/15\)](#)
 - [General Properties of Fungicides Used in Grapes \(7/15\)](#)
 - [Fungicide Efficacy for Grape Diseases \(6/17\)](#)
 - [Treatment Timing for Key Diseases \(6/17\)](#)
 - [Fungicide Resistance Management \(6/17\)](#)
 - [Pathogen Testing Service for Grapes \(7/15\)](#)
-

Insects and Mites

- [Ants \(7/15\)](#)
- [Black Vine Weevil \(7/15\)](#)
- [Black Widow Spider \(7/15\)](#)
- [Branch and Twig Borer \(7/15\)](#)
- [Cutworms \(7/15\)](#)
- [Drosophila Flies \(7/15\)](#)
- [European Fruit Lecanium Scale \(7/15\)](#)
- [False Chinch Bug \(7/15\)](#)
- [Grape Bud Beetle \(7/15\)](#)
- [Grape Leafroller \(7/15\)](#)
- [Grape Phylloxera \(7/15\)](#)
- [Leadcable Borer \(7/15\)](#)

Diseases

- [Armillaria Root Rot \(Oak Root Fungus\) \(12/14\)](#)
 - [Botryosphaeria Dieback \(12/14\)](#)
 - [Botrytis Bunch Rot \(12/16\)](#)
 - [Crown Gall \(12/14\)](#)
 - [Downy Mildew \(12/14\)](#)
 - [Esca \(Black Measles\) \(12/14\)](#)
 - [Eutypa Dieback \(12/14\)](#)
 - [Phomopsis Cane and Leafspot \(12/14\)](#)
 - [Phomopsis Dieback \(7/15\)](#)
 - [Pierce's Disease \(12/14\)](#)
 - [Powdery Mildew \(12/14\)](#)
 - [Summer Bunch Rot \(Sour Rot\) \(12/16\)](#)
 - [Virus Diseases \(7/15\)](#)
-

Nematodes

- [Nematodes \(6/16\)](#)
-

Weeds

- [Grape Weed Photo Gallery, with Common and Scientific Names of Weeds Commonly Found in California Vineyards \(7/15\)](#)
 - [Integrated Weed Management \(7/15\)](#)
 - [Weed Management in Organic Vineyards \(7/15\)](#)
 - [Special Weed Problems \(7/15\)](#)
 - [Susceptibility of Spring/Summer Weeds to Herbicide Control \(7/15\)](#)
 - [Susceptibility of Winter Weeds to Herbicide Control \(7/15\)](#)
 - [Herbicide Treatment Table \(12/16\)](#)
-

Thank You

<http://ucanr.edu/sites/eskalenlab>

UCDAVIS

DEPARTMENT of PLANT PATHOLOGY