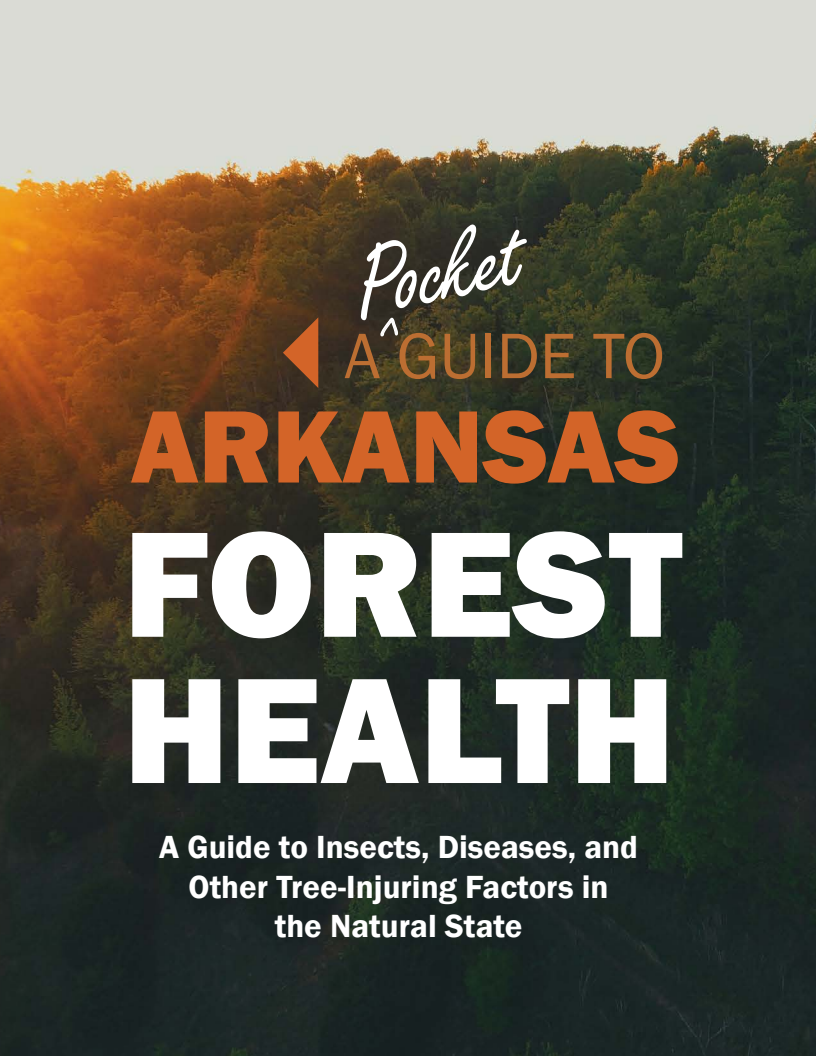

Pocket

A GUIDE TO

ARKANSAS FOREST HEALTH

A Guide to Insects, Diseases, and Other Tree-Injuring Factors in the Natural State

Produced January 2022, Arkansas Department of Agriculture

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Foreward from the Arkansas Forest Health Specialist

This book describes many of the common tree-injuring issues that are observed in Arkansas. It can be used as an identification tool. Insects and diseases are grouped together based on how the damage occurs, such as defoliation. Some management recommendations are offered in this book, but every situation is different, so we recommend contacting a specialist to determine how to mitigate an issue.

It is important to understand that native insects and pathogens are an essential piece of our natural world. Observing defoliation by a native insect should spark admiration, not concern. However, in rare cases, some pests increase in abundance to the point where their presence harms trees. In many cases, the best way to stop these problems is to ensure the optimal health for trees. Prevention may usually be the only possible way to guarantee healthy trees.

Water stress, advanced age, and carbon starvation may cause trees to become stressed and therefore susceptible to various pests. Such adverse conditions are common in the residential setting, as the growing conditions experienced by trees in the urban landscape are much different than the rural ecosystems where they historically existed. This book includes issues that may be encountered in both urban and rural forests.

Also included in this book are several non-native, invasive pests of trees. Unlike native pests, these pests can kill vigorous, healthy trees. If you believe you have seen these invasive threats, please notify your nearest University of Arkansas Cooperative Extension or contact the Arkansas Department of Agriculture.

Use this guide to enjoy observing trees and the organisms that interact with them. I hope readers will cultivate a sense of appreciation of living things and be good stewards for our environment.

Chandler Barton
Forest Health Specialist
Arkansas Department of Agriculture, Forestry Division

“The beauty of the natural world lies in the details.”

– *Natalie Angier*

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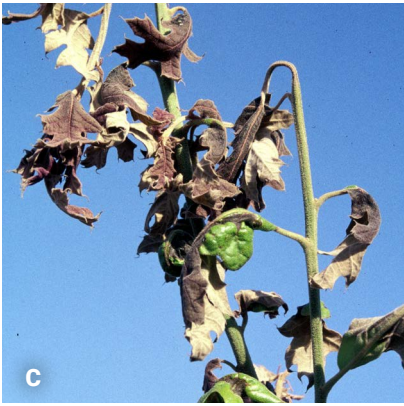
“In every walk with nature one receives far more than he seeks.”

– *John Muir*

ABIOTIC INJURY



Cold or freezing injury

Cold or freezing injury

HOSTS: All trees.

SIGNIFICANCE: Extreme cold, or extreme drops in temperature can stress trees by killing tissues, including buds, twigs, and leaves.

RECOGNITION: Commonly called “winter burn”, this occurs when a tree in very cold or frozen ground experiences warm, windy conditions that cause leaves to respire. The warm wind “pulls” water out of the stomata on the leaves, which causes leaves to lose water, desiccate (dry out), and die. When temperatures drop suddenly, plant tissues that are not cold-hardened (i.e., ready for the cold) can be injured by the rapid temperature change.

MANAGEMENT: Plant tree species on appropriate sites, as some trees are more cold tolerant than others. Beyond this, there is little one can do to prevent or manage cold or freezing injury.

Photos: (A) Freeze damage in the Ozark Highlands, where the lower elevations were damaged and higher elevation foliage emerged after the freeze event; (B) Cold injury on young conifer, note the green foliage at the bottom was insulated by snow; (C) Cold injury on hardwood.

Sunscald

Sunscald

HOSTS: All trees, especially younger trees with thin bark.

SIGNIFICANCE: This injury occurs when the important vascular tissues are rapidly reactivated from winter dormancy by warm, sunny conditions. It occurs during late-winter or early-spring months, typically on the south or southwest facing sides of the tree due to direct solar warming.

RECOGNITION: Bark cracking often occurs, which creates an infection point for disease. Cambium and phloem can be damaged under uncracked bark and that affected area may appear sunken in comparison to healthy tissue. Old sun scald damage may not be apparent until the bark detaches from the tree.

MANAGEMENT: Choose species less susceptible to sun scald, e.g. maple is susceptible due to its smooth, thin bark. When planting, consider how a tree could be protected from sunny conditions during the winter. A commercially available wrap (white, breathable material) may protect the tree during high risk months.

Photos: (A) Old sunscald showing missing bark and cracking; (B) Uncracked bark with a sunken hole into the phloem; (C) Bark missing and cracking in the cambium.

Drought

Drought

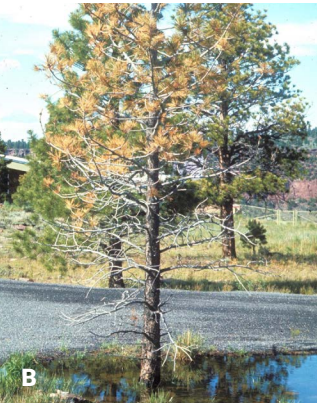
HOSTS: All trees.

SIGNIFICANCE: Drought occurs when there is insufficient water for trees to obtain and uptake. Drought stress can occur on individual trees even when major regional drought is not identified. Drought causes trees to lose foliage and fine roots, and can be a major stress agent which can often lead to secondary insect infestations (e.g. Ips bark beetles and turpentine beetles).

RECOGNITION: Wilted foliage is a common sign of water stress, and hardwood trees often prematurely abscise leaves, even in the middle of summer.

MANAGEMENT: In urban landscapes, water trees when they show signs of water stress, and consider planting more drought-tolerant tree species. There is little that can be done in natural, unmanaged areas. In commercial plantings, consider planting at a wider initial spacing to give each tree more room to grow (and more soil space and potential water to obtain).

Photos: (A) Conifers often show brown foliage in response to drought; (B and C) Hardwoods tend to exhibit drooping or curling leaves under drought conditions.



Flooding damage

Flooding damage

HOSTS: All trees.

SIGNIFICANCE: Prolonged flooding results in reduced oxygen availability for roots (i.e., anaerobic conditions) and poor uptake of essential micronutrients, which can lead to reduced root growth and tree stress. Flood waters can carry objects that may cause physical damage to tree trunks, or in some cases push a tree over. Flood waters may also deposit thick layers of sediment and debris, or wash away soil, changing the soil line and further stressing the tree. Stressed trees are increasingly susceptible to many secondary insects and pathogens, e.g. anaerobic organisms like bacteria increase in abundance and ambrosia beetles are attracted to airborne chemicals produced by the stressed tree.

RECOGNITION: After heavy precipitation or snowmelt events, a water line is generally visible on tree stems. Deposited debris and/or sediment may also be visible.

MANAGEMENT: In natural areas, salvage harvests may be used for severely affected trees. Applications of phosphorus can encourage root growth, but be cautious with nitrogen applications, as these will encourage trees to grow foliage (which can't be supported without a healthy root system).

Photos: (A and B) Prolonged flood waters can stress trees by depriving roots of oxygen, (C) which may lead to additonal tree health risks including loss of foliage.

Lightning damage

Lightning damage

HOSTS: All trees.

SIGNIFICANCE: Lightning wounds create infection courts for diseases to enter the tree, and secondary bark beetles often attack and kill the tree. Severely damaged trees are usually beyond saving and often die shortly thereafter from any number of damage or secondary issues.

RECOGNITION: Fresh lightning strikes can be recognized by a long split or jagged "stripe" down the stem, usually appearing as though the bark was ripped off. This strike line may go straight down the tree or wind around the tree. Branches may explode and shatter, leaving a significant amount of debris underneath the struck tree.

MANAGEMENT: High value trees, or those close to homes or other structures, may be candidates for lighting protection systems. Trees in natural areas cannot be effectively protected. Pruning may be employed to eliminate hazardous branches that result from the strike.

Photos: Lightning can make a straight (A) or slightly curved (B) descent down the trunk. In either case, the damage will appear as though bark was ripped off the tree.

Hail damage

Hail damage

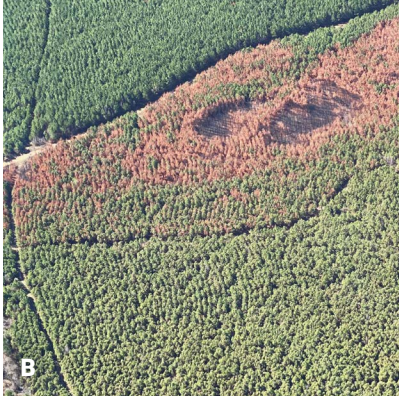
HOSTS: All trees.

SIGNIFICANCE: Hail can create wounds in stems, branches, and leaves, and can lead to a loss of branch and leaf tissue. Wounds can lead to structural instability.

RECOGNITION: Hail damage leaves foliage tattered, torn, and knocked off. Twigs and branches may be tattered, split, and broken. Fruits may be split, pitted, or knocked to the ground. Damage is always initiated on the upper side of the leaf, twig, or stem, or side of the trunk facing the storm.

MANAGEMENT: There is no preventative treatment that can be applied, but after-storm care is crucial. Evaluate the damage, and strategically prune if necessary (i.e., remove broken or hanging branches). If early in the growing season, fertilizer may help the tree recover from the loss of tissue.

Photos: (A) An old hail damage wound that has partially healed; (B) Hail damage is worse on the side of the tree that faced the wind and storm; (C) Bark may appear tattered from hail damage.



Fire damage

Fire damage

HOSTS: All trees.

SIGNIFICANCE: Recent fire damage can create wounds and cankers on trees that may attract secondary insect pests, like Ips bark beetles and turpentine beetles. While the tree may (and often does) survive, fire damage makes a weak point on the tree stem, increasing that tree's susceptibility to wind breakage. Wildfires or fires conducted under marginal conditions can consume the duff layer and injure the cambium layer of affected trees, causing immediate or delayed mortality. The heat rising from an understory fire can easily kill leaves or needles in the canopy.

RECOGNITION: Look for deep, black, burned areas on tree boles. Leaves in the crown can take a red or brown scorched appearance.

MANAGEMENT: For prescribed fires, use a proper burn management plan, and conduct the burn with professionals under appropriate conditions. In the case of wildfires, attempt to maintain burn-friendly environments, with reduced fuel load and without overstocked stand conditions. In the event that the leaves in the crown scorch and die, look for new growth at the ends of branches before considering removal; some fire-tolerant tree species, like shortleaf pine, can recover from a fully scorched crown.

Photos: (A) Relatively new fire scar on pine; (B) Wildfire damage in a loblolly plantation, note the fire line that was constructed to stop the fire; (C) Fire scar on hardwood.

Mechanical wounding

HUMAN-CAUSED

Mechanical wounding

ABIOTIC AGENTS: Anything.

HOSTS: All trees.

SIGNIFICANCE: Wounds can create infection points for disease, attract secondary insects that could further wound the tree, and physically weaken the tree.

RECOGNITION: Many insects, fungi, bacteria, and other pests use wounds to enter the tree. These secondary pests can exacerbate the initial wound and physically weaken the tree, as well as causing secondary damage that may further stress the tree and possibly lead to tree mortality. Many physical wounds occur during harvesting activities, or at construction sites, including large changes in the soil level due to grading.

MANAGEMENT: Avoid injuries and soil grade changes within an area at least the crown's drop-line to minimize damage to tree roots and stems. Under normal circumstances, trees have the ability to heal wounds and compartmentalize the affected area to prevent spread of disease.

Photo: Mechanical wounds on a pine stem, made by construction equipment. Bark was scraped off in large chunks.

Herbicide damage

HUMAN-CAUSED

Herbicide damage

HOSTS: All trees.

SIGNIFICANCE: Herbicide, by definition, kills plants. Most trees can tolerate a small amount of herbicide damage, but some cannot and will die shortly after exposure. New foliage is much more susceptible to herbicide damage than is older foliage, meaning trees are the most susceptible in springtime during leaf-out.

RECOGNITION: Several symptoms may be seen, including deformed foliage (e.g. curled or twisted leaves), stunted branch or leaf growth, discolored or chlorotic foliage, leaf scorch, or spotted color patterns on leaves, leaf abscission, or groups/clusters of stunted or deformed leaves. Trees may die from overexposure to herbicides.

MANAGEMENT: Only use herbicides under appropriate, label-recommended conditions. Do not use herbicides in the vicinity of trees that may be taken up in tree roots and cause damage. Avoid herbicide drift.

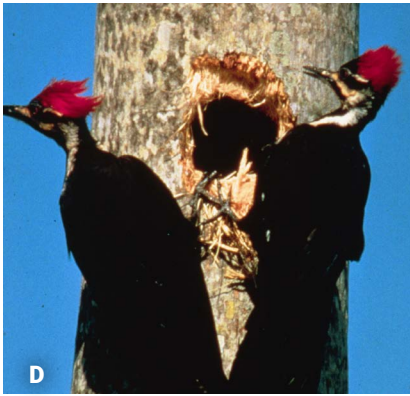
For reporting suspected herbicide misuse in Arkansas, please call the Arkansas Department of Agriculture, Plant Industry Division at (501) 225-1598.

Photos: Herbicide damage can result in (A) discolored leaves, (B) deformed and/or discolored foliage, or (C) dead foliage.

“There’s nothing wrong
with having a tree
as a friend.”

– *Bob Ross*

WILDLIFE



Yellow-bellied sapsucker *(Sphyrapicus varius)* and other woodpeckers

Yellow-bellied sapsucker *(Sphyrapicus varius)* & other woodpeckers

ORDER: Piciformes **FAMILY:** Picidae

HOSTS: Many tree species.

SIGNIFICANCE: Most woodpeckers do not negatively impact trees. Woodpeckers are predators on insects that feed inside living trees, and these birds can help control insect populations.

RECOGNITION: These birds often stand at a sharp angle on the sides of trees so they can hammer into the bark and wood with their beaks. Feeding holes are round to oval with jagged, messy edges. All woodpeckers build nesting cavities in tree trunks. Others, like the yellow-bellied sapsucker, form feeding holes in straight horizontal lines where they eat sap and insects attracted to the sap.

MANAGEMENT: By leaving dead trees (snags) woodpecker populations can be encouraged, and often birds will preferentially forage on snags.

Photos: (A) Yellow-bellied sapsucker; (B) Woodpecker damage from foraging; (C) Sapsucker damage on tree trunk; (D) Woodpeckers hollow out trees to use as nest sites.


A


B


C

White-tailed deer

Odocoileus virginianus

White-tailed deer

Odocoileus virginianus

ORDER: Artiodactyla **FAMILY:** Cervidae

HOSTS: Many tree species.

SIGNIFICANCE: Bucks rubbing antlers on trees (called "buck rubs") can severely damage stems, leading to secondary pests and diseases, stem breakage, and in some cases mortality. Deer browsing can weaken or kill small seedlings and saplings.

RECOGNITION: Buck rubs look like deep abrasions on saplings and branches, where most of the bark is often stripped off, sometimes hanging in pieces. Deer browse appears as a flat cut on the end of the twig (compared to rabbit feeding, which leaves twigs or seedlings cut at about a 45° angle).

MANAGEMENT: Little can be done in natural areas short of installing a deer-proof fence to keep animals out of the area. In landscape situations, foul-smelling sprays (usually sulphur-based) can be effective repellents; these spray-on formulations will need to be reapplied after rains.

Photos: (A) Deer browse leaves a straight cut on a stem; (B) The sapling in front of this buck has been rubbed and stripped of the bark.

Feral hogs

Sus scrofa

WILDLIFE

Feral hogs

Sus scrofa

ORDER: Artiodactyla **FAMILY:** Suidae

HOSTS: Feral hogs occupy a wide variety of habitats but show preference for riparian areas.

SIGNIFICANCE: Feeding and wallowing can lead to crop loss, destruction of wildlife habitat and food sources, pasture damage, water pollution, disease transmission and predation of native wildlife (including small mammals, reptiles, and ground-nesting birds).

RECOGNITION: Feral hogs range from 70-450 lbs., their fur can be solid red, black, spotted, or striped. Feral hogs are nocturnal and highly mobile, making them difficult to spot.

MANAGEMENT: Trapping and hunting. There are a variety of methods to remove feral hogs. The most effective method for removing large percentages of a population is through trapping, using entire sounder (group of feral hogs) management practices. Landowners experiencing feral hog damage are encouraged to call USDA APHIS Wildlife Services at (501) 835-2318 for assistance. Additional information and resources can be found at: **https://www.agriculture.arkansas.gov/arkansas-department-of-agriculture-services/feral-hog/**

Photos: (A) A group of wild feral hogs; (B) Male Sus scrofa; (C) Access road damaged by feral hogs; (D) Repeated scratching of feral hogs after mud bath.

“But deep down, at the molecular heart of life, the trees and we are essentially identical.”

– *Carl Sagan*

INSECTS


A


B


C

Forest tent caterpillar

Malacosoma disstria

Forest tent caterpillar

Malacosoma disstria

ORDER: Lepidoptera **FAMILY:** Lasiocampidae

HOSTS: Preferred hosts include many species of oaks (*Quercus* spp.) and several other hardwoods such as sweetgum, cherry, birch, tupelo, cottonwood, ash, and willow. Will not eat red maple (*Acer rubrum*) or conifers. In southeastern Arkansas, heavy defoliation occurs on overcup oak, *Quercus lyrata*.

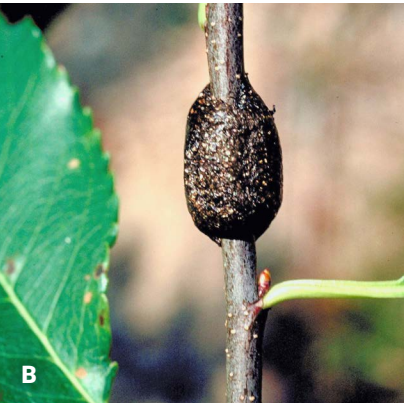
SIGNIFICANCE: High populations can result in nearly complete defoliation of trees, but this rarely kills the tree. Most of the impact is on aesthetics of the tree. Multiple years of defoliation can weaken the tree.

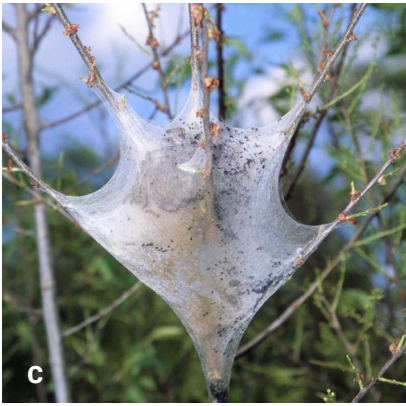
IDENTIFICATION: Larvae have white "boot prints" or "penguins" in a line along their dorsal (back) side. Larvae do not make tents. Adult moths are brown.

BIOLOGY: One generation per year. Eggs, laid on twigs, hatch in the spring and larvae feed gregariously for a couple weeks, then they tend to wander more as they get older. Larvae are present for about 8 weeks, after which they spin cocoons in leaves, on bark, or any protected place. Adult hatch in about 2 weeks, and they live about 2 weeks. Adult feed and do not mate, and females lay eggs which overwinter on twigs.

MANAGEMENT: Management is generally not recommended as populations naturally rise and fall. In urban settings contact or systemic insecticides can be effective.

Photos: (A) Larva of the forest tent caterpillar - note the white boot print or penguin pattern; (B) Egg mass; (C) Adult moth.





Eastern tent caterpillar

Malacosoma americanum

Eastern tent caterpillar

Malacosoma americanum

ORDER: Lepidoptera **FAMILY:** Lasiocampidae

HOSTS: Preferred hosts include trees in the Rosaceae (rose) family, primarily cherry (*Prunus* spp.) and apple and crabapple (*Malus* spp.) trees. Larvae will also feed on peach, rose, hawthorn, and many other hardwood trees.

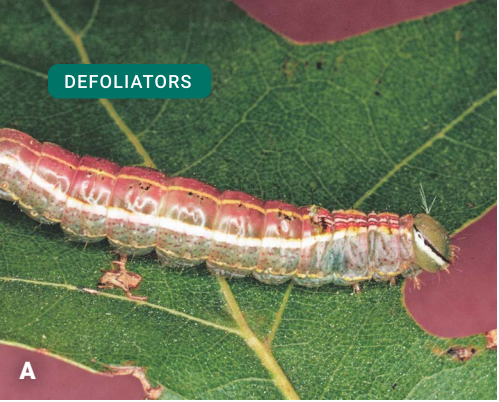
SIGNIFICANCE: Larvae can completely defoliate small trees, but trees rarely die. Aesthetics can be a concern, as many consider the webs unsightly.

IDENTIFICATION: Larvae have a white stripe in a line along their back. Adults are dirty white in color. Larvae make tents in branch crotches.

BIOLOGY: One generation per year. Eggs, laid on twigs, hatch in spring. Larvae leave the nest to feed, but return when not feeding. After about 6 weeks of feeding larvae spin cocoons on bark, leaf little, or anywhere protected. Adults emerge after about 3 weeks, do not feed, mate, and lay eggs, which overwinter on the twig.

MANAGEMENT: Webs can be destroyed by hand or pruned out. Egg masses can be removed in the spring. Contact insecticides are also effective.

Photos: (A) Larva of the eastern tent caterpillar - note the white line; (B) Egg mass - these can be manually removed in spring; (C) Tent with caterpillars inside - these can be physically removed or torn open to allow natural enemies to get the caterpillars.



Variable oakleaf caterpillar

Lochmaeus manteo

Variable oakleaf caterpillar

Lochmaeus manteo

ORDER: Lepidoptera **FAMILY:** Notodontidae

HOSTS: Many oak (*Quercus* spp.), with a preference for white oak (*Q. alba*). Also eats many other hardwoods including linden, beech, walnut, yellow poplar, apple, and persimmon.

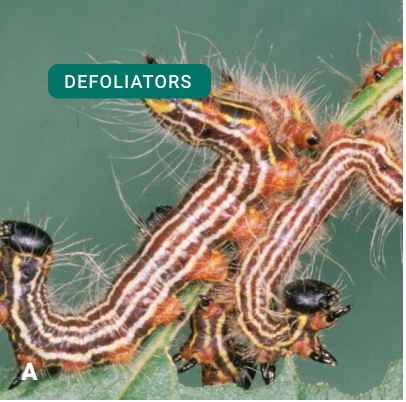
SIGNIFICANCE: Defoliation is mostly aesthetic, though heavy populations can be a nuisance due to all the excrement (sometimes called frass) that drops to the ground.

IDENTIFICATION: Larvae are yellowish-green, with a broad orange/red band down the back. Adults are a dull brown or gray.

BIOLOGY: Two generations per year. The insect overwinters as a prepupa in the soil, pupates in early spring, and adults emerge in late spring. Eggs are laid on the leaves and young larvae skeletonize leaves. Older larvae consume all but the leaf veins.

MANAGEMENT: Management is seldom warranted, though contact and systemic insecticides are effective. Natural enemies usually control populations. It may be necessary to sanitize/clean sidewalks and parking lots under defoliated trees since the frass may become slippery after rain.

Photos: (A) Red phase of the variable oakleaf caterpillar; (B) Adult; (C) Larvae hatching from an egg mass; (D) Green phase of the larva.


A


B


C

Yellownecked caterpillar

Datana ministra

Yellownecked caterpillar

Datana ministra

ORDER: Lepidoptera **FAMILY:** Notodontidae

HOSTS: Oaks, elm, basswood, willow, and many other hardwoods, fruit trees, and ornamentals.

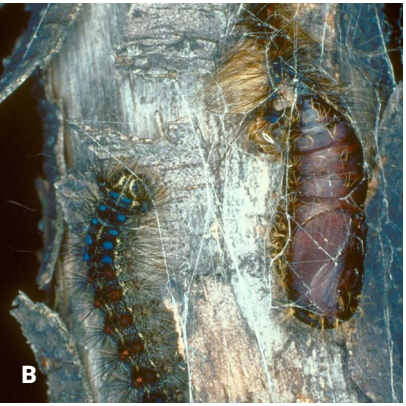
SIGNIFICANCE: Defoliation is mostly aesthetic, especially on urban or landscape trees and shrubs.

IDENTIFICATION: Adults are reddish-brown. Larvae have black heads, with reddish bodies and alternating yellow and red lines along the sides and back. When disturbed, the larvae curl their heads and rear upward in a defensive, U-shaped posture.

BIOLOGY: One generation per year. Overwinter as pupa in the soil, adults emerge in mid-summer. Larvae are active in late summer and fall, and can severely defoliate areas of a tree (or entire smaller trees and bushes). Larvae will congregate on branches, and raise their heads and posterior when disturbed, making a "U" shape.

MANAGEMENT: Management is seldom warranted, though contact and systemic insecticides are effective.

Photos: (A) Mature larvae showing characteristic defensive posture; (B) Adult moth; (C) Young larvae often feed gregariously.



Spongy moth

Lymantria dispar

Spongy moth

Lymantria dispar

ORDER: Lepidoptera **FAMILY:** Erebidae

HOSTS: Most oaks, sweetgum, apple, basswood, birch, willows, and many other hardwood species.

SIsignificance: *L. dispar* is a non-native pest capable of massive outbreaks and extensive defoliation. This pest has occurred in infestations caused by introduced egg masses on vehicles. Severe defoliation can weaken trees and increase their susceptibility to other pests and diseases. If detected, report to your local extension representative.

IDENTIFICATION: Adult females are white, while adult males are brown. Larvae have five pairs of blue dots starting at the head, followed by six pairs of red dots ending at the rear. Larvae are also covered in long, dark hairs that can irritate the skin.

BIOLOGY: One generation per year. Overwinter as egg masses, which hatch in mid-spring. Larvae feed for about a month, after which they spin cocoons and pupate on trees, the ground, or almost any other object to which they can crawl. Adults emerge in early summer, mate, and lay eggs. Females have wings but can't fly, but males do fly.

MANAGEMENT: The best management is to reduce the number of preferred tree species in a stand. Chemical controls are effective and can be applied aerially. The federal Slow-the-Spread program closely monitors spongy moth populations and is heavily involved in management activities and decisions.

Photos: (A) Larvae have pairs of blue and red spots; (B) Pupae are in loosely constructed cocoons; (C) White adult females do not fly, but brown adult males do fly.

Fall webworm

Hyphantria cunea

Fall webworm

Hyphantria cunea

ORDER: Lepidoptera **FAMILY:** Erebidae

HOSTS: Many hardwood trees including persimmon, elm, sweetgum, walnut, maples, sourwood, and pecan.

SIGNIFICANCE: Damage is mostly aesthetic, but small trees can be completely defoliated.

IDENTIFICATION: Forms large webs that cover the ends of branches.

BIOLOGY: Three generations per year. Eggs are laid on leaves and hatch in about a week; larvae feed for 4-8 weeks. There are two color morphs (races) of mature larvae: black and orange. Larvae pupate on the ground in thin cocoons, which often have bits of leaf litter, hairs, or soil interwoven. They overwinter in cocoons. Adult moths are white and sometimes have small black spots.

MANAGEMENT: Webs can be removed by hand, or torn open to allow natural enemies (like birds and wasps) to prey on the larvae.

Photos: (A) Older larvae are yellow with black spots, but usually hide in the webs during the day; (B) Webs cover the ends of branches and get larger as larvae grow; (C) Adult moths lay white egg masses.


A


B


C


D

Fall cankerworm

Alsophila pometaria

Fall cankerworm

Alsophila pometaria

ORDER: Lepidoptera **FAMILY:** Geometridae

HOSTS: Elms, ash, maples, hackberry, oaks, walnut, willow, and many other hardwood trees.

SIGNIFICANCE: Larvae can cause major damage on early spring growth of trees, and can be serious problems in urban areas. Damage can be both aesthetic on trees, and elsewhere because of the large amounts of frass produced by the larvae.

IDENTIFICATION: Adults are dull brown to gray; females are wingless. Larvae may be light green with white lines running the length of their body, or dark brownish-green with a black stripe on their back. Larvae are also called “loopers” or “inchworms” because of how they crawl.

BIOLOGY: One generation per year. Larvae pupate in the soil. Adults emerge in late fall to mate and lay eggs. Eggs overwinter on twigs; larvae hatch in spring and feed on newly-emerging leaves until mid-summer.

MANAGEMENT: Contact or systemic insecticides are effective. Tree-banding, which captures larvae (if placed in the spring) or adults (if placed in the fall) as they travel up and down the tree trunk, is also effective, particularly in urban areas.

Photos: All green (A) and black striped (B) color morphs of larvae; (C) Adults are gray moths; (D) Pupae are yellow/green, and found in the soil.


A


B


C

Pine webworm

Pococera robustella

Pine webworm

Pococera robustella

ORDER: Lepidoptera **FAMILY:** Pyralidae

HOSTS: Various pine (*Pinus* spp.) species.

SIGNIFICANCE: Usually attacks young seedlings, but damage is rarely severe enough to impact growth.

IDENTIFICATION: Adults are gray or brown. Larvae are light gray with tan stripes along the body.

BIOLOGY: Usually two generations per year. Overwinters as a pupa on the ground, with adults emerging in spring to mate and lay eggs on needles. Young larvae mine the needles, while older larvae construct a web that gets filled with frass; one or more larvae may use a single web. Larvae exit the nest to clip needles which they bring back to the nest to consume.

MANAGEMENT: Control is usually not necessary. Webs can be removed by hand.

Photos: (A) Brown larvae are rarely seen, as they usually stay within their nest; (B) Nest; (C) Adults are small brown moths.


A


B


C


D

Loblolly pine sawfly

Neodiprion taedae linearis

Loblolly pine sawfly

Neodiprion taedae linearis

ORDER: Hymenoptera **FAMILY:** Diprionidae

HOSTS: Various pine (*Pinus* spp.) species, particularly loblolly pine.

SIGNIFICANCE: Defoliation can be severe, but annual defoliation does not appear to weaken trees since feeding occurs on old needles. Some pine plantations in southeastern Arkansas experience severe defoliation every April.

IDENTIFICATION: The small, rarely seen adults have brown bodies and black markings. Larvae have several black stripes extending down the body and a reddish, brown head. When disturbed, larvae raise their heads and rear ends up in a defensive posture.

BIOLOGY: One generation per year. Overwinter in the egg stage on needles. Larvae emerge in spring. Young larvae feed on the edge of needles (leaving brown, wilted needle remnants and the symptom of "flagging"), while older larvae consume the whole needle. Larvae pupate in crevices or in the duff layer. Adults lay eggs in the canopy.

MANAGEMENT: Management is rarely required since outbreaks subside when the new flush of growth replaces lost needles.

Photos: (A) Pine trees are defoliated; (B) Several Neodiprion taedae linearis feeding on the needles; (C) The larva of loblolly pine sawfly feeding on a needle; (D) Tops of the pine trees are defoliated.

Redheaded pine sawfly

Neodiprion lecontei

Redheaded pine sawfly

Neodiprion lecontei

ORDER: Hymenoptera **FAMILY:** Diprionidae

HOSTS: Various pine (*Pinus* spp.) species.

SIGNIFICANCE: Defoliation can be severe, and repeated defoliation by multiple generations can weaken trees.

IDENTIFICATION: Adults have reddish bodies and black wings. Larvae are yellowish with black spots and a red head. When disturbed, larvae raise their heads and rear ends up in a defensive posture.

BIOLOGY: Up to three generations per year. Overwinter as pupae in the soil or duff in tough brownish cocoons.

MANAGEMENT: Control is rarely needed since natural enemies can lower sawfly abundance. Contact insecticides are effective if an outbreak persists.

Photos: (A) Larvae of Neodiprion lecontei; (B) Larvae of Neodiprion lecontei feeding on the needles; (C) Adult redheaded pine sawfly.


A


B


C

Pine Colaspis beetle

Colaspis pini

Pine Colaspis beetle

Colaspis pini

ORDER: Coleoptera **FAMILY:** Chysomelidae

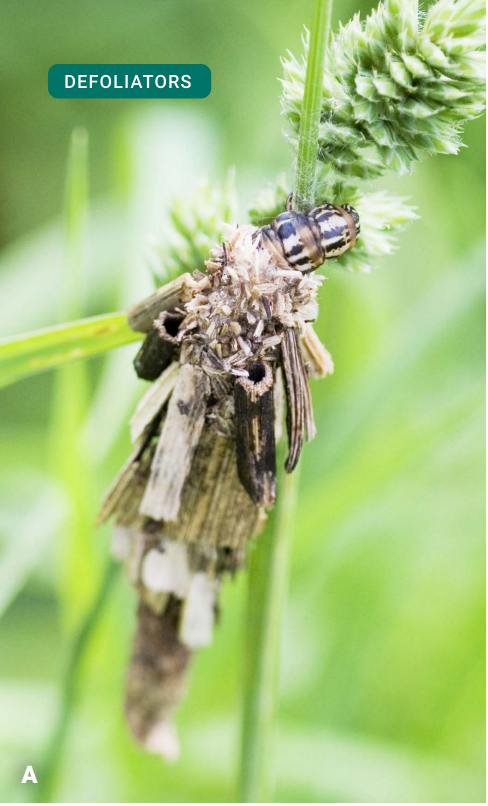
HOSTS: Southern Pine, bald cypress, ornamental spruces.

SIGNIFICANCE: When abundant, adult feeding can cause foliage to appear brown and thinned. Adults will chew on the midrib of the needle leaving behind a jagged edge, and the remaining needle will turn brown.

BIOLOGY: Adults will mate and lay eggs in the soil and emerge in the late spring and early summer. Larvae feed on herbaceous vegetation roots and burrow deep within the winter months.

MANAGEMENT: Trees normally will not die and new growth will appear in the late summer.

Photos: (A) Two adult Colaspis pini; (B) Adult male and female Colaspis pini; (C.) Tree looks defoliated and browning.



Bagworm moth

Thyridopteryx ephemeraeformis

Bagworm moth

Thyridopteryx ephemeraeformis

ORDER: Lepidoptera **FAMILY:** Psychidae

HOSTS: Many, but often eastern red cedar (*Juniperus virginianus*), junipers (*Juniperus* spp.) or arborvitae (*Thuja occidentalis*).

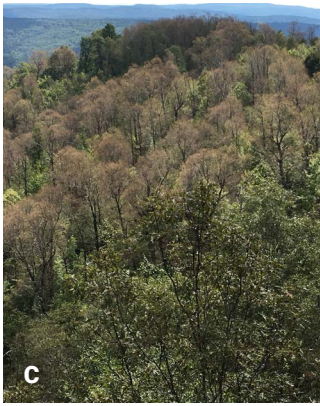
SIGNIFICANCE: Small plants may be killed by heavy infestations. Larger trees can usually tolerate repeated or heavy defoliation, though it will cause stress.

IDENTIFICATION: The stage most often noticed is the larvae, which constructs a "bag" out of plant materials (from the host on which it's feeding) and silk it produces. Adult male moths are dark, and about an inch across the wings.

BIOLOGY: Young larvae make a small bag (~1/4" long or so) which is enlarged as the larva grows, up to 1 ½ to 2" long. Larvae pupate in the bags in late summer. Adult males leave the bag and find females, which remain in the bag. Mating occurs, and the female lays eggs inside that same bag, she then crawls out and dies. Eggs overwinter in the bag and hatch the next spring. Some remain on that host plant, while others disperse via crawling or ballooning.

MANAGEMENT: Bags can be manually removed from the plant. Chemical controls can be used, but should target the young larvae.

Photos: (A) Bagworm larvae; (B) Defoliated tree with bagworm larvae; (C) Male adult bagworm moth.



Common walkingstick

Diapheromera femorata

Common walkingstick

Diapheromera femorata

ORDER: Phasmatodea; **FAMILY:** Diapheromera

HOSTS: Various hardwood species.

SIGNIFICANCE: Defoliation can be severe, and repeated defoliation can weaken trees.

IDENTIFICATION: Wingless adults can be 3-4" long, and are often a green or brown color. All life stages resemble a twig. Females are larger than males.

BIOLOGY: Adults mate in late summer and the female lays eggs, which drop to the forest floor and overwinter there. In spring, eggs hatch and nymphs crawl up trees to begin feeding on leaves. In Arkansas, outbreaks are common in high elevation areas of the Boston and Ozark Mountains.

MANAGEMENT: Outbreaks of this insect are rare, and management is seldom needed as natural enemies usually control populations. Since defoliation occurs so late in the growing season, trees are generally uninjured.

Photos: (A) Adult Diapheromera femorata; (B) Common walkingstick feeding on leaves; (C) Defoliated trees.


A


B


C


D

Scales

Scales

ORDER: Hemiptera **FAMILY:** Many different families.

HOSTS: Many woody plant species.

SIGNIFICANCE: Most are aesthetic pests. For some (e.g. soft scales) their feeding and excretion of unused fluids (i.e., honeydew) can leave a sticky coating on branches and leaves underneath, resulting in the growth of sooty mold. Hard scales, like obscure scale (*Melanaspis obscura*), do not produce honeydew or sooty mold. Kermes scale (*Allokermes* spp.) can cause dieback of branch tips.

IDENTIFICATION: Scales are highly variable in appearance, but all are relatively small (i.e., <5mm in diameter or length).

BIOLOGY: Varies according to species, but in general scales have a mobile crawler stage right after hatching. The crawler then settles down permanently, inserts its mouthparts into the plant, and begins feeding on plant vascular tissue.

MANAGEMENT: Several different kinds of natural enemies help manage populations. Infested material can be removed by hand. Chemical management is difficult because scales are often covered with a waxy substance once they mature, though insecticidal oils and other pesticides are effective, especially on the crawler stage. Additionally, scale outbreaks may occur if chemical control strategies kill non-target natural enemies.

Photos: (A) Soft scales; (B) Brown soft scales; (C) Pine needle scale with predatory ladybird larva; (D) Tuliptree scale.

Crape myrtle bark scale

Acanthococcus lagerstroemiae

Crape myrtle bark scale

Acanthococcus lagerstroemiae

ORDER: Hemiptera **FAMILY:** Eriococcidae

HOSTS: Crape myrtles (*Lagerstroemia* spp.).

SIGNIFICANCE: Mostly an aesthetic pest. Their feeding and excretion of unused fluids (i.e., honeydew) can leave a sticky coating on stems and branches beneath. Sooty mold often grows on honeydew-coated plant parts. Heavy infestations can reduce plant growth and flower production.

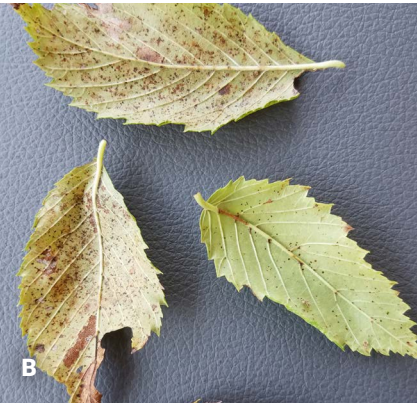
IDENTIFICATION: Small (~1/16") white scales are visible on crape myrtle stems and branches. A bright pink fluid is visible when scales are squished.

BIOLOGY: Eggs overwinter, and the mobile crawler stage searches on the plant for a suitable location on which to settle down permanently. The insect inserts its mouthparts into the plant, and begins feeding on plant sap. The whitish or grayish "cap" is produced as it feeds.

MANAGEMENT: Pesticides or insecticidal oils and soaps are more effective on crawlers than on adults. A soil drench in the spring with imidacloprid or dinotefuran is also effective. Natural enemies may provide some control of populations, such as the twice-stabbed lady beetle.

Photos: (A) Missing bark on crape myrtle trunk; (B) Acanthococcus lagerstroemiae covering crape myrtle branches; (C) Heavy crape myrtle bark scale infestation.


A


B


C

Lace bugs

Corythucha spp.

Lace bugs

Corythucha spp.

ORDER: Heteroptera **FAMILY:** Tingidae

HOSTS: Elms (*Ulmus* spp.), sycamores (*Platanus* spp.), and many other hardwood trees and shrubs.

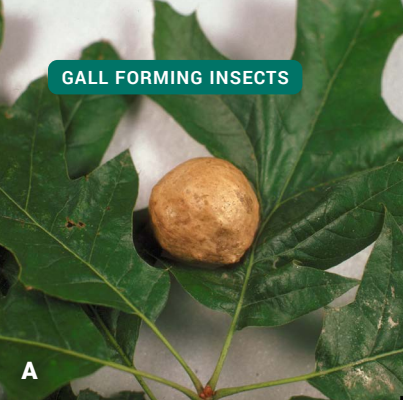
SIGNIFICANCE: Feeding is usually an aesthetic issue, though some premature defoliation may occur from heavy feeding.

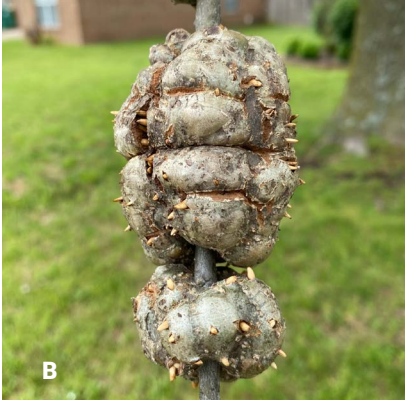
IDENTIFICATION: Lace bugs are usually very host-specific (e.g. elm lace bug, *Corythucha ulmi*, feeds on elm; sycamore lace bug, *Corythucha ciliata*, feeds on sycamore; etc.). Adults are small (~1/8" long) and have delicate-looking, often ornate wings and a "hood" extending over the head. Nymphs do not have wings. Dark spots (frass) and light spots (damage from feeding) can be seen on the undersides of leaves where lace bugs are present.

BIOLOGY: Females lay eggs on the underside of the leaf. Eggs hatch, and nymphs develop into adults in a few weeks. Populations tend to increase as the growing season progresses, and several generations may occur in a season.

MANAGEMENT: Maintain plant vigor – this will help plants cope with the damage. Remove dead leaves below the tree, as lace bugs can overwinter in this duff layer. Insecticides (contact or systemic) can be used, but natural enemies usually keep lace bug populations in check.

Photos: (A) Lace bugs nesting on an inner side of leaf; (B) Elm leaves damaged by Corythucha ulmi; (C) Adult lace bug.





Gall-forming insects

Galls

CAUSE: Various insects, especially the wasps in the family Cynipidae and the gall midges in the family Cecidomyiidae. Galls may also be formed by mites, fungi, and bacteria.

HOSTS: Many hardwood and occasionally conifer species.

SIGNIFICANCE: Infected trees may lose leaves or experience twig mortality, but the presence of galls is rarely fatal to the tree.

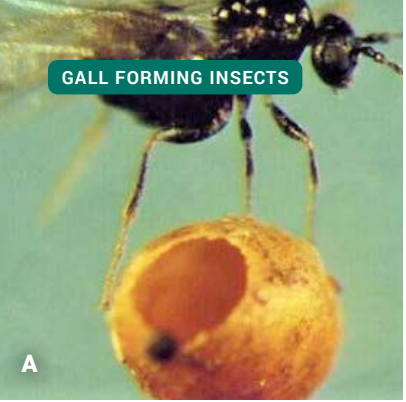
IDENTIFICATION: Often appear as growths on twigs or leaves; there is a wide variation in size and appearance.

BIOLOGY: Galls form as a tree response to colonization, egg-laying, or feeding, and the gall itself is the tree's reaction to the gall-maker. Galls often grow as the organism inside grows, using nutrients from the tree as food. The biology of individual galls is highly variable. Horned and gouty oak galls, which are caused by a tiny wasps in the family Cynipidae, form on small diameter twigs and can reach golf-ball size.

MANAGEMENT: In most cases, natural enemies control populations of the gall-causing organism. Infected tissues can be manually removed and disposed of.

Note from author: There are a huge variety of galls, and many are distinguished by their appearance on a specific host. However, the organisms that produce galls are poorly understood. When photographing galls, we recommend using the iNaturalist community to help identify it to species level.

Photos: (A) Oak apple gall; (B) Horned oak gall, (C) Horned oak gall; (D) Wool sower gall.



Jumping oak gall wasp

Neuroterus spp.

Jumping oak gall wasp

Neuroterus spp.

ORDER: Hymenoptera **FAMILY:** Cynipidae

HOSTS: A variety of white oak species (white oak, burr oak, post oak and live oak).

SIGNIFICANCE: Hundreds of galls can form on a single leaf. Mid-summer foliar necrosis may appear, severity increases when gall numbers are high. Necrosis can lead to twig and branch die-back.

IDENTIFICATION: First generation galls are non-detachable and turn from green to brown. Second generation galls are mustard colored with larvae and easily detachable. Larvae are cream-colored with dark mandibles, curled inside galls. Adult wasps are .75 mm in length, dark brown or black with reddish legs and glassy wings.

BIOLOGY: Two generations per year. Second generation galls fall from leaves mid-summer. The movement of the tightly-packed larvae inside causes the galls to "jump" and lodge in soil or leaf litter where they overwinter. Larvae pupate within galls and adults emerge in early spring.

MANAGEMENT: Jumping oak galls are considered an aesthetic issue, where the infested trees recover in the following years. Silvicultural practices, such as altering species richness and structural diversity, may reduce the likelihood of an outbreak, and prescribed burning may directly reduce jumping oak gall populations. Maintain tree health and clear leaf litter in residential areas.

Photos: (A) Adult Neuroterus sp. wasp; (B) White oak leaves infested with jumping oak gall; (C) Close-up of jumping oak gall with many galls already detached from the leaf.

Ambrosia beetles

Ambrosia beetles

ORDER: Coleoptera **FAMILY:** Curculionidae **SUBFAMILY:** Scolytinae

HOSTS: Many woody plants.

SIGNIFICANCE: Most ambrosia beetles attack weakened trees, but some (like the granulate ambrosia beetle to redbay ambrosia beetle, see also laurel wilt) can attack live, healthy trees. Trees in excessively wet conditions may be more attractive to these beetles.

IDENTIFICATION: Most adult beetles are small (1–2 mm) and brown. Adult beetles make small entrance holes on the stem, and fine sawdust is often observed under the hole. The tunneling beetles generate frass and sawdust, which sticks together and gets pushed out of the entrance hole like a spaghetti noodle (these are also called "toothpicks"). Noodles may or may not be visible, as they are fragile and tend to be broken or washed away by wind and rain.

BIOLOGY: Adults tunnel into the xylem and introduce fungal spores, which they carry with them. The fungi grow in the tunnels, and both adults and larvae feed on the fungi – they do NOT feed on the wood or phloem. Larvae develop in the tree and then spread to new trees.

MANAGEMENT: Promote tree health to avoid infestation. There is no known effective treatment once beetles have colonized a tree.

Photos: (A) Typical ambrosia beetle; (B) "Noodles" or "toothpicks" are visible on the left side of the wound; (C) Ambrosia beetle larvae feed on fungus growing inside the galleries.


A


B


C

Pinhole borers

(Several Species)

Pinhole borers

Euplatypus compositus, Myoplatypus flavicornis, Oxoplatypus quadridentatus

ORDER: Coleoptera **FAMILY:** Curculionidae **SUBFAMILY:** Platypodinae

HOSTS: Many woody plants.

SIGNIFICANCE: Pinhole borers are ambrosia beetles, and attack weakened or dying trees.

IDENTIFICATION: Most adult beetles are small (3–5 mm) and brown. Adult beetles make small entrance holes on the stem, and fine sawdust is often observed under the hole.

BIOLOGY: Adults tunnel into the xylem and introduce fungal spores, which they carry with them. The fungi grow in the tunnels, and both adults and larvae feed on the fungi – they do NOT feed on the wood or phloem. Larvae develop in the tree and then spread to new trees.

MANAGEMENT: Promote tree health to avoid infestation. There is no known effective treatment once beetles have colonized a tree.

Photos: (A) Adult pinhole borer; (B) Fine sawdust from the entrance holes; (C) Pinhole borer tiny entrance holes.


A


B


C

Ips bark beetles

Ips avulsus, I. calligraphus, I. grandicollis, I. pini

Ips bark beetles

Ips avulsus, I. calligraphus, I. grandicollis, I. pini

ORDER: Coleoptera **FAMILY:** Curculionidae **SUBFAMILY:** Scolytinae

HOSTS: Pines (*Pinus* spp.).

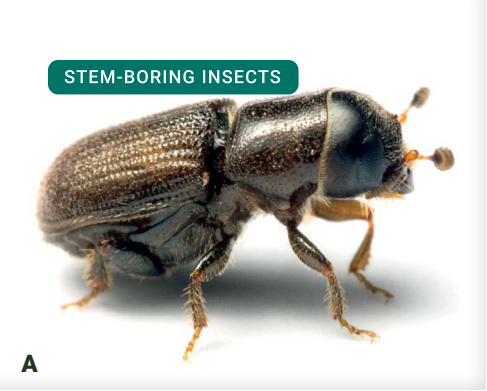
SIGNIFICANCE: These bark beetles commonly infest weakened, stressed, injured, or recently killed trees. In Arkansas, Ips bark beetles frequently infest drought stressed trees and regional outbreaks occur with recurrent drought cycles. *Ips avulsus* may infest individual branches, in which case trees can survive infestation. However, once Ips beetles attack the bole, tree death usually occurs.

IDENTIFICATION: Adults are small (1-4mm) brown beetles with points on the rear end. Whitish or reddish pitch tubes are often found on bark plates (the flat parts), and boring dust may collect below the pitch tubes. Adults create I-, Y-, H-, or X-shaped vertical galleries under the bark. Needles on trees attacked by Ips bark beetles first turn yellow, then red, then brown.

BIOLOGY: Adults bore through the bark into the phloem, where males excavate a small "nuptial chamber". Females come, mate, and create the letter-shaped gallery, laying eggs in the galleries. Larvae feed on phloem, later emerging to find new hosts. The entire life cycle can be completed in just a few weeks. Ips beetles also introduce bluestain fungi into the sapwood. While these fungi don't impact the structural integrity of the wood, it does discolor it.

MANAGEMENT: Since infestations are generally short-lived, infestations usually don't require management. In certain cases where justifiable risk is identified, it may be recommended to harvest before losses occur. Infested trees should be harvested while beetles are still inside. A forester should be contacted to promote good forest health and silviculture that prevents infestations.

Photos: (A) Ips adults have spines on their posterior; (B) Ips spp. galleries; (C) Drone image of red scattered trees caused by Ips spp.


A


B


C


D

Southern pine beetle

Dendroctonus frontalis

Southern pine beetle

Dendroctonus frontalis

ORDER: Coleoptera **FAMILY:** Curculionidae **SUBFAMILY:** Scolytinae

HOSTS: Pines (*Pinus* spp.), especially loblolly and shortleaf pine.

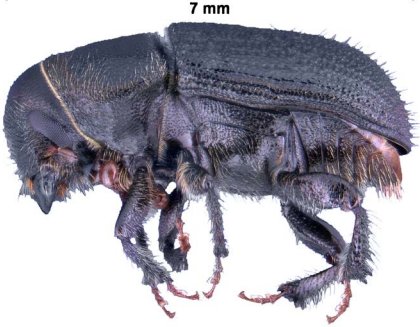
SIGNIFICANCE: When populations are low, southern pine beetles mainly attack weakened or stressed trees. These beetles develop expanding infestations, and when populations erupt, these beetles are capable of killing large acreages of healthy pines, having huge economic impacts. For this reason, expanding infestations should be treated while they're still small. Southern pine beetle is a historically important pest in Arkansas, however, an outbreak has not occurred in the state since the mid-1990s.

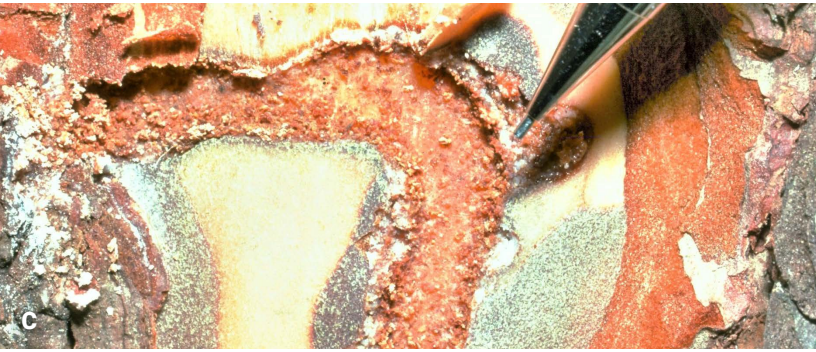
IDENTIFICATION: Adult beetles are smaller than a grain of rice and black, with smooth rear ends. They are shaped similar to turpentine beetles, but much smaller. Whitish to reddish pitch tubes are formed, usually in the cracks of the bark. Tunnels under the bark are winding and S-shaped.

BIOLOGY: Adult females tunnel into trees and release pheromones to attract additional beetles, which can help to overwhelm a tree's defensive capabilities. Larvae feed and develop on the phloem. Bluestain fungi are introduced into the tree.

MANAGEMENT: Promote healthy stands by using standard silvicultural techniques like vegetation management and thinning. When infestations erupt, infested trees plus a surrounding buffer of healthy trees can be removed to stop the spread of active spots. Cut and leave procedures are recommended for small spots (<50 trees) during summer months.

Photos: (A) Adult SPB; (B) Pitch tubes are often in the bark cracks; (C) Winding galleries made by adults; (D) Aerial view of a SPB outbreak - note fading trees on the edge.





Turpentine beetles

Dendroctonus terebrans and *D. valens*

Turpentine beetles

Dendroctonus terebrans and *D. valens*

ORDER: Coleoptera **FAMILY:** Curculionidae **SUBFAMILY:** Scolytinae

HOSTS: Pines (*Pinus* spp.).

SIGNIFICANCE: Turpentine beetles usually attack weakened, stressed, or injured trees, and may breed in cut pine stumps. Turpentine impact is usually minor, and unlike other bark beetles, trees can often withstand small turpentine beetle infestations unless attacks occur around the entire tree perimeter. Attacks start at the bottom of the tree and move up the trunk, but rarely go above ten feet. During times of drought turpentine beetle damage may increase due to the stress on trees.

IDENTIFICATION: Adult beetles are about the size of a kernel of corn, and either black or dark red, depending on species. Large whiteish or reddish pitch tubes (often the diameter of a quarter and sometimes over 1" deep) are formed when adults chew into the tree stem, normally in the lower 10' on the bole.

BIOLOGY: Adults tunnel through the bark into the phloem, where they excavate a gallery (shaped like a ? or upside down J). Females lay eggs in the gallery and larvae feed on phloem. Larvae pupate in the inner bark, adults emerge and find a new host tree.

MANAGEMENT: Promote healthy trees through proper silviculture. Small infestations usually die out on their own. Single trees can be protected with insecticides (injected or applied to the lower stem).

Photos: (A) Adult black turpentine beetle; (B) Large pitch tubes are usually on the lower 10' of the bole; (C) Turpentine beetle gallery.

Checkered beetle

aka Clerid beetle (Several Species)

HELPFUL INSECT SPOTLIGHT

Checkered beetle

(Several species)

ORDER: Coleoptera **FAMILY:** Cleridae

HOSTS: Bark and ambrosia beetles.

SIGNIFICANCE: Checkered beetles are voracious predators on several species of bark beetles, including the southern pine beetle and Ips bark beetles. Adult checkered beetles commonly feed on other adult beetles outside of the bark, while the checkered beetle larvae feed on other beetle larvae under the bark. *Thanasimus dubius* is an important predator of pine bark beetles in the southeastern U.S.

IDENTIFICATION: Up to an inch long, these (often hairy) beetles are usually brightly colored, with patterns of red, black, orange, or yellow. They can often be found on dead/dying pine trees.

BIOLOGY: Females lay eggs on trees infested with bark and wood boring beetles. Eggs hatch, and larvae enter the tree in bark beetle galleries in search of prey. Small larvae feed on bark beetle eggs, while larger larvae prey on other larvae. After larvae develop they pupate in the outer bark. Adults emerge after about two weeks and feed on adult bark beetles.

MANAGEMENT: No management is necessary. Checkered beetles may exist under the bark after bark beetles have emerged; therefore, it is important to note that removing a dead tree could remove these beneficial insects inside of it.

Photos: (A & B) Checkered beetle larvae in bark beetle galleries; (C) Thanasimus dubius consuming a southern pine beetle.


A


B


C

Pine tip moth

Rhyacionia frustrana

Pine tip moth

Rhyacionia frustrana

ORDER: Lepidoptera **FAMILY:** Tortricidae

HOSTS: Pines (*Pinus* spp.), especially loblolly and shortleaf pine.

SIGNIFICANCE: Larval feeding can cause the death of growing terminals, leading to multiple leaders and bushy trees. Damage is most often in young trees.

IDENTIFICATION: Adult moths are about ¼" long, and tan with brown stripes. Larvae look like little hairless caterpillars inside shoot tips. Look for brown, dying shoots, sometimes with webbing or resin on the end of the terminal.

BIOLOGY: Adults lay eggs on needles, and larvae hatch and feed on expanding shoots. Later they tunnel into the shoot and feed as they burrow downward towards the stem; this feeding hollows out and kills the shoot. Up to 2-4 generations occur each year in Arkansas.

MANAGEMENT: Pheromone traps and scouting can help detect adults, which will help determine proper timing for effective chemical control on young trees. In general, the more site prep that occurs, the more tip moth damage. Site prep opens up the site and reduces competition for the seedlings, but it also exposes the shoots and buds to tip moths and decreases cover for natural enemies. Tip moth infestations on urban/landscape trees can usually be pruned out by hand.

Photos: (A) Adult moth; (B) Dead terminals resulting from larval feeding; (C) Close-up of attacked terminal showing the white web/cap made by the larva.

Reproduction weevils

Pales weevil: *Hylobius pales*

Pitch-eating weevil: *Pachylobius picivorus*

Reproduction weevils

Pales weevil: *Hylobius pales*
Pitch-eating weevil: *Pachylobius picivorus*

ORDER: Coleoptera **FAMILY:** Curculionidae

HOSTS: Pines (*Pinus* spp.).

SIGNIFICANCE: These weevils can cause heavy mortality in recently planted pines, particularly in areas planted soon after harvest.

IDENTIFICATION: Adults are up to ½" long, thick-bodied, and dark brown or black. They have a snout, which holds the chewing mouth-parts on the end. Damaged seedlings will be girdled (i.e., have the bark and phloem removed/chewed off) near the ground, and may show damage both above and below the soil line.

BIOLOGY: Adults are attracted to chemical odors emitted from recently cut stumps or dying pines. Adults mate and lay eggs on the root collar or large roots, larvae hatch and bore into the roots and feed on phloem. Adults feed on live roots, shoots, and buds of pine seedlings and trees.

MANAGEMENT: Avoid planting seedlings within six months following a harvest. If the site was harvested after June, wait until the following year to plant. Many pine seedlings can be purchased pre-treated with an insecticide that will protect seedlings from reproduction weevil damage.

Photos: (A) Feeding damage on young pine seedling; (B) Adult Hylobius pales; (C) Adult Pachylobius picivorus.

Emerald ash borer

Agrilus planipennis

Emerald ash borer

Agrilus planipennis

ORDER: Coleoptera **FAMILY:** Buprestidae

HOSTS: Ash trees (*Fraxinus* spp.).

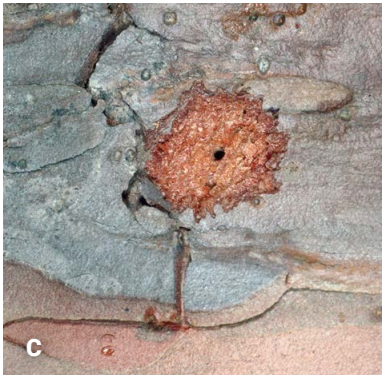
SIGNIFICANCE: The emerald ash borer (EAB) is arguably the worst invasive insect to ever impact North American forests. EAB larval feeding kills all species of ash tree, and trees as small as 1" in diameter are susceptible. Adult feeding on ash foliage is inconsequential to the tree.

IDENTIFICATION: Adults are a small (~½" long) metallic, emerald green beetle. Larvae can be up to 1" long, are white, and have flat heads. Galleries are meandering and winding on the inner bark and phloem.

BIOLOGY: Adult EAB emerge in spring, mate, and lay eggs on ash bark. Larvae hatch and bore into the phloem, where they feed and develop throughout the summer and fall.

MANAGEMENT: High-value trees can be protected, and even saved if EAB infestations are caught early enough, by several insecticides. Uninfested high-value trees can be protected by injections if they are in the vicinity of infestations. Biological control agents can provide modest control of EAB populations in natural areas, but only under circumstances where EAB populations are high.

Photos: (A) Adult EAB; (B) EAB exit holes; (C) EAB larvae feeding in the winding galleries.



Sawyer beetles

Monochamus spp.

Sawyer beetles

Monochamus spp.

ORDER: Coleoptera **FAMILY:** Cerambycidae

HOSTS: Pines (*Pinus* spp.).

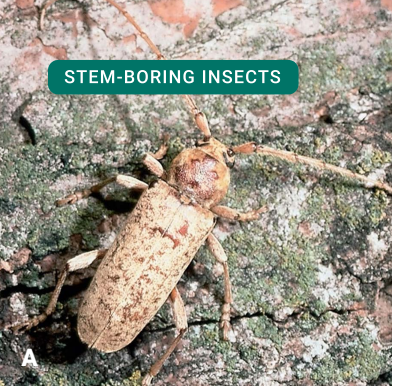
SIGNIFICANCE: Pine sawyers attack and feed on stressed, dying, dead, or recently cut trees. Adults can carry the pinewood nematode, which can cause pine wilt disease, a potentially fatal disease to pines.

IDENTIFICATION: Adult beetles are large, with bodies up to 1 ½" long and antennae 2–3 times as long as the body on males. Larvae are large white grubs, and can be up to 3" long.

BIOLOGY: Eggs are inserted into small niches that the female chew into the bark of trunks or large limbs. The larva chews into the tree and feeds on the remaining phloem and wood. Larval chewing may be audible when standing near an infested tree. Larvae pupate in wood, and adults chew their way out upon emergence. Generations can overlap considerably, but in warm summer months the complete life cycle may take about two months.

MANAGEMENT: Maintain healthy trees by using proper silvicultural management strategies. There is no treatment method once beetles are inside a tree.

Photos: (A) Adult Monochamus spp.; (B) Larval longhorned beetle; (C) Niche chewed into the bark where a female lays eggs into the phloem.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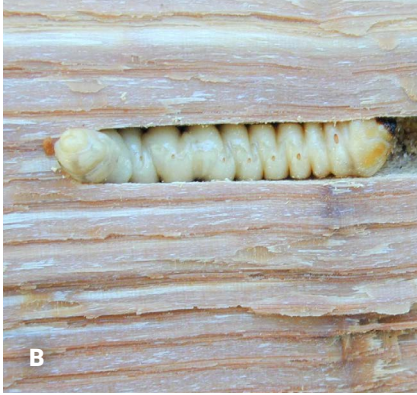

B


C

Red oak borer

Enaphalodes rufulus

Red oak borer

Enaphalodes rufulus

ORDER: Coleoptera **FAMILY:** Cerambycidae

HOSTS: Various species of oak (Quercus), primarily those in the red oak subgenus (Erythrobalanus).

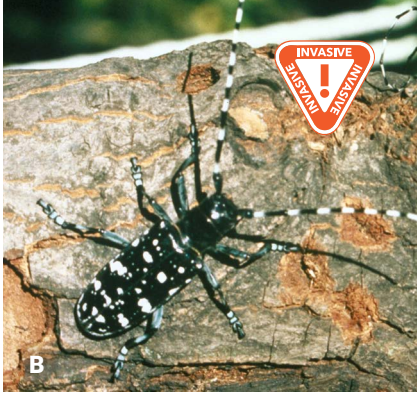
SIGNIFICANCE: The red oak borer is primarily identified as a secondary pest; boring damage from larvae can weaken trees and increase susceptibility to other wood boring insects and decay organisms. However, large populations can girdle trees and lead to death. Red oak borer galleries can also compromise lumber quality and lead to economic loss. An outbreak of red oak borer occurred in Arkansas in the Ozark and Ouachita Mountains between 1999 and 2003.

IDENTIFICATION: Like all longhorned beetles, the antennae of red oak borer adults are much longer than their body. Adults are brown and tan and covered in fine hairs. External signs include extruded frass resembling fine sawdust, wet spots caused by sap oozing from boring holes, wood slivers, and ovular exit holes.

BIOLOGY: Red oak borers have a two-year lifecycle. Females lay eggs in midsummer on bark surface, often in crevices or near wounds. Young larvae bore through bark and spend first year creating galleries in phloem. Second year larvae bore into xylem, where pupation occurs. Adults typically emerge in odd-numbered years in late spring/early summer.

MANAGEMENT: Woodpeckers and carpenter ants are important natural predators of larvae. Silvicultural control may be effective by removing infested and susceptible trees from stands. Contact insecticides are impractical because beetles spend most of their lives inside the tree. Systemic insecticides are also ineffective because they do not target larvae feeding on xylem and phloem.

Photos: (A) Adult Enaphalodes rufulus; (B) Larvae of Enaphalodes rufulus; (C) Scattered browning oaks.



Asian longhorned beetle

Anoplophora glabripennis

Asian longhorned beetle

Anoplophora glabripennis

ORDER: Coleoptera **FAMILY:** Cerambycidae

HOSTS: Many hardwood trees, with a preference for ash, birch, elm, maples, poplars, and willows, among others.

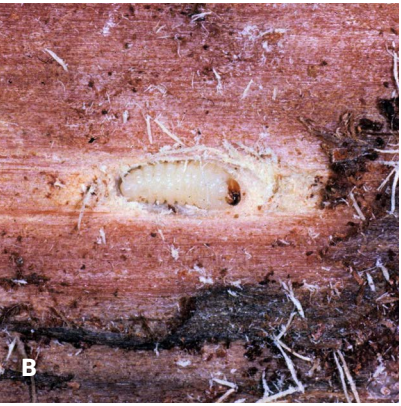
SIGNIFICANCE: Infestation by this beetle likely means death for the tree, as feeding damage can kill the tree, and the structural damage left by boring larvae renders the tree susceptible to breakage. This insect is a non-native invasive species, and should be reported if detected.

IDENTIFICATION: Adults are large (up to 1 ½" long) black beetles with white spots on the elytra, black and white banded antennae, and blue feet. Larvae can be up to 2' long and yellowish in color. Sawdust-like frass can be found at the base of the trunk and on infested branches.

BIOLOGY: One generation per year. Adults chew depressions on tree bark and deposit an egg, which hatches, and the larva bores into the tree. The larva feeds on phloem for several weeks, after which it bores into the wood and forms tunnels as it feeds. Larvae pupate in the wood, and adults chew their way out in the spring.

MANAGEMENT: Infected trees do not recover; sanitation is the only control option. If you have any questions or believe you have seen Asian longhorned beetle please contact Arkansas Department of Agriculture at (501) 225-1598. Additional information and resources can be found at: **https://www.aphis.usda.gov/aphis/resources/pests-diseases/asian-longhorned-beetle**

Photos: (A) Emergence hole made by adult ALB as they exit the tree; (B) Adult ALB; (C) ALB larva.



Eastern pine weevil

aka Deodar weevil

Pissodes nemorensis

Eastern pine weevil

Pissodes nemorensis

ORDER: Coleoptera **FAMILY:** Curculionidae

HOSTS: Various pines (*Pinus* spp.) and deodar cedar (*Cedrus deodara*).

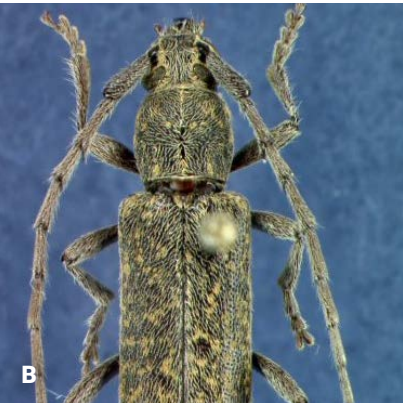
SIGNIFICANCE: Weevils attack stressed, injured, weakened, or dying trees. Under certain conditions, sporadic mortality in young trees and seedlings may be caused by this weevil.

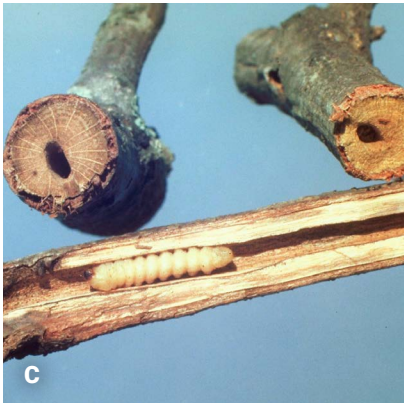
IDENTIFICATION: Adults are about ½" long, mottled brown/gray. Larvae make chambers out of little wood shavings (called "chip cocoons") in which they pupate – these are the most easily identifiable sign of deodar weevils. Woodpeckers may strip bark off heavily infested trees, revealing the chip cocoons underneath. Crowns of infested trees turn red or brown during winter and early-spring months.

BIOLOGY: One generation per year. Adults become active in the fall, feed on phloem, and mate. Eggs are laid on the bark, and larvae emerge, feed on the inner bark, and pupate in chip cocoons under the bark.

MANAGEMENT: Maintain tree health and vigor through proper silviculture or tree care techniques.

Photos: (A) Adult Pissodes nemorensis; (B) Larva in a "chip cocoon"; (C) Vacated "chip cocoons".





Twig girdler *Oncideres cingulata* & Twig pruner *Anelaphus villosus*

Twig girdler *Oncideres cingulata* & Twig pruner *Anelaphus villosus*

ORDER: Coleoptera **FAMILY:** Cerambycidae

HOSTS: Many hardwood species, especially pecan, hickory, elm, persimmon, oaks, dogwood, poplar, and various fruit and landscape trees.

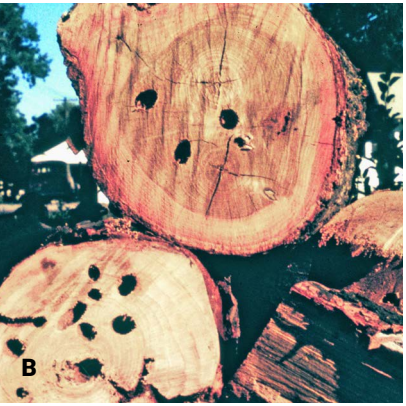
SIGNIFICANCE: Feeding damage from these beetles is rarely fatal, but can weaken trees or affect aesthetic quality of landscape trees. The girdled twigs can noticeably litter the ground prior to leaf senescence.

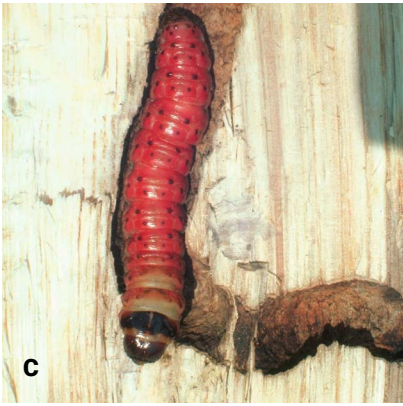
IDENTIFICATION: Adult beetles have long antennae, and are generally a grayish color. Larvae resemble white, hairless caterpillars, and can be found inside twigs.

BIOLOGY: One generation per year. Adult beetles lay eggs on twigs and chew most of the way through the branch. Eggs hatch, larvae bore into the twig and feed. Strong winds break off the twigs, and the twig with the larva inside falls to the ground, where the larva finishes developing. Adults emerge the following year.

MANAGEMENT: Collect and destroy fallen twigs in winter to reduce insect population levels.

Photos: (A) Twig girdler adult; (B) Oak twig pruner adult; (C) Cross-section and side view of a twig split open to reveal oak twig pruner larva inside.





Carpenterworm moth

Prionoxystus robiniae

Carpenterworm moth

Prionoxystus robiniae

ORDER: Lepidoptera **FAMILY:** Cossidae

HOSTS: Many hardwood trees.

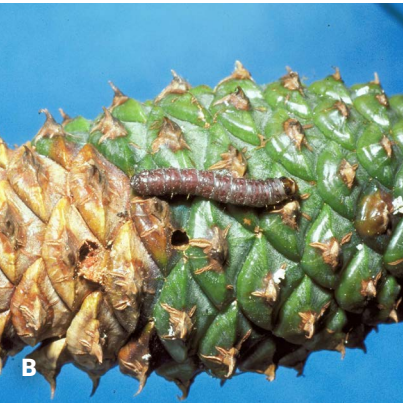
SIGNIFICANCE: Feeding by the larvae can create large holes in tree stems, significantly degrading the value of the product and weakening the tree, creating a hazard.

IDENTIFICATION: Adult moths can be over 3" across the wings, with bodies of over an inch long. Forewings are mottled grayish/blackish. Larvae can be several 2-3" long and may have a whitish/greenish/reddish color.

BIOLOGY: Adult females lay eggs on bark and the larvae bore into the tree upon hatching. Larvae may feed up to 4 years on the wood, and periodically expel boring dust and frass from the hole it created. Pupation occurs in the tunnel, and the pupal case is often seen hanging from the tunnel after the adult emerges.

MANAGEMENT: Chemical management is usually not recommended. Several natural enemies that keep populations in check. If only a few trees or damage holes are present, a metal wire can be inserted into the hole to crush the larva. Pheromone traps are also available to help control high populations.

Photos: (A) Male and female Prionoxystus robiniae; (B) Large gallery holes; (C) Larval of the Prionoxystus robiniae.



Southern pine coneworm

Dioryctria amatella

Southern pine coneworm

Dioryctria amatella

ORDER: Lepidoptera **FAMILY:** Pyralidae

HOSTS: Pines (*Pinus* spp.).

SIGNIFICANCE: The greatest impact comes from damage to cones in seed orchards, though these insects can attack other parts of a pine tree. Attacks often occur near cankers or damaged areas.

IDENTIFICATION: Adult moths are ~¼" long brownish-gray moths, and larvae are up to ½" long. These insects are most often recognized by the frass that accumulates outside larval feeding areas (e.g. cones) or the relatively large pitch masses at feeding sites (especially on stems and branches). This moth is also called the "pitch moth" because of the amount of pitch that can accumulate at feeding sites.

BIOLOGY: These insects have a complicated life cycle. Adults are active May-October. Insects often overwinter as young larvae in protected areas (e.g. at the base of cones, under bud scales, in fusiform galls). As larvae become active, they continue to feed where they overwintered or migrate to developing buds or expanding shoots. Larvae may finish their development there or migrate a second time to another feeding site. Pupation occurs where the larvae last fed. Cones infected with southern cone rust are often attacked and eaten.

MANAGEMENT: Various insecticides can be used to prevent or minimize losses in seed orchards. Damage to other parts of the tree can be prevented by maintaining tree health and vigor, and avoiding mechanical damage to stems and branches.

Photos: (A) Adult Dioryctria amatella; (B) Larval feeding on a pine cone; (C) Dioryctria amatella also feeds on stems near wounds and branch scars, producing pitch masses.

“In nature, nothing is perfect, and everything is perfect. Trees can be contorted, bent in weird ways, and they’re still beautiful.”

– *Alice Walker*

DISEASES

A

B

Anthracnose

(Several species)

Anthracnose

Several Species

ORDER: Diaporthales **FAMILY:** Gnomoniaceae

HOSTS: Several hardwood tree species.

SIGNIFICANCE: Anthracnose is usually an aesthetic issue which may cause premature leaf drop late in the growing season, but in some cases (e.g. Dogwood anthracnose) the damage may result in dead twigs and stems. Over time this disease can weaken a tree.

IDENTIFICATION: Leaf spots or lesions may have tan or purple borders, and have a papery/transparent appearance. Damage is often worst from the bottom to the top of the tree.

BIOLOGY: Spores overwinter on fallen leaves or twigs and infect new leaves in spring or early summer. Lesions or spots form on the leaves, which may grow into each other and cause premature leaf drop. From these lesions, new spores can infect additional leaves. The disease is often more prevalent during wet years, especially with oak anthracnose (*Apiognomonia errabunda*) as prolonged wet periods during spring.

MANAGEMENT: Foliar sprays can help minimize fungal damage. Prune and discard dead branches and remove fallen leaves as these serve as reservoirs for fungal inoculum. Maintain tree health and vigor by using appropriate and approved cultural techniques, such as mulching and fertilization. Eradication of the fungus is unlikely, as spores can travel long distances through the air. Planting resistant selections should be encouraged when possible.

Photos: (A) Leaves are starting to curl and have tan spots and lesions; (B) Tree leaves appear to have tan lesions covering parts of the leaves.

Tubakia leaf spot

Tubakia dryina

Tubakia leaf spot

Tubakia dryina

ORDER: Diaporthales **FAMILY:** Tubakiaceae

HOSTS: Many oaks (*Quercus* spp.).

SIGNIFICANCE: This disease does not seriously harm trees and is mainly an aesthetic issue.

IDENTIFICATION: Symptoms begin as reddish-brown spots on spring leaves, and as the disease progresses the spots may coalesce into splotches. There may be a yellowish halo around the spot. This disease tends to develop in mid- to late summer.

BIOLOGY: The fungus releases spores through spore-producing sacs called asci. Wind and rain help disperse spores, which can infect leaves. The disease is often worst in late summer or early fall. Recently transplanted trees are often more susceptible to this disease.

MANAGEMENT: Generally, no management is required. Removing infected leaves in the fall can help reduce inoculum around the tree, and carefully pruning and removing a few branches may promote air flow in the foliage. Maintaining tree health can help the tree tolerate this disease.

Photos: (A) Close up on the reddish-brown spot on a leaf; (B) Leaves covered with reddish-brown spots.

Bacterial leaf scorch

Xylella fastidiosa

Bacterial leaf scorch

Xylella fastidiosa

ORDER: Xanthomonadales **FAMILY:** Xanthomonadaceae

HOSTS: Oak, maple, pecan, mulberry, sweetgum, sycamore, and ash.

SIGNIFICANCE: This disease causes premature browning of the leaves, weakening the tree into a chronic decline.

IDENTIFICATION: The browning or "scorched" appearance occurs first on the outer margins of leaves. It is often mistaken for drought damage. Typically, a yellow band borders the dead portion of the leaf. The only way to confirm bacterial leaf scorch is with a bioassay laboratory test.

BIOLOGY: The bacterium is spread by planthopper insects when they feed on infected tissue. Once inoculated, the bacterium spread systemically in the plant's vascular tissue. There may be a connection between bacterial leaf scorch and water stress, as symptoms tend to occur in mid to late summer.

MANAGEMENT: There is no effective cure for bacterial leaf scorch, and the success of systemic injection treatments is not conclusive. If only some of the branches are affected, it might be possible to limit spread by selectively pruning the diseased branches. Provide the tree with supplemental watering during periods of hot, dry weather conditions.

Photos: (A) Edges of a leaf that are curling and browning; (B) Edges of the leaf that looks scorched.


A


B


C

Needle cast

(i.e., *Lophodermium* and *Rhizosphaera* spp.)

Needle cast

(i.e., *Lophodermium* and *Rhizosphaera* spp.)

ORDER: Rhytismatales **FAMILY:** Rhytismataceae

HOSTS: Pines (*Pinus* spp.).

SIGNIFICANCE: Most cases of this disease are aesthetic, and don't cause measurable damage to the tree.

IDENTIFICATION: The disease causes trees to look as if the needles are browning and prematurely falling off, while closer inspection reveals the needles turning reddish-brown, starting at the tip and moving inward.

BIOLOGY: Tiny black fruiting bodies on dead needles release spores, which are spread by wind or rain to infect young, emerging needles in spring and early summer. Infection symptoms then appear the following spring.

MANAGEMENT: Fungicides can be used for high-value trees (e.g. Christmas trees) but usually no management is necessary. Controlled burning can remove fallen needles and may help reduce inoculum. Infected trees should be monitored for other secondary pests like Ips bark beetles.

Photos: (A) Dark spots on infected needles are the fungal fruiting bodies; (B) Stands can look brown from a distance; (C) but close inspection reveals that only the older needles are affected.

Brown spot needle blight

Lecanosticta acicola

Brown spot needle blight

Lecanosticta acicola

ORDER: Capnodiales **FAMILY:** Mycosphaerellaceae

HOSTS: A variety of pine species. Particularly aggressive on longleaf and Scots, it can colonize shortleaf, slash, spruce, loblolly, and eastern white pines.

SIGNIFICANCE: Causes needle loss, reduced branch growth, and sometimes death.

IDENTIFICATION: Small spots form on the needles during the summer. These are yellow at first and later turn brown and coalesce. Needle browning and loss may occur in fall. Infection is most common on seedlings or lower branches.

BIOLOGY: Caused by a fungus which overwinters in diseased needles either still on the tree or on the litter. Spores are released from early spring throughout summer during high moisture periods, and spread by wind and rain splash.

MANAGEMENT: Promote air circulation around trees and keep needles dry. Specifically, avoid overcrowding and prune bottom branches. Fungicides may also be used as a protective measure in spring and summer. In longleaf pine forests, low intensity prescribed fire during the winter is effective at removing infected needles and reducing the inoculum.

Photos: Brown spots covering all the needles.

Heterobasidion root disease

Heterobasidion irregulare

Heterobasidion root disease

Heterobasidion irregulare

ORDER: Russulales **FAMILY:** Bondarzewiaceae

HOSTS: Most conifers, especially pines (*Pinus* spp.).

SIGNIFICANCE: Heterobasidion root disease (HRD) is one of the most significant root diseases of pines in the eastern U.S. HRD infections can lead to reduced growth, windthrow, and tree mortality. Trees afflicted with HRD are often attacked by secondary bark beetles.

IDENTIFICATION: Look for areas with thin or chlorotic crowns, dying or dead trees, or windthrown trees, particularly in managed stands. Symptoms typically appear 3-8 years after a harvest. Fruiting bodies (basidiocarps) form bracket-shaped conks at the base of trees and stumps. Conks are brown on top, whitish underneath, and often grow into and through needles and duff. Secondary bark beetles (e.g. Ips or turpentine beetles) are often seen in HRD-weakened trees.

BIOLOGY: Airborne spores are produced in conks at the base of infected trees and stumps. Spores landing on freshly-cut stumps can initiate the disease, which can spread through root grafts to neighboring trees.

MANAGEMENT: Prevent infections through proper silviculture and harvesting methods. Use appropriate chemical stump treatments on freshly-cut stumps to prevent infection.

Photos: (A) Crown symptoms of HRD; (B) HRD conks growing on an infected stump; (C) Soil stuck to resin-soaked roots, a typical symptom of HRD.

Littleleaf disease

Phytophthora cinnamomi

Littleleaf disease

Phytophthora cinnamomi

ORDER: Peronosporales **FAMILY:** Peronosporaceae

HOSTS: Pines, especially shortleaf (*P. echinata*) and loblolly (*P. taeda*).

SIGNIFICANCE: This is the worst disease to affect shortleaf pine, and contributed to the decline of shortleaf as a major commercial species. It is still one of the top forest health issues for shortleaf pine.

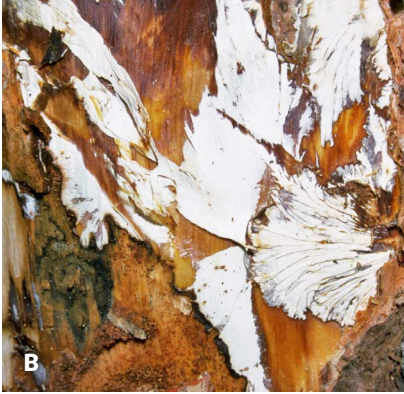
IDENTIFICATION: Look for chlorotic, shortened needles and shortened twigs; overall canopy decline and reduced radial growth; heavy cone production with smaller-than-normal cones. Fine root growth will be reduced. Mortality usually begins in dominant trees >20 years old.

BIOLOGY: Trees on poorly drained soil are more susceptible, as *P. cinnamomi* isn't a true fungus, rather, it's a water mold capable of moving through water. *Phytophthora cinnamomi* can remain dormant in the soil or infected roots for several years, and symptoms show when trees are stressed. When conditions are right, *P. cinnamomi* breaks dormancy and infects root tips and root growth.

MANAGEMENT: It is impossible to eradicate *P. cinnamomi*. The best strategy is to plant tree species or cultivars that are tolerant or resistant to littleleaf disease, and keep existing trees stress-free through proper silviculture.

Photos: (A) Typical littleleaf disease symptoms are shortened needles; (B) and sparse, thinning crowns.


A


B


C

Armillaria root rot

Armillaria spp.

Armillaria root rot

Armillaria spp.

ORDER: Agaricales **FAMILY:** Physalacriaceae

HOSTS: Many woody species.

SIGNIFICANCE: These common, opportunistic fungi often infect trees that are wounded or stressed. Infection can lead to increased tree decline, dieback, and mortality.

IDENTIFICATION: Infected trees appear stressed, exhibiting decline and dieback. Visible signs of the pathogen are clusters of tan/orange colored, gilled mushrooms on or near infected trees. White webs/sheets of mycelia can be found underneath bark of infected trees on the lower stem and roots. Stringy, black fungal structures may also be present.

BIOLOGY: The fungus can grow from infected roots and stumps into nearby trees, while long-distance dispersal occurs via spores. The fungi can survive years in old infected stumps and roots.

MANAGEMENT: Maintain healthy and injury-free trees through proper tree care and adequate safeguards during construction activities. Infected material (e.g. roots, stumps) can be removed to lessen the chance of future infections to other trees.

Photos: (A) Black, stringy rhizomorphs are characteristic of Armillaria; (B) Scattered red trees in the stand; (C) If you're lucky, you might see the fruiting bodies, also known as honey mushrooms.

Butt rots

Butt rots

Many different species cause root and butt rot.

HOSTS: Many woody plant species.

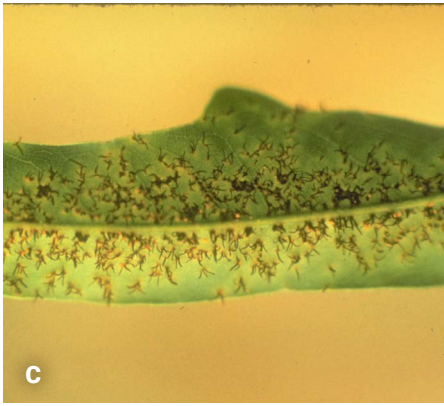
SIGNIFICANCE: These fungi contribute to the decline and death of many trees, especially those in urban/landscape environments.

IDENTIFICATION: Butt rot fungi are most often noticed once they have infected the lower stem or large roots. Swellings, cracks in the bark, and conks (some shelf-like) are commonly seen.

BIOLOGY: Most of these fungal species spread through airborne spores produced on conks on infected trees. Fungi often enter the tree through wounds.

MANAGEMENT: Prevention is key. Maintain good tree health through proper planting techniques and care, and avoid injuries to the large roots and lower stem.

Photos: (A) Ganoderma spp.; (B) Ganoderma spp.; and (C) Inonotus spp. fruiting bodies.



Fusiform rust

Cronartium quercuum f. sp. *fusiforme*

Fusiform rust

Cronartium quercuum f. sp. *fusiforme*

ORDER: Uredinales **FAMILY:** Cronartiaceae

HOSTS: Pines (*Pinus* spp.), especially loblolly (*P. taeda*) and shortleaf (*P. echinata*), and oaks (*Quercus* spp.) as the secondary/alternate host.

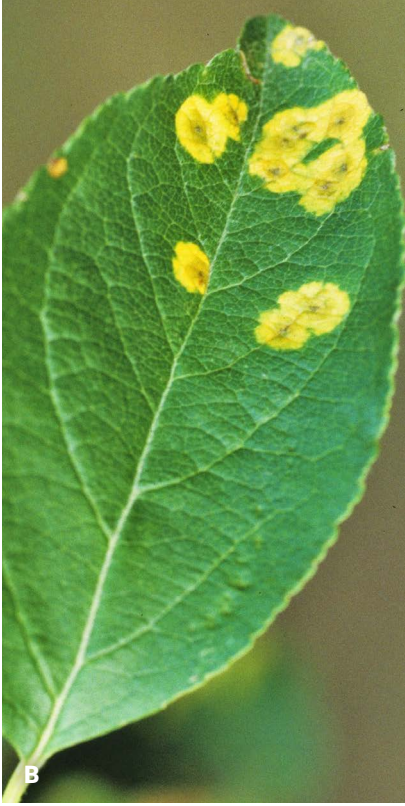
SIGNIFICANCE: The most serious disease of pines in the southeastern U.S., fusiform rust causes branch and stem cankers that result in breakage, stem deformity, and tree mortality. Cankers often attract secondary stem-boring insects.

IDENTIFICATION: Swollen galls are normally visible on pine branches or stems, and in spring raised aecia are produced on the galls, turning them bright orange as they produce wind-dispersed aeciospores (spores).

BIOLOGY: Spores from pines infect leaves of oaks; spores from infected oaks then re-infect succulent, growing tissues of pines.

MANAGEMENT: The best management is to plant fusiform-resistant or less susceptible trees. Fungicides are effective in nursery settings. Galled branches or individual trees can be removed (especially in landscape or urban settings). In natural areas or commercial forests, widespread damage may warrant complete removal of the stand and replacement with resistant or less susceptible trees.

Photos: (A) Large fusiform canker with orange spores present; (B) Stem breakage is common at fusiform cankers; (C) Fusiform rust on oaks produces little black strand-like structures.



Gymnosporangium rusts

(aka cedar-apple rust: *Gymnosporangium* spp.)

Gymnosporangium rusts

(aka cedar-apple rust, *Gymnosporangium* spp.)

ORDER: Pucciniales **FAMILY:** Pucciniaceae

HOSTS: Primary hosts are cedars (*Juniperus* spp.); alternate hosts are apples (*Malus* spp.), hawthorns (*Crataegus* spp.), and other pome fruits.

SIGNIFICANCE: This disease is not usually a concern on cedars in the Southeast, but may impact fruit tree production or ornamental cedars.

IDENTIFICATION: Galls (sometimes up to 2" in diameter) form on cedar hosts. Second year galls produce gelatinous, orange reproductive structures (telial horns) in wet spring weather. Leaf spots and petiole/twig cankers form on alternate hosts, as well as yellow/orange fruiting bodies on leaves and fruit.

BIOLOGY: Galls form a few months after infection on cedars, and the next year orange telial horns are produced on galls. These telial horns eventually dry out and release spores, which infect alternate hosts. The spores grow on leaves, twigs, or fruit, and infect cedars again later that year.

MANAGEMENT: Management is not usually required. Galls can be removed by hand and destroyed. Fungicides may be appropriate in some situations, especially to protect primary hosts.

Photos: (A) Rust gall in spring showing bright orange telial horns; (B) Yellow leaf spots on an apple leaf.

Pine needle rust

Coleosporium spp.

Pine needle rust

Coleosporium spp.

ORDER: Pucciniales **FAMILY:** Coleosporiaceae

HOSTS: Many pines (*Pinus* spp.) with alternate hosts in the Asteraceae family (e.g. asters and goldenrod).

SIGNIFICANCE: This disease is mostly an aesthetic issue, as infected trees rarely die.

IDENTIFICATION: Raised white to pink fruiting bodies (resembling little wings or sacks) on needles.

BIOLOGY: Fruiting bodies appear in spring, and infected needles fall from the tree. The fruiting bodies rupture and release orange spores which infect an alternate host. Fungal fruiting bodies produced on the alternate host produce spores which infect a pine host again.

MANAGEMENT: Management is usually not necessary or cost-effective. Regularly mowing the nearby aster and goldenrod can suppress the disease cycle.

Photos: (A and B) Pine needle rust on loblolly pine - rust looks like small whitish pouches on needles.


A


B


C

Bot Canker

Botryosphaeria spp.

Bot Canker

Botryosphaeria spp.

ORDER: Botryosphaeriales **FAMILY:** Botryosphaeriaceae

HOSTS: The genus of Botryosphaeria are opportunistic fungi that infect hundreds of trees and shrubs. Many canker species are not host-specific, but disease symptoms may be distinctive to each host species.

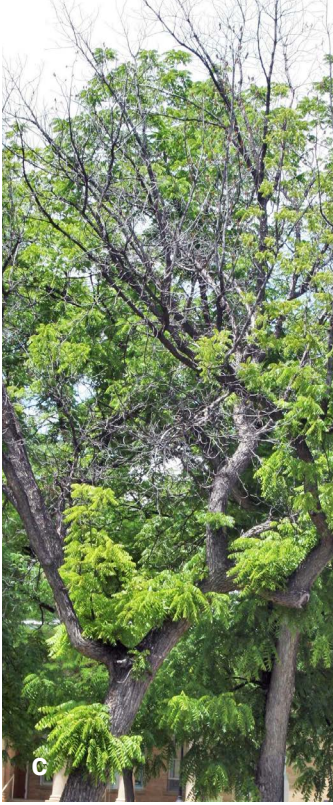
SIGNIFICANCE: Infected trees will experience chronic dieback of branches. This disease occurs on host plants that experience other stressors, and it can contribute to the decline and mortality of the host.

IDENTIFICATION: Branch dieback will occur with wilting and scorched foliage. Upon closer inspection, twig cankers may be found that are either darkened, sunken, or fissured. Signs of the pathogen are black fruiting bodies (pycnidia) that erupt through the bark.

BIOLOGY: This fungus overwinters in dead plant tissue. Spread by wind and rain, spores colonize plant tissue through wounds and other openings.

MANAGEMENT: There are no effective fungicide controls for Botryosphaeria canker. Ensure trees are in optimal growing conditions and avoid mechanical injury. Inadequate irrigation may incite problems with this canker. When planting a tree, choose the plants that are adapted to the setting and hardiness zone.

Photos: (A) Browning of the leaves; (B) One Botryosphaeria canker on a branch; (C) Large amount of black Botryosphaeria cankers on a branch.



Thousand cankers disease

Geosmithia morbida

Thousand cankers disease

Geosmithia morbida

ORDER: Hypocreales **FAMILY:** Bionectriaceae

HOSTS: Walnut trees (*Juglans* spp.), especially black walnut (*J. nigra*).

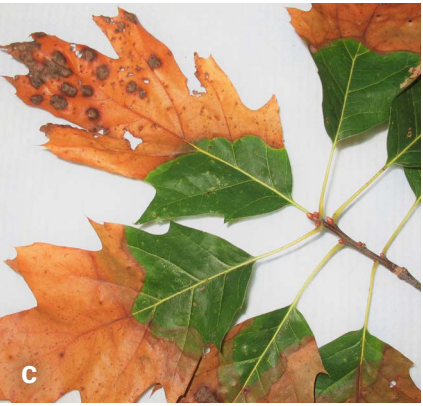
SIGNIFICANCE: Walnut trees are one of the most highly-valued hardwood trees in the eastern U.S. Thousand cankers disease (TCD) can result in leaf loss, twig and branch dieback, declining tree health, and mortality.

IDENTIFICATION: Look for yellowing or declining crowns, premature leaf loss and branch dieback, and dark roundish lesions on the bark. Tiny beetle emergence holes may be visible on twigs. Scraping back the dark lesions reveals dark stained wood.

BIOLOGY: Walnut twig beetles (*Pityophthorus juglandis*) infect the tree with *G. morbida* spores when they attack. Their attack and gallery construction causes a small lesion. When the next generation of beetles emerges, they pick up and spread the fungus.

MANAGEMENT: There is no prevention or cure once a tree has TCD. Prevent the spread of the disease by not moving infected wood. Heat treatments can be used to sanitize wood prior to movement.

Photos: (A) Each walnut twig beetle gallery causes a small canker to form; (B) Small round holes indicate adult beetles have entered or left the tree; (C) Crown dieback from TCD.



Oak wilt

Bretiziella fagacearum

Oak wilt

Bretiziella fagacearum

ORDER: Microascales **FAMILY:** Ceratocystidaceae

HOSTS: Oaks (*Quercus* spp.), especially red oaks.

SIGNIFICANCE: This lethal vascular wilt disease of oaks is one of the worst diseases of this genus in the U.S. Oak wilt is uncommon in Arkansas and is historically documented in the northern counties. This disease is often confused with the oak decline complex.

IDENTIFICATION: Leaves on infected trees turn dull-green to bronze and have dying tissue along leaf margins and veins. Later, leaves turn yellow to brown and prematurely fall off. Staining occurs in twigs. Fungal mats may be observed beneath bark when it cracks.

BIOLOGY: Sap-feeding beetles (Nitidulidae) are attracted to fungal mats. Beetles then transport spores to fresh cuts or wounds on healthy trees, which results in their infection. Locally, the disease can spread through root grafts.

MANAGEMENT: There is no cure for an infected tree. Reduce the chance of disease spread by pruning only during dormant periods. Prevent root-to-root transmission by trenching around local infections and severing the root grafts.

Photos: (A) Wilted and browning leaves typical of oak wilt symptoms; (B) A pocket of oak wilt; (C) Leaves in the red and white oak group typically brown from the edge in; (D) Fungal mats are attractive to beetles, which can spread fungal spores.


A


B


C

Pitch canker

Fusarium circinatum

Pitch canker

Fusarium circinatum

ORDER: Hypocreales **FAMILY:** Nectriaceae

HOSTS: Pines (*Pinus* spp.).

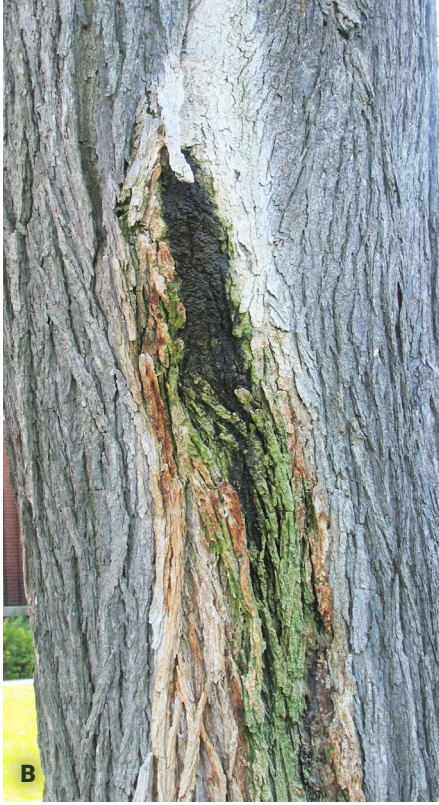
SIGNIFICANCE: Causes death of terminal shoots and branches in larger trees, which can reduce stumpage value and lead to tree mortality. Can cause high levels of mortality in seedlings, especially in commercial pine plantations.

IDENTIFICATION: Infected terminals and shoots have reddening needles or exhibit branch flagging. Sunken cankers exude large amounts of resin (pitch, hence "pitch canker"), and the wood exhibits a characteristic wedge shape beneath the canker. Occasionally fruiting bodies are observed in needle fascicle scars.

BIOLOGY: Infections are started when spores germinate and colonize insect-caused or mechanical injuries, most often during late summer and fall. Spore dispersal is enhanced by wind and rain from storms. The fungus also kills female flowers, cones, and seeds.

MANAGEMENT: Use resistant stock when planting, and good silvicultural practices to avoid infection. Stands with severe infections may need to be clearcut.

Photos: (A) Dead branch tips with wilted needles; (B) Heavy resinosis in an infected shoot; (C) Heavy resin droppage down the tree stem.



Bacterial wetwood
(slime flux)

Bacterial wetwood
(slime flux)

This disease is caused by several different types of bacteria.

HOSTS: Many conifer and hardwood tree species.

SIGNIFICANCE: Causes water-soaked areas in stems, limbs, and roots. Lessens the value of sawlogs and lumber. Creates slimy, frothy seepage that flows downward and may attract other insects.

IDENTIFICATION: Water-soaked areas with slimy or frothy seepage. Bark and wood may become discolored.

BIOLOGY: Bacteria enter the tree through wounds, especially the roots.

MANAGEMENT: There is no cure or prevention for bacterial wetwood. Keep trees healthy and unstressed through proper silviculture and tree care techniques.

Photos: (A) Older bacterial wetwood infection evidenced by the discolored wood; (B) New/ current bacterial wetwood infection - note the dark, wet area in the center. In both cases the seepage dripping down the tree is evident.

Hypoxylon canker

Biscogniauxia spp.

Hypoxylon canker

Biscogniauxia spp.

ORDER: Xylariales **FAMILY:** Xylariaceae

HOSTS: Many hardwood trees, especially oaks (*Quercus* spp.).

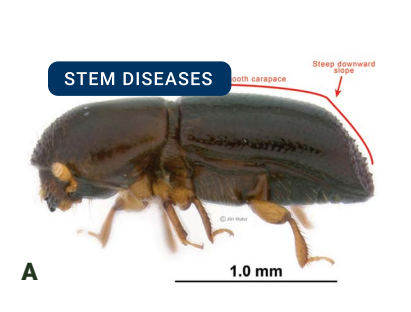
SIGNIFICANCE: The pathogen infects limbs and stems of stressed trees. This secondary pathogen may be the final "nail in the coffin" for trees, but is not a primary tree killer.

IDENTIFICATION: Infected tissues often develop cankers that may be brown (and often powdery), gray, or black. It is common to observe this pathogen on trees declining from drought.

BIOLOGY: The Biscogniauxia fungal spores are common, and tend to be present on all trees. Normally living on the bark, a healthy tree keeps the fungus in check with its natural defenses. But, when trees are stressed, the fungus is able to grow into the tree tissues, form cankers, and further weaken and possibly kill the tree.

MANAGEMENT: There is no chemical treatment for hypoxylon canker. Early infections on branches may be pruned off and removed. Maintain tree health through proper tree care and silviculture.

Photos: Gray (A) and black (B & D) cankers; (C) Large gray canker at the base of a tree that was previously removed - this tree experienced damage from new home construction.



Laurel wilt

Raffaelea lauricola

Laurel wilt

Raffaelea lauricola

ORDER: Ophiostomatales **FAMILY:** Ophiostomataceae

HOSTS: All trees in the laurel (Lauraceae) family, including sassafras, laurel trees, and bay trees.

SIGNIFICANCE: This disease is fatal to nearly every tree that becomes infected. One successful beetle entrance can spread the disease. The disease can be damaging to sassafras in Arkansas, especially in the Ozark Mountains where it is ecologically important.

IDENTIFICATION: Infected bay trees often have brown leaves hanging on branches long after the tree dies, while infected sassafras trees exhibit early drought symptoms (i.e., wilting, yellowing leaves). Ambrosia beetle noodles may be visible on the tree stem.

BIOLOGY: Trees become infected with laurel wilt by the redbay ambrosia beetle, *Xyleborus glabratus*. The beetle enters the tree, boring into the stem to create galleries in which to cultivate the *R. lauricola* fungus. Beetle larvae feed on fungus growing in the galleries, and the fungus clogs the xylem of the host plant. After adult beetles emerge they search out a new host plant and start the disease cycle again.

MANAGEMENT: There is no cure for laurel wilt, but keeping trees healthy and unstressed won't hurt. Fungicides can protect high-value trees. Researchers are working to develop resistant trees.

Photos: (A) Xyleborus glabratus; (B) Dead redbay tree; (C) Dark staining in the sapwood of an infected tree.


A


B


C

Phytophthora cankers

Phytophthora spp.

Phytophthora cankers

Phytophthora spp.

ORDER: Peronosporales **FAMILY:** Peronosporaceae

HOSTS: Many conifer and hardwood species.

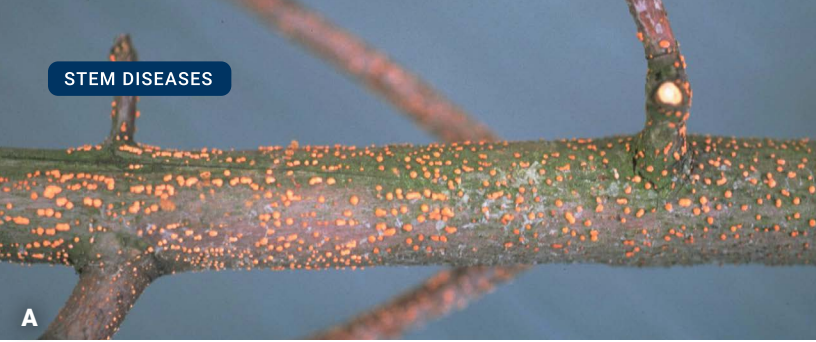
SIGNIFICANCE: Cankers may stunt the growth of trees, cause root and root collar decay, contribute to thinning crowns and branch dieback, and lead to tree mortality.

IDENTIFICATION: Dark cankers on branches and the stem ooze a dark sap, which often bleeds down the branch or trunk. Reduced canopy foliage, chlorotic leaves or needles.

BIOLOGY: The disease organism is a water mold that can move itself through water. Phytophthora are primarily soil-borne organisms, and likely infects through rain splashing in soil, insect vectors, or the movement of infected plants and soil.

MANAGEMENT: This disease doesn't produce fruiting bodies, so an accurate diagnosis is important. Promote soil drainage, and keep trees healthy by alleviating stress through proper tree care, proper planting, and silviculture. Laboratory confirmation is often required to definitively determine Phytophthora as the issue.

Photos: (A) Bleeding canker at base of tree; (B) Foliar symptoms on landscape shrubs; (C) Saplings killed by Phytophthora spp.



Nectria canker *(Neonectria ditissima)* & Nectria dieback *(Nectria cinnabarina)*

Nectria canker *(Neonectria ditissima)* & Nectria dieback *(Nectria cinnabarina)*

ORDER: Hypocreales **FAMILY:** Nectriaceae

HOSTS: Many hardwood tree species.

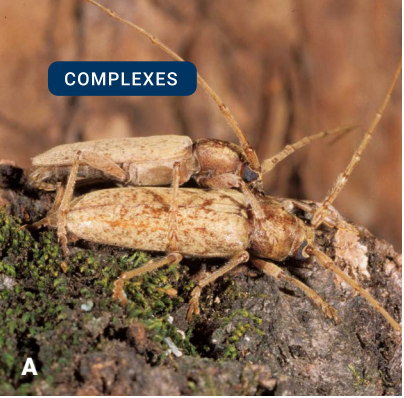
SIGNIFICANCE: These fungi cause canker and dieback on trees worldwide. The disease is usually not fatal, but can make the infected area susceptible to further infection and susceptible to breakage. *Nectria* spp. also negatively impact the aesthetics of the tree.

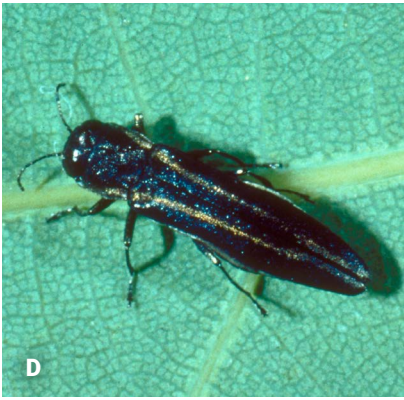
IDENTIFICATION: Sunken area of bark at the base of dead or dying branches. Small creamy white or reddish-orange fruiting bodies. The tree will develop callus tissue to try to isolate the infection. Fruiting tissues may also be reddish-purple.

BIOLOGY: The fungus overwinters on the tree in slow-growing callus tissue. Pinkish to orange or light purple spore-producing structures develop in spring or early summer. In late summer and fall, orange-red fruiting structures are produced. Both types of structures release spores that are spread by water and can invade susceptible nearby tissues.

MANAGEMENT: Choose plants that are adapted to that particular area, as they will be less likely to be stressed by heat or cold. Keep plants healthy and give them proper maintenance and care. Prune out infected tissues during dry periods.

Photos: (A) Orange-red fruit structures covering a branch; (B) Growing callus tissue on the trunk; (C) Sunken bark at the base of the trunk.





Oak decline

Oak decline

HOSTS: Oaks (*Quercus* spp.).

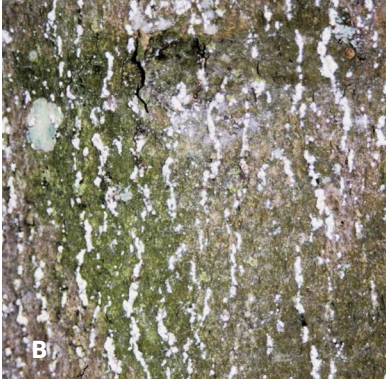
SIGNIFICANCE: Can lead to reduced canopy, branch dieback, and mortality of mature oaks.

IDENTIFICATION: Trees exhibit reduced or thinning canopy and eventual mortality. Trees on south or southwest facing slopes are more susceptible, as are trees in overstocked stands.

BIOLOGY: Oak decline is caused by a complex of factors. Poor site characteristics (e.g. poor soils, lack of water or nutrients) or lack of management (e.g. allowing stands to become overstocked or heavily dominated by one species) can weaken trees and allow secondary pests, like insects (e.g. longhorned beetles and ambrosia beetles) and fungi (e.g. hypoxylon canker, armillaria root rot), to further weaken and/or kill trees.

MANAGEMENT: Prevent tree stress by planting the right species on the right sight. Maintain proper stocking through selective harvests, and don't let stands get overstocked. In single-tree scenarios, water and fertilize to alleviate tree stress.

Photos: (A) Red oak borer, a cerambycid beetle that attacks weakened oak trees; (B) Thinning canopy of declining oak; (C) Armillaria fruiting bodies; (D) Two-lined chestnut borer.



Beech bark disease

Beech bark disease

HOSTS: American beech (*Fagus grandifolia*).

SIGNIFICANCE: The most serious disease of American beech, this fungus causes cankers and mortality.

IDENTIFICATION: Waxy, woolly, white scale insects on the bark, or red fruiting bodies from the fungus. Wounds may bleed a brownish liquid.

BIOLOGY: Two things are required for beech bark disease (BBD): a scale insect, and the fungus. The invasive beech scale insect, *Cryptococcus fagisuga* (the most common BBD-causing insect), initially appears as wooly, white tufts in bark crevices. The native *Xylococcus betulae* scale insect occasionally causes BBD. The fungi that contribute to BBD are *Neonectria faginata* and *N. ditissima*. These fungi infect the tree through wounds caused by scale insect feeding. Red spore-producing structures are made by the fungus; these form in lemon-shaped clusters on the bark. Spores are released in the fall, and spread through wind.

MANAGEMENT: There is no cure for beech bark disease. Limit disease spread by not moving infected firewood. In natural areas, select for resistant trees (those showing no signs of the scale or canker). High-value trees can be protected from the scale insect by the use of insecticides.

Photos: (A) Older canker on beech trunk; (B) White, woolly tufts made by the invasive beech scale; (C) Red spore-producing structures from the BBD fungus.

“The creation of a
thousand forests is
in one acorn.”

– *Ralph Waldo Emerson*

OTHER BIOTIC INJURY

Mistletoes

Phoradendron serotinum var. *serotinum*

OTHER

Mistletoes

Phoradendron serotinum var. *serotinum*

ORDER: Santalales **FAMILY:** Viscaceae

HOSTS: Many tree species, primarily hardwood.

SIGNIFICANCE: Mistletoe infection sites result in structurally weak areas on tree limbs and can create infection courts for other diseases and pests.

IDENTIFICATION: Red or white berries; green, waxy leaves and stem growing out of woody branches.

BIOLOGY: After a seed lands on a host tree branch, it germinates and attaches to the branch throughout the course of the first year. In the second year the mistletoe develops a strand and sinkers (akin to a root system) and begins growing the shoot and leaves.

MANAGEMENT: Pruning out the infected branch is a fast, effective way to immediately remove the mistletoe. Simply breaking off the mistletoe will eliminate the vegetative portion and reduce tree water loss, but it will regrow in 2-3 years. The use of chemical sprays (e.g. active ingredient ethephon {[2-chloroethyl] phosphonic acid}) can also be used to remove mistletoe.

Photos: (A) Mature tree heavily infected with mistletoe; (B) Mistletoe can take over entire branches; (C) Green leaves and flowers of mistletoe.

Witches’ brooms

Witches' brooms

CAUSE: Various insects, fungi, nematodes, or microorganisms; some are caused by genetic mutations.

HOSTS: All tree species.

SIGNIFICANCE: Witches' brooms can affect the appearance of the tree, and may cause a weak point in the branch or stem at the point of infection.

IDENTIFICATION: Looks like a dense group of shortened shoots growing with very tight spacing from a single point. It can resemble a bird's nest or broom.

BIOLOGY: Chemical reactions or genetic mutations interfere with normal plant hormone dynamics. Auxin is the plant hormone that normally controls the non-primary growing tips from growing too much, and the plant hormone cytokinin interferes with auxin's control. When auxin no longer controls the growing tips, dense witches' brooms can form.

MANAGEMENT: Witches' brooms can be pruned out by hand; avoid improper pruning as this can increase the tree's susceptibility to disease.

Photos: Witches' brooms on hardwood (A) and pine tree (B).

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