Cankers and Wilts

What is a canker? - necrosis of stem tissue - sometimes a visible canker is formed other times shoots are killed too quickly.

How is one formed? - **death of cambium**

via direct colonization of cambium by pathogen - Ex: mostly ascomycetes or imperfect stages, many of which are weak or opportunistic pathogens; colonization mostly via wounds, perhaps endophytic colonization?, more rarely though leaves and into twigs (*Discula)*

via colonization of cambium or sapwood following by secondary infections - ex: rusts followed by ascomycetes like *Nectria*,

via decay of sapwood resulting in death of adjacent cambium - Ex: canker rots - some *Phellinus sp*., *Fomitopsis cajanderi*, many others

Some photos:

Target cankers caused by *Nectria galligena* and *Ceratocystis fimbriata*

Sunken cankers caused by *Dermea pseudotsugae* and *Phomopsis lokoyae* on Douglas-fir, Diplodia canker on pine

Huge elongate stem canker caused by **Stalactiform rust - *Cronartium coleosporioides*** on lodgepole pine

Importance of canker fungi

very common on all types of trees, but usually of little consequence. Often become a problem as other stress factors activate them: other pathogens, insects, damage, and **climatic stress** (especially correlated with the limits of host geographic range) - best example cypress canker

Exceptions: **introduced canker fungi** are some of most virulent pathogens (Chestnut blight, dogwood anthracnose, pitch canker, beach bark disease, SOD)

General characteristics of canker causing fungi

Usually causes by ascomycetes, and mitotic spore states are often important
cankers are especially common outside the range of a host
they may interact with other "predisposing" organisms that weaken the branch or tree

often they show up first as flagging branches, which may or may not spread into main stem

secondary decay fungi are often introduced - causing defects and structural weakness at canker

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Some commom cankers

Atropellis canker - *Atropellis pinicola* - very common cause of branch death (flagging) on Sugar pine. - often mistaken for blister rust because of canopy flagging.

Cypress canker - *Seiridium cardinale*

Host range - *Cupressus spp*. (& *Sequoia*?) seen almost exclusively in trees planted outside natural range - **and this range is very finely defined**.

Signs and symptoms - flagging, resinous "diffuse" cankers, small black fruitbodies (acervuli). Distinctive conidia

Disease is spread short distance by rain splashed conidia, and long distance by wind-borne ascospores. Transmission by the cypress moth may also occur.

Cytospora spp - asexual states of *Leucostoma* and *Valsa*

many spp involved - both hardwood and conifers are hosts

usually associated with damaged or stress limbs or trunks (e.g. frost damage, mistletoe) *C. abietis* on red fir with mistletoe

Best sign distinctive asexual spore stage - yellow to orange tendrils of stick spores. The sexual state (clustered black perithecia) is common on some hosts.

Hypoxylon mammatum - Aspen canker. causes a canker rot which can result in snapping of main stem. cankers are often associated with branch stubs; serious losses in Lake states,

Wood endophytes - a reminder

Hypoxylon fragiforme - a wood decaying ascomycete on hardwoods
spore 'eclosion' in milliseconds following exposure to host bark exudates
endophytic colonization of bark and wood followed by long latent period
activated by slow drying of wood

Chestnut blight - *Cryphonectria* *(Endothia)* *parasitica
Life cycle of pathogen

Pitch canker** - ***Fusarium circinatum
Life cycle - only asexual state known; sticky conidia, via wounds in wet weather (south east) vectored by non-specific beetle associates (Cal), no chlamydospores, also can be seed transmitted. Rapidly growing trees most successful

Common insect vectors (Cal) : *Pityophthorus* spp.- twigs, *Conophthorus radiatae* (weevil) - cones, *Ips* - branches & boles.

History - first described in SE in 1930s - many VC groups, first seen in California in 1986 in Monterey, now throughout range of Monterey pine, also in LA basin and Mendocino CO. only 5 VC groups in CA,

Cankers and Wilts

*__Dogwood Anthracnose__ - *Discula destructiva*
rain splashed asexual spores - infects leaves and causes an anthracnose, moves to twigs and branches and kills entire tree.
pacific northwest then Eastern US mid 1970s
Japanese dogwood is resistant

Fusicoccum Arbuti (=*Nattrassia mangiferae* in your book) mitotic state of *Botryosphaeria*
Madrone canker - know from Puget sound areas since 1968. - periodic outbreaks associated with drought, sun scald, unclear whether this is native or introduced.

Generalities about wilts
Wilt - a self explanatory symptom
Cause: colonization of xylem and rapid movement through it
host reaction - tyloses
primarily a problem in angiosperms - Exception? reasons
all ascomycetes

Common wilt fungi

Fusarium oxysporum complex

life cycle - asexual spores, chlamydospores (long residence time in soil), soil borne inoculum, also many non-pathogenic root colonizing strains.

Hosts - wide host range mostly herbaceous, tree hosts many monocots (e.g.)Bananas, Palms, Mimosa wilt (photos of it).

F. oxysporum f. sp. pernicosum - mimosa wilt

Symptoms - drooping leaves in early to mid summer, remaining leaves turn yellow and fall off. Some trees die within a month of first symptoms, other die branch by branch over several months. White frothy fermented-smelling gel exudes from cracks in bark of main truck and larger limbs, brown streaking of sapwood, Sporodochia (masses of conidia) at lenticels on killed branches.

introduced? to SE in 1930? spread rapidly (by humans via transported soil), Chlamydospores in soil

"F. oxysporum f. sp. cubense" - actually several different species (Panama wilt of banana)
long residence time at site, problem of resistance-breeding in triploid host

Verticillium wilt - caused by *Verticillium* *dahliae* & *V. albo-atrum*

Asexual with conidia and sclerotia - soil borne inoculum

Host range very broad - among trees all are angiosperms, most important are orchard trees (e.g. **Avocado, Pistachio, Persimmon, grapes)**, important forest/ yard trees include **Maple** and Tulip poplar.

Symptoms - acute versus chronic:
Acute (appearing in late summer/early fall) : leaf curling & necrosis esp. from edges back, wilting , die back; staining in sapwood; sometimes strip cankers and predisposition to canker fungi esp. *Cytospora* and *Nectria.*
Chronic: sparse foliage, reduced growth, stunted leaves and twigs, distress crops of seeds.
Symptoms of both types may be off & on over several years and may be restricted to some branches.

symptoms related to growth in host & toxins?, transpiration stream, movement between annual rings, heat effects

Environmental factors - water stress, excess N,

Infection via soil-borne inoculum (microsclerotia), root graphs, leaf-dispersal in some hosts.

Management - primarily an orchard and urban problem, change to resistant species (conifers) where possible; balanced nutrients - slightly higher in K and lower in N, systemic fungicides for "show trees", Salicilic acid?

Oak wilt ***Ceratocystis fagacearum***
Hosts - all oaks & by inoculation chestnut, tanoak, chinkapin, but in nature it is most deadly in black oak, live oak groups. Differences among hosts

Life cycle - similar to Dutch Elm disease - beetle vectored via sticky spores, both sexual and asexual; also by root graphs. **Peculiar pressure pads of mycelium**- formation of pads sensitive to timing of death and rate of drying.

Insect vectors - Sap beetles - Nididulides in north, Bark beetles: *Pseudopityophthorus minutissimus* & *P. pruinosus* in South.

Mystery about lack of genetic variation

Dutch Elm disease ***Ophiostoma*** *(Ceratocystis)* ***ulmi & O. novo-ulmi***
Hosts - all North American and European Elms

signs & Symptoms - wilting, flagging, staining of sapwood, sporulation under bark

Life cycle of disease: **Pathogenic versus Saprophytic stages & beetle vectoring**,; **transmission via root graphs**, role or lack of it for cerato-ulmin

Beetle vectors ; **European elm bark beetle** (*Scolytus multistriatus)* and the Native elm bark beetle (*Hylurgopinus rufipes*)

Management - not feasible in native forest, in urban settings - beetle control, sanitation, trenching (to break up root graphs), pruning & injection of systemic fungicides on high value trees. dsRNAs?

Bacterial scorches

Causal agent: xylem inhabiting bacterium - "***Xylella fastidiosa"***

Host range: wide, some hosts harbor the bacteria but are asymptomatic (e.g. grasses) Orchard crops - **Pierce's disease** (grapes), Almond scorch, most important forest hosts elms, oaks, sycamores, buckeyes

Symptoms - leaves begin to curl and look scorched in mid to late summer; Xylem elements plugged with gums etc. Often occurs every year - may be accentuated in draughts. Predisposition to twig & canker fungi (e.g. *Botryosphaeria*), bark beetles (elm)

Transmission by leaf hoppers, aphids, spittle bugs, also via graphs, symptomless plants serve as reservoirs,

Geographic range - limited to warmer climates

Management - resistant varieties (grapes), others?

References

* **Introduced pathogens; not native to North America**

See canker diseases pp341-347 in your text, and wilts are 358-362

References in case your interested

Information on these diseases is not found in Pacific Coast Conifers, but can be found in Diseases of Tress and Shrubs: Mimosa wilt 378, Oak wilt 364, Dutch Elm disease 366, *Verticillium* 374-377, *Scorch*: 384

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