Oak Wilt in Relation to Other Tree Diseases

ISA-T Oak Wilt Certification Training

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Examples of Existing Tree Diseases in Texas

- Herbicides
- Drought, other abiotics
- Declines (numerous species)

Abiotic

- Black spot (elm)
- Oak leaf curl
- Actinopelte on oak
- Leaf rust on oak
- Unkown virus on hackberry
- Brown spot needle blight
- Needle rusts
- Lophodermium needle cast
- Anthracnose (ash)
- Anthracnose (sycamore)

Foliar

- Hypoxylon cankers (hardwoods)
- Mistletoe (true and dwarf)
- Giant dodder (native,exotic)
- Endothia canker
- Botrydiplodia canker
- Phomopsis (and others) tipblight
- Pitch canker
- Cedar x Hawthorne rust
- Fusiform rust
- Crown gall
- Smooth patch

Branch, Trunk

- Bacterial wetwood
- Dutch elm disease
- Oak wilt
- Native elm wilt
- Fusarium Wilt (mimosa)
- Pinewood nematode
- Bacterial leaf scorch
- Fire blight
- Lethal yellows on palms

Vascular

- Ganoderma root rot
- Heterobasidion root rot
- Phytophthora root /crown rot
- Sudden oak death (nurseries)
- Cotton root rot
- Root knot nematode on Pecans
- Heart rots (numerous species)

Root Rots

- Sooty mold
- Ball moss
- Lichens

Non - pathogens

What's Wrong With My Tree?

- Tree problems are difficult to diagnose
- Actual diagnosis isn't important
- Prognosis may be more important
- Are levels of diagnosis

Fusiform rust of slash pine

Why Are Tree Problems Difficult to Diagnose?

- A large portion of the tree is mostly inaccessible to analysis
- Spatial relationship between the cause and effect may be obscure
- Trees support the growth of dozens of microbes
- Tree respond slowly to injuries
- One cause - one disease relationship is relatively rare

Why is Prognosis Important?

- Refers to prospects for recovery
- Has the opportunity to save time and money
- May even prevent doing more harm than good
- Emphasizes looking for other problems, e.g. hazardous trees

Levels of Confidence in Diagnosing Tree Diseases

- Degrees of flexibility are acceptable Sometimes a 100% reliably positive diagnosis is achieved
- Accuracy depends on whether information complete

Levels of Confidence in Diagnosing Tree Diseases

- Often can only achieve 90 - 100% reliability
- Indicative diagnosis sometimes appropriate
- Exclusionary diagnosis can be useful

Five Step Process in Diagnosing Tree Diseases

- Goes beyond simply looking at the tree and trying to identify cause
- Diagnosis may have high degree of uncertainty
- May still be useful

  - will lead to prognosis

  - educate client for future plantings and care of remaining trees
- Broad consideration of spatial and temporal trends in the disease syndrome

Five Step Process in Diagnosing Tree Diseases

1. Pattern of mortality in time and space within the population of trees
2. Patterns of mortality in time and space for individual trees
3. Symptoms - foliar, branches, trunks, roots
4. Signs
5. Clinical diagnostic aids

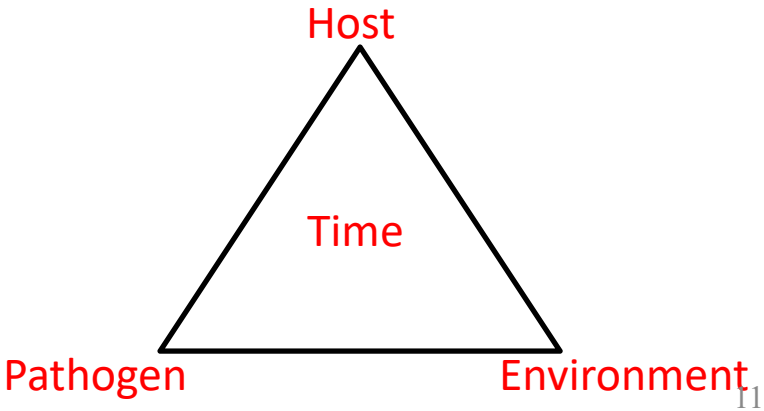
What Must We Know To Diagnose Tree Diseases?

1. Host characteristics
2. Potential pathogens and their characteristics
3. Conditions that allow the disease to develop

What Must We Know To Diagnose Tree Diseases?

- **Host characteristics,**
- **Potential pathogens and their characteristics,**
- **Conditions that allow the disease to develop.**

The Disease Triangle



Examples of pathogens

Abiotic Pathogens

Nutrient deficiencies
Poor water relations
Climatic extremes
Air pollution
Toxic chemicals
Herbicides

Biotic Pathogens

Fungi
Bacteria
Viruses
Nematodes
Phytoplasmas
Parasitic flowering plants

The Declines

Combination of abiotic and biotic pathogens
Possibly the most common of tree disease, syndromes
May occur on any species of trees
Symptoms usually similar for different species and locations

Example of an Abiotic Pathogen

Iron Chlorosis

- Caused by lack of iron,
- Particularly in high pH soils (> 7.0),
- More of a problem on non-native plants (but not exclusively),
- Also often prevalent on disturbed sites,
- Difficult to correct, but supplemental iron can be used
  - Soil applications,
  - Direct injection of tree.

Examples of an Abiotic Pathogens

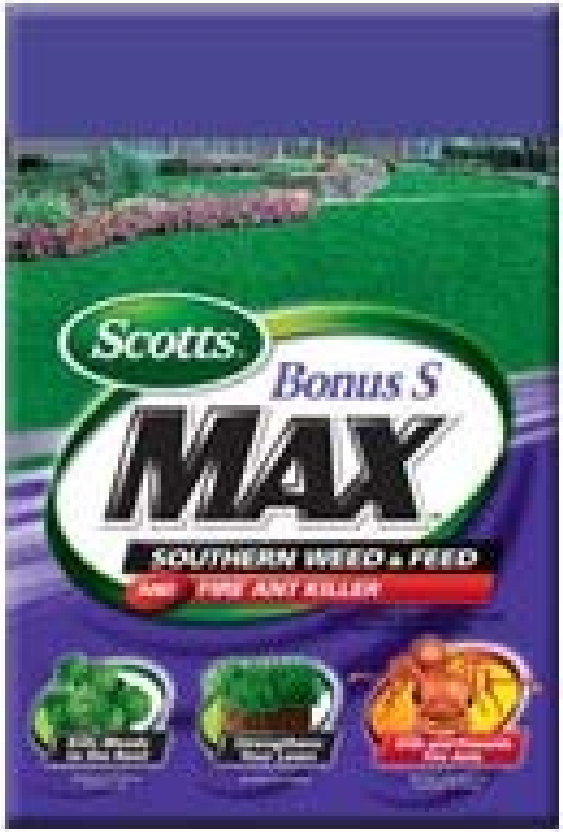
Herbicide Damage - Treaty Oak

Velpar®

Hexazinone - broad spectrum weed and brush control

Weed and Feed with Atrazine

Chlorophyl - inhibiting herbicide



Where Not to Use

"Do not apply under the branch spread (dripzone) of trees and shrubs……"

Examples of Abiotic Pathogen

Severe Drought = Severe Stress = Disease

- Trees respond to drought,
  - compensate for the stress,
- If unsuccessful, symptoms develop,
- If sufficiently severe, tree will die.

Examples of pathogens

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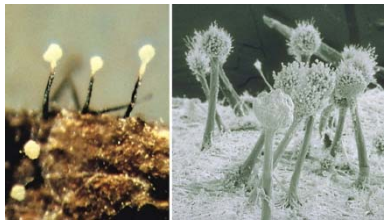
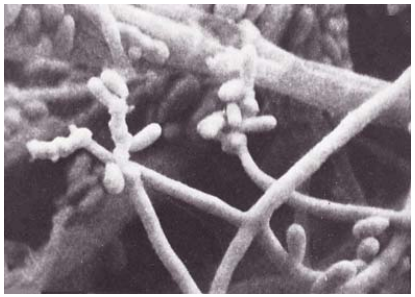
Vascular Diseases

- **Some of the most damaging of all tree diseases,**
- **Usually rapid, often fatal,**
- **Many are considered to be introduced, exotic pathogens,**
- **Usually vectored by insects.**

Dutch Elm Disease

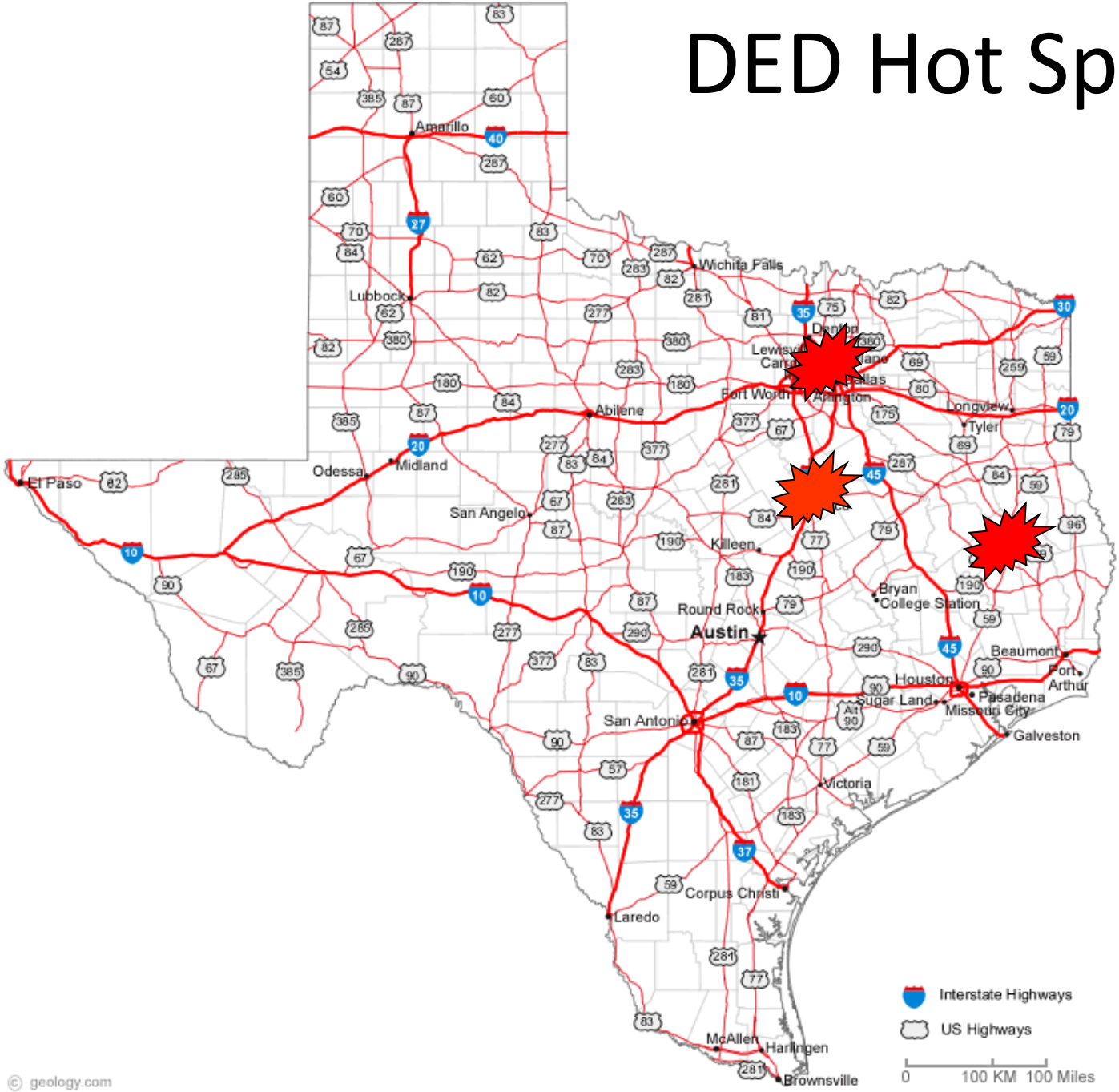
The Pathogen





- *Ophiostoma novo-ulmi,*
- Vascular parasite,
- Invaded North America in mid 1920s,
- Spread throughout native elm population,

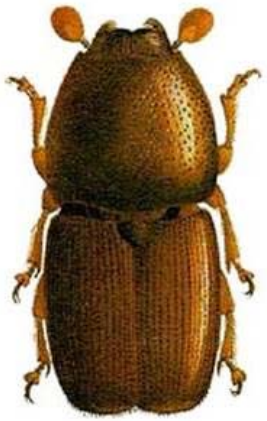
DED Hot Spots



Dutch elm disease

Disease Biology

- Elm bark beetles are vectors,
- Also spreads through root grafts,
- Inoculum forms in beetle galleries,
- Every tree source of inoculum.



Dutch elm disease

Management

- Detection,
- Isolation,
- Removal,
- Disposal,
- Injection,
- Host resistance.

Common Foliar Problems on Trees in Texas

Powdery Mildew on oak

Leaf Curl on oak

Black Spot on elm

Rust on post oak

Fireblight on Bradford Pear

Virus on hackberry

Some Attributes of Foliar Diseases and Their Control

- Broadleaved, deciduous hardwoods rarely harmed by foliar diseases,
- Potential damage usually doesn't justify extraordinary control measures,
- Chemical sprays generally not recommended,
- Sanitation (rake leaves, pick up twigs, remedial pruning) usually sufficient,
- Good tree health practices.

Examples of pathogens

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Role of Environment in Tree Diseases

- the 3 factors

1. Predisposing factors
2. Inciting factors
3. Contributing factors

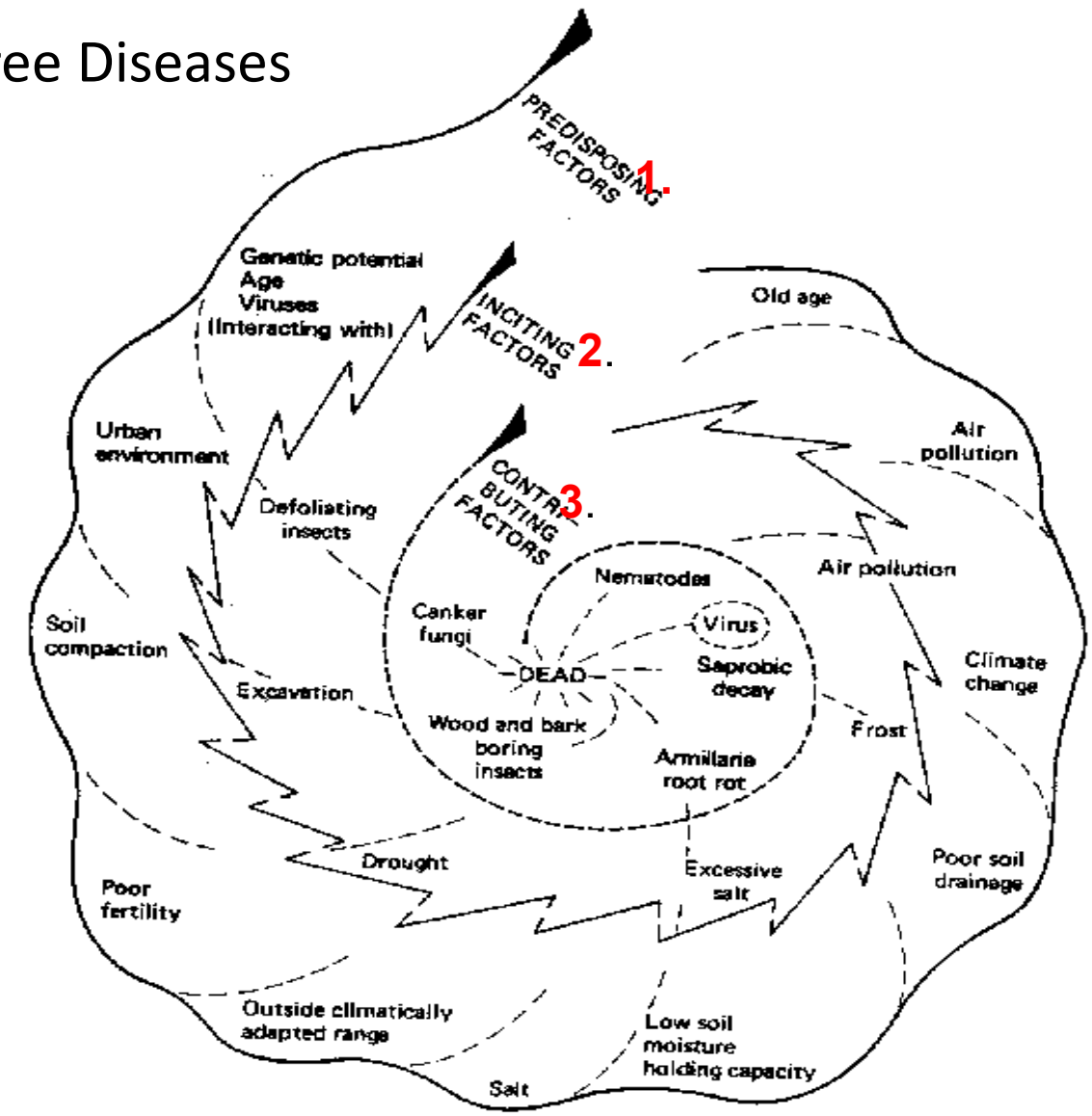


Fig. 1. Decline disease spiral (Reprinted with permission from Tree Disease Concepts by Paul D. Manion c 1991, Prentice-Hall, Inc., Englewood Cliffs, NJ).

Types of Pathogens
The Declines

- **Combination of abiotic and biotic pathogens,**
- **Possibly the most common of tree disease, syndromes**
- **May occur on any species of trees,**
- **Symptoms usually similar for different species and locations.**

Drought In Leakey, TX – Inciting factor

Summary of Drought Effects

Predisposing factor, Inciting factor

- Mild drought = mild stress = little strain,
  - no detrimental effects,
- Moderate drought = moderate stress = predisposing strain,
  - wilting, mild scorching,
  - infection by pests and diseases that normally do no harm,
- Severe drought = severe stress = disease,
  - drought becomes a pathogen,
  - dieback, death……

Long-Term Consequences of Drought

Drought as a Predisposing Factor, if Tree Survives

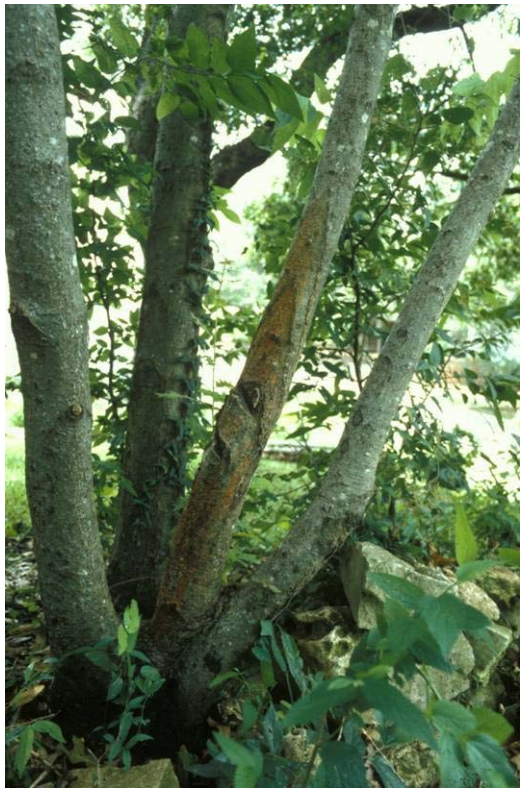
- Weakened, starch depleted trees,
- Unable to respond to pests and pathogens,
  - Normally do them no harm,
  - “secondary”, “weak” pathogens,
  - Usually consist of cankers, root rots, wood boring insects,
- Syndrome called “Diseases of Complex Etiology” or Declines.

Tree Diseases Expected to Increase Due to Drought in Texas

Contributing Factors and Their Control

1. Twig and branch cankers,
   - Hypoxylon canker on oaks,
   - native elm wilt on cedar elm,
2. Root rots,
   - Ganoderma root ,
3. Bacterial Leaf Scorch,

Cankers



Endothia gyrosa on oak

Hypoxylon atropunctatum on oak

Nectria canker on dogwood

Hypoxylon Canker

Pathogen, Hosts

- ***Hypoxylon atropunctatum*,**
- **a fungus, spread by wind blown spores,**
- **been found on oaks, elms, sycamores, pecans.**

Hypoxylon Canker

Disease Biology

- Non-aggressive facultative parasite,
- Present on healthy trees,
- Some level of predisposition of host required,
- Poor water relations the most commonly implicated source of stress.

Commonly Held Opinions and Observations of Hypoxylon Canker

- “Colonizes stressed trees”,
- “Weak parasite”,
- “Causes no harm to healthy trees”
- “…lives harmlessly in very outer bark and aids the tree in quickly shedding limbs and branches…”
- “It is extremely rare to observe Hypoxylon canker on the trunk and the tree recover”
- “Disease does not spread from tree to tree”
- “It would be inaccurate to say a tree died from Hypoxylon canker”

Conclusions – Bassett and Fenn, 1984

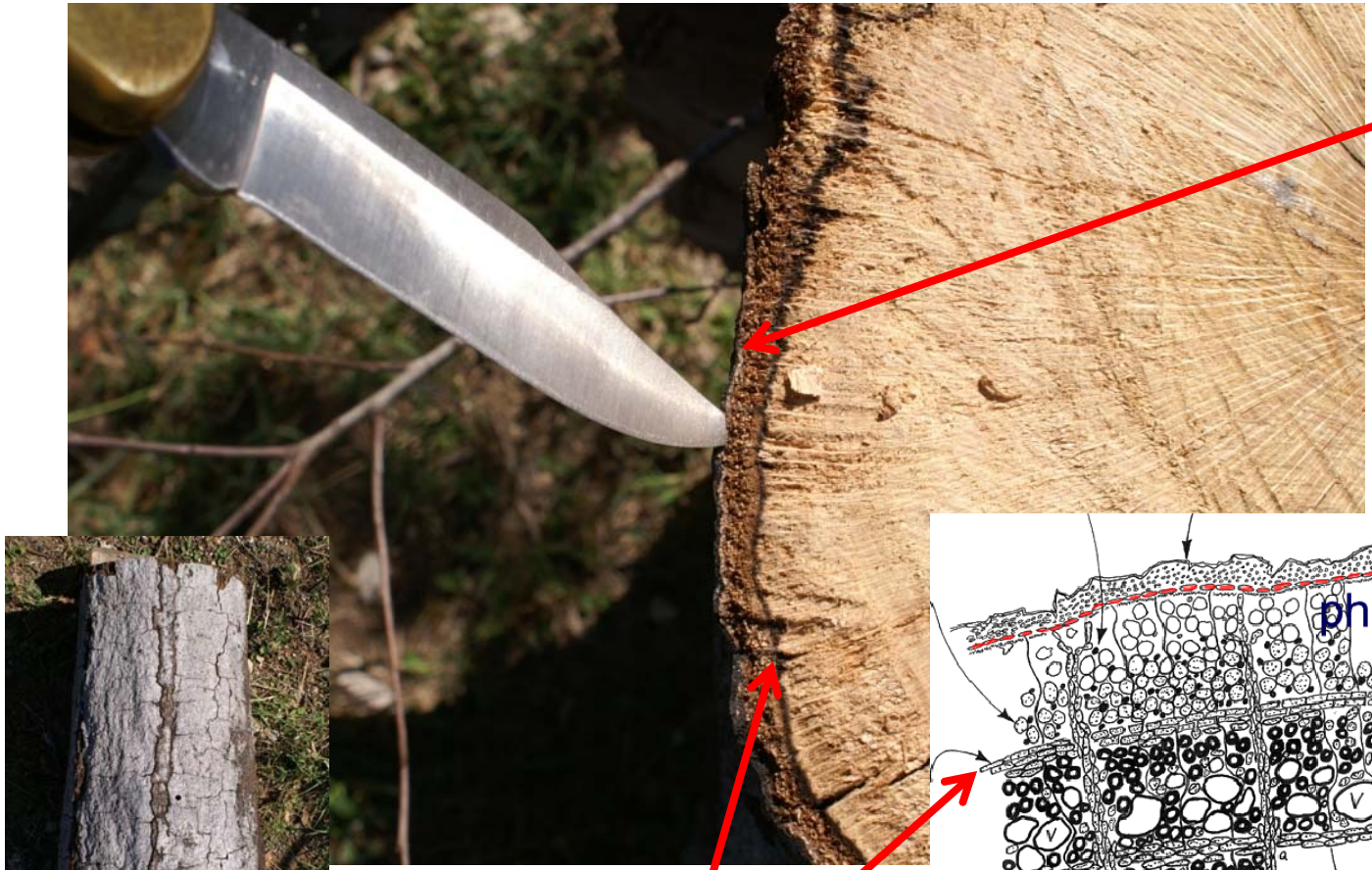
Research on Hypoxylon Canker

- Most important conclusion – the "natural" occurrence of Hypoxylon in 57% of branches and 11% of trunks of apparently healthy oaks,
  - Note: not ALL trees were colonized,
- Latent colonization explains the rapid increases following drought,
- Previously found species differences were not observed,
  - greater incidence of stromata development in red/black oaks vs. white/post oaks probably due to differences in drought resistance,
  - note: this was borne out in Brazos Valley, where incidence in water oaks exceeded post oaks in 2011.

Observations on Hypoxylon Canker of Oaks in Texas - Pathogen, Hosts

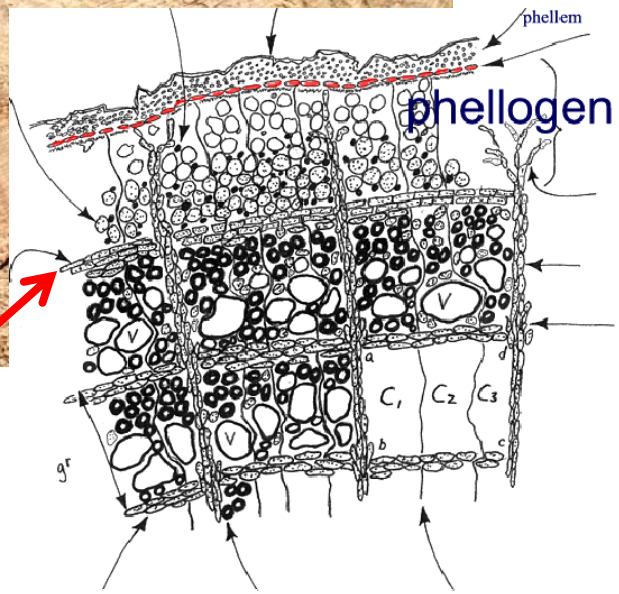
- *H. atropunctatum* on red oak species,
- Not always lethal,
- Trees appear to be to compartmentalize expanding cankers,
  - Success probably depends on stress management,
- May have implications for control.

Colonization by Hypoxylon



Phellogen = cork cambium

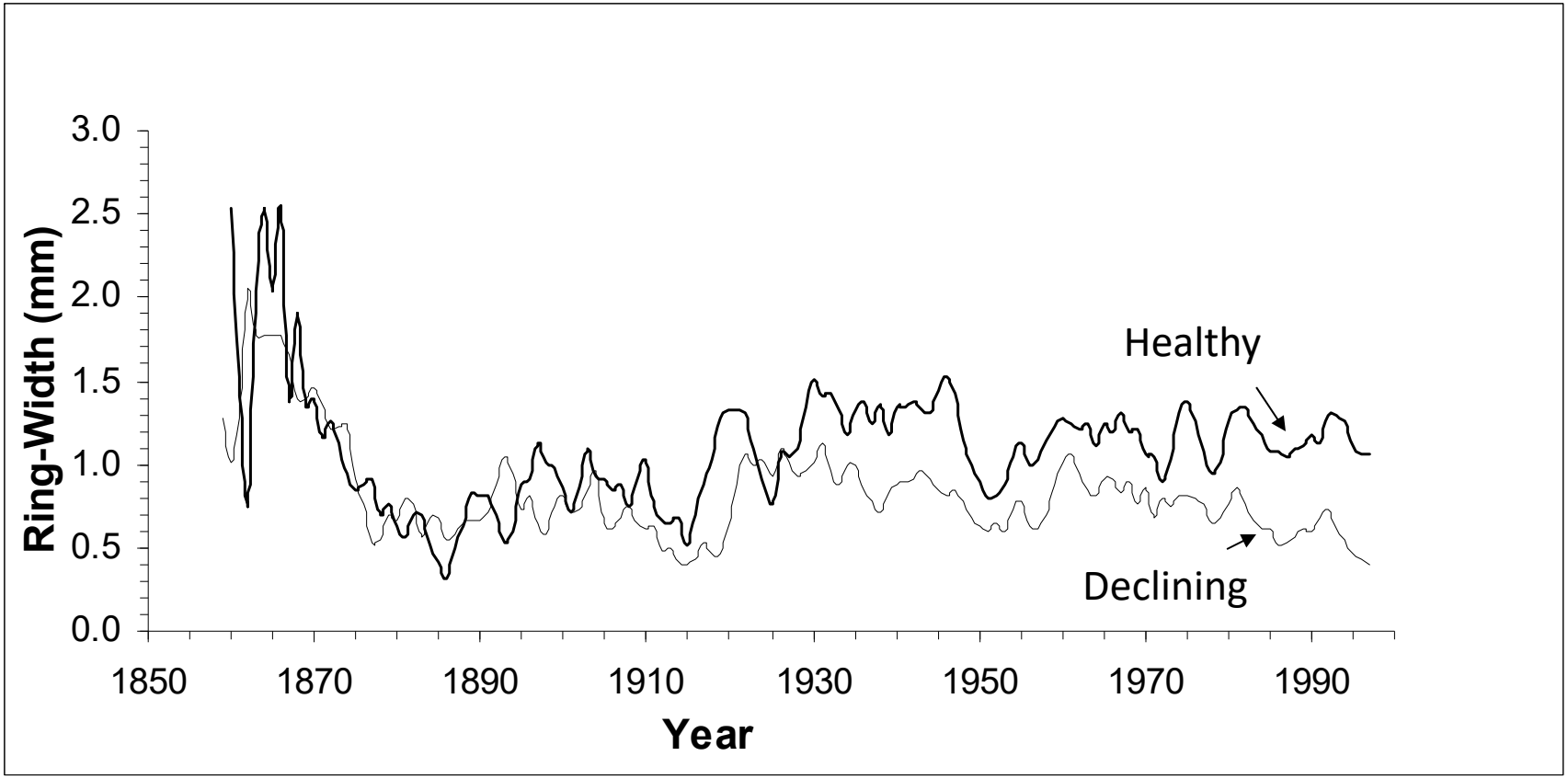
Cambium



Colonization by Hypoxylon

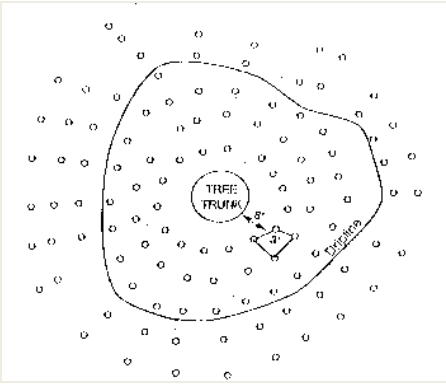
White rot and zone lines

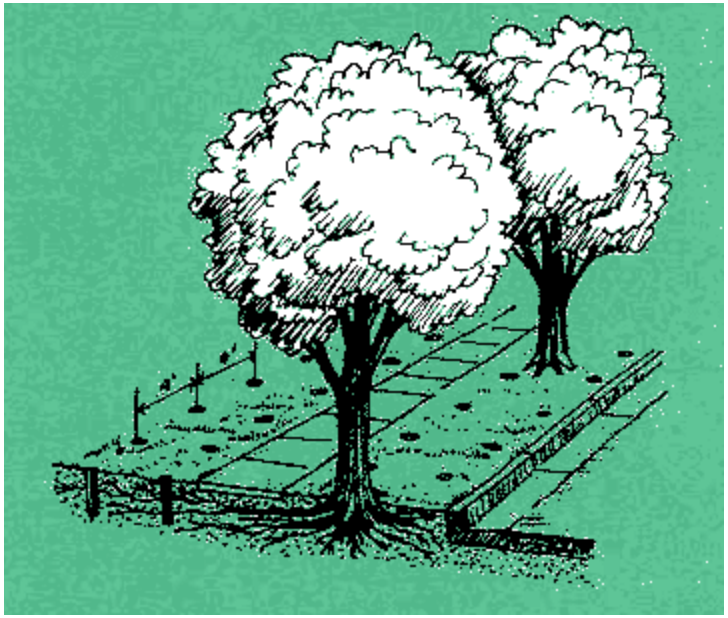
Average annual ring-width chronologies of health vs. severely declining post oaks



Hypoxylon Canker

Management

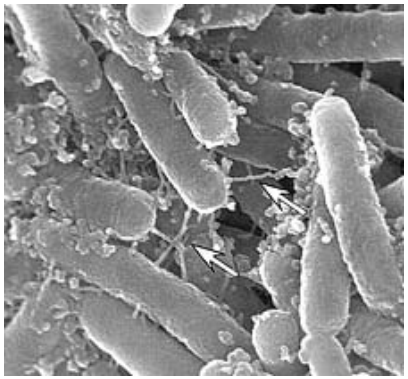




- Best Practices for maintaining healthy trees,
- Proper watering, ferilization, avoidance of stress,
- Note vertical mulching.

Bacterial Leaf Scorch

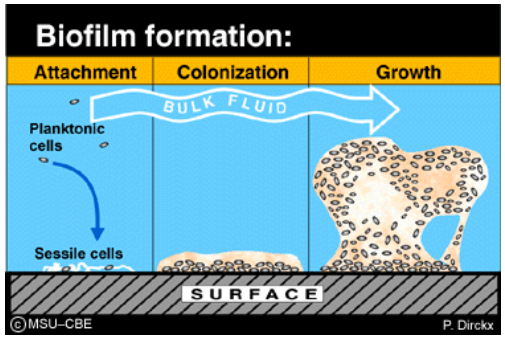
Pathogen, Hosts

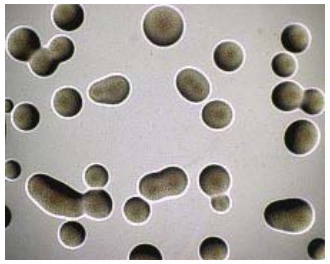


- *Xylella fastidiosa*,
- Xylem limited, fastidious bacterium,
- Many different strains,
- Oaks, elms, sycamores, mulberry, catalpa, maple, birch, sweetgum, many fruits

Bacterial Leaf Scorch

Disease Biology

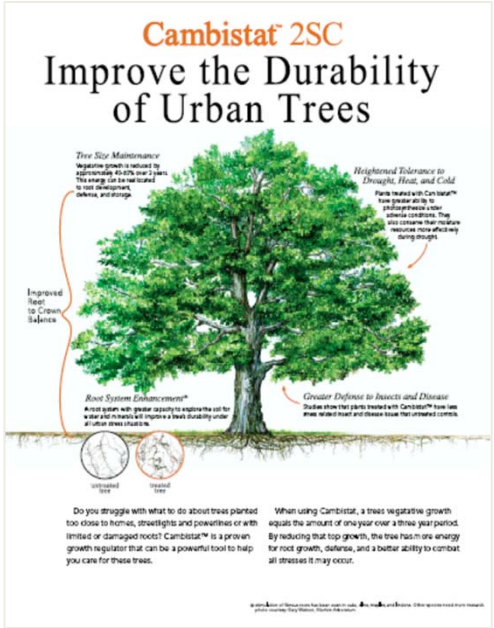




- Spread by insect vectors,
- Produces biofilms,
- Sharpshooters,
- Limited by low temperatures,
- Stress probably involved to some degree.

Bacterial Leaf Scorch

Management



- Best Practices to maintain tree health,
- Proper diagnosis critical,
- Vector management,
- Antibiotic injections (?),
- Treatments to improve stress response,
  - Cambistat®

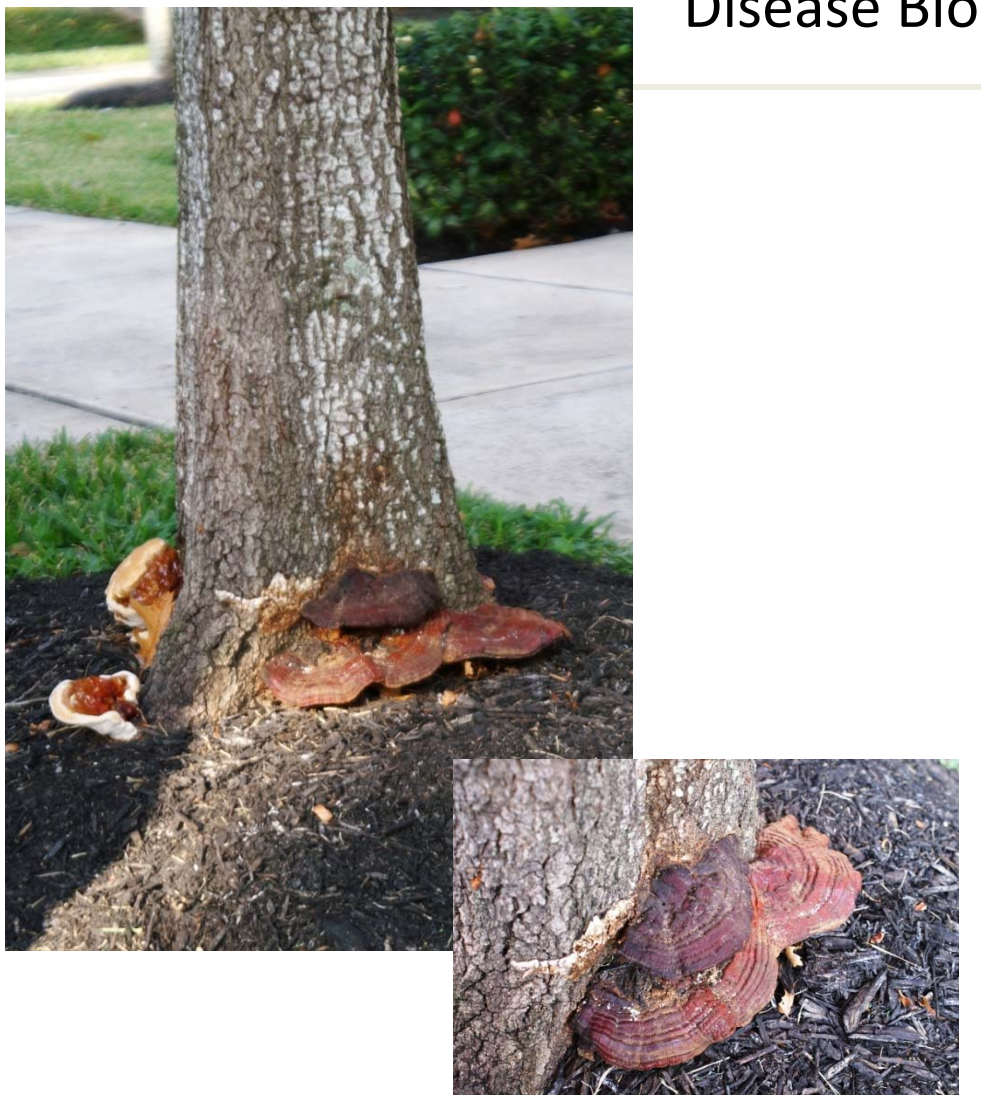
Ganoderma Root Rot

Pathogen, Hosts

- *Ganoderma* spp.
- Occurs statewide,
- A basidiomycete, produces “conks”,
- Wide host range on hardwoods, some conifers.

Ganoderma Root Rot

Disease Biology



- Produces windblown spores,
- Infects through wounds on roots at base of tree,
- Also spreads tree to tree by overlapping roots,
- Stress undoubtedly involved in disease development.

Ganoderma Root Rot

Management

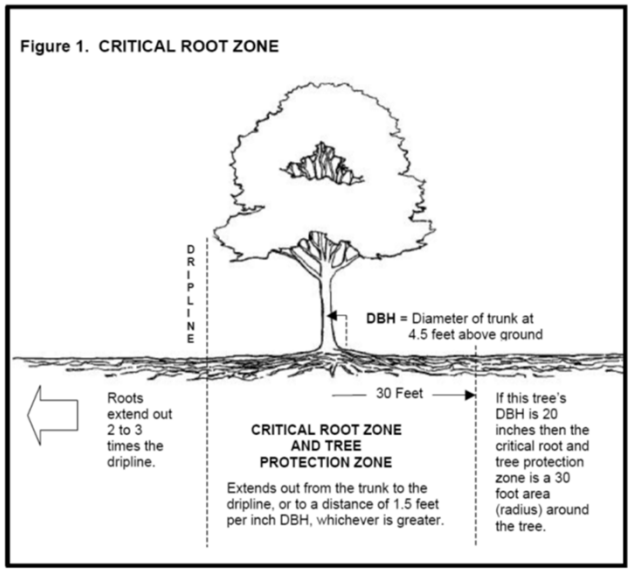
- Best Practices to maintain healthy trees,
- Grind stumps?
- Proper tree selection,
- Avoid basal wounds,
- Vertical mulching!

Managing Declines

- Improve tree health, avoid further stress,
- Plant the proper tree for the site,
- Manage fertilization and watering practices,
  - Note vertical mulching,
- Manipulate tree health directly,
  - Cambistat®,
- Remedial pruning,
- Proper pruning,
- Reduce stress.

Vertical Mulching for Enhancing Tree Health

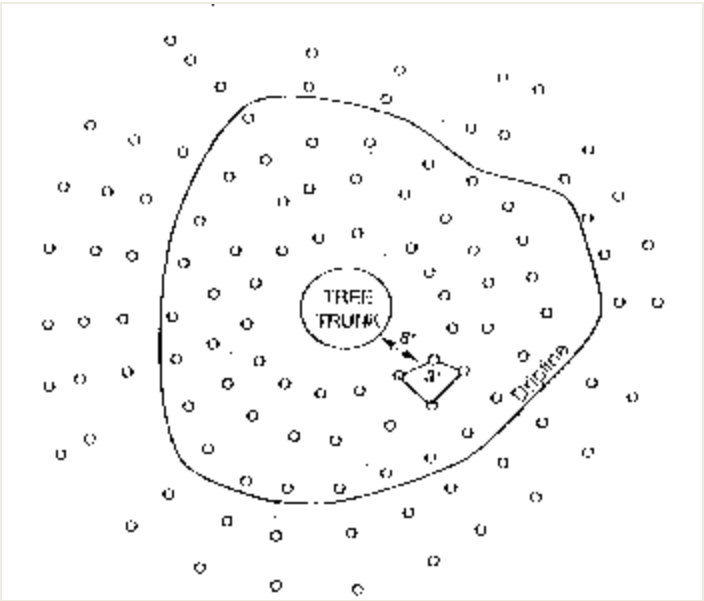
Objectives

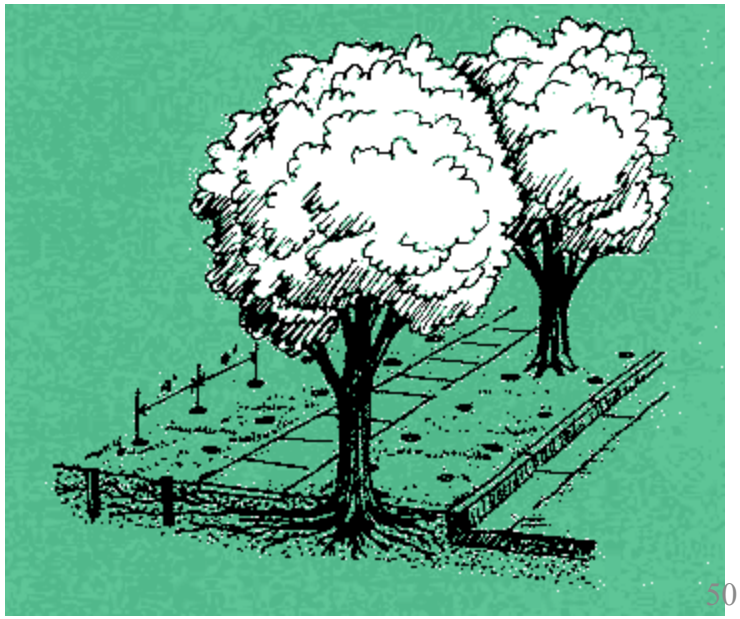


- Improve soil properties,
- Stimulate growth of root system,
- Increase tolerance to soil pathogens,
- Enhance growth of crown and tolerance to canker pathogens, heart rots, and other contributing factors.
- Pan, J.F. 1958. Effects of Vertical Mulching and Subsoiling on Soil Physical Properties. Agron J 51:412-414.
  - decreased bulk density values,
  - increased soil aggregation.

Implementing Vertical Mulching

1. **Identify root zone,**
2. **Drill holes,**
   - **2” wide, 18 – 24 “ deep**
3. **Fill holes with treatment,**
   - **Ground organic matter,**
   - **mulch, bark, etc.**

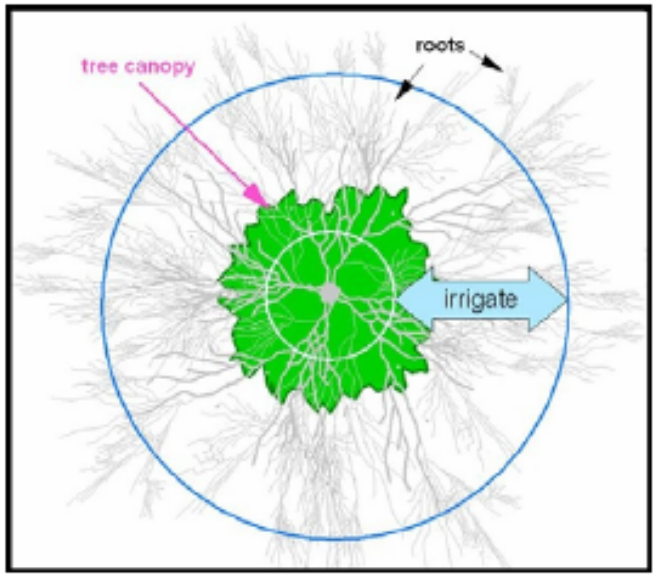




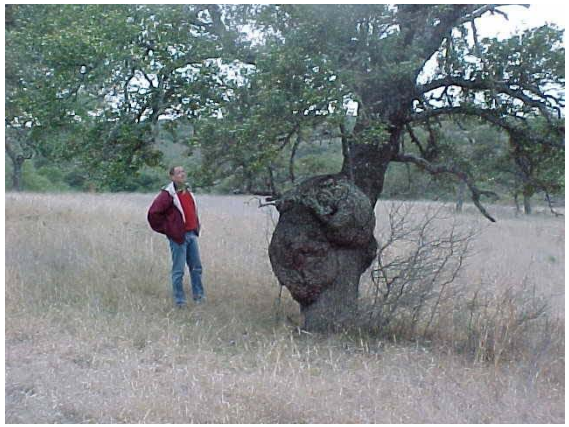
Managing Moderate to Severe Drought

Addressing the Predisposing and Inciting Factors

- Proper diagnosis is critical,
- Supplemental water,
  - for each inch of trunk diameter (width across) measured at knee height, the tree will need about 5 gallons. A 12” tree, then, would need about 5 x 12 = 60 gal of water,
  - the screwdriver technique,
- Do not prune trees during a drought?
- Do not plant trees during a drought?
- Do not fertilize during a drought!
- Mulching,
  - 3 to 4 inches,
  - do not bury the root system!!!
- Prompt removal of hazardous trees,
- Proper selection for replanting,
  - native, adapted plants.



Other Random Problems and ……



Questions?

Cotton Root Rot

General Characteristics

- Pathogen: *Phymatotrichum omnivorum*
- Hosts: more than 2,000 plant species, mostly dicots
- Range: restricted to Southwest U.S. and Mexico
- Type: parasitizes cortex and phloem

Cotton Root Rot

Signs and Symptoms

- Occurs in expanding patches
- Causes multiple, coalescing, necrotic lesions on all sizes of roots
- Incipient symptoms are slight yellowing and bronzing of foliage
- Advanced symptoms consist of rapid wilting, necrosis, and death
- Produces mycelial strands, spore mats and sclerotia

Cotton Root Rot Symptoms

Cotton Root Rot Signs

Mycelial Mats

Rhizomorphs

Cotton Root Rot

Disease Cycle and Epidemiology

- Sclerotia initiate new infections – persist in soil for decades in absence of host.
- Spread through movement of sclerotia infested soil.
- Grows to adjacent plants by root contact.
- Prevalent in calcareous clay soils with pH of 7.0 – 8.5.
- Most likely to occur above 82° C

Cotton Root Rot

Control

?

Sudden Oak Death

General Traits

- First appeared in 1995
- Has killed tens of thousands of oaks in northern California
- Also infects leaves and branches of rhododendron, bigleaf maple, and other related understory species
- Caused by Phytophthora ramorum
- Currently restricted to Oregon and California
- No controls available except prevention and quarantines

Sudden Oak Death

Symptoms

Oak Symptoms

- Bleeding cankers
- Drooping of new growth
- Rapid browning of healthy crowns

Foliar Hosts

- Branch dieback
- Foliar leaf spots
- Twig cankers
- Wilting

Sudden Oak Death

Texas Nursery Survey

- Cooperative USDA APHIS sponsored project
- Involves 6 Midwestern States
- Texas response involves survey of 50 nurseries distributed throughout state
- - standardized sampling protocol
- - isolation for *P. ramorum* and other *Phytophthora* spp. commonly found in Texas nurseries
- Also will involve survey for any suspect, unusual, or chronic undiagnosed oak problems
- Suddenoakdeath.tamu.edu