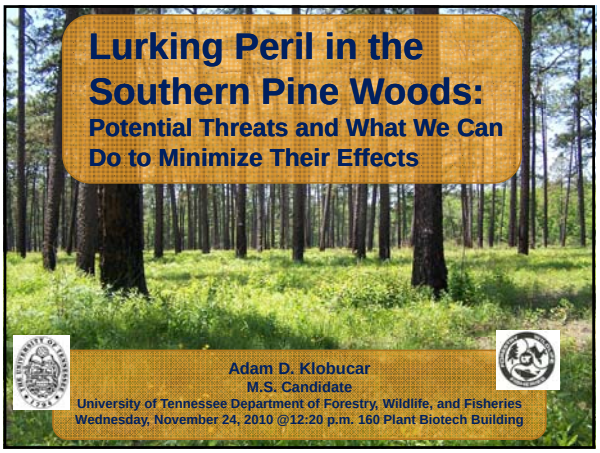


OUTLINE

- U.S. Forest Products Industry
- Forest Products in the Southern U.S.
- Losses Due to Insects and Disease
- Fusiform Rust
- Pitch Canker
- Southern Pine Beetle
- Future Directions

U.S. FOREST PRODUCT INDUSTRY

- Forest and paper industry
  - 8% of total U.S. manufacturing
  - Annual sales of $240 billion (Products)
- In 1992, total timber harvested had a value of $24 billion
  - >21% of total value of agricultural crops
  - Leading agricultural commodity
  - Highest-valued crop (>wheat and corn)
- In 2009, 451 million m^3 of timber harvested

FOREST PRODUCTS INDUSTRY IN THE SOUTH

- In 1994, the impact of forestry and forest products was $90 billion
- In each of the southern 13 states, the forest industry ranks in the top 10 among manufacturing industries in:
  - Employment
  - Payroll
  - Income
- In many southern states, e.g. LA and GA, in the manufacturing section, the forest industry ranks number one in:
  - Employment
  - Output
  - Value-added

FOREST INVENTORY IN THE SOUTH

- Total forestland
  - ~214 million total acres
  - ~181 million in private landownership
- Growing stock ~276.9 billion board feet
  - ~108 billion bf in softwood
- ~11.5 billion ft^3 in annual growth
  - In TN, 749 million ft^3 in growth
- ~10.1 billion ft^3 in annual removals
  - 6.5 billion ft^3 of which is softwood

2008 ROUNDWOOD PRODUCTS IN THE SOUTH

- Southeast Region (FL, GA, NC, SC, and VA)
  - ~3.8 billion ft^3 total
    - ~2.8 billion ft^3 in softwood
- Southcentral Region (AL, AR, KY, LA, MS, OK, TN, and TX)
  - ~5.3 billion ft^3 total
    - ~3.6 billion ft^3 in softwood
- Tennessee
  - ~353 million ft^3 total
    - ~85 million ft^3 in softwood

LOSSES IN FORESTED AREA DUE TO INSECTS AND DISEASE

- In 1952, it was reported that 35% of gross annual growth was lost due to disease and insect outbreaks
- Losses increasing at an alarming rate
  - In 2004, approximately 9.5 million acres of forest in the U.S. were infected by insects and disease (may be greater that year due to pine beetle outbreaks)
- In Tennessee, 163 million feet^3 are lost every year to insects, disease, and fire

JUST A SMALL LIST OF DISEASES AND INSECTS IN THE SOUTHEAST U.S.

CONIFERS	HARDWOODS
Southern pine beetle	Chestnut blight#
Annonsus root rot	Lucidus root and butt rot
Pales/pachylobius weevil	Mistletoe
Littleleaf diease	Oak wilt
Mistletoe	Powdery mildew
Armillaria root rot	Armillaria root rot
Brown spot on longleaf pine	Beech bark disease
Fusiform rust	Emerald ash borer *
Pitch canker	Thousand canker disease *

FUSIFORM RUST

- *Cronartium quercuum f. sp. fusiforme*

IMPACT OF FUSIFORM RUST

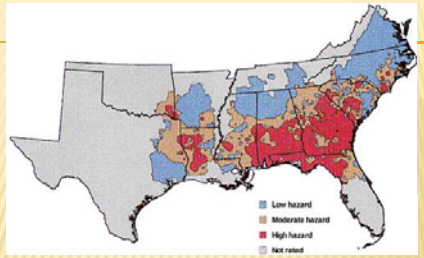
- 13.9 million acres have at least a 10% infection rate in the Southeast U.S.
- Annual losses due to disease are high:
  - 562 million board feet of sawtimber
  - 194 million ft^3 of growing stock
- This resulted in an estimated loss of $35 million annually to landowners
- Highest occurrence in GA, AL, SC, FL, and MS

FUSIFORM RUST

- Alternating hosts
  - Alternate host is primarily slash and loblolly pine; also can affect pitch and pond pine
    - Causes galls and cankers that weaken stem
    - Infects in early spring
  - Primary host is oak
    - Most severe damage in members of the red/black oak group (Primarily water, willow, and laurel oaks)
    - Defoliation mostly; rarely mortality
- Heaviest mortality in pines less than 10 years of age; mostly seedling 3-4 years old
- Serious deformities in older pine trees

Occurrence in loblolly pine

Occurrence in slash pine



- Dilemma!!
  - High hazard ratings for breakouts are areas with well-drained soils and high site quality
  - Areas that are best for intensive pine management are also well-drained soils and high site quality

FUSIFORM RUST

Identification

- On pine trees
  - Young needles can become necrotic
  - Spindle shaped swellings on branches and main stems (fusiform shaped galls)
  - Yellow aeciospores found on surface of galls
- On oak trees
  - Relatively inconspicuous
  - Yellow uredial spores/black telia on lower surface of leaves




FUSIFORM RUST

More Identification

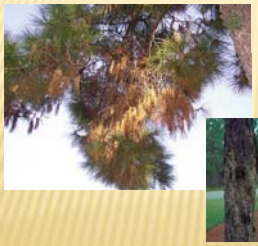
- Galls that occur on branches may develop adventitious shoots
- Multiple infections may result in the growth of forked pines
- Pines often break at the gall due to weaker tissue


CONTROL AND MANAGEMENT

- Use fungicide in nurseries and seed orchards (Bayleton, Benodanil) because economically feasible
- In high hazard areas, use longleaf or shortleaf pine
- Use closer spacing to mimic natural pruning of infected branches
- Prune branch if gall is >15 cm from the stem
- Use rust resistant seedlings (Expensive)
- Oak management

PITCH CANKER

- *Fusarium circinatum*



IMPACT OF PITCH CANKER

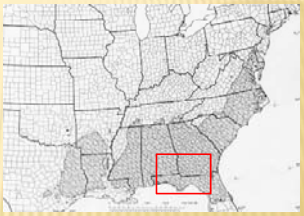
- Total amounts of infection are not documented
  - First documented in the western U.S.
- In 1976, disease was present on 1.1 million acres in Florida alone
- In epidemic areas:
  - 25% mortality in pole size stands
  - Infection levels have been reported to be over 90%

PITCH CANKER

- Susceptible hosts are:
  - Most Southern pines
  - Mainly longleaf, loblolly, pitch, and slash pines
  - Shortleaf and pond pine typically recover
  - Infection rare in younger stems
  - Saplings suffer from growth loss and deformities
  - Mature trees infected typically do not recover
- Can infect plantations, seed orchards, and nurseries
  - Infection occurs during the summer and fall

PITCH CANKER

- 1946, first documented in U.S. (North Carolina)
- Important date: 1974
  - Found in seed orchards of loblolly pine in NC and MS
  - Found in planted slash pines in FL
- Also found in CA, Mexico, Spain, South Africa, and Japan

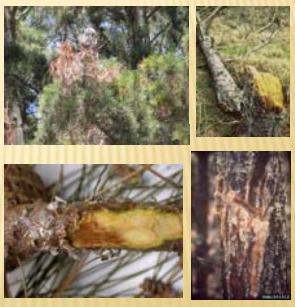


Very similar range to loblolly pine

PITCH CANKER

Identification

- Tip die-back symptom aka "flagging"
- Excessive pitch flow
- Canker (If not covered in pitch)
- Breakage at point of canker (In older pines)



PITCH CANKER

Important Infection Courts

- Pine tip moth damage
- Mechanical injury caused by shakers or other equipment
- Broken cone base (Rare)
- Inoculum can be transferred by pads of shakers in seed orchards



MANAGEMENT AND CONTROL

- Plantations
  - Cost effective fungicides are unknown
  - Prevention most important technique
  - Use resistant strands where cost effective
  - Avoid areas with excessive drainage
  - Limit fertilization
  - Thin overstocked/ diseased stands
  - Burn/broadcast logging debris


MANAGEMENT AND CONTROL

- Seed Orchards
  - Avoid excessive fertilization
  - Avoid wounding trees with cone shakers
  - Clean/ sterilize shakers to prevent spread of inoculum
  - Avoid mower damage
- Nurseries
  - Screen seed sources for contamination
  - Use sterile media/fumigate soils
  - Cutout dying/ infected trees ASAP

SOUTHERN PINE BEETLE

- *Dendroctonus frontalis* Zimmermann

IMPACT OF SOUTHERN PINE BEETLES

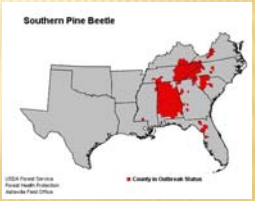
- Annual losses include:
  - Over $200 million dollars
  - 100 million board feet of sawtimber
  - 20 million ft^3 of growing stock
- Effects during severe outbreaks:
  - 2.7 million acres affected in 2007
  - Between 1973-1977, 4.5 billion board feet of timber destroyed by SPB
- Most important beetle pest in the Southern U.S.

SOUTHERN PINE BEETLE

- Capable of infesting all pines in Southern U.S.
  - Primarily loblolly, slash, and shortleaf pines
  - Longleaf pine is "resistant" due to high amount of resin production
- Primary host selection- "focus tree"
  - Females locate susceptible trees and release the pheromone, frontalin, to attract other SPB's to surrounding trees
- Creates larval galleries in xylem and phloem which weaken/overcome the pine

Southern pine beetle range

Current areas with outbreak



SOUTHERN PINE BEETLE

- What makes a pine susceptible?
  - Over-mature
  - Stressed
    - Dense stands
    - Drought
  - Damaged
    - Wind
    - Fire
    - Mechanical Damage
- Can introduce blue stain fungus
- Mortality can occur within 3-4 months

IDENTIFICATION

- Boring holes on bole of pine
- Boring dust and pitch tubes on outside of bark
- "Flagging" of foliage
  - May be too late at this point
- Serpentine shaped galleries
  - "S" shaped filled with frass and sawdust
  - Galleries from ips beetle are free of frass and larvae feed in circular shape

MANAGEMENT AND CONTROL

- Preventative
  - Thin to a basal area of less 9 m^2/ha or 39 ft^2/ac
  - Reduces competition and increases vigor of individual stems
  - Avoid damaging stems
- Curative
  - Prompt removal
    - Removal all infected stems
    - Create a buffer and cut all green stems 50-100 feet from infection sites
  - Can cut and leave, cut and spray, or pile and burn

FUTURE DIRECTIONS

- Constantly monitor stands for disease
- Don't wait! Take immediate action when outbreak/infection is initially observed
- For professionals, don't be afraid to seek help
  - Knowledgeable people are willing to assist you
- The world is dynamic so always be prepared
- New problems are coming about everyday
  - Mass movement of people and spread of invasives

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QUESTIONS?