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A Guide to Common Forest Pests in Georgia

Terry Price, Forest Health Specialist, Georgia Forestry Commission

Introduction

This publication was prepared for foresters, forest rangers, forest patrolmen, county agents, teachers and students to aid them with the identification, prevention and control of common forest and shade tree pests in Georgia. It is not intended to be a complete guide to all of the pests of trees. More detailed information is available from numerous other publications, some of which have been listed in the appendix.

The pests discussed are the pine bark beetles, ambrosia beetles, pine reproduction weevils, pine tip moths, defoliators of pine and hardwood trees, twig and branch girdlers and pruners, annosus root rot, fusiform rust, littleleaf disease, hypoxylon canker, pitch canker, foliage diseases, oak decline, and Dutch elm disease. Information on animal and storm damages has been included to bring attention to these sometimes overlooked damaging agents.

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Pine Bark Beetles



Figure 1 - The Southern pine bark beetles. Top to bottom: *Ips avulsus*, *Ips grandicollis*, *Ips calligraphus*, *Dendroctonus frontalis* (SPB) and *Dendroctonus terebrans* (BTB). Photo by Gerald Lenhard, LSU

Pine bark beetles are the most destructive insects of pines in Georgia. They occur across all land ownership patterns and geographic regions of the State. Since 1962 annual losses from outbreaks have exceeded five million dollars in the State. Six species occur in Georgia but only five are of economic importance (Figure 1).

Records of southern pine beetle (SPB) outbreaks in Georgia go back as early as the 1700's. Statewide outbreaks occur every 5-10 years with local, less intense infestations occurring annually.

Ips and black turpentine beetle (BTB) outbreaks seem to coincide with droughts, logging activities, naval stores, or wildfires. It is not uncommon for these insects to increase as SPB outbreaks decline.

Aerial detection is the most efficient method of locating bark beetle spots. Large forested areas can be surveyed in a relatively short period of time. From the airspots can be classified by size and type, which will aid entomologists in predicting future trends. Many small



Figure 2 - A Southern Pine Beetle infestation Photo by Terry Price, GFC

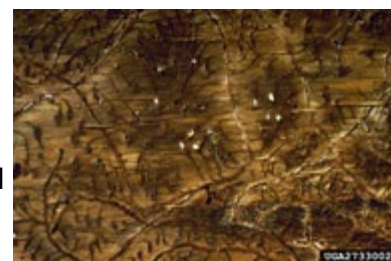


Figure 3 - Southern Pine

(5-10 trees) scattered spots usually indicate the beginning of a serious outbreak. As the outbreak progresses, spot size may increase 10-50 fold (Figure 2). Aerial detection and suppression surveys are an important aspect of a bark beetle prevention and control program.

Southern Pine Beetle - This beetle attacks all species of southern yellow pines of sapling, pulpwood and sawtimber size. It is particularly destructive in overmature and overcrowded stands. Infestations are often caused by extended droughts, flooding, lightning strikes, and man caused disturbances. Adult beetles are about 3/32" in length and reddish brown to black (Figure 1). Trees are killed when thousands of adult beetles bore underneath the bark to feed and lay eggs (Figure 3). Blue staining fungi are carried on the beetles' bodies from tree to tree. These fungi once introduced into trees will proliferate into the water conducting tissues stopping sap movement within the tree (Figure 4). This causes the needles to dry more rapidly.

Signs of attacks on the outside of the tree will be pitch tubes and boring dust (Figure 5 and 6). Needles will turn a pale to yellow green, then red, then brown (Figure 7). The time required for the needles to begin fading after an attack depends on many factors. Trees attacked during the summer will begin to fade in about two weeks, whereas, those attacked in early spring or late fall may not turn color for several weeks to months.

The SPR produces several broods per year. Approximately 30-40 days are required for the completion of one brood during the warmer months. During the winter all stages (eggs, larvae, pupae, and adults) can be found under or in the bark of infested trees.

Control In Forest Stands - After an SPB spot has been detected from the air, it must be ground checked. Recently attacked trees will have green needles and cannot be seen from the air, therefore, a spot may appear from the air to consist of only a few affected trees. A closer examination on the ground may reveal 10 or more green topped, infested trees for every discolored tree.

Currently four methods of control are being recommended in Georgia. These are salvage, cut and leave, cut and spray, and pile and burn. Another method which involves the use of behavioral chemicals is being tested throughout the south. Based on preliminary results this method may prove to be an alternative in controlling small isolated spots.

Salvage is the removal of all infested trees along with a

Beetle egg galleries and larvae
Photo by Terry Price, GFC



Figure 4 - Cross-section of a blue stain infested log
Photo by James McGraw, NC State



Figure 5 - Southern Pine Beetle pitch tubes
Photo by Terry Price, GFC



Figure 6 - Bark beetle boring dust
Photo by Terry Price, GFC



Figure 7 - Southern Pine

buffer strip of green uninfested trees. It is the most practical and effective method of control when the demand for timber is good. Salvage is not effective when:

- Spots are inaccessible to logging equipment.
- Spots are too small to be harvested economically.
- Wood quotas restrain the movement of wood.
- There is a shortage of wood producers.
- When salvage is impractical cut and leave is recommended as an alternative.

Cut and leave is the felling of all infested trees, plus a buffer of uninfested trees toward the spot center and leaving them. This method has been shown to disrupt spot growth during the warmer months (May-September) but should not be used on spots having over 50-100 infested trees.

Chemical control is used on a very limited basis and is recommended only for spots having fewer than 20 trees. The chemicals that are registered for bark beetle control are restricted use pesticides and can be applied only by licensed pesticide applicators (see appendix).

Pile and burn is an effective control method for small spots but is seldom used because of the time and expense involved in doing it.

If pre-commercial stands become infested, good control can be achieved by knocking all the trees down and burning.

Beetle infestation showing the different stages of needle fade
Photo by Terry Price, GFC



Figure 8 - Attacks from SPB and Ips engravers can be prevented in standing trees by applying the insecticide to the entire outer bark surface. However, trees already infested cannot be saved by spraying and should be removed/
Photo by UGA Archives



Figure 9a - Ips larvae feed out in a fan pattern away from the adult gallery
Photo by USFS Archives



Figure 9b - Adult Ips egg galleries
Photo by USFS Archives

Control In Lawn and Shade Trees - Trees that have been mass attacked by southern pine beetles cannot be saved by the application of an insecticide to the

outside bark or by injecting it into the tree. Homeowners need to be aware of unscrupulous persons advocating the use of systemic chemicals for the control of any pine bark beetle. Research has yet to prove the efficacy of these compounds.

The most important step in stopping a beetle infestation in a yard is to remove all infested trees. Residual healthy trees can be protected by the application of an approved insecticide to the entire outer bark surface of the trunk (Figure 8). Tree companies are often limited by their spray equipment and can only spray up the tree about 15 feet. This will not be effective in preventing attacks from the southern pine beetle or *Ips* engravers.

Lightning struck pines should be removed as soon as possible to avoid a southern pine beetle or any other bark beetle problem.

Preventing Beetle Attacks In Pine Stands - Dense stocking results in reduced diameter growth and creates conditions favorable to beetle infestations. Thinning stimulates growth and vigor in young stands and reduces the chances of a beetle infestation. Stands should be thinned at the onset of competition. Thinning intensity will depend upon the age of the stand, site index, total stand density, management objectives and the area of the state. In Georgia basal areas of 80 to 100 feet square per acre are recommended to reduce the potential for a beetle attack. Pine stands in the northern half of Georgia are susceptible to ice damage if thinned too heavily. Spacing trees around 600 per acre at establishment will reduce the number of thinnings required thus lessening the effects of ice.

Damage from recent logging activities favors all of the bark beetles. Skinned trees next to skid trails, logging roads and loading decks should be removed.

Susceptibility of trees to beetle attacks increases with age and causes a marked decline in diameter growth. Mature and overmature trees seldom respond to thinnings and should be replaced with the most resistant pine species or a species mixture suited to the site. Pine rotations should be shortened in areas where beetles have historically caused considerable timber losses.

Ips Engraver Beetles

These beetles can multiply rapidly in fire or storm damaged timber, in logging slash or along powerlines in recently pruned pines. Duration of *Ips* outbreaks is usually short-lived (3-6 months), and they are not as widespread as SPB outbreaks. Trees attacked by SPB are often attacked by one or more species of *Ips*. The *Ips* engravers tunnel underneath the bark of living trees producing galleries that are characteristic of each species (Figure 9). Blue staining fungi are also introduced into trees by the *Ips*.

The small southern pine engraver prefers the upper portions of trees such as limbs and tops and is often found in logging slash. The five-spined southern pine engraver is found more often above mid-hole and will also attack logging slash. The six-spined engraver is found most frequently in the bottom 1/2 of trees but during outbreaks it can be found in 4" diameter tops.

Ips beetles can be distinguished from other bark beetles by the shape of their rear ends, which are scooped out and surrounded by blunt spines (Figure 1).

The smallest *Ips* completes its life cycle in about 20 days during warm weather and may produce ten or more generations per year. The 5- and 6-spined engravers develop over a 20-25 day period producing 6 or more generations per year.

Trees attacked by *Ips* beetles don't always produce pitch tubes. Reddish-brown boring dust is produced and will be sprinkled up and down the tree in the bark

crevices (Figure 6).

Damage from Ips beetles can be minimized in forest stands by maintaining tree vigor, delaying thinnings during droughts and/or outbreak years, and rapidly salvaging storm damaged trees. All thinnings should be continuous with as much of the tops being utilized as possible. If thinning operations are started and then delayed, the beetles emerging from the logging slash will be more likely to attack standing trees. A continuous thinning provides fresh slash that tends to keep the beetles away from standing trees. Limbgating operations tend to favor Ips' buildups. The limbs are piled in heaps and do not dry out as fast as they should. The piles should be scattered periodically to allow for drying.

During droughts, aerial surveys should be intensified in areas where Ips have historically been a problem.

Ips outbreaks in recreational and urban areas can be devastating in overmature trees. During the summer of 1980 the 4 and 6 spined Ips killed over 30,000 board feet of shortleaf and loblolly pines along the fairways of an 18-hole golf course. This particular local outbreak was started by a few lightning strikes. It was intensified by drought. Statewide, Ips outbreaks accounted for 12,000 cords and over 490,000 bd. ft. of timber being salvaged during 1980.

Trees can be protected from Ips attacks by spraying the entire trunks of trees (Figure 8). The same insecticides that are recommended for the SPB are also registered for use against Ips beetles (see appendix).

Black Turpentine Beetle

This beetle is found most frequently in trees damaged by logging and landscaping equipment, naval stores operations, and lightning. Outbreaks are also triggered by droughts. During droughts, infestations often appear in sawtimber sized trees in low lying areas. Pulpwood and sawtimber sized trees of all ages are attacked.

Trees attacked by black turpentine beetles will have pinkish-white globs of gum on the bottom 6 feet of trunk (Figure 10). Pinkish-white boring particles also accumulate at the base of trees. Kicking back the duff layer from around the trees base will expose the boring particles.

The adult beetles tunnel underneath the bark and construct a broad vertical gallery in the cambium. Eggs are laid in clusters along the sides of the gallery (Figure 11). Development is completed over a 70-80 day period during the warmer months.

Trees damaged during skidding and road building should be removed along with scheduled removals. Black turpentine beetles are highly attracted to the turpentine odor that emanates from tree wounds. Wounded trees are almost certain to be attacked.

Insecticides can be used to prevent or control attacks by this beetle. In naval stores operations trees should be sprayed prior to being chipped. Field experiments have demonstrated the effectiveness of lindane/water emulsion sprays in preventing



Figure 10 - Black Turpentine Beetle pitch tubes
Photo by Terry Price, GFC



Figure 11 - Black Turpentine Beetle adults with egg mass
Photo by Terry Price, GFC

beetle attacks on naval stores trees. Yard trees damaged by bulldozers or other heavy equipment should be sprayed soon after the damage occurs to prevent these beetles from attacking. Prevention is always a better approach than control.

Ambrosia Beetles

There are many species of ambrosia beetles that attack hardwood and coniferous trees. Ambrosia beetles are so named because they cultivate a mold type fungus in their galleries, upon which they feed. Some species attack green logs, dying trees, or twigs and branches of living trees (Figure 12).

The species that attack logs and dying trees can cause considerable degradation in lumber. The beetles damage the wood by boring uniform circular pin holes through the wood. The fungus they cultivate causes black stains throughout the wood which further causes degradation (Figure 13). Ambrosia beetle tunnels also provide entrances for certain wood rot fungi which can do serious damage in untreated wood. Logs should be removed from the forest and utilized as soon as possible to prevent attacks from the pin hole borers.

The species attacking twigs and branches of living trees can cause extensive dieback, particularly in weakened trees. These beetles carry species of fungi on their bodies that are capable of causing tree mortality. The black twig borer, *Xylosandrus compactus*, has recently been associated with branch dieback on transplanted laurel and live oaks. A *Fusarium* spp. was isolated from dead and dying twigs and branches taken from trees that had been attacked by the beetles. This beetle is expected to become a serious pest of hardwood trees in areas where it becomes established. In Georgia it has been associated with dieback on holly, magnolia and various oak species.

Attacked twigs and branches should be pruned and destroyed. Trees should be watered during dry periods. Recently transplanted trees are very susceptible to black twig borer attacks. To minimize susceptibility don't transplant stock over 3-4 inches in diameter at the ground. Severe damage and death has occurred when larger trees are transplanted.

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Pine Weevils

Weevils that damage pines in Georgia can be classified as seedling debarking weevils, terminal weevils and root collar weevils. Damage from weevils can be heavy in local areas where certain forestry practices favor their development.

Debarking Weevils

Weevils that are notorious for debarking pine seedlings are the pales weevil and the pitch-eating weevil.

The pales weevil, *Hylobius pales*, (Figure 14) prefers loblolly, shortleaf, pitch, and white pine seedlings. The adult weevils damage seedlings by chewing small holes on the stem above and below the ground. Seedlings are often girdled. The pitch-eating weevil, *Pachylobius picivorus*, is very similar to the pales weevil in appearance and habits (Figure 14B).

Serious damage from debarking weevils can be prevented or reduced if those conditions which favor weevil development are avoided. The weevils are attracted to recently cut pine areas where there is an abundance of pine stumps and buried slash. Adult weevils deposit eggs in roots of freshly cut pine stumps or buried slash. The larvae hatch in a few days and begin feeding beneath the bark. Upon emergence the new adults will seek out seedlings to feed on. Seedlings planted on or adjacent to these cutover areas are attacked by the newly emerging weevils and older adults.

The following guidelines will help reduce weevil damage:

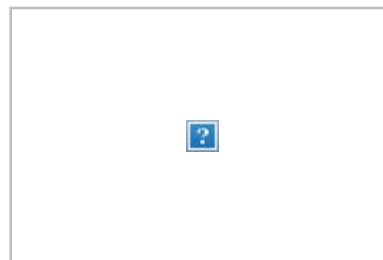


Figure 14a - Pitcheating weevil adult and feeding damage
Photo by Robert Anderson, USFS



Figure 14b - Pitcheating weevil feeding on a 4 year old slash pine seedling
Photo by Terry Price, GFC



Figure 14c - Pitcheating weevil feeding damage
Photo by Terry Price, GFC

- Delay planting one year on cutover pine sites if the cutting was not completed before July.
- If planting cannot be delayed, the seedlings should be dipped in an approved insecticide (see appendix).
- Delay clearcutting pine stands that are adjacent to recently planted pine plantations until the seedlings are big enough to withstand any feeding that may occur. Usually by age three-four seedlings are big enough to survive weevil feeding, however, damage can be extensive in some locations (Figure 14C).

Terminal Weevils

Terminal weevils in the genus *Pissodes* are very similar in appearance and habits. The adults are 3/16"- 5/16" in length depending on the species and vary in color from reddish brown to dark brown. The front wings (elytra) are marked with patches of white scales. Two common species that occur in Georgia are the white pine weevil (*Pissodes strobi*) and the deodar weevil (*P. nenlorensis*) (Figure 15).

The white pine weevil attacks the terminals of white pine in Georgia. Damage is done by the adults and larvae. The adults emerge in the spring and lay eggs in feeding pits on the terminals. Upon hatching the larvae tunnel in the cambium often killing stems. Puncture wounds made by the adults while feeding and laying eggs sometimes are so numerous that the stems are girdled (Figure 16). When a terminal is killed it is replaced by an adjacent branch which results in a crooked or forked stem. Damage can be severe at times (Figure 17).

The following management recommendations have been developed to reduce losses from the white pine weevil:

- Plant seedlings on soils where the hardpan is three or more feet from the surface.
- Regenerate white pine in mixture with hardwoods.
- Use insecticides in Christmas tree plantings (see appendix).

The deodar weevil is active all winter and lays eggs in the fall and winter in small puncture holes chewed in



Figure 15 - Deodar weevil
Photo by Gerald Lenhard, LSU



Figure 16 - Terminal weevil feeding
Photo by USFS Archive

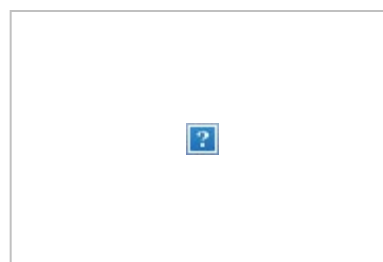


Figure 17 - Terminal weevil feeding
Photo by USFS Archive



Figure 18 - Deodar weevil pupa in its wood chip-lined pupal cell
Photo by Gerald Lenhard, LSU

the bark. The larvae have feeding habits similar to white pine weevil larvae in that stems are often girdled. Unlike the white pine weevil, the deodar weevil remains inactive during the summer in the ground litter.

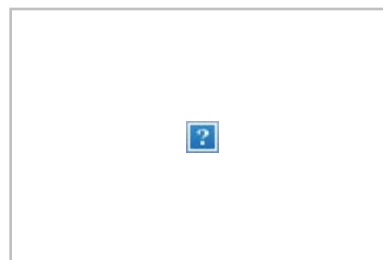


Figure 19 - Terminal dieback of deodar cedar caused by environmental stress.
Photo by Terry Price, GFC

Deodar cedars are preferred hosts but loblolly, slash, shortleaf and longleaf pines are attacked. This weevil is often found breeding in pines that have been attacked by pine bark beetles and those infected with pitch canker. The wood chip cocoons made by the larvae are readily visible underneath the bark of infested trees (Figure 18)

No controls are necessary for the deodar weevil in forest stands. Deodar cedars growing in yards, parks and along city streets are hosts of this weevil and should be kept in a healthy condition. Deodar cedar terminals are often killed by sudden, extreme changes in temperature or by extended droughts (Figure 19). Damaged terminals are often attacked by the weevils.

The fungus *Botryosphaeria dothidea* has been isolated from damaged terminals also and can cause a progressive dieback of the tree if the dead wood is not pruned properly.

Root Collar Weevil

The southern pine root weevil *Hylobius aliradicis*, occasionally damages the roots of seedling and sapling- sized loblolly and slash pines in southern Georgia. Damage appears to be worse in droughty years and on stressed trees. The larvae bore extensively in the root collar area of the trees. They pupate in wood chip cocoons similar to the other weevils (Figure 18). These pupal cells can be found under the bark at or below the ground line in dying trees.

White Fringed Beetle

This weevil historically has been a serious problem in cotton, peanuts, okra, velvetbeans, soybeans, and sweet potatoes. The larvae and adults have been observed feeding on more than 380 species of plants. The larvae feed on the roots, whereas, the adults feed on other plant parts above the ground.

The adults are dark gray with a whitish band along the outer wing margins. Larvae of this insect have recently been found feeding on the roots of newly planted slash and loblolly pine seedlings (Figure 20). Mortality does occur but appears to be insignificant at this point in time. However, due to the increasing number of farming failures, more and more agricultural lands are being planted in pines. This weevil has the potential of becoming a major pest on pine seedlings throughout Georgia and the South.

Control of the weevils in agricultural fields has been achieved by rotating crops and/or spraying with insecticides. Subsoiling or harrowing fields prior to planting trees could possibly provide some control by exposing the larvae to birds and other predators.

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Pine Tip Moths

There are three species of pine tip moths occurring in Georgia: the Nantucket pine tip moth, *Ryacionia frustrana*, the pitch pine tip moth, *R. rigidana*; and the subtropical pine tip moth, *R. subtropicana*.

The Nantucket pine tip moth is the most widely distributed species and causes the most damage to recently planted pines. All native pines up to about 15 feet in height are attacked except longleaf and eastern white pines. Although slash pine is highly resistant, it may be attacked when planted on poor sites. Loblolly pine and shortleaf pines are the favored hosts. Severe and repeated attacks often result in stunted, bushy, and deformed trees. Loblolly pines can be seriously stunted when planted on droughty soils (Figure 21).

The adult Nantucket pine tip moth is about 1/4" in length with irregular brick red and coppery patches on the forewings (Figure 22). The wing span is about 1/2". Sometimes the pitch pine moth is found with the Nantucket pine tip moth and positive field identification is difficult. However, they have similar habits. The larvae of both species are small, yellowish to brownish and are approximately 3/8", in length.

The adult moths (Nantucket) of the overwintering generation emerge in early spring. Depending on weather conditions, spring emergence may occur as early as January in extreme south Georgia or as late as April in north Georgia. Egg laying begins soon after adult emergence. The temperature greatly influences the incubation period. After the larvae hatch they begin to feed on new shoots near the base of the needles or the base of the buds. A protective web is spun over their bodies while they feed. Eventually this web becomes covered with pitch and is a characteristic sign of tip moth infestations in the tips of seedlings (Figure 23). When the larvae have completed their development, a cocoon is spun in the hollowed out shoot tip and pupation occurs within. Winter is passed as pupae within the injured tips. Two to four generations occur per year in Georgia.



Figure 21 - Repeated tip moth attacks cause undesirable bushing in seedlings.
Photo by Terry Price, GFC



Figure 22 - Nantucket pine tip moth
Photo by James Richmond, USFS

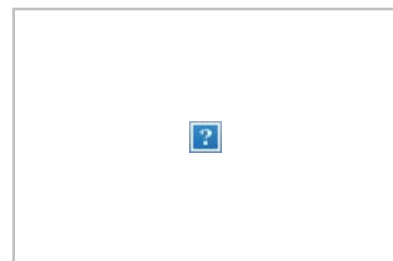


Figure 23 - Resin mass indicating a tip moth attack
Photo by Terry Price, GFC

The subtropical pine tip moth is found in south Georgia on slash pine. Damage is usually of no significance but control may be justified in newly established tree improvement orchards.

Control of the Nantucket pine tip moth in Christmas tree plantations and in newly established seed orchard plantings is best achieved by deploying pheromone baited traps. These traps help determine moth emergence so that insecticide applications will coincide with egg laying and larval hatching. A lot of managers make the mistake of applying an insecticide every 2-4 weeks from March to September in hopes of suppressing moth populations. Improperly timed insecticide applications are of no benefit and in most cases create problems with various scale insects by killing off their natural enemies. Infested tips can be pruned and burned if time and labor permit.

Georgia Forest Research Paper #44, "How To Time Dimethoate Sprays Against The Nantucket Pine Tip Moth," is available from any Georgia Forestry Commission office. The information in the paper can help Christmas tree growers determine their spraying schedules. There are also a few private entomology consultants that are available in Georgia that will deploy the pheromone traps for growers and set up spray schedules for them. More information can be obtained by writing Georgia Forestry Commission, P. O. Box 819, Macon, Georgia 31298-4599.

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Defoliators

Tree defoliators capable of serious damage are usually sporadic in nature and only cause noticeable damage in certain years. Attacked trees may be partially or completely defoliated. Pines and other softwoods can be killed or seriously weakened with one defoliation. Hardwoods usually recover following repeated light defoliation but successive heavy defoliations result in extreme growth loss and mortality.

Light defoliation (less than 20%) normally will not affect the overall health of the tree, but moderate to severe defoliation will reduce growth. From 70%-100% reduction in diameter growth often occurs with two or more consecutive seasons of moderate to heavy defoliation.

Pines weakened by defoliation are made more susceptible to attacks from bark beetles, particularly the Ips engravers.

Hardwoods weakened by repeated defoliations are subject to attacks from various wood borers, ambrosia beetles and diseases like hypoxylon canker (on oaks).

Damage from defoliating insects to forestry production in Georgia is of minor concern at the present writing. However, periodic outbreaks of caterpillars such as the forest tent caterpillar, various sawflies and the oak leaf skeletonizer do occur and can attract considerable attention.

The oak leaf skeletonizer caused extensive damage to chestnut oaks in portions of Dawson and Pickens counties during the 1987 growing season. Bee keepers are sometimes affected when various caterpillars eat the flowers off of sourwood and other flowering trees



Figure 24 - Elm leaf beetle larva
Photo by SFIWC Archive



Figure 25 - Japanese Beetle
Photo by E. Bradford Walker, Vermont
Department of Forests, Parks and Recreation



Figure 26 - Fall Webworm on pecan
Photo by G. Keith Douce, UGA

before their bees can gather the nectar and pollen. Sourwood flowers early in the spring and is one of the first plants visited by bees. Moderate damage to sourwood flowers occurred in 1987 in portions of the north Georgia mountains.

The gypsy moth has not become established in Georgia at this time although male moths have been trapped in the state since the early 1970's. It is expected to be a serious forest and urban tree pest upon establishment.

Control of defoliators in Georgia has not been necessary under forest conditions. Christmas tree plantations and yard trees can be protected by applying a recommended insecticide (see appendix). Some common tree defoliators are illustrated in figures 24-35.



Figure 27 - Forest tent caterpillar larvae. Note the white skeleton key-hole shaped spots down the back.
Photo by USFS Archives



Figure 28 - Eastern tent caterpillars
Photo by Terry Price, GFC



Figure 29 - Oak skeletonizer damage
Photo by Jim Solomon, USFS



Figure 30 - Variable oak leaf caterpillar
Photo by Jim Solomon, USFS



Figure 31 - Male gypsy moth
Photo by SFIWC archive



Figure 32 - Redheaded pine sawfly larvae.
Photo by Ron Billings, Texas Forest Service



Figure 33 - Pine webworm damage on loblolly pine seedling.
Photo by Terry Price, GFC



Figure 34 - Anisota worm (green striped maple worm)
Photo by John Godbee



Figure 35 - Evergreen bagworms
Photo by Terry Price, GFC

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Terry Price, Forest Health Specialist, Georgia Forestry Commission

Twig and Branch Girdlers and Pruners

The twigs and branches of hardwood trees are often attacked by various long-horned, wood-boring beetles. Two common species in Georgia are the twig girdler, *Oncideres Cingulata*, and the twig pruner, *Elaphidionoides villosus* (Figure 37). Both species attack oak, hickory, pecan and many other hardwood species. Damage can be severe in pecan and other fruit tree orchards.

The damage done by these insects can be distinguished from each other by the girdle on the twig or branch. The twig girdler beetle chews around the outside of the twig until it is almost severed (Figure 36). Eventually these twigs will break and fall to the ground or may even bend at the girdle and swing in the tree (Figure 38). The twig pruner's girdle is made by the grub from within the branch or twig and there is no visible outside girdle (Figure :39). In both situations, however, the result is the same. Both twigs and branches are girdled.

The larvae (grubs) spend the winter in the girdled twigs and branches. A good method of control is to collect the twigs and branches that fall to the ground and burn them. Those hanging in the tree should be collected and burned as well. This should begin soon after the damage is noticed and continued through the winter months.



Figure 36 - Twig girdler
Photo by Clemson University



Figure 37 - Twig pruner
Photo by Jim Solomon, USFS

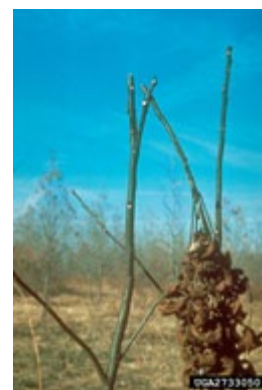


Figure 38 - Twig girdler damage on pecan
Photo by Jim Solomon, USFS



Figure 39 - Twig pruner larvae and damage.
Photo by Jim Solomon, USFS

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Terry Price, Forest Health Specialist, Georgia Forestry Commission

Annosus Root Rot

Annosus root rot can be a serious problem of pines in plantations that have been thinned one or more times. Loblolly, slash and white pines are affected most but shortleaf and longleaf are sometimes infected.

The fungus which causes annosus root rot, *Heterobasidion annosum*, enters pine plantations when its airborne spores land on freshly cut stump surfaces. The spores progress downward into the roots and then spread to adjacent healthy trees through root contacts in the soil. Roots wounded during the plowing of fire breaks or road building may become infected as do freshly cut stumps.

Infected trees begin to show symptoms 1-3 years following inoculation. Crowns will thin, turn light green to yellow and have shortened needles that may be tufted at the branch ends. These symptoms are very noticeable when sick trees are compared to healthy trees (Figure 40). The fungus can rot the roots so badly that some trees may fall over on their own or do so during moderate to heavy winds. Wind-thrown trees in a pine plantation may indicate root rot (Figure 41). The roots of windthrown trees can be examined for resin soaking (an early infection symptom) or for white stringy decay (an advanced infection symptom) (Figure 42). These symptoms along with windthrow are usually a positive sign that root rot is present. Occasionally the fungus will develop fruiting bodies of conks at the base of living and dead trees or stumps. These conks are hard to see because they are frequently formed below the litter layer around the tree or stump base and are most prevalent during the cool, wet winter months (Figure 43).

Annosus root rot is found throughout Georgia on certain sites. There are several soil series that are high hazard



**Figure 40 - Pines infected with root rot can be distinguished from healthy trees by their pale green color. (infected tree left)
Photo by USFS Archives**



**Figure 41 - Root sprung or wind thrown trees indicate root rot.
Photo by USFS Archives**



for disease (Figure 44). It is best to consult with a soil scientist or forester for a more detailed description of a particular site. Below is a broad classification of sites for possible root rot occurrence:

- **High Hazard** - Sandy or sandy loam soils with at least 65% sand in the upper 12 or more inches above a clay layer and with no high seasonal water table.
- **Intermediate Hazard** - Silt and silt loam soils 12 or more inches deep.
- **Low Hazard** - Poorly drained clay and clay loam soils or those with high water tables.

Managing Established Stands

If plantations are severely infected (50+ %), they should be clearcut and regenerated. Usually by this time infection centers are scattered throughout the stand and future thinnings will necessitate removing too many trees thus leaving the stand understocked. When regenerating high hazard sites a wider spacing should be used. This will delay the first thinning and ultimately reduce the total number of thinnings made during the rotation. Low hazard sites require no special planting treatments.

Uninfected plantations that have never been thinned should have the stumps treated with granular borax at the first thinning (Figure 45). If the stand remains uninfected prior to each subsequent thinning then borax should be used after each thinning. The biocide, *Phlebia gigantea*, containing the antagonistic fungus, should be used on stump surfaces in stands that are already infected. Borax is of no value once a stand has become infected.

Summer thinnings appear to lessen the damage from root rot. High stump temperatures over 90°F are likely to kill the fungus spores as they land on the surfaces. High temperatures also retard *H. annosum* spore production. Summer thinnings may create a bark beetle problem in some areas of the state when beetle populations are high. Land managers should contact the Georgia Forestry Commission office nearest them for information on beetle activity before doing summer thinnings. Summer thinnings may be considerably less effective in mountains of North Georgia where maximum summer temperatures are usually much lower than in more southernly portions of the state.

For further information on borax and the biocide write to the Georgia Forestry Commission, P. O. Box 819, Macon, GA 31208-4599.

Appreciation is extended to Dale A. Starkey, Plant Pathologist, USDA Forest

Figure 42 - Roots damaged by root rot
Photo by USFS Archives



Figure 43 - Fruiting conks of root rot
Photo by USFS Archives



Figure 44 - Distribution of root rot in the South. Red indicates high hazard soils. Blue indicates moderately hazardous soils.
Photo by USFS Archives



Figure 45 - Treating stumps with borax
Photo by USFS Archives

Service, Pineville, LA for some of the information used here.

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Terry Price, Forest Health Specialist, Georgia Forestry Commission

Fusiform Rust

Fusiform rust, *Cronartium quercuum* f. sp. *fusiforme*, is the most damaging disease of slash and loblolly pines throughout the southeastern United States. This disease causes stem, branch and trunk cankers (galls) to form on infected trees (Figures 46 and 47). The majority of infections occur prior to age 5. In the early spring active galls produce yellow-orange spores (aeciospores) that are windblown to young, tender oak leaves (Figure 48). Water, willow, and laurel oaks are the most susceptible species affected. The fungus goes through three additional spore stages underneath the oak leaves. The fourth and final stage results in basidiospores being formed. The basidiospores are windblown to new pine needles and/or succulent green bark areas of young trees thus completing the disease life cycle.

The amount of infection in planted and natural pine stands varies considerably across the South (Figure 49). Factors such as individual tree resistance, site characteristics and rust virulence all interact to influence infection levels.

When regenerating sites to pine, land managers must take steps to deal with fusiform rust. Below are some practices that will help minimize rust problems and protect economic investments.

Artificial Regeneration

Use rust resistant seedlings (improved) that are available from state and privately owned nurseries. These seedlings are the result of many years valuable research that hopefully will result in increased seedling



Figure 46 - Fusiform rust branch canker
Photo by Terry Price



Figure 47 - Fusiform rust trunk canker (inactive)
Photo by USFS Archives



Figure 48 - Rust spores underneath oak leaf
Photo by USFS Archives

resistance to the disease. Further protection from rust is provided by timed applications of fungicides to these seedlings at the nursery. However, sometimes these fungicides do not get applied for one reason or another. Occasionally seedlings will leave the nursery that are rust infected. Seedlings should be inspected for obvious stem swellings and culled prior to planting (Figure 50). Infected seedlings should be reported to the appropriate nursery officials immediately. Don't wait.

In high hazard regions (Figure 49) increase planting densities to allow for anticipated losses. This will, of course, increase the number of thinnings required throughout the life of the stand.

Consider site preparation techniques that reduce oak trees unless they conflict with other management objectives (prescribed burning, herbicides, and intensive mechanical preparation). It has been suggested by various pathologists that windrows containing large amounts of oak stumps and debris may provide ample oak sprouts that will later serve as alternate host material for future rust infections.

Use seed from a resistant source. Seed should be treated with an approved bird and rodent repellent (see appendix).

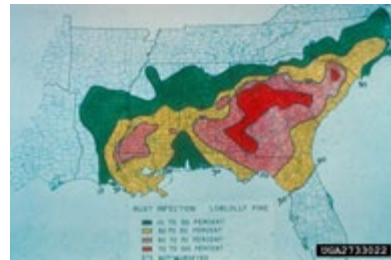


Figure 49a - Rust hazard map for loblolly pine
Photo by USFS Archives



Figure 49b - Rust hazard map for slash pine
Photo by USFS Archives



Figure 50 - Rust damage on nursery seedlings
Photo by USFS Archives

Natural Regeneration

If the seed tree or shelterwood method is used, select disease-free seed trees.

Managing Established Stands

Evaluate plantations at age 3-5 to ascertain the amount of rust infection. Plantations that are showing 50% or more infections should be seriously considered for clearcutting. If the decision is made not to clearcut, a sanitation cut should be planned as soon as it is economical.

After age 5 it is usually uneconomical to clearcut and start over. However, rotation ages will need to be adjusted in order to maximize on the establishment costs.

In older stands with less than 50% stem infections, remove as many stem cankered trees as possible with each thinning. Try to maintain a basal area of 75-85 sq. ft. per acre or at least 200 trees per acre.

When thinning plantations, be sure to consider annosus root rot.

Appreciation is extended to Robert L. Anderson, Supervisory Forest

Pathologist, USDA, Forest Service, Asheville, NC for some of the information used here.

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Terry Price, Forest Health Specialist, Georgia Forestry Commission

Littleleaf Disease of Pine

Around 1936 many of the shortleaf pine stands that had seeded-in on abandoned farm lands in the Piedmont regions of Georgia were characterized by trees having yellow-green foliage and unusually short needles (Figure 52). These trees were best described as having littleleaf symptoms; hence, the name littleleaf disease. Many of the stands were 20- to 30-years-old. Further investigations associated the syndrome with soil series such as Wilkes, Mecklenburg, Tatum, Orange, and Vance. The sites were severely eroded due to previous agricultural activities and subsequent abandonment. The topsoil was almost completely eroded away. On such sites tree roots were weakened by heavy clay subsoils with poor internal drainage.



Figure 52 - Symptoms of littleleaf are fading crowns, numerous cones, and short stunted needles and twigs. Photo by USFS Archives

Research then and more recently has identified at least two soil-borne fungi associated with littleleaf; *Phytophthora cinnamomi*, and species of *Pythium*. These fungi kill the root tips of stressed trees. As more and more feeder roots are killed, essential element uptake by the tree is reduced even though adequate elements may be present. As trees weaken, the symptoms become more pronounced. Trees eventually die from littleleaf.

The disease is most prevalent in stands 30-to 50-years-old. The fungi associated with littleleaf are widely distributed in the soils of the southeastern United States.

There are no quick cures for littleleaf disease but there are several recommendations that foresters can follow to minimize losses. Trees under 20 years of age or 3-4 inches in diameter rarely show littleleaf symptoms. Infected trees can live as long as 5 to 6 years after initial symptoms appear but some trees may die in as little as one year. This is particularly true during extended droughts or when trees have been attacked by bark beetles.

The amount of littleleaf in a stand dictates the management of that stand. The following guidelines should help foresters and landowners better manage their littleleaf stands:

- If up to 10 percent of the trees in the stand have symptoms, diseased trees should be removed by 10 year intervals.
- If 10-25% of the trees in the stand have symptoms, remove all diseased trees at six year intervals.

- If 25-50% of the trees in the stand have symptoms, clearcut and regenerate with Virginia pine or hardwoods. This is particularly true for stands being managed for pulpwood. Loblolly pine is about one-third as susceptible as shortleaf and may be considered as an option on littleleaf sites. It does, however, sustain severe damage on many sites within the range of littleleaf disease. Rotations for loblolly on high hazard sites should be shortened to 30 or 40 years.

Pitch Canker

The pitch canker fungus, *Fusarium moniliforme* var. *subglutinans*, can infect most of the southern pines but more damage is done to slash and Virginia pines. It gains entrance into trees through wounds. After the fungus gains entrance into the tree, the tips of terminal and lateral branches are often girdled and killed (Figure 53). Upon close examination of the dead shoots, the wood will be pitch soaked beneath the bark. Trunk cankers are also caused by the fungus (Figure 54).

The disease has not been a serious problem to pine plantations in Georgia. However, since the disease has the potential to outbreak (sporadically), the land manager should be aware of its presence.

Several management options are available for managing the disease in slash pine plantations:

- Infected trees should be removed during thinnings.
- When regenerating stands, consider using the seed tree method because native seed sources may be more disease resistant than nursery seedlings from a particular seed source.
- When establishing new plantations, avoid regenerating near existing diseased stands. Regulate stocking densities to avoid over crowding and individual tree stress.

Management guidelines for seed orchards:

- Avoid damage to trees from shakers, boom trucks and other equipment.
- Inform personnel on the proper handling of equipment and the importance of not wounding trees.

Management guidelines for Christmas tree plantations:

- Sell or remove all infected trees as soon as possible.
- Pruning provides ideal wound sites for pitch canker to invade. In areas where pitch canker is prevalent, favor eastern red cedar over Virginia and white pines since these two species are susceptible to



Figure 53 - Pitch canker damage on slash pine.
Photo by USFS Archives



Figure 54 - Excessive pitch flow caused by the pitch canker fungus
Photo by Terry Price, GFC

the fungus.

Appreciation is extended to Dr. Frank H. Tainter, Professor, Department of Forestry, Clemson University and Steven W. Oak, Plant Pathologist, USDA Forest Service, Asheville, NC for some of the information used here.

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Foliage Diseases

Diseases that attack the needles, twigs and leaves of forest and shade trees often develop into spectacular events. With the exception of a few, most of these fungi do very little harm to the tree. Christmas tree growers may experience severe defoliation during wet springs.

The most serious needle disease of pine is caused by the brown-spot needle fungus, *Scirrhia acicula* (Figure 55). Longleaf pine seedlings can be seriously damaged. Severe needle blight on young seedlings can increase the length of time it takes longleaf pine to grow out of the grass stage (Figure 56). The disease affects both planted and natural seedlings in the field.

Infected needles in the early stages are irregularly yellow to brown spotted, with green tissue in between the spots. Needles are eventually killed by the girdling action of the fungus.

Brown spot can be controlled in nurseries by spraying with an approved fungicide. Prescribed burning is recommended for control of the disease in plantations. Burns should be made only when the disease is causing damage, and weather conditions are favorable for burning.

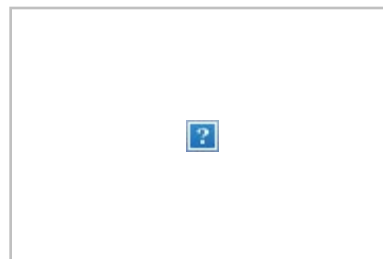
Leaf blister of oaks is perhaps the most conspicuous leaf disease of the pointed leaf oaks such as scarlet and southern red. Certain of the entire leaf oaks are also attacked. The disease is more prevalent during wet springs. Infected leaves will have blister-like eruptions. Premature leaf lull is common while the leaves are only partially dead. The fungus overwinters on twigs and



Figure 55 - Brown spot needle blight
Photo by USFS Archives



Figure 56 - Seven year old longleaf pine. Trees on right were treated with Benomyl prior to planting. Trees on left received no treatment
Photo by Ed Cordell, USFS



dead leaves. Raking up and burning the infected leaves as they fall will destroy overwintering spores thus reducing the source of inoculum for next year. Applications of an approved fungicide can be made in the spring just as the buds are swelling.

A disease of flowering dogwood caused by the fungus *Discula spp.* was discovered in Georgia during the 1987 growing season by U. S. Forest Service pathologists. The disease was cultured from dogwoods growing on the Chattahoochee National Forest in northwest Georgia. Initial symptoms are a small, purple rimmed spots and large blotches on the leaves (Figure 58). Dieback of small twigs occurs initially with larger branches dying later. The dieback usually progresses from the bottom to the top of infected trees. Death of the tree may occur in one to three years. Susceptible trees appear to be those growing on droughty, shallow soils, low in organic material; and those that are in a general decline. Affected branches can be pruned. Yard trees should be watered, mulched and fertilized periodically to increase their vigor.

Figure 58 - Spots caused by *Discula sp.* fungus on dogwood.
Photo by Terry Price, GFC



Figure 59 - Needle cast
Photo by Terry Price, GFC



Figure 60 - *Actinopelte* fungus spots on oak
Photo by USFS Archives

Needle cast refers to the shedding of needles of pines due to various species of fungi (*Lophodermium*, *Hypoderma*). The fungi responsible for this casting produce black spots of different shapes on the older needles. Affected needles turn brown and are shed (Figure 59). New tufts of green needles will be present on the branch ends. Needle cast shows up in the spring and fall and tends to show up more in years with lots of rainfall. Longleaf pines will naturally shed their older needles during dry years and this shedding should not be confused with needle cast. Needle cast very seldom causes permanent damage to trees therefore, negating the use of fungicides.

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Miscellaneous Diseases of Hardwoods

Wilt Diseases

Wilt diseases affect trees' ability to transport water and other materials. This results in moisture stress which leads to wilting. Although water may be plentiful, the vessels that carry it within the tree are clogged up by the action of the disease-causing organisms. Wilt diseases can be introduced into trees by insects or by spores gaining entrance through wounds or root grafts. Once infected, a tree may die gradually or suddenly depending on the nature of the disease and the vigor of the tree before infection. A common wilt affecting elm trees in Georgia is Dutch elm disease.

The fungus that causes Dutch elm disease was introduced into the United States many years ago. It was first identified in Georgia in 1967. This disease, *Ceratocystis ulmi*, affects all native elm species. The earliest symptoms are wilting, curling and yellowing of leaves on one or more branches, followed by leaf fall and death of the branches (Figure 61). Trees of all ages can be affected. Trees may die within a few weeks of the onset of symptoms or may die a limb at a time over a period of a year or more. The springwood of the last annual ring of an infected tree shows in cross section as a dark-brown ring or as a series of dark dots (Figure 62). The only sure way of identification of the disease is by culturing the fungus in the lab from wood samples taken from infected trees.



Figure 61 - Early symptoms of Dutch elm disease
Photo by Ed Barnard,
Florida Division of Forestry



Figure 62 - Discoloration caused by Dutch elm disease
Photo by Ed Barnard,
Florida Division of Forestry

Dutch elm disease is transmitted to healthy trees by two species of bark beetles: the smaller European elm bark beetle and the native elm bark beetle. Both beetles breed in dead or dying elms. Upon emergence from infected trees, the adults will seek out a healthy tree and begin to nibble in the crotches of twigs, thereby, inoculating the tree with the fungus.

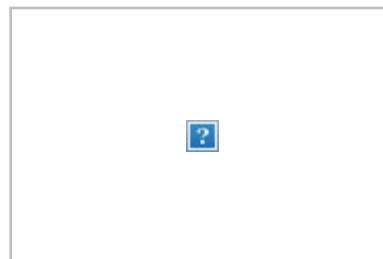
Native elm species that are infected usually cannot be saved when more than 5 percent of the branches are dying. Pruning out the dying branches followed by the use of a systemic fungicide (see appendix), is the best method of controlling the disease in trees having 5 percent or less branch wilting. Healthy elms can be protected by removing any dead or dying trees to eliminate potential breeding sites

for the beetles. Uninfected trees can be sprayed with an insecticide to prevent the beetles from feeding, but the chemical registered for this purpose is a restricted pesticide and can be applied only by a licensed pest control person. Some of the Asian and European elms are moderately resistant to the disease and should be favored over the native species.

Two other wilt diseases that should be mentioned are mimosa wilt and oak wilt. Mimosa wilt is common throughout the south and is a very serious disease on native mimosa trees. Oak wilt has not been positively identified in Georgia, but it is present in South Carolina, North Carolina, Tennessee, Virginia, Kentucky and Texas. Species of the red oak group are the most susceptible.

Hypoxylon Canker

Hypoxylon canker is a common disease of oaks and hickories in Georgia. All *Hypoxylon* spp. are wood parasites. Most of the species are weak pathogens in that initial infections are in trees that have been injured by drought, flooding, fire, lightning, construction damage or storms. There are many different species of *Hypoxylon*.



**Figure 55 - Brown spot
needle blight
Photo by USFS Archives**

Older trees which have been weakened by root, branch or trunk injury, or lack of moisture are especially susceptible to infection. The most conspicuous symptoms of this disease are mottled grayish areas where the bark has sloughed off (Figure 63a). These areas generally appear first on the deadbranches and later on the main stem. Usually one to several branches in the upper crown will turn brown and die one to two years prior to tree death. Ambrosia beetles usually attack infected trees causing a buildup of wood borings at the tree base.

There is no control for this disease. Dead trees should be removed as soon as possible to prevent the fungus from spreading to nearby uninfected trees.

Oak Decline

Oak decline is a name often used to describe the decline and death of various oak species for lack of a better descriptive name. Several species of fungi have been isolated from the roots of oaks that are exhibiting decline symptoms. The syndrome appears to be associated with oaks growing on poor soils with symptoms being prevalent following extended droughts. Several thousand acres have been affected in Georgia; the most recent year being 1985. The early symptoms are leaf discoloration and dieback in the tops of trees. Several years may be required for death to occur. Tree death is more sudden during droughts. *Hypoxylon* spp. are often associated with oak decline.

Since the decline occurs over a period of years, land managers have time to harvest infected areas before tree mortality becomes too serious. Urban trees should be watered during droughts and fertilized periodically to keep them in a vigorously growing condition.

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Animal Damage

The animals that are damaging to forestry in Georgia are the beaver, deer, rabbit, certain burrowing rodents and seed-eating birds.

Beaver are beneficial to water conservation and wildlife habitat development, but some timber producers can suffer substantial timber losses when timber stands are flooded. Based on a Georgia Forestry Commission beaver damage survey in 1975, the total damage to pine and hardwood was estimated at \$45 million statewide. Between 1967 and 1975, the area of damage increased by 128 percent, with over 287,000 acres being inundated in 1975.

Trapping is an effective method in reducing beaver in local areas, but it must be kept up over a long period for complete control.

Damage estimates to forest trees by deer for the State are not collected on a regular basis, but isolated areas of damage have exceeded 100 acres. Deer damage young pine stands by feeding on the terminals of recently planted pine seedlings. Damage to pine seedlings appears to be heaviest in February and March where natural browse has been damaged by late frosts. In 1985 in a middle Georgia county, approximately 109 acres of seedlings were ruined by deer. A seedling survival inspection revealed that over 85% of the seedlings had been clipped down to mid-stem (Figure 64). The landowner was forced to replant the entire field. Christmas trees and young trees in seed orchards are often damaged when antlered bucks use them for scraping posts (Figure 65).



Figure 64 - Deer damage to one year old loblolly seedling.
Photo by GFC Archives



Figure 65 - Deer scrape damage on eastern red cedar.
Photo by GFC Archives

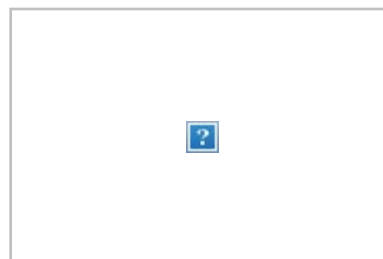


Figure 66 - Squirrel gnawing damage.
Photo by Terry Price, GFC

Seedlings can be treated with a repellent prior to planting to discourage deer from feeding on them. Seed orchard trees can be wrapped with various materials such as heavy kraft paper or burlap.

Rabbits damage seedlings by gnawing or biting them off at various heights. There are two signs in the field that will help foresters determine whether the seedlings were damaged by deer or rabbits:

- Deer clip the seedlings straight across and leave a ragged edge; rabbits clip them off at an angle (Figure 64).
- Droppings will usually be present. Rabbit pellets are usually deposited at the base or near the base of damaged seedlings. Deer droppings are deposited at random throughout the area. It is not uncommon to find droppings from both animals in the same area. Rabbit droppings are round, whereas deer droppings are oval (Figure 64).

Squirrels are not considered pests of forest trees, however, city trees can be seriously damaged when natural foods are limited. Shade trees can be completely stripped of their bark on most of the branches (Figure 66). Heavy damages have been reported on maples and other thin barked species. Isolated trees can be banded with metal flashing to prevent squirrels from climbing in them. Trees growing next to buildings and other objects cannot be adequately protected by banding. Trapping squirrels in live traps and transporting them to less populated areas has not proven effective either.

Several species of scratching birds can consume enough pine seed to render artificially seeded areas worthless. Pine seed should be treated with a repellent before they are sown or broadcast. Table One lists some of the more common methods of controlling/preventing animal tests. Be sure to check with the Georgia Department of Natural Resources before applying any control to an animal population. Game laws change periodically depending on animal population trends.

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A Guide to Common Forest Pests in Georgia

Terry Price, Forest Health Specialist, Georgia Forestry Commission

Storm Damage

Storms of various types and intensities do considerable damage to forest stands in Georgia. Based on best estimates during the last decade, over 24.5 million board feet and 1.5 million cords of pine and hardwood were destroyed following 29 reported storms.

Tornadoes occur more frequently than ice storms but do not cover as large an area. Georgia Forestry Commission records indicate that 28 tornadoes did an estimated \$4.3 million of damage which averaged over \$186,000 per occurrence. (1973-1986). However, four major ice storms occurring during the same period did over \$26 million of damage or \$6.5 million per occurrence.

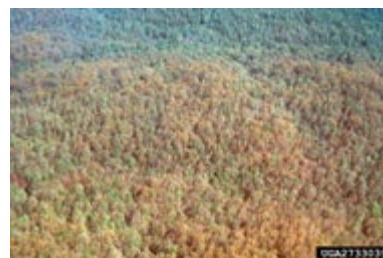


Figure 70 - A 400 acre tract of upland hardwoods, shortleaf and Virginia pines damaged by hail, cerambycid beetles and pinewood nematodes. Photo by Bob McMurry, GFC

The areas of the State where the moderate to severe storms have occurred since 1973 are shown in figures 67-69. Numerous other tornadoes and ice accumulations occurred but did only light damage and were not recorded. As the records indicate, tornadoes occur more frequently during April and May and ice storms are more common during January and February.

Hail storms are usually associated with severe thunderstorms and occur more frequently during spring and summer. Most hail storms do very little noticeable damage to forests but occasionally will cause serious defoliation and branch damage. A hail storm in 1985 damaged about 400 acres of pine and hardwood in northeast Georgia (Figure 70). The damage was so severe that wood sawyers (*Monochamus* spp.) became epidemic in the pine. These insects are vectors of the pinewood nematode. The nematodes cause a wilt disease of pines. The entire area was clearcut due to the damages from the sawyers and nematodes.

Land managers can reduce the impacts of high winds and ice by regulating stand densities. Pine plantations in areas likely to be hit by ice should not be thinned more than one-third of the total basal area at a time. Short leaf and Virginia pines are more resistant to ice than loblolly. Loblolly should be maintained at denser stockings than shortleaf and Virginia pines. Slash and longleaf pines are very susceptible to breakage from ice accumulations and should not be planted north of a line extending through Muscogee, Bibb, and Richmond Counties, Georgia.

Pine stands that have been damaged by winds, hail or ice should be evaluated as soon as possible. Damaged trees should be salvaged to prevent pine bark beetles (see pine bark beetles).

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Further Readings

Available from Georgia Forestry Commission, P. O. Box 819, Macon, Ga. 31298-4599

1. Guidelines for Managing Pine Bark Beetles in Georgia
2. Pine Bark Beetles in Urban Areas
3. How to Time Dimethoate Sprays Against the Nantucket Pine Tip Moth
4. Growing the Japanese Flowering Cherry Trees in Georgia
5. Hypoxylon Canker of Oaks and Hickories in Georgia

Available from the USDA, Forest Service Library, 1720 Peachtree Road, NW, Atlanta, Georgia 30334

1. Silviculture Can Reduce Losses from the Southern Pine Beetle (Handbook #57(3))
2. Woodpeckers and the Southern Pine Beetle (Handbook #564)
3. An Aerial Observer's Guide to Recognizing and Reporting Southern Pine Beetle Spots (Handbook #560)
4. Identification and Biology of Southern Pine Bark beetles (Handbook #634)
5. Southern Pine Beetles Can Kill Your Ornamental Pine (Bulletin #226)
6. Ips Bark Beetles in the South (Forest Insect & Disease Leaflet #129)
7. Control of Pales and Pitch-Eating Weevils in the South
8. Pales Weevil (Forest Insect & Disease Leaflet #104)
9. The Nantucket Pine Tip Moth (Forest Insect & Disease Leaflet #70)
10. Major Hardwood Defoliators of the Eastern Forests (#224)
11. A Guide to the Insect Borers, Pruners, and Girdlers of Pecan and Hickory (Technical Report SO-64)
12. Littleleaf Disease (Forest Insect & Disease Leaflet #20)
13. Fusiform Rust of Southern Pines (Forest Insect & Disease Leaflet #26)
14. Oak Decline (Forest Insect & Disease Leaflet #165)
15. Annosus Root Rot in Eastern Pines (Forest Insect & Disease Leaflet #76)
16. Brown-spot Needle Blight of Longleaf Pines (Forest Insect & Disease Leaflet #44)
17. Nursery Diseases of Southern Pines (Forest Insect & Disease Leaflet #32)
18. Nursery Diseases of Southern Hardwoods (Forest Insect & Disease

Leaflet #137)

19. Pt-A Beneficial Fungus That Gives Your Trees a Better Start in Life. (Gen. Rpt. 5A-GR8, 1980)
20. How to Recognize and Quantify Ectomycorrhizae on Conifers (For. Bull. 3A-FB/p8 1979)

The following book can be obtained at cost by writing the Superintendent of Documents, Washington, DC 20402

1. Insects of Eastern Forests (Misc. Publication 1426) Revised

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