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

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

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

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

- **Root Rots**
  - 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
  - Sooty mold
  - Ball moss
  - Lichens
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

- Host
- Pathogen
- Environment
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

*Nectria* canker on dogwood

*Hypoxylon atropunctatum* on oak
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, fertilization, 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.

  - 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 $5 \times 12 = 60$ 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
- Sudden oak death.tamu.edu