Tree Health Issues

Tree Selection, Fertilization and Management, Disease Management, Troubleshooting Disease Problems, Pruning, etc.!!!!

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Multi-County New Landowner Series

March 18th, 2016

Washington County Fairgrounds Sales Facility

1305 Blue Bell Rd.

Brenham, TX

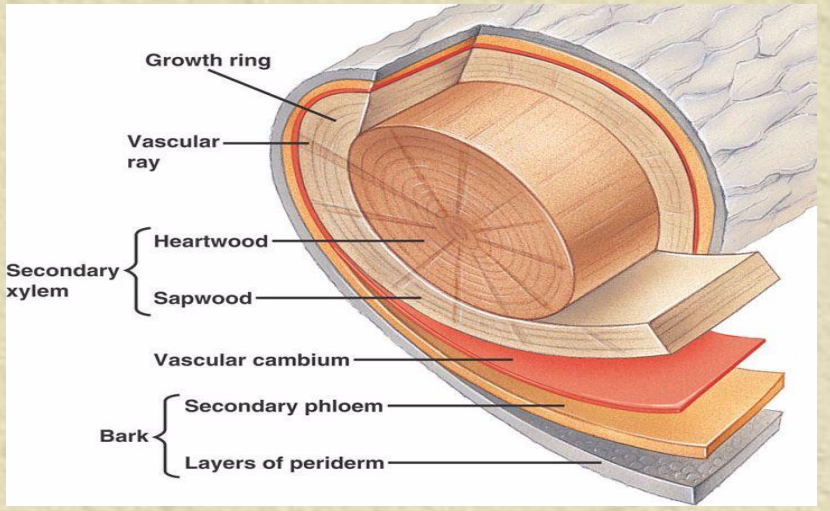
TEXAS A&M AGRILIFE RESEARCH

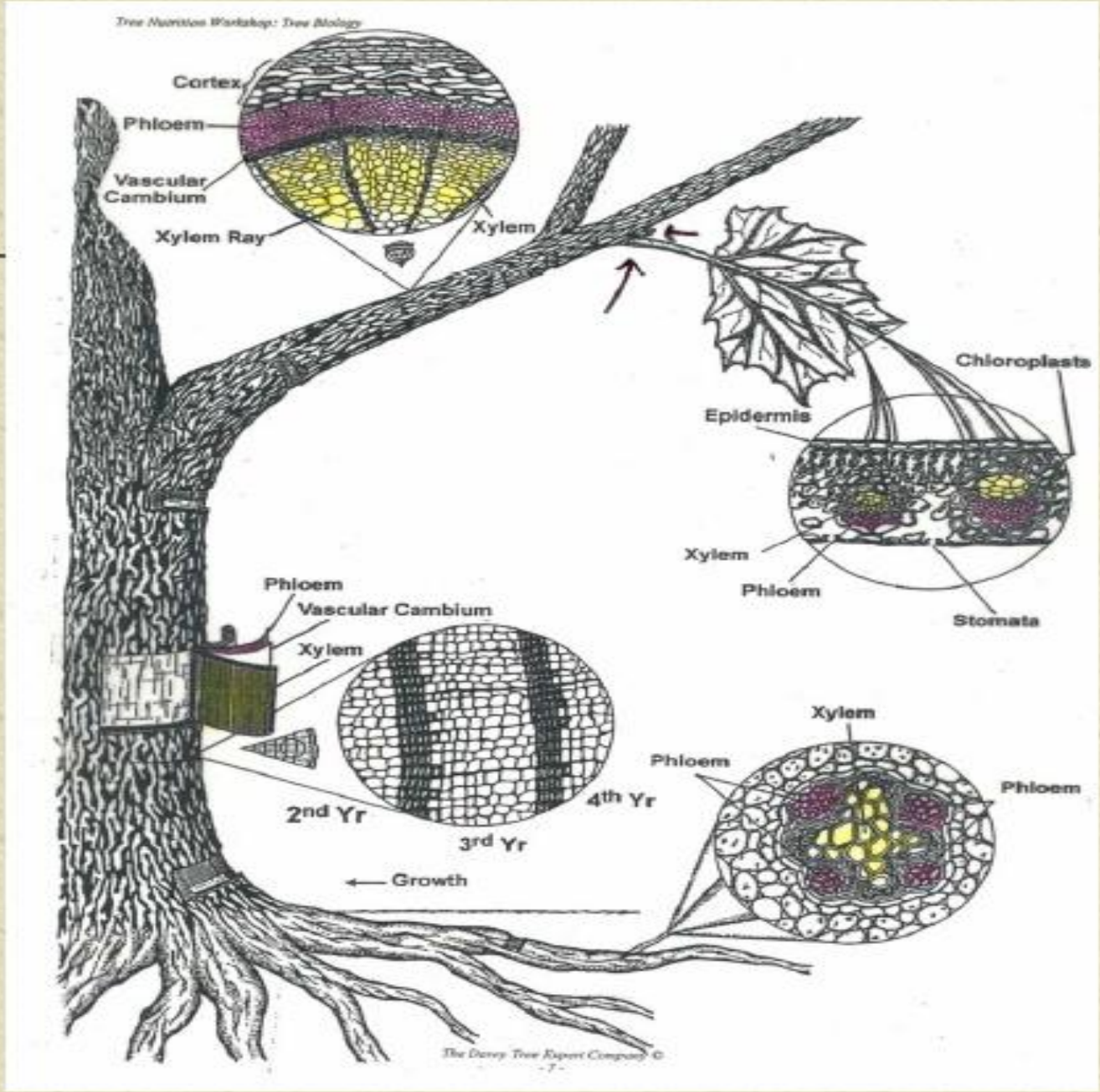
THE TEXAS A&M UNIVERSITY SYSTEM 1876

TEXAS A&M AGRILIFE EXTENSION

Tree Biology

5% Leaves
15% Stems
60% Trunk
15% Woody Roots
5% Absorbing Roots

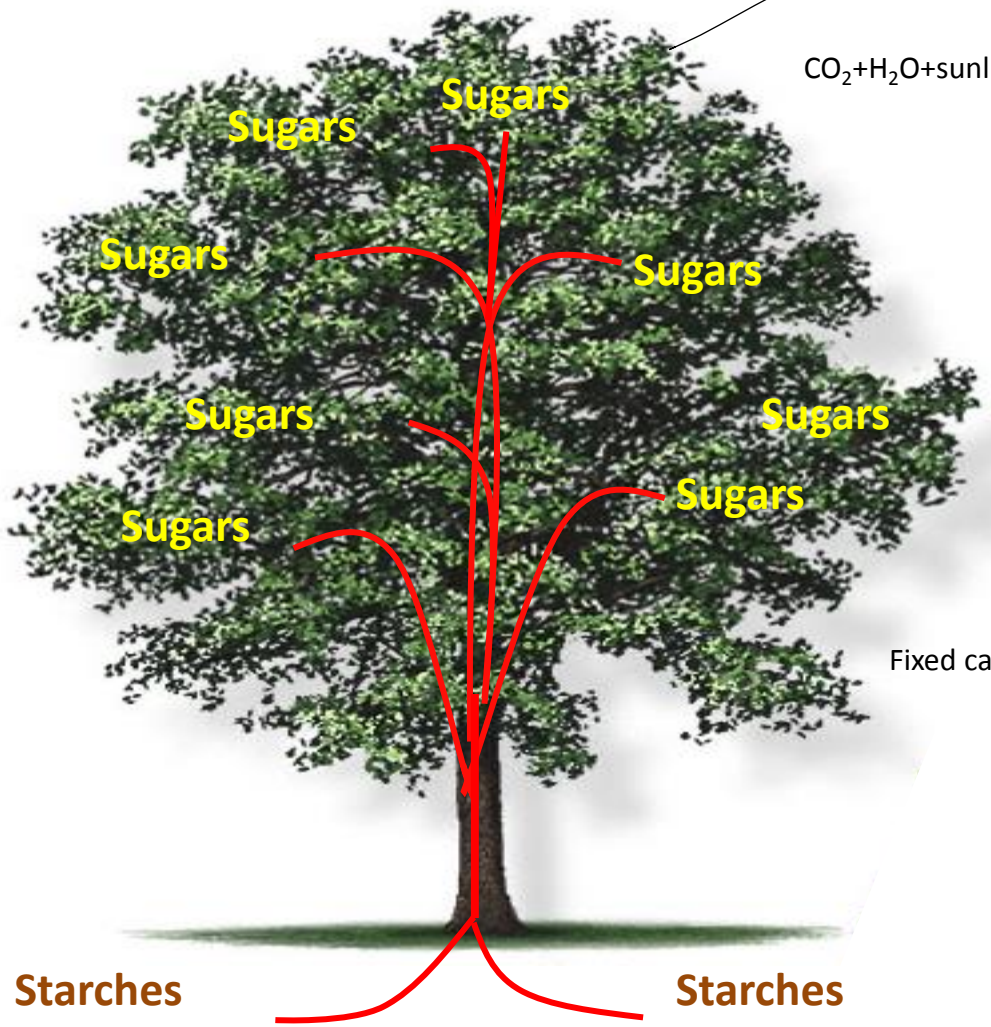




I. Tree Physiology and Resource Allocation

Resources, in the form of sugars and starches, needed for growth, reproduction, and host defense.

Water is a building material in photosynthesis, a reaction medium for cell chemistry and a transport medium.



Photosynthesis

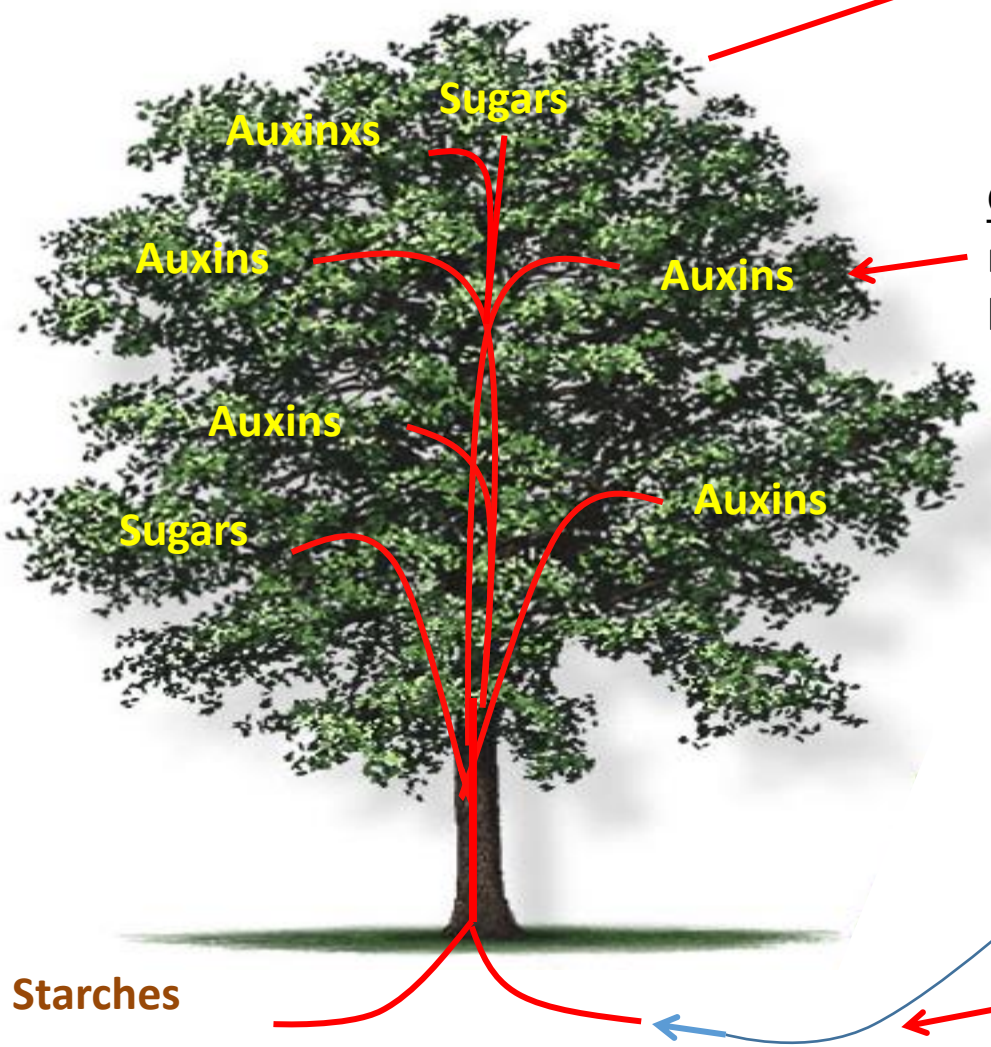
$CO_2 + H_2O$+sunlight $\rightarrow$ O_2 + fixed carbon (sugars)

Cellular Respiration

Fixed carbon + O_2 $\rightarrow$ $CO_2 + H_2O$ + biological energy

II. Tree Physiology and Water Transport

Nutrients and Growth Regulators



Transpiration from foliage is the driving force of water transport.

Growth regulators produced at apical meristems to insure proper form through branching patterns, types of foliage, etc.

Absorption of water from soil is necessary to supply demand of the tree in response to Transpiration.

Macro- and micro nutrients absorbed with water N, P, K, etc.

What can go wrong?

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 can go wrong?

Types of pathogens

Abiotic

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

Biotic

- Fungi
- Bacteria
- Viruses
- Nematodes
- Parasitic flowering plants

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.

www.plantfacts.ohio-state.edu

Example of an Abiotic Pathogen

Herbicide Damage - Treaty Oak

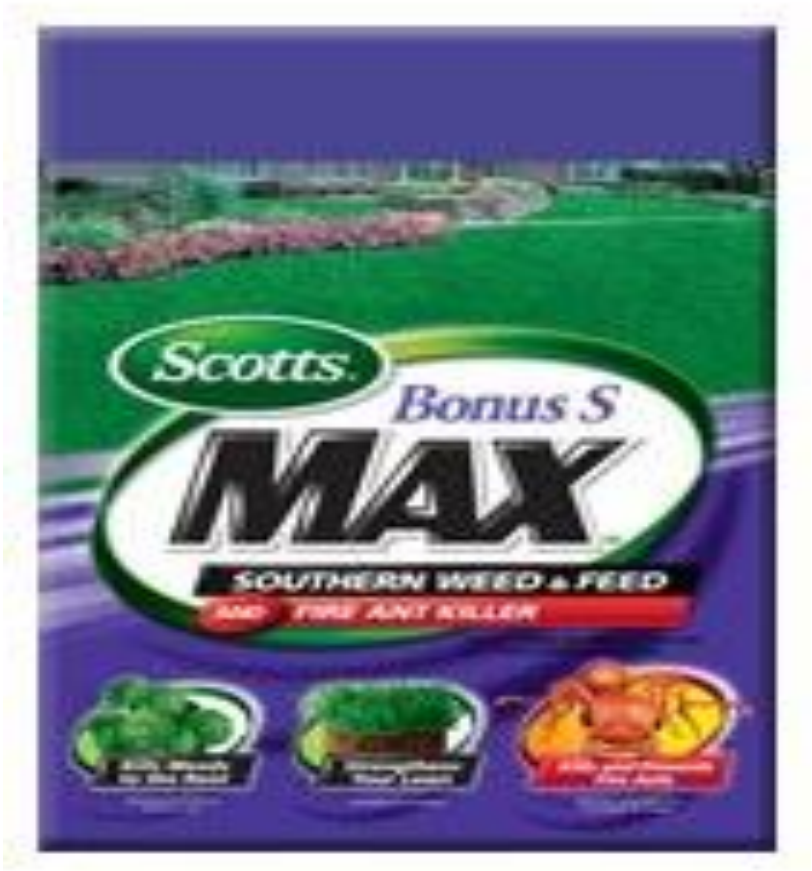
Velpar®

Hexazinone - broad spectrum weed and brush control

Herbicide Damage

Unknown product, Austin, TX

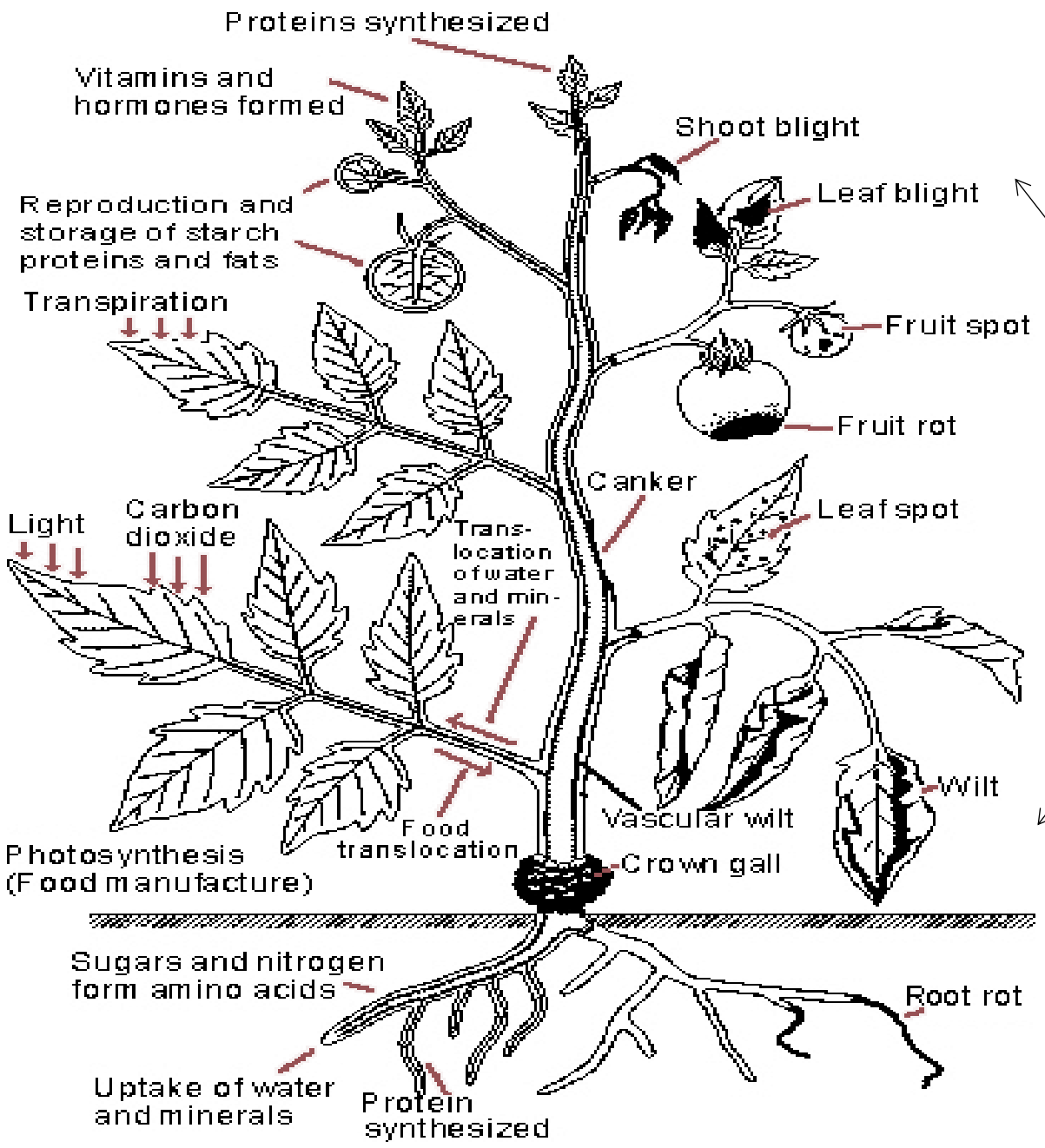
Weed and Feed with Atrazine



Where Not to Use

Stay 18-24 inches away from plants, flowers, and mulched areas.
Not registered for use under dripzone of trees and shrubs.

Healthy Plant Function



Types of Disease

Biotic

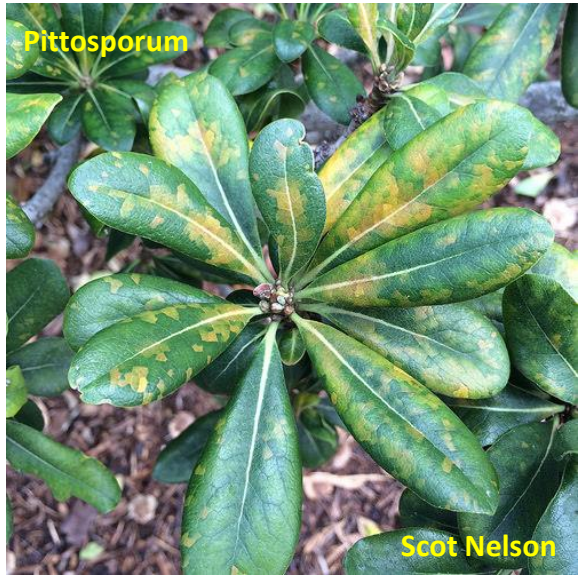
- Fungi
- Bacteria
- Viruses
- Nematodes
- Parasitic flowering plants

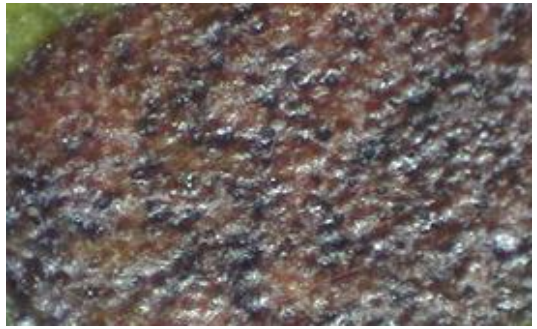
Foliar Diseases

Cercospora Leaf Spot

Ligustrum, Nandina, Photinia, Pittosporum,

- Encouraged by warm wet weather,
- Circular to angular spots,
- Mid to late summer,
- All but the youngest leaves retained when serious,
- Repeated infections lead to decline in health of shrub,
- Often starts in bottom of plant and moves up through,
- Small black fruiting bodies with magnification.





www.clemson.edu/extension/horticulture

Powdery mildew

Rose, crapemyrtle, gardenia,photinia, wisteria

- many different hosts, many different species of fungi,
- general requirement for high relative humidity, but not free water,
- moderate temperatures, shady areas,
- high heat inhibits fungal development,
- white, powdery growth on surface of foliage,
- new growth dwarfed, distorted,
- premature defoliation.

Sooty Mold

gardenia, ligustrum, pyracantha, cars

- Black coating in surface of leaf,
- Not considered an infection, caused by fungi,
- Follows insect infestations (often aphids)
  - honeydew provides nutrition for fungal growth,
  - clear, sugary insect secretions,
- May induce stress, yellowing leaves.

Control of Foliar Diseases of Ornamentals

- Potential resistant selections,
- Purchase disease – free plants,
- Space plants to allow for air movement, rapid evaporation,
- Drip irrigation,
- Collect and discard fallen foliage,
- Chemical (fungicides) – Chlorothalonil (DACONIL 2787 4.1F, DACONIL ULTREX); Macozeb (DITHANE T/O 80W, FORE 80W; thiphante-methyl +3336, thiophante-methyl+mancozeb (ZYBAN 75W, DUOSAN 75W); triadimefon (BAYLETON 35W); triforine (TRIFORINE EC 18.2E).

Soil Born Pathogens and Diseases

Root Knot Nematodes

boxwood, rose, hibiscus, gardenia, holly, yaupon, nandina, photinia, pittosporum, wisteria

- More of a problem on warm, sandy, irrigated soils,
- Galls or swelling on roots,
- Poorly functioning root system,
- Aboveground symptoms non-specific,
  - yellowing, stunted growth, early wilting,
  - slow decline and death,
- No current effective controls.

Cotton (Texas) Root Rot

All !

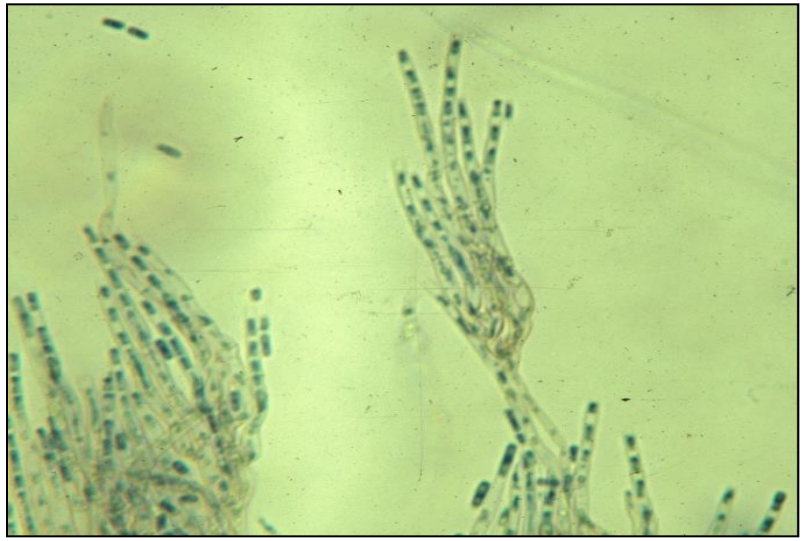
- Caused by fungus *Phymatatrichopsis omnivora*,
- Large host range, native to alkaline, low-organic matter soils of southwestern U.S.,
- May occur in small areas of landscape,
- Rapid wilt and death in summer, early fall,
- Dead and dying leaves remain attached to plant,
- Some plants in well maintained landscapes decline more slowly,
- Plants may exist in landscape for years before becoming infected,
- Produces signs,
  - rhizomorphs,
  - spore mats.

Control Strategies ? - CRR

- Avoidance,
  - knowing where the pathogen is.
- Fumigation,
  - works initially, but limited effectiveness.
- Fungicides,
  - flutriafol (Topguard Terra®) proven effective in cotton and grape,
  - no label for ornamentals.
- Soil amendments,
  - sulfur not effective in changing soil pH,
  - high nitrogen fertilizers ineffective.
- Organic Matter,
  - should help in creating biodiversity of soil flora.
- Rootstocks,
  - currently, the only practical solution.

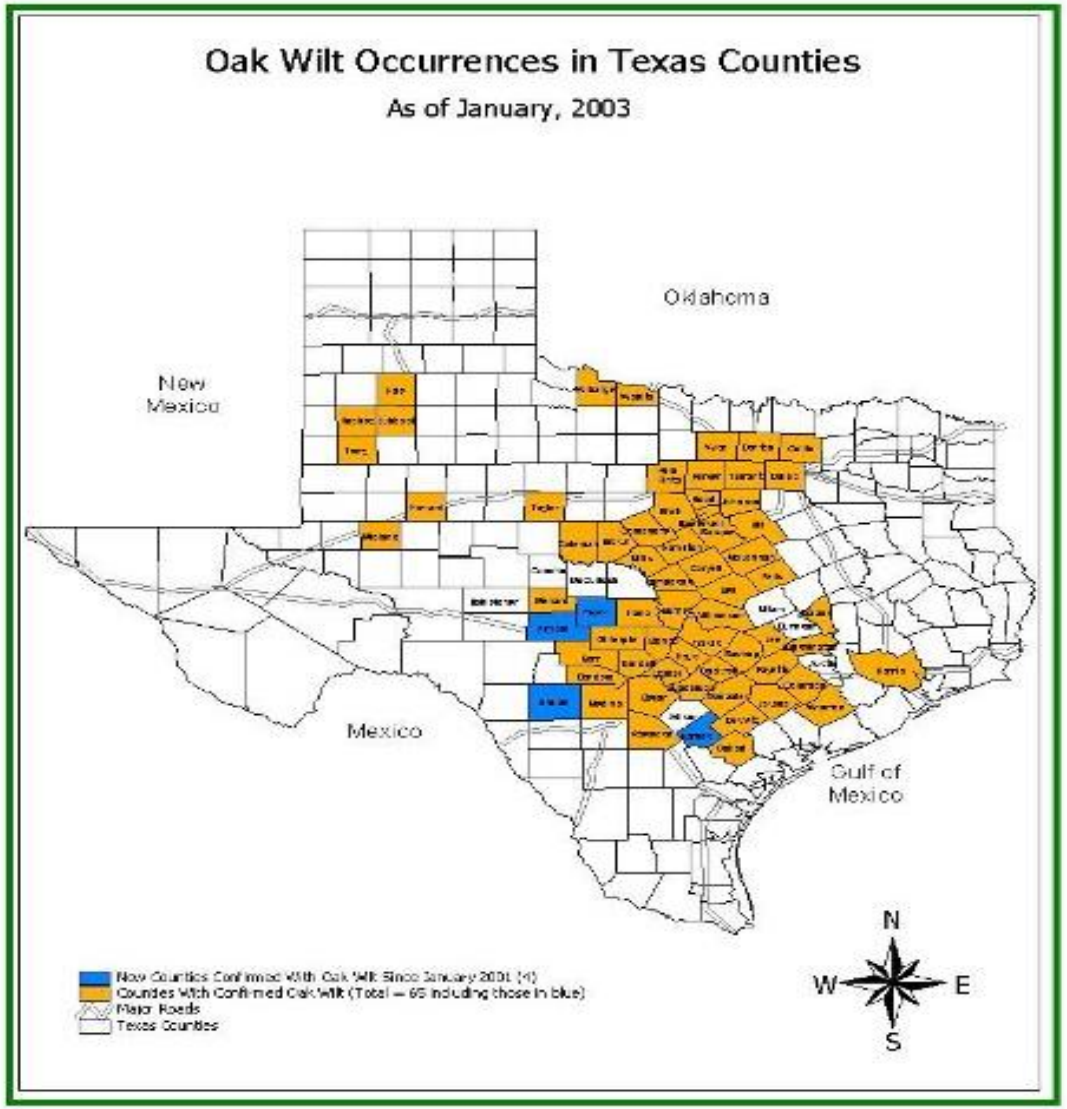
Vascular Diseases of Trees

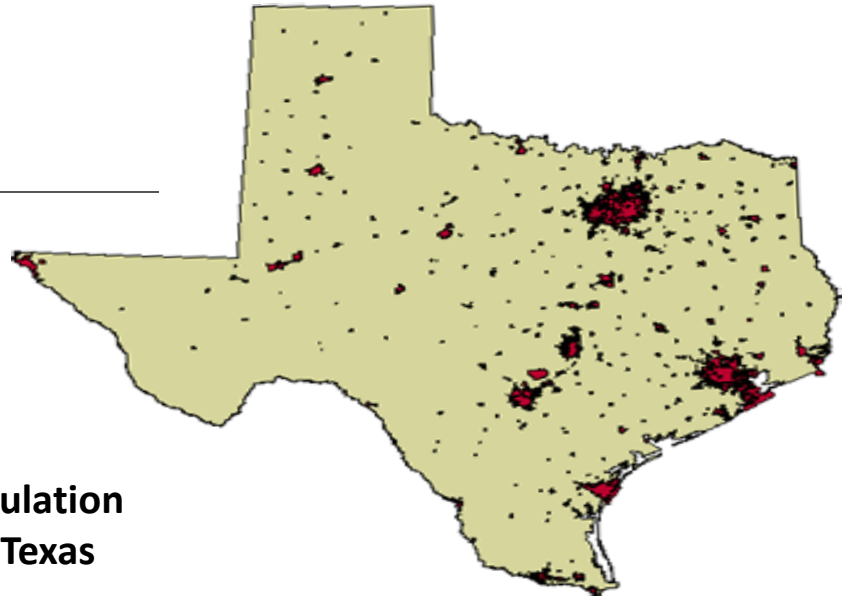
Oak Wilt



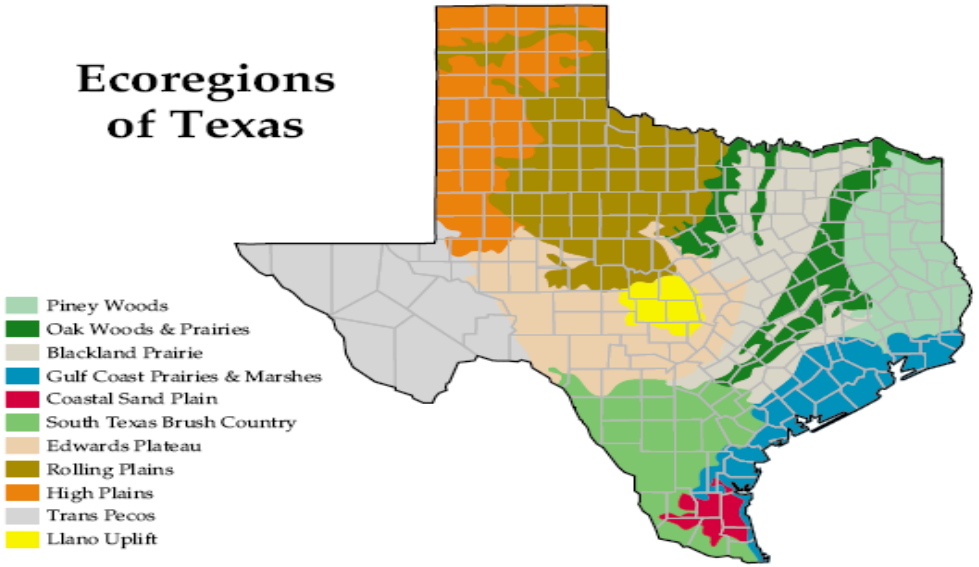
- *Ceratocystis fagacearum,*
- vascular parasite,
  - Affects water conducting vessels,
- Sensitive to high temperatures,
- Very poor saprophyte,
- Two mating types,
- Two types of spores.

Range of Oak Wilt in Texas and Impact on Major Population Centers





Major Population Centers in Texas



Oak species affected by oak wilt in Texas

RED OAKS = Susceptible	
Q. texana	Spanish Oak
Q. marilandica	Blackjack Oak
Q. nigra	Water Oak
WHITE OAKS = Resistant	
Q. sinuata var. breviloba	Shin Oak
Q. glaucoides	Lacey Oak
Q. polymorpha	Mexican white oak
Q. stellata	Post Oak
LIVE OAKS= variable	
Q. virginiana	Southern live oak
Q. fusiformis	Plateau live oak

Oak Wilt Disease Cycle

Infection of *Quercus* spp. by *Ceratocystis fagacearum* in Texas

Nitidulid Beetles

Mat Formation

1. Red Oak Phase

Contaminated Nitidulids = "Overland spread"

Dead Red Oak (next spring)

Dying Red Oak (Fall)

wound

Healthy red oak

Infected Red Oak (late summer)

Healthy live oak

Dead

Infected Red Oak (early summer)

Root connections

No mats, no beetles

2. Live Oak Phase

"Local spread" = Rapid, spreading Live oak mortality

Root Connections

Diseased Live Oak

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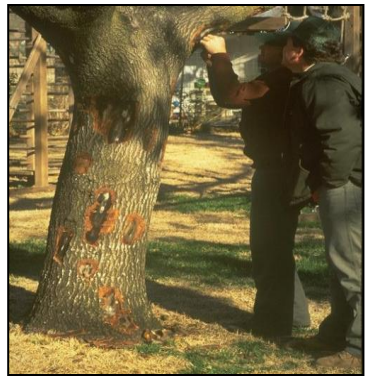
Improving Lives. Improving Texas.

Prepared by D.N. Appel
March 2011

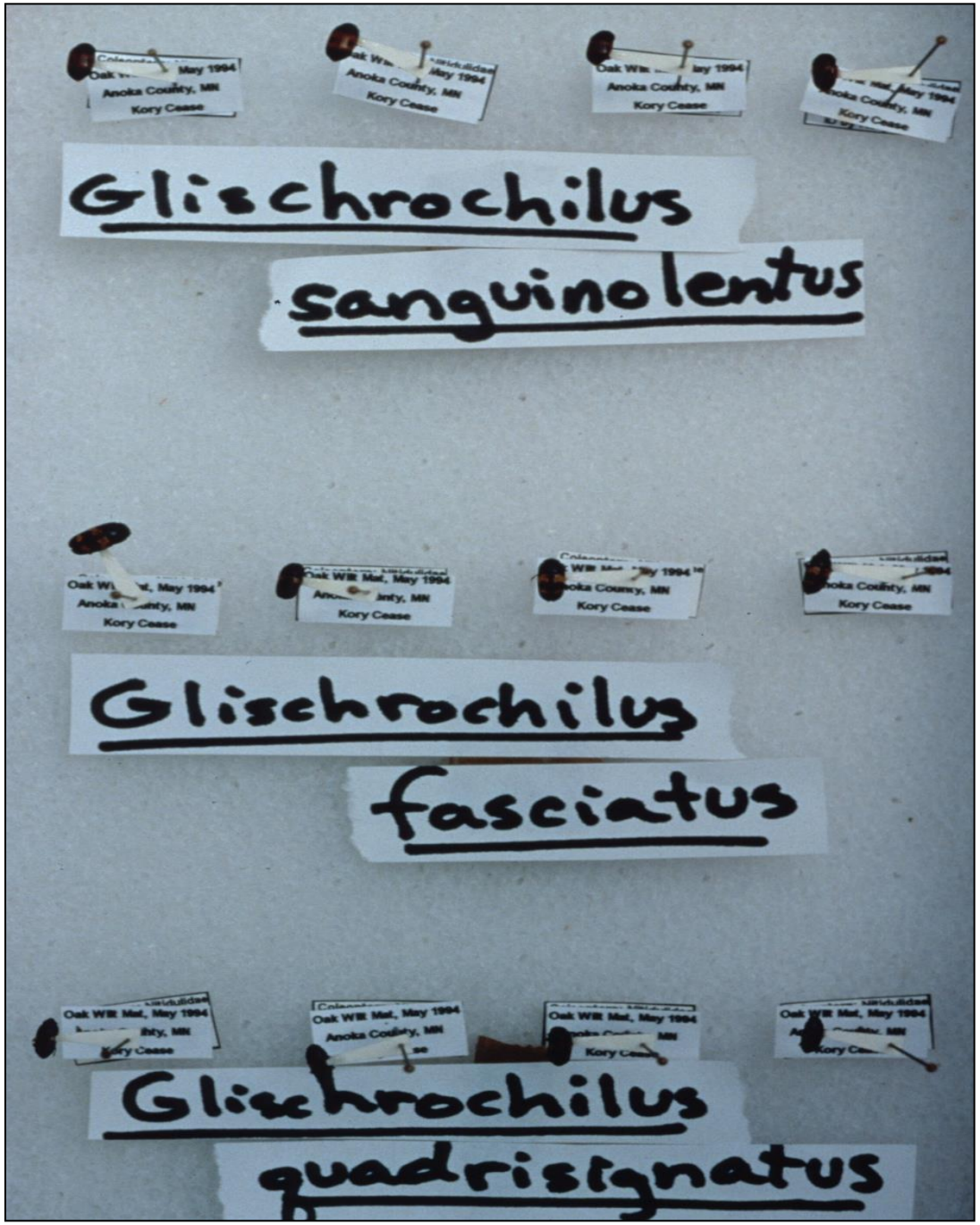
Fungal Mats

- Contain spores for spread by the beetle,
- Produced **only** on red oaks,
  - trees killed in late summer,
- Mycelial mats form under bark,
  - accelerated by cool, moist conditions,
- Multiple mats per tree,
- Produce a sweet odor like rotting melons.



Beetle Spread

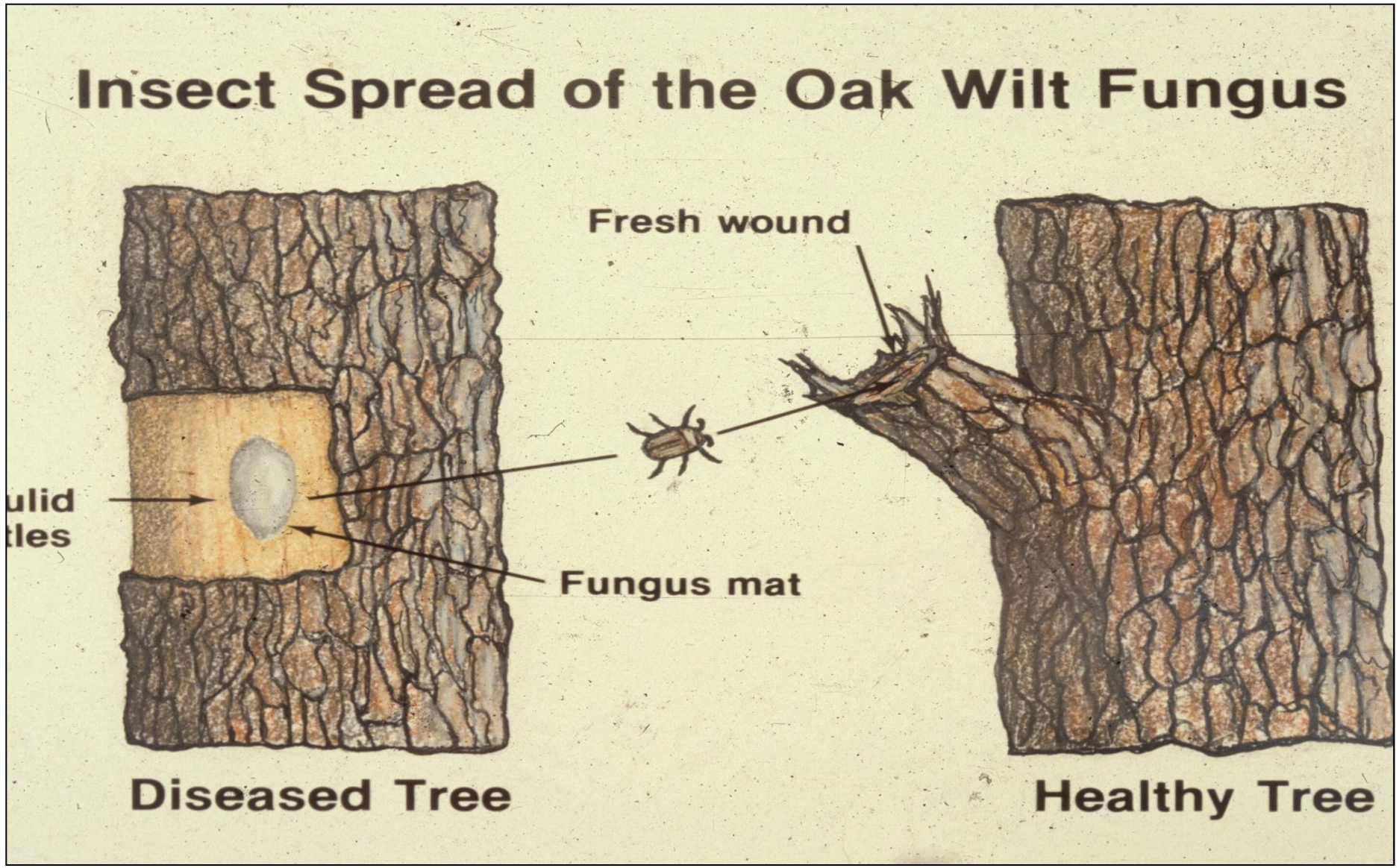
Nitidulid Beetle



Beetle Spread

- Beetles are only opportunistic
- Sap feeding beetles
- Attracted to sweet smelling odors- ripe fruit, fresh wounds on trees
- Peak beetle populations is in the spring
- High temperatures limit beetle activity
- Visit healthy trees rather than dead trees

Beetle Spread



Oak Wilt Control Options

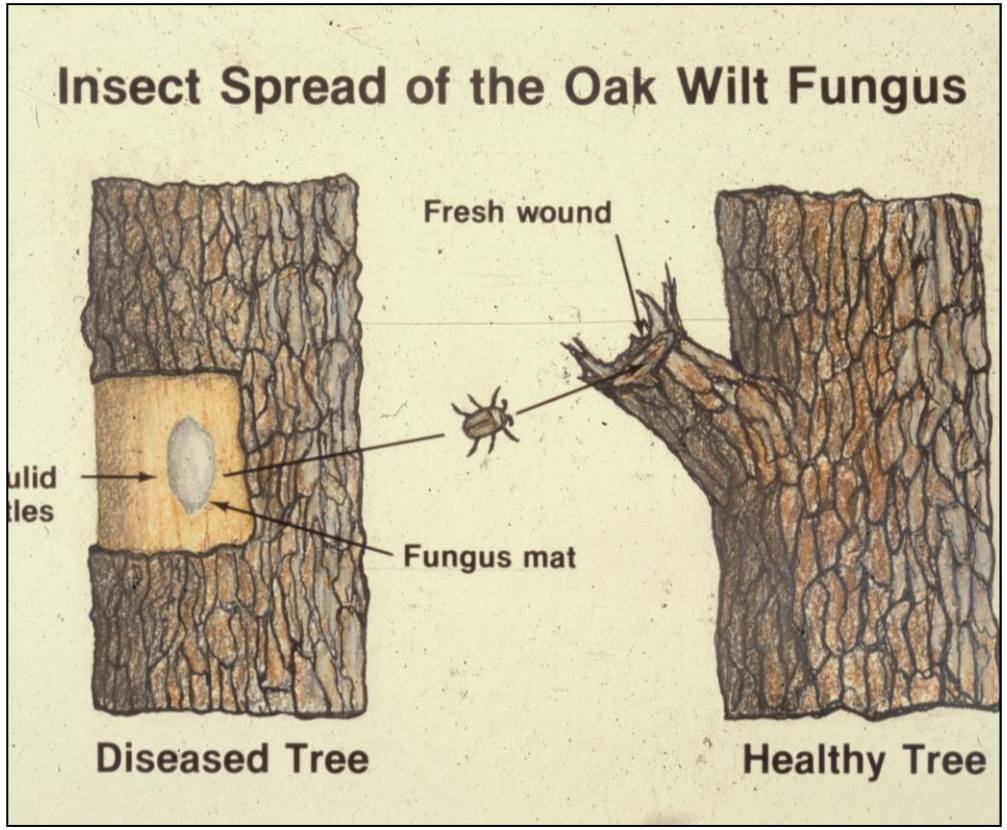
- Always starts with diagnosis
- Prevention - avoid wounding in spring
- Prevention - use wound paints
- Prevention - cautious movement of firewood
- Direct control - trenching
- Direct control - intravascular injection with fungicides
- Plant resistant/immune trees

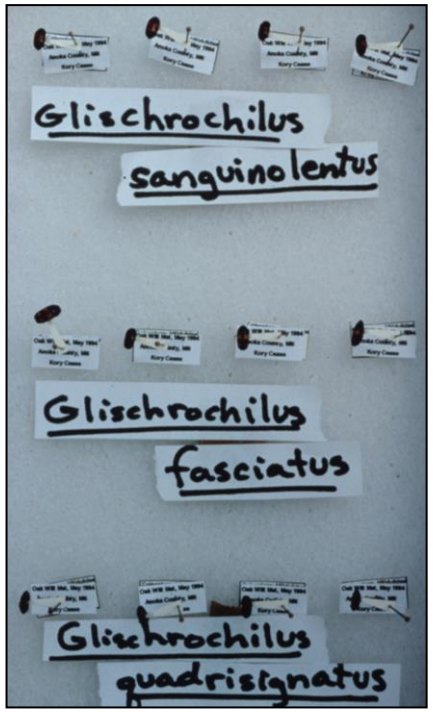
Oak Wilt Diagnostics

Oak Wilt Control Options

Why do Pruning Paints Prevent Oak Wilt?

- Nitidulid beetles cannot make wounds on trees,
- Require something else to wound tree,
- They then spread fungus from diseased tree to wound on new tree,
- Must be a fresh wound!

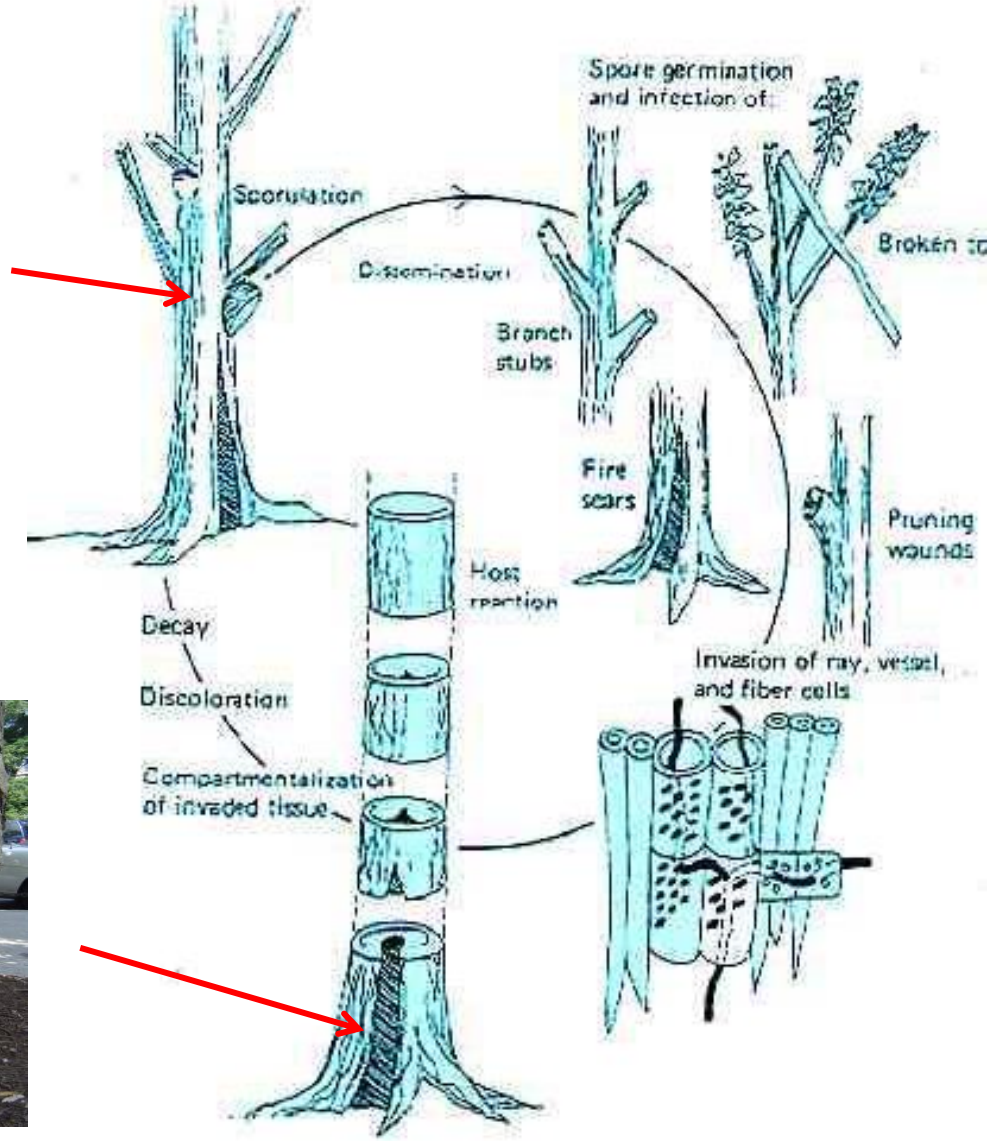




Wound Dressings – Oak Wilt, Yes!

Wound Dressings – Decay, No!

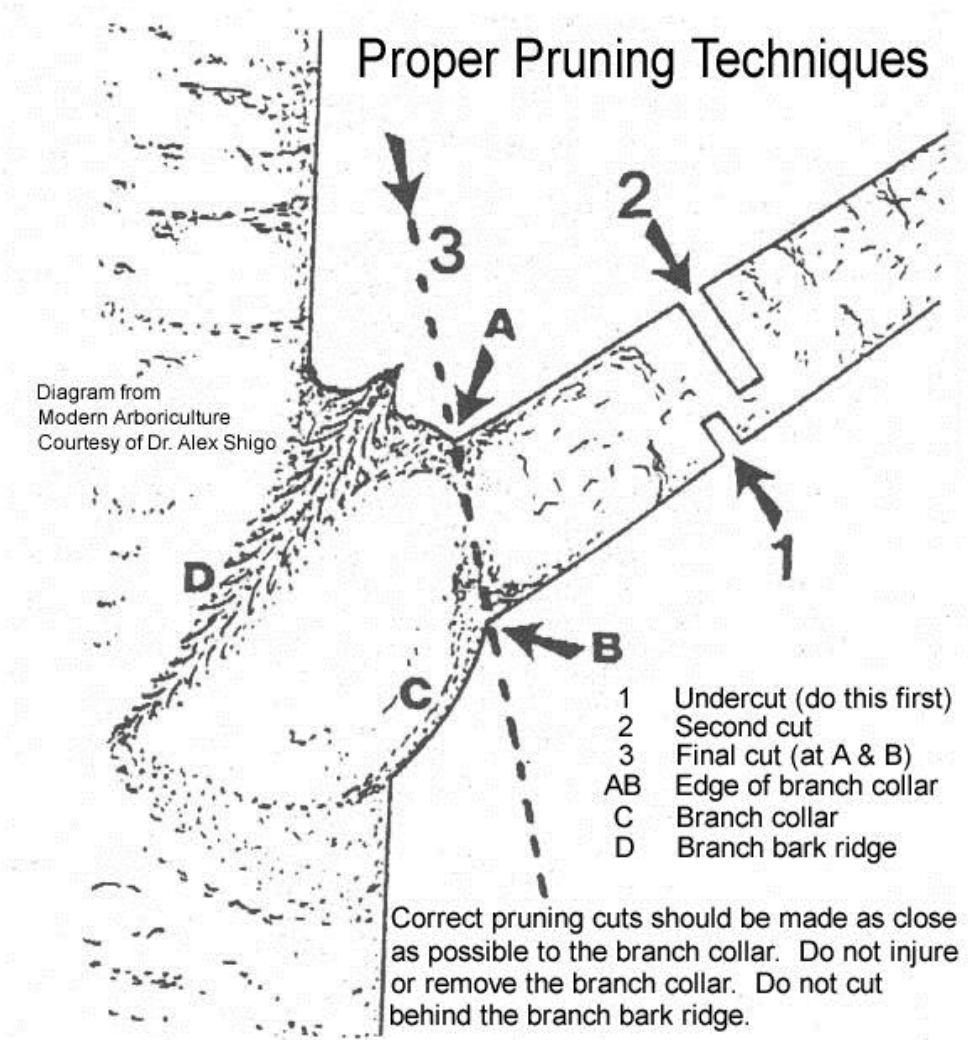
- Pruning cuts are indeed locations for infection,
  - only decay organisms!!!
- BUT…..wounds do not have to be fresh,
- Wound paints are not permanent barriers,
- Wound paints also shown to be phytotoxic,
- Trees have there own mechanisms to cope, if healthy.



Proper Pruning Practices

Target Pruning

- First cut is the undercut (1),
  - Prevents bark tearing,
- Second cut removes weight (2),
- Third cut removes stub (3).

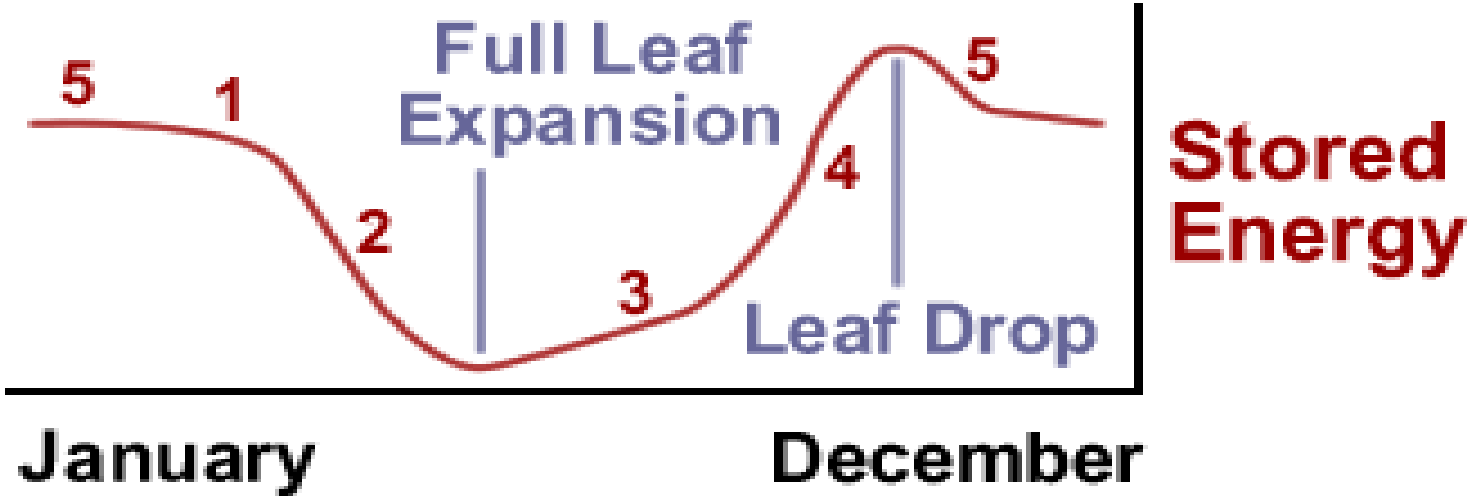


Bad Pruning Examples

No. 5 Wrong time of year

- Period 5 is best,
- Avoid period 2,
  - leaves still making sugars
- Avoid period 4,
  - increases water sprouting
  - decay organisms producing spores,
  - energy needed for leaf abcision,
- Pruned deadwood anytime,
- Spring flowering – prune after flowering to maximize.

Graph of Resource Availability for Wound Response



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

Diebacks, Declines

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

The Causes of Declines

- the 3 factors

1. Predisposing factors

1. Genetic potential
2. Climate change
3. Air pollution
4. Etc.

2. Inciting factors

1. Site disturbance
2. Drought
3. herbicides

3. Contributing factors

1. Canker fungi
2. Root rots
3. Wood boring insects.

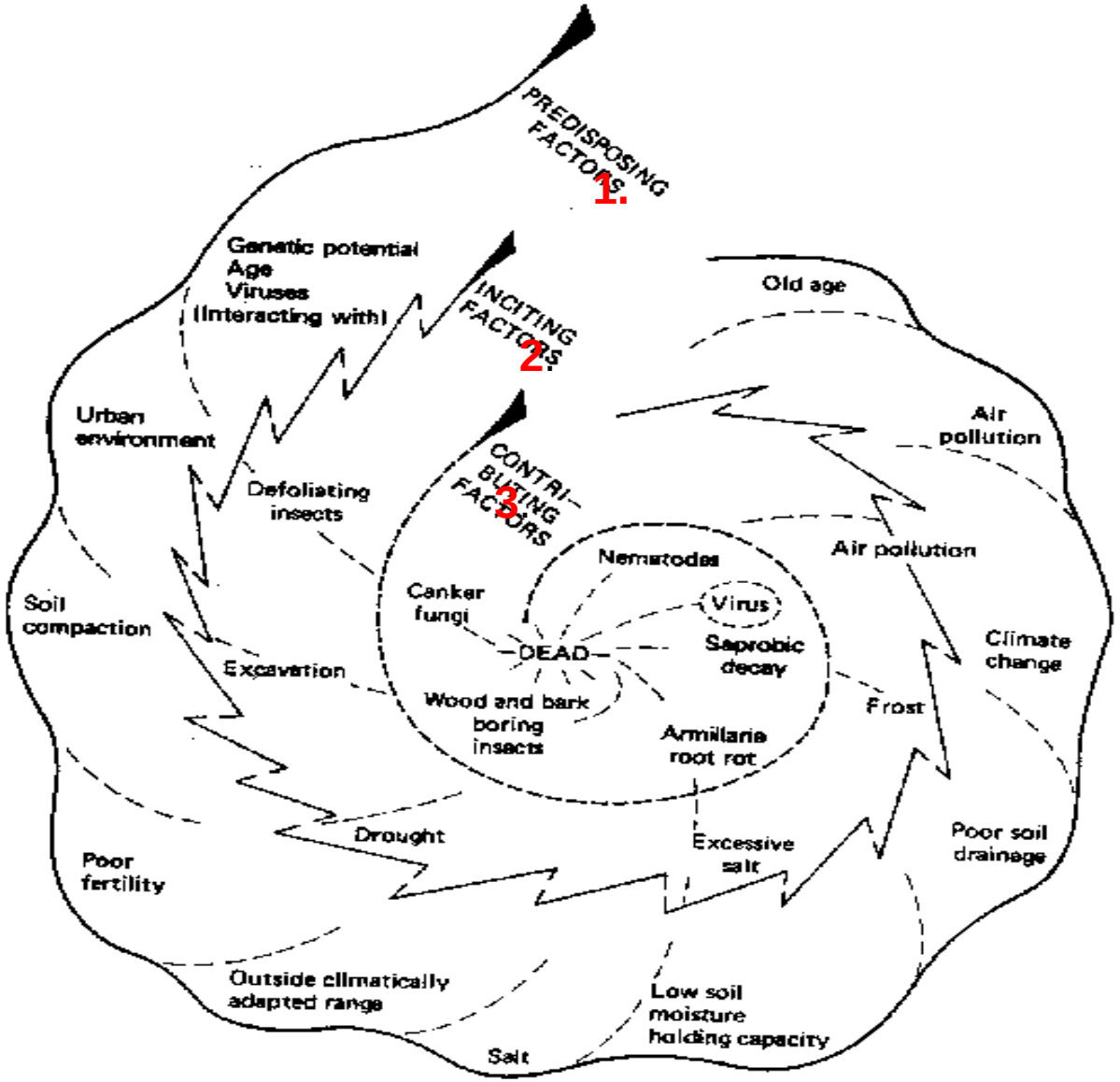


Fig. 1. Decline disease spiral (Reprinted with permission from Tree Disease Concepts by Paul D. Manion c 1991, Prentice-Hall, Inc., Englewood Cliffs, NJ).

Drought Damage In Leakey, TX

II. The Effects of Drought on Trees - Two Categories

What happens in a tree exposed to drought?

1. **Pre – clinical effects**,
   - physiological,
   - cannot see them, but can measure them,
2. **Clinical effects**,
   - Symptoms result,
   - visible manifestation of host response.

Wilting in a dogwood tree

Mild Drought = Pre-Clinical Effects

- Resource allocation during mild drought stress,
  - Trees must respond to compensate with stored reserves,
    - e.g. osmotic adjustment of cell contents, stomatal closure, root suberization.
  - storage carbohydrates (starches) are mobilized,
  - slight depletions of carbohydrates reserves,
- No external evidence of stress,
  - normal growth, reproduction, defense against pests and diseases.

Moderate Drought = Pre-Clinical or Clinical Effects

- Resource allocation during moderate drought stress,
  - storage carbohydrates (starches) are mobilized,
  - greater depletions of carbohydrates reserves,
  - tree respond but fail to adequately compensate with stored reserves,
- May be no external evidence of stress, but effects are detrimental.
  - tree cannot grow normally,
  - tree cannot respond to resist pests and diseases,
- There will be long term consequences!

Severe Drought = Clinical Effects

- Resource allocation during severe drought stress,
  - storage carbohydrates (starches) are mobilized,
  - significantly greater depletions of carbohydrates reserves,
  - tree respond but fail to adequately compensate with stored reserves,
- Clear external evidence of stress = symptoms,
  - tree responds to limit damage and survive,
  - wilting, scorching, premature defoliation, twig and branch dieback, death.

Influence of Species Variability

- Any species can be damaged by drought,
- Some are more tolerant than others,
  - Damage will depend on the degree,
- Observations in Brazos County,
  - Water oaks and Blackjack oaks very susceptible,
  - Post oak and cedar elms very tolerant,
- Native trees more tolerant than exotics,
- Many lists available.

Summary of Drought Effects

- Mild drought = mild stress = little strain,
  - no detrimental effects,
- Moderate drought = moderate stress = predisposing strain,
  - 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,
4. Lophodermium needle cast of pines,
5. Dutch elm disease,
6. Invasive tree pathogens,
   - Thousand Cankers of Walnut,
   - Citrus greening?

Hypoxylon Canker

Pathogen, Hosts

Post Oak

- *Hypoxylon atropunctatum*,
- a fungus, spread by wind blown spores,

Hypoxylon Canker

Pathogen, Hosts

- *Hypoxylon tinctor*
- Host = Sycamore

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.

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.

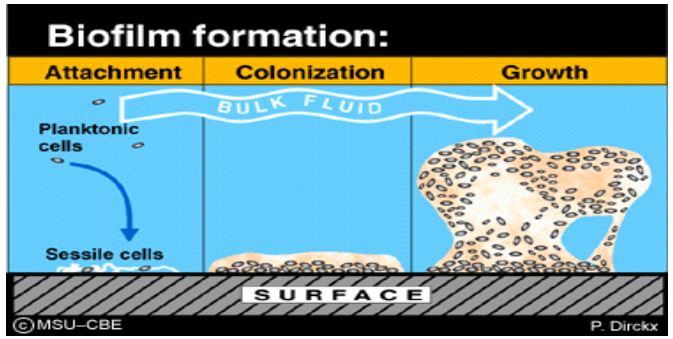
Bacterial Leaf Scorch

Xylella fastidiosa

- caused by a xylem-limited bacterium, vectored
  by insects (sharpshooters, leafhoppers)
- many hosts, many strains of the bacterium,
- primary symptom is irregular marginal scorching
  on affected foliage,
  - appear mid- to late-summer,
  - express on isolated branches and spread,
- slow decline and dieback of affected plants.

Bacterial Leaf Scorch

Disease Biology



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

Phytophthora root and crown rots

boxwood, azalea

- Many hosts,
- Excessive yellowing and loss of foliage,
  - N fertilization may temporarily alleviate symptoms,
  - some wilt,
- Incidence depends on excessively moist soils, shaded conditions, fertilization,
- Internal discoloration of roots,
  - advancing from smaller roots to larger roots and crown,
- Gradual to sometimes rapid death of plant.

Wood-boring Insects

Flat headed borers

http://bugguide.net/e

Two lined chestnut borer

- Oaks of all species, especially live and post oaks,
- Females lay eggs in bark cracks and crevices,
- Larvae created meandering galleries,
- Girdle branches, trunks, in stressed trees,
- Often start in top, dieback proceeds down through crown,
- Do not attack healthy trees!

Flat headed apple tree borer

- Many deciduous hosts, shade and fruit trees,
- Adults emerge in spring, lay eggs in bark cracks,
- Larvae burrow into trunks and branches, tunnel through phloem,
- Particularly damaging to young, newly planted trees and older, weakened trees.

Managing Declines
and the Contributing Factors

- 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.

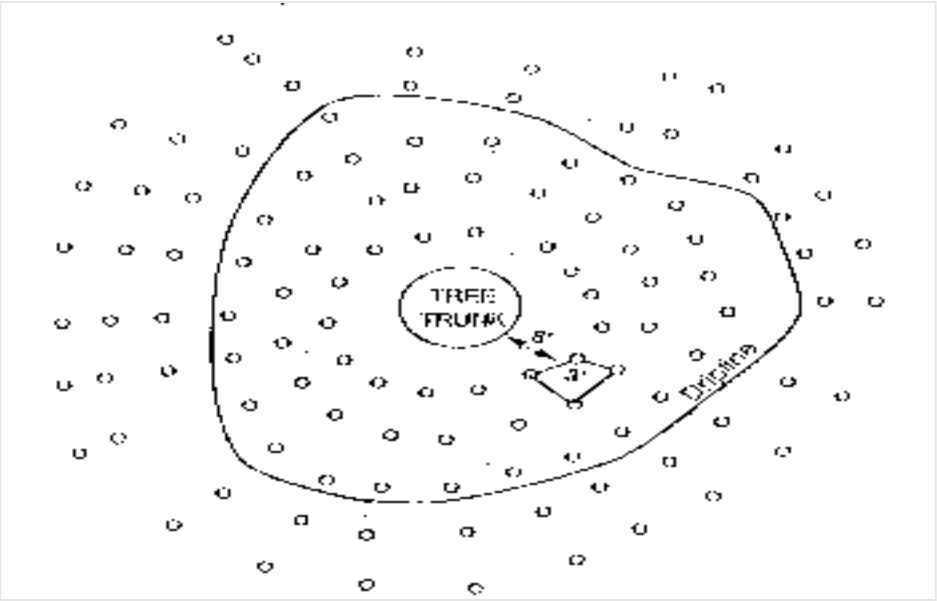
Vertical Mulching for Enhancing Tree Health

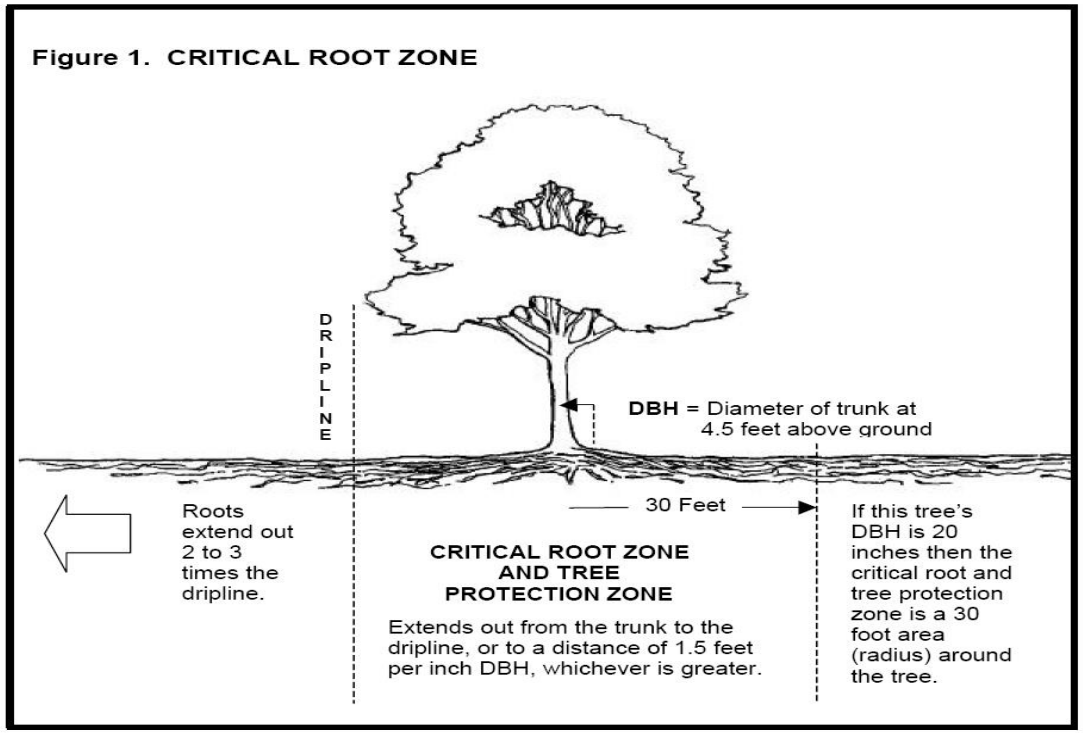
Objectives

- 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.
3. Fill holes with treatment.





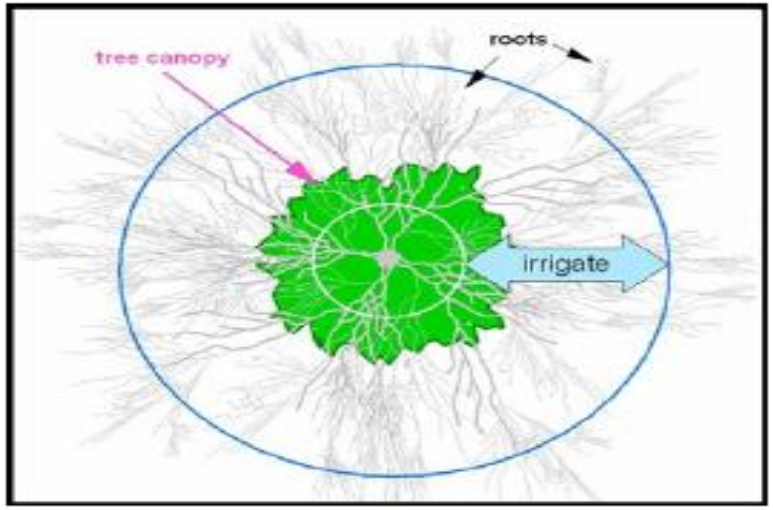
Managing Wood Borers

- Prevention,
  - plant adapted species,
  - proper watering,
  - avoid wounding on trunk,
  - do not stack firewood against trunk,
  - monitor tree health,
- Chemical control (Pest control applicators only),
  - Bifenthrin (ONYX®), permethrin (ASTRO®).

Managing Moderate to Severe Drought

Addressing the Predisposing and Inciting Factor

- 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.



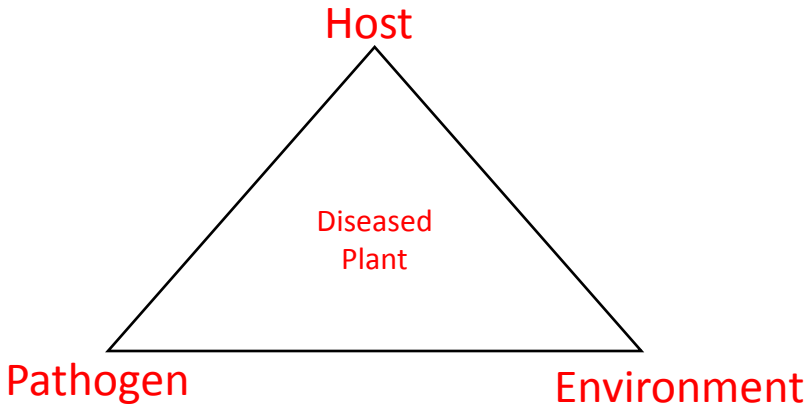
Dealing With Drought at the Landscape Level

- Some evidence from studies in forestry demonstrates that thinning improves trees response to drought,
  - Conventional wisdom is that thinning improves stress response in remaining trees,
- An alternative point of view is that thinning will open a stand to further drying and make matters worse,
- Perhaps a compromise is to remove understory vegetation to reduce competition for resources.

What Must We Know To Diagnose Plant Diseases?

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

The Disease Triangle

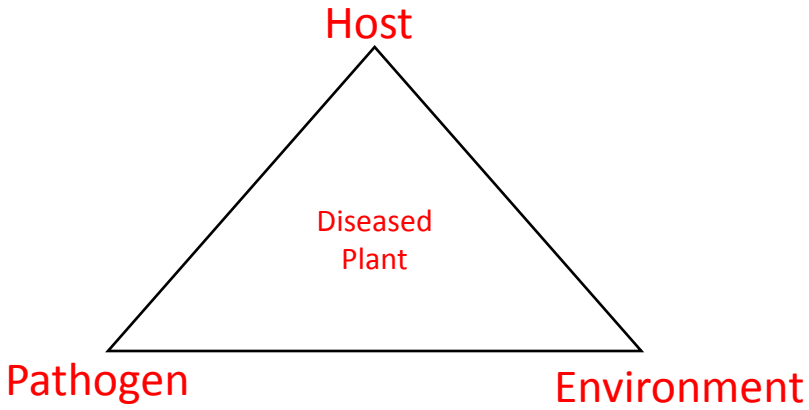


What Must We Know To Diagnose Plant Diseases?

Giant Asian Dodder, Houston, TX

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

The Disease Triangle



Levels of Confidence in Diagnosing Tree Diseases

- Tree problems are difficult to diagnose,
- Degrees of flexibility are acceptable. Sometimes a 100% reliably positive diagnosis is achieved,
- Accuracy depends on whether information complete.

Lightning Damage

Levels of Confidence in Diagnosing Tree Diseases

- Often can only achieve 90 % or less reliability,
- Indicative diagnosis sometimes appropriate,
- Exclusionary diagnosis can be useful.

Porcupine damage

Levels of Confidence in Diagnosing Tree Diseases

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- Indicative diagnosis sometimes appropriate,
- Exclusionary diagnosis can be useful.

Sapsucker damage

New and Emerging Diseases

Rose Rosette

- Virus disease spread by an eriophyid mite (?) and vegetative propagation,
- Many symptoms,
  - Reddening of viens on lower leaf surface,
  - Leaf deformation (crinkling, brittle) and yellow mosaics and reddening,
  - Witches' brooms,
- Present mostly in North Texas.

photos © Raj Singh, LSU AgCenter

Need Help?

Screenshot of Website

The Texas Plant Disease Diagnostic Laboratory

Director: Dr. Kevin Ong
Diagnostician: Sheila McBride

http://plantclinic.tamu.edu

Other pathogens/diseases/?

Ball moss

Smooth patch

END