



Canker & Rust Diseases:

by

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CALFIRE

**Insect and Disease
Identification and
Management Training
Redding, CA**



TREE CANKERS

■ CANKER:

- Localized necrotic areas on bark of branches or tree trunk.
- Caused by a disease organism.
- Cannot be caused by non-infectious agents.

■ CAUSE OF TREE CANKERS:

- Fungi, mistletoe, and bacteria



TYPES OF TREE CANKERS

■ ANNUAL

- Canker becomes inactive after one growing season.
- Agent dies out.
- Callus tissue heals over wound toward center.

■ DIFFUSE

- Canker grows through host tissue rapidly, tree can't respond.
- Lethal

■ PERENNIAL

- Cankers persist for many years.
- Annual callusing along the disease margin.
- Forms rings which may appear target-shaped.

EXAMPLES OF TREE CANKERS

- Annual
 - *Fusarium* spp.



EXAMPLES OF TREE CANKERS

- Diffuse
 - Hypoxylon
 - Chestnut blight



EXAMPLES OF TREE CANKERS

- Perennial
 - Nectria canker on walnut





TREE CANKERS

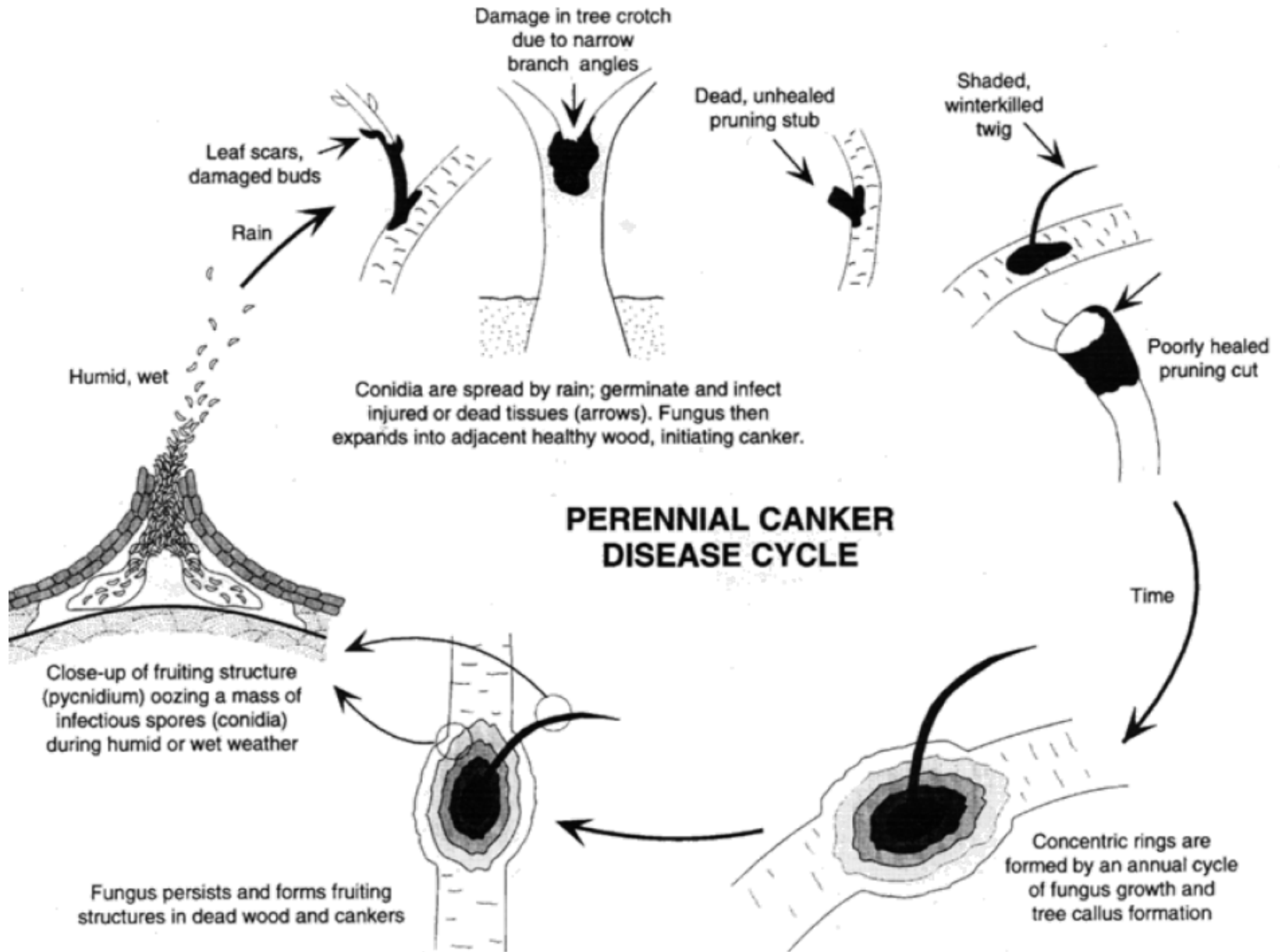
■ ENTRANCE

- Broken branches
- Trunk wounds
- Rusts enter through stomates.

■ DEVELOPMENT

- Primarily grows in inner bark and cambium.
- Cambium death causes drying and death of underlying wood.
- Cells killed by direct penetration and toxins.
- Usually spread during dormant season, tree callus checks spread during growing season.

Typical life cycle of canker fungi





Cytospora Canker

Cytospora albietis

- **Hosts:** True firs, rarely Douglas-fir.
- **Life Cycle:**
 - Weak parasite – attacks weakened trees by other agents – insects, fire, other diseases, and human activities.
 - Dwarf mistletoe – predisposes fir to Cytospora canker.
 - Cytospora spreads by conidia (asexual spores) by rain splash
 - Infects through wounds and girdles and kills branches.

CYTOSPOR CANKER

- Damaging disease of true firs
- Trees all sizes affected
- Mortality result of heavy infection.



Cytospora Canker

- **Symptoms:**
 - Girdle branches 6 months -2 years
 - Spore horns - spores dissolve in water
 - Sunken canker



Diplodia

- *Sphaeropsis sapinea*
- Infects several pines (ponderosa & Monterey)
- Death of current shoots, major branches, and entire tree
- Beneath canker is dark, resin-soaked wood
- Common on mature and stressed trees

Diplodia

- Symptoms begin in Spring
 - Coincide with bud break and shoot and needle elongation
- High moisture and humidity
- Infect through wounds.
- Fungus present year round in dead needles, needle sheaths, twigs and cones.



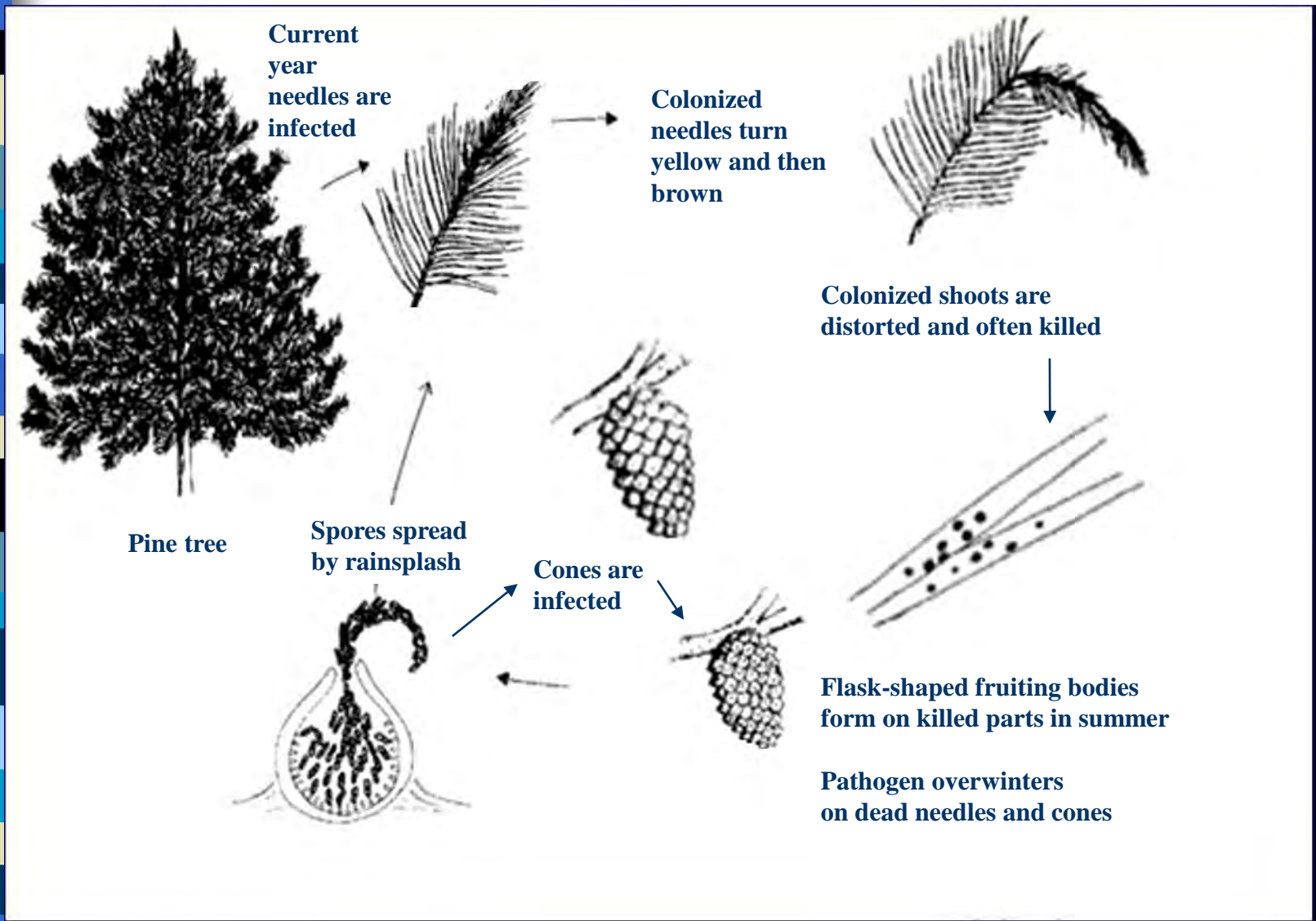
Diplodia

- Current years shoots are shorter than normal
- Needles retained on tree
- Resin soaked bark
- No evidence of insects killed the shoot



Figure 2. Infected shoot. Bark has been removed show discoloration of the wood in the dead shoot

Disease cycle



Diplodia

Disease Cycle

- Pycnidia formed on needles, fascicle sheaths, scales of seed cones and bark



- Spores are dispersed from March to October
- High moist conditions are needed for infection



- Fungus penetrates needles resulting in stunted shoots and needles.





Diplodia Management

- Stand or recreation site sanitation
- Remove severely infected trees
- Trees planted on productive sites
- Prune and destroy infected material and cones. Prune during dry weather
- In landscape, a fungicide + pruning may reduce infections

Pitch Canker

- Not native to CA
- Native SE US
- Found in S. Africa, Spain, Portugal, and Chile
- *Fusarium circinatum*



PITCH CANKER

- Spores are wind blown
- Insect carry spores
 - Engraver beetle (*Ips* spp.)
 - Twig beetle (*Pityophthorus* spp.)
 - Cone beetle (*Conophthorus radiata*)
 - Deathwatch beetle
 - *Ernobius Punctulaus*)

ZONES OF INFESTATION

April 1998

- Bark Beetle Infestation Zone
- Pitch Canker Infestation Zone
- Ranger Unit Boundary



Pitch Canker

- Pitch canker on bark of Monterey pine
- Infects from feeding insects or other wounds
- Low resistance in Monterey pine



PITCH CANKER



Sudden Oak Death



In the mid-1990s, large numbers of tanoaks and coast live oaks began to die in the coastal counties of central California.

California Bay Laurel

Umbellularia californica

- necrotic leaf tips
- black irregular patterned “zoneline” between healthy & non-healthy tissue
- chlorotic leaf margin



Tanoak

Notholithocarpus densiflorus

- dieback of young shoots
- “zone line” on under side of bark
- mortality



Coast Live Oak

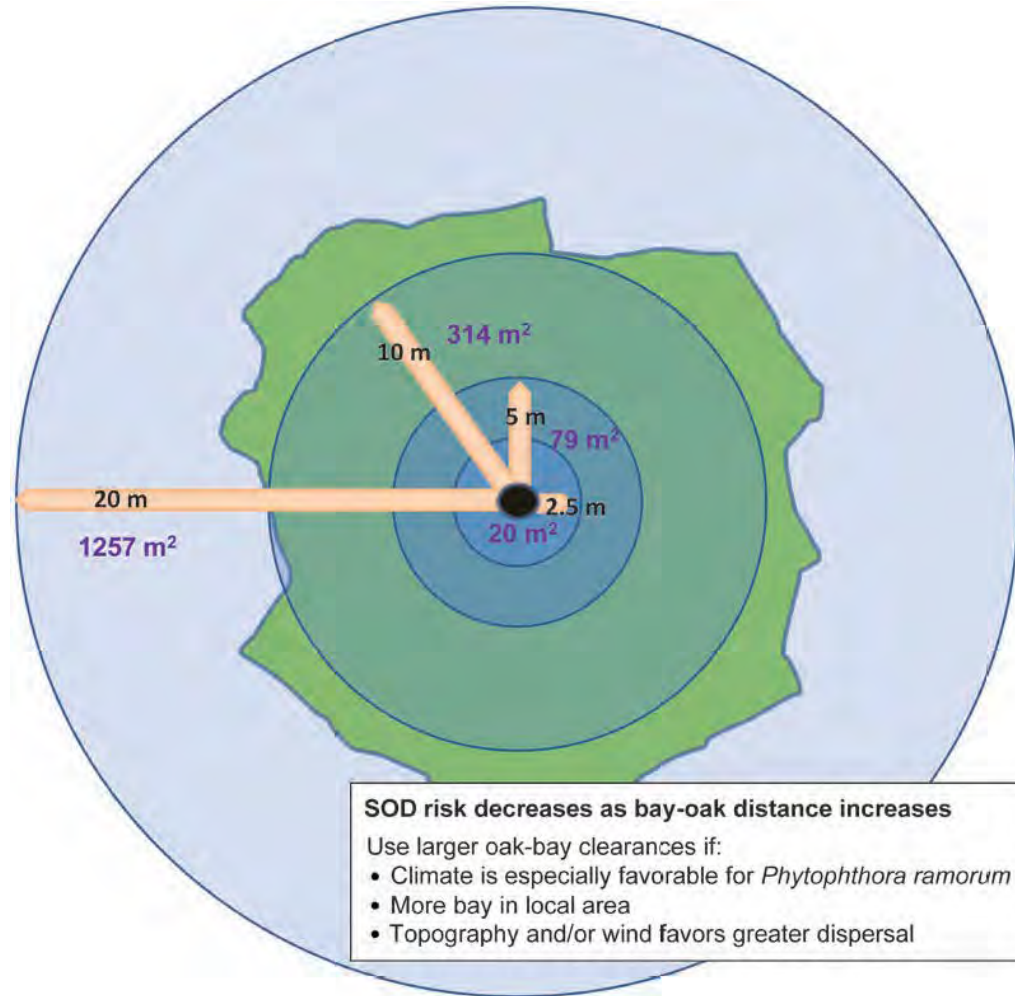
Quercus agrifolia

- discoloration of foliage
- bleeding cankers
- “zone line” on under side of bark
- mortality



Bay Management

- In California, risk is largely based on proximity to California bay laurels.
 - Removal of bays within 15 feet of oak trunks.
 - Combine with chemical treatments





General Canker Management

- Prevention (reduce stress)
 - Hard to eradicate once affected.
 - Plant resistant varieties
 - Healthy, well-adapted seed stock
 - Protect young, thin barked trees from sunburn damage.
 - Proper water and fertility programs (summer vs. winter)
 - Avoid injury to trunk and limbs



Canker Management

- Once disease occurs.....
 - Increase plant vigor for recovery
 - Prune and/or remove dead bark (always disinfect tools).
 - Prune 2-3” below canker margin – branch cankers
 - Discard infected material (practice sanitation)



RUSTS

- Obligate parasites
- Some rusts have primary hosts
- Some rusts have primary and alternate hosts

- Autoecious - rusts with one host – primary
- Heteroecious - rusts with two hosts are – primary and alternate host



RUSTS

- **Macrocyclic rust – long cycle rust**
 - Produces all 5 spore types
- **Demicyclic rust – medium cycle rust**
 - Omits uredia
- **Microcyclic rust – short cycle rust**
 - Produces basidiospores, teliospores and spematia.



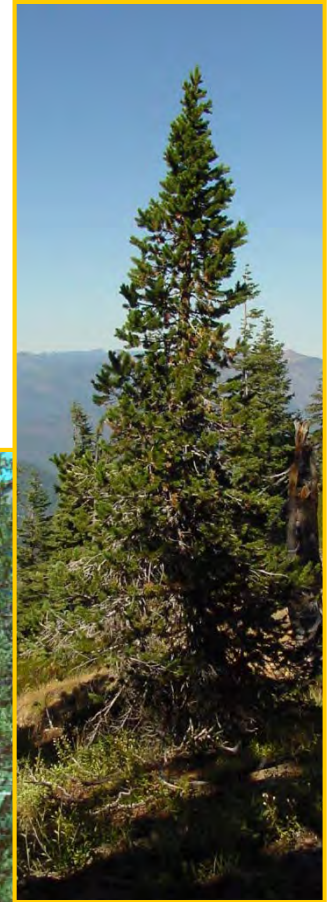
RUSTS

- Most complex of cankers due to number of spore stages that may be involved
- Rusts generally enter through stomates.

California White Pine Hosts



Whitebark



Western White



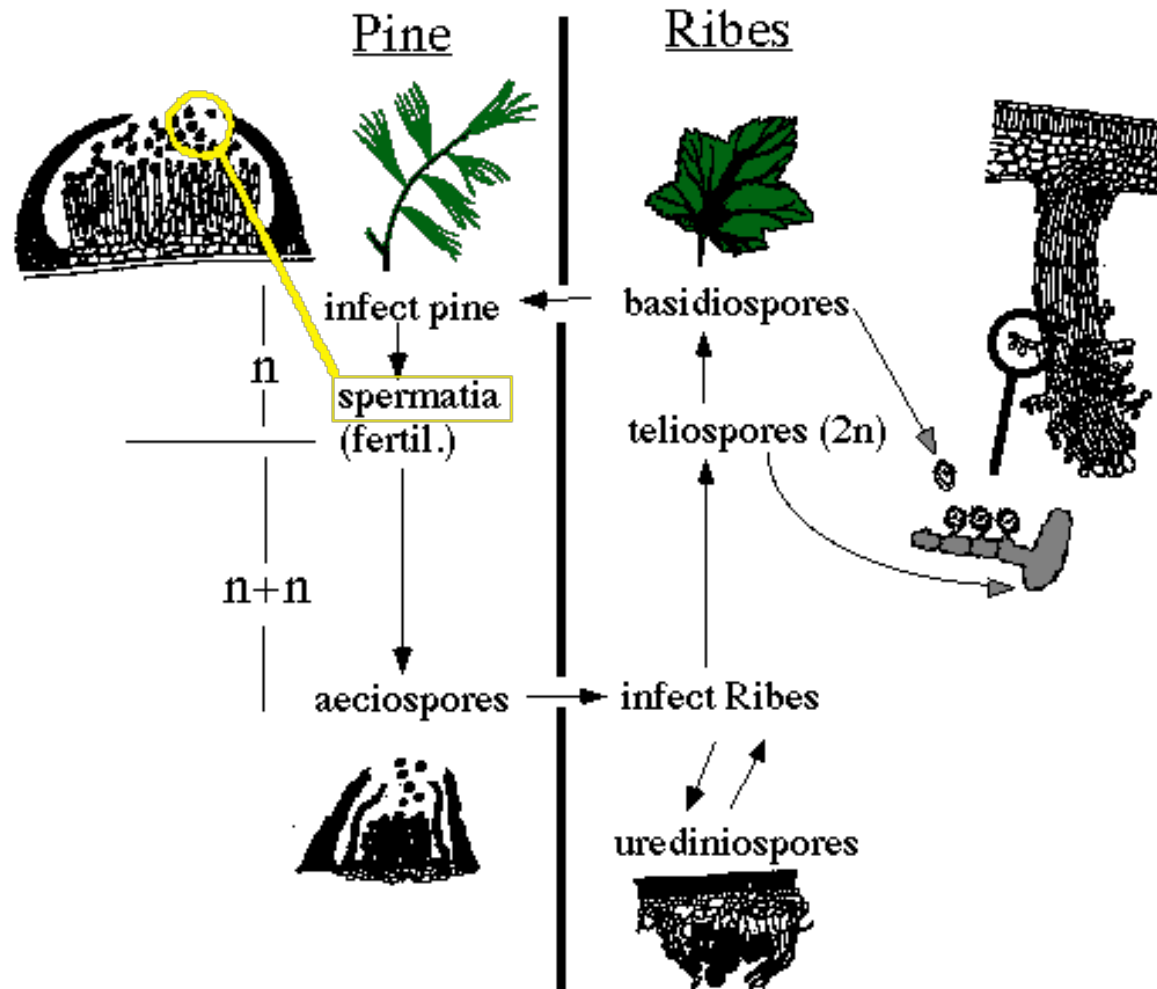
Sugar



Bristlecone

Foxtail

White Pine Blister Rust Disease Cycle





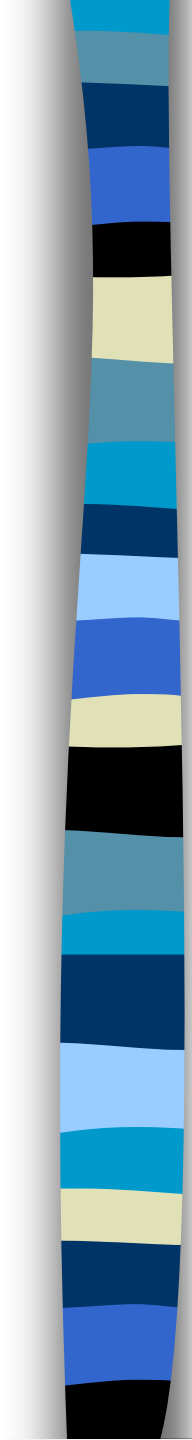
SPORE STAGES OF WHITE PINE BLISTER RUST

■ White Pine Blister Rust

- Stage 0 – Spermatium (Pycniospores)
- Stage 1 – Aeciospores
- Stage II – Urediospores
- Stage III – Teliospores
- Stage IV - Basidiospores

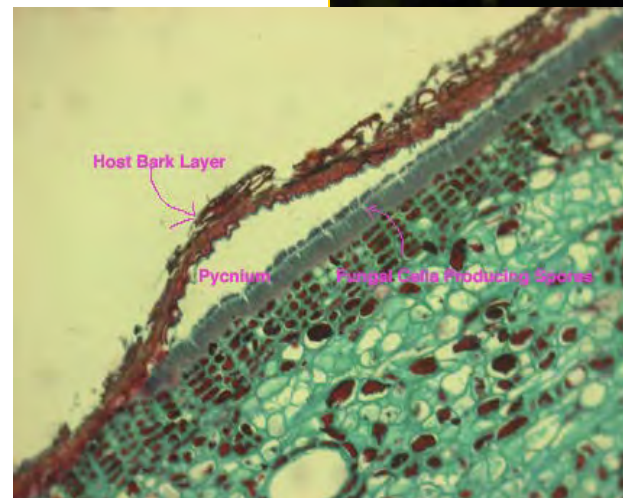
WHITE PINE BLISTER RUST

STAGE 0

- 
- Stage 0 = Spermatium (Pycniospores)
 - Haploid (n)
 - Produced in a spermogonium (pycnium) on the bark of white pine.
 - Pressure builds up inside and the spores ooze out 2 – 3 years after tree has been infected.
 - Some spores are (+) and some (-) and they perform a sexual function.
 - Spores are sticky and insects feed on them.
 - White blisters appear in the same area the spring following spermatium production.

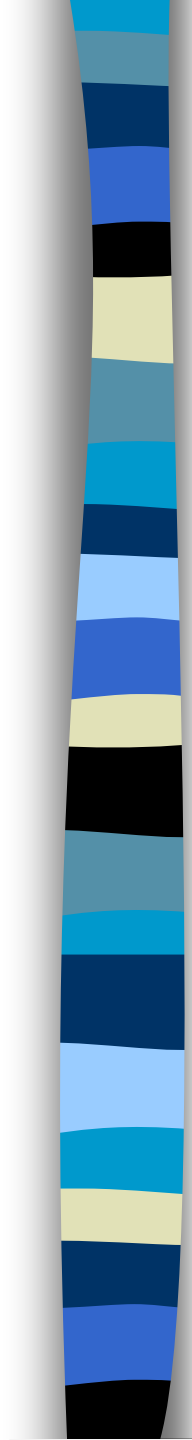
Stage 0 – Pycniospores

- Sticky yellow to orange
- Smelly
- Sugary
- Spread by flies
- Sexual function



WHITE PINE BLISTER RUST

STAGE I

- 
- Stage I = Aeciospores
 - Dikaryotic ($n + n$)
 - Formed in an aecium in the same place as the spermatia were the previous year.
 - New spermatia produced around the outside.
 - Canker spreads each year until the tree or branch is girdled.
 - Spores are carried by the wind to *Ribes* spp. In the spring.
 - Able to travel up to 350 miles.
 - Spores germinate on the *Ribes* leaves and enter through the stomates.

Stage 1- Aeciospores

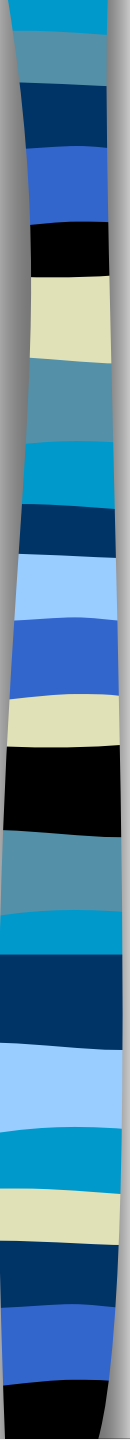
- Early Spring
- White papery covering
- Powdery
- Wind disseminated
- Yellow → White
- Spread 350 miles



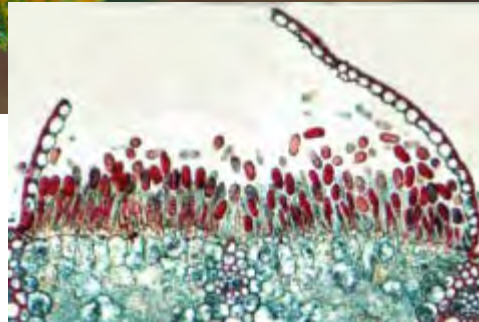
WHITE PINE BLISTER RUST

STAGE II

- Stage II = Urediospores
- Dikaryotic ($n + n$)
- Produced on the *Ribes spp.* On the lower surface of the leaves.
- Produced in the uredium two weeks after infection.
- Infects other *Ribes spp.*
- More Urediospores are formed, cycle is repeated 5 – 6 times.
- Spores are airborne and travel several hundred yards.



Stage 2 - Urediospores





WHITE PINE BLISTER RUST

STAGE III

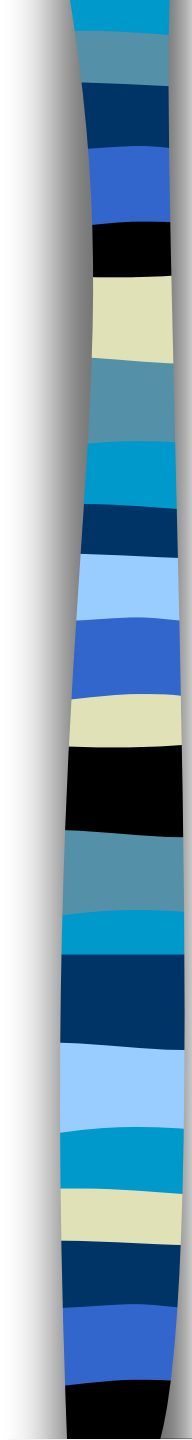
- Stage III = Teliospores
- Dikaryotic ($n + n$) progressing to diploid ($2n$).
- Formed on the under side of the *Ribes spp.* Leaf in the old uredium.
- Over wintering stage
- Meiosis occurs and 4 Basidiospores are formed.

Stage 3 - Teliospores

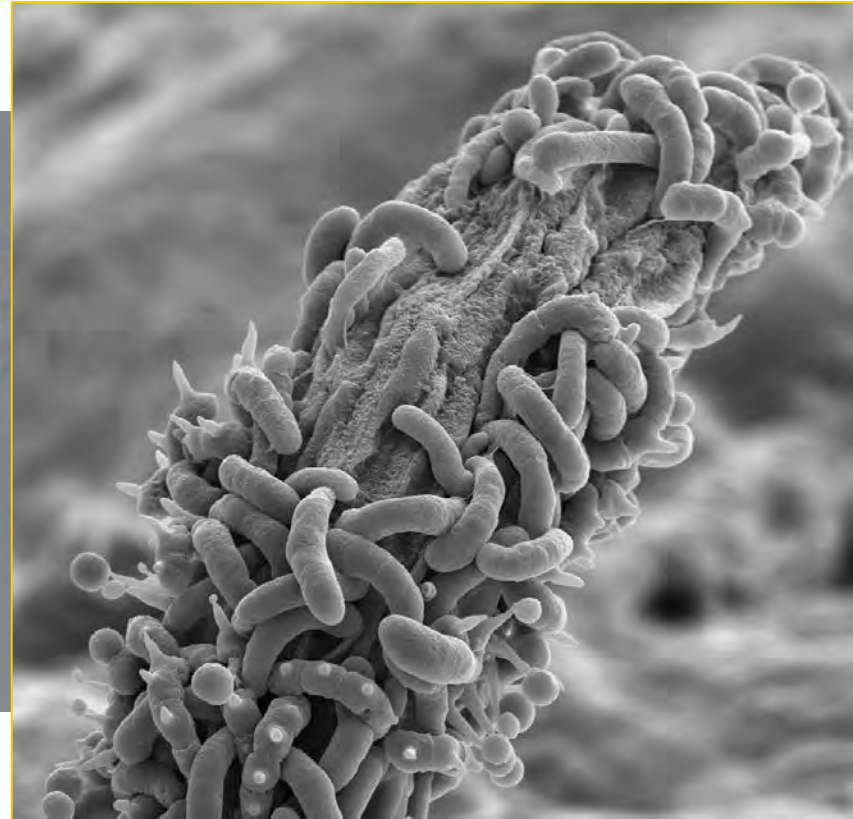


WHITE PINE BLISTER RUST

STAGE IV

- 
- Stage IV = Basidiospores
 - Haploid (n)
 - From teliospore in spring.
 - Airborne and travel up to 900 feet to land on white pine.
 - Spores germinate and enter through stomates on leaves.

Stage 4 - Basidiospores

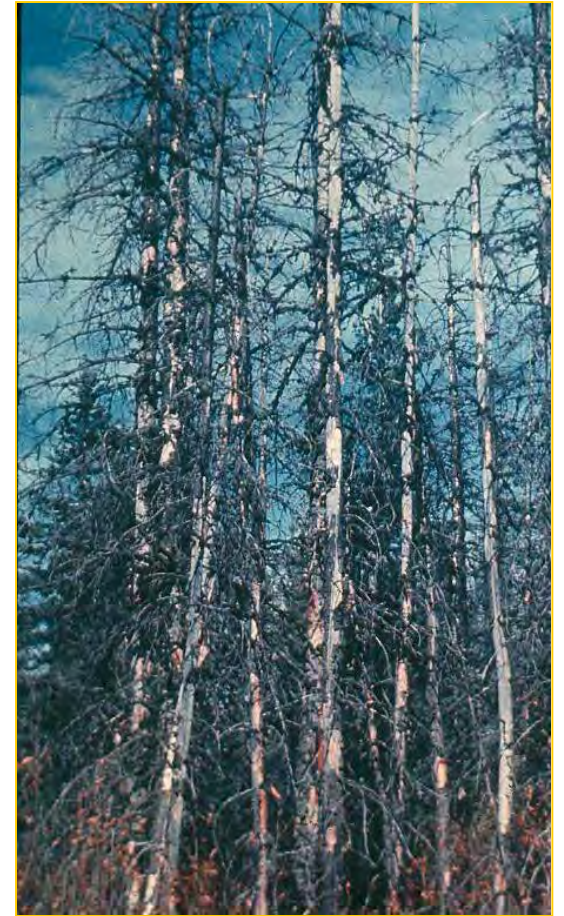


Basidiospores Shot from Teliospore “Hairs” can Infect Pine Needles

Dead Branch “Flags” in Sugar Pine



Blister Rust Cankers and Mortality





White Pine Blister Rust Control

■ Genetic Resistance

- Deploy resistant seedlings
 - Major Gene Resistance, Multigenic Resistance
- Foster natural regeneration from survivors
 - Even from “Good” infected trees

■ Silviculture

- Shade out alternate hosts
- Closed canopy conditions not as favorable for infection
- Prune lower branches

■ Historical: *Ribes* eradication

Peridermium harknessi

- WESTERN GALL RUST
- SPERMATIA AND AECIAL STAGE ON PINES





WESTERN GALL RUST

- WGR has a two-year life cycle.
- In May-July, climate dependent, aecial spores form.
- Damaging rust throughout CA.
- Spores become airborne and infect new shoots.
- Galls visible on branches about 1.5 to 2 years
- Galls grow and release spores each spring - girdle the host stem or branch.
- Major hosts – lodgepole, ponderosa, bishop, shore and Monterey pine.
- Autoecious

Melampsorella caryophyllacearum

- MELAMPSORA
RUST BROOM
- Spermata and
aeciospores on
true firs
- Uredia and
teliospores on
chickweed





RUST MANAGEMENT

- Removal of infected trees
- Don't plant pure stands
- Resistance
- Raising the understory
- Pruning

Questions ???

