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CONTROL OF THE BLACK TURPENTINE BEETLE

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PHOTOS ON THE COVER

Background Photo - Slash pines killed by the black turpentine beetle.

Left Photo - Adult black turpentine beetle.

Right Photo - Large pitch tubes on the bark at the base of a pine tree attacked heavily by the black turpentine beetle.

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THE BLACK TURPENTINE BEETLE

The black turpentine beetle, Dendroctonus terebrans *(Olivier),* is a black, hard-shelled beetle about 3/8 inch long with head- and tail ends rounded (Fig. 1). The black turpentine beetle (abbreviated "BTB") is one of the largest members of a group of insects known as bark beetles. Bark beetles are so named because they tunnel between the bark and wood of trees, thereby introducing blue stain fungi, disrupting water movement, and causing eventual death of the tree.

All pine species in Georgia are subject to attack by BTB. The beetle has been particularly destructive to slash and longleaf pine worked for gum naval stores in the Coastal Plain Region. During the early 1950's, before insecticidal control methods had been developed, a severe widespread outbreak of BTB virtually forced many turpentine farmers out of business.

WHERE BLACK TURPENTINE BEETLES ATTACK

BTB attacks freshly-cut pine stumps and trees stressed or weakened by disease, fire, lightning, drought, growth stagnation, or old age. Man also creates conditions in forest stands that invite BTB attacks. For example, "skinned" tree trunks or large roots and soil compaction incurred during logging. In urban areas BTB is commonly a pest at construction sites when trees are damaged during digging and grading operations.

Pine stands worked for naval stores are periodically subject to BTB attacks, particularly during droughts, or when narrow bark bars between faces increase tree stress. Trees wounded mechanically and treated with the herbicide, paraquat, for lightwood production may also be attacked by BTB and other bark beetles.

HOW TO RECOGNIZE BLACK TURPENTINE BEETLE ATTACKS

Before appropriate control procedures can be started, one must determine whether BTB or other bark beetles are attacking the pines. The best clues for identifying the presence of BTB are the large pitch tubes (Fig. 2) that are found within the lowest three to six feet of the tree trunk. Pitch tubes resulting from the earliest attacks, however, usually occur within 18 inches above the ground. The pinkish-white to reddish-brown pitch tubes have a diameter about the size of a 50-cent piece and form on the bark surface at the point where the beetles bore through the outer bark into the pitchy white inner bark next to the wood.

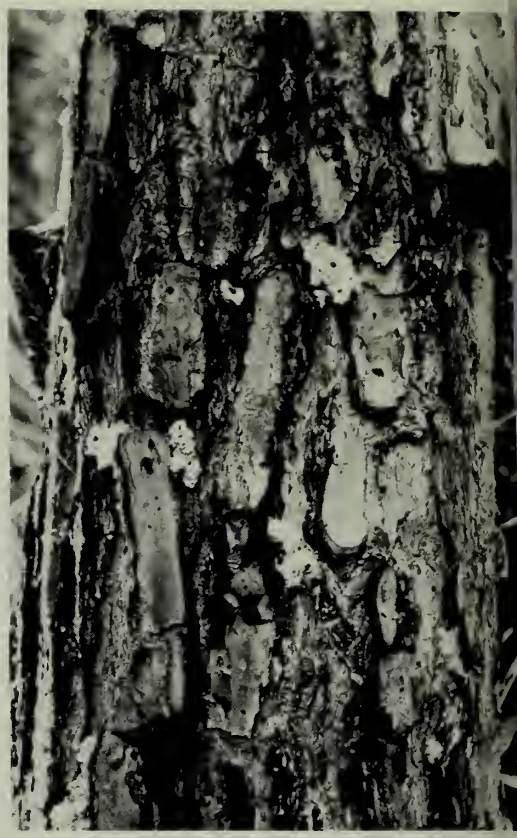

Figure 2. --Typical pitch tubes made by black turpentine beetles when attacking the lower trunks of southern pines.

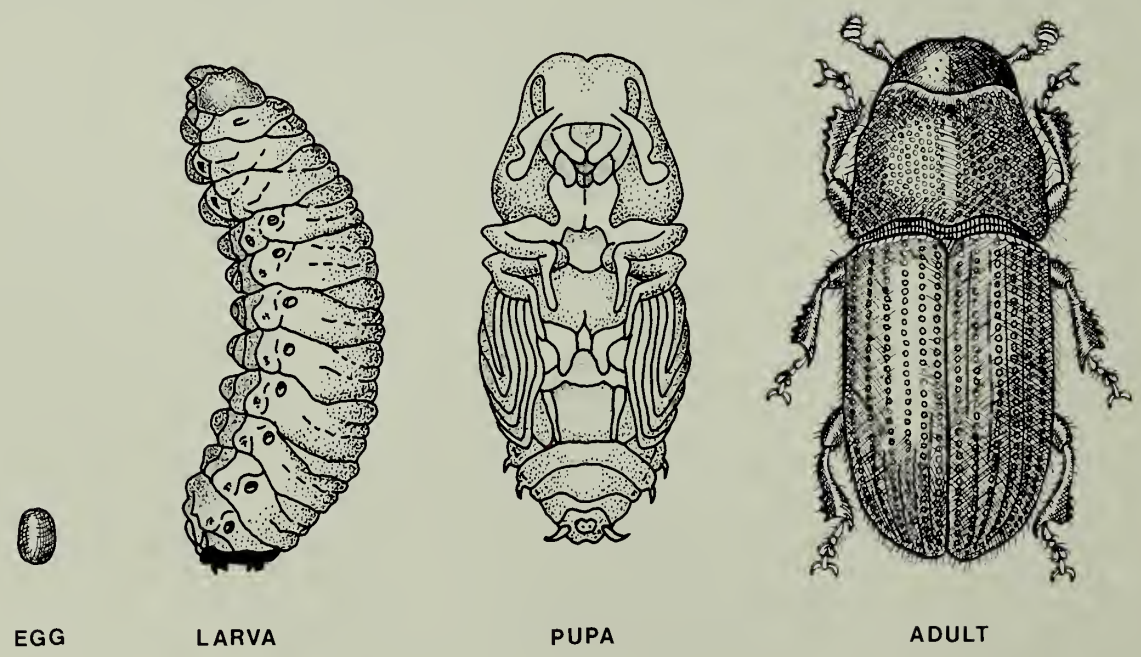

Figure 1. --Life, or developmental, stages of the black turpentine beetle.

- LEGEND -

(1) Pitch tube at beetles' entrance into bark.

(2) Female BTB excavating egg gallery between bark and wood.

(3) Male BTB clearing egg gallery of pitch and debris.

(4) Elongated pocket containing eggs along side of gallery.

(5) Irregular-shaped area of inner bark consumed by groups of larvae (grubs).

(6) BTB pupae (transformation stage from grubs to beetles).

(7) Newly-formed (pale yellow or callow) beetle.

(8) Callow adults turn to black color before emergence from tree or stump.

(9) Emergence (exit) hole of newly-formed beetles.

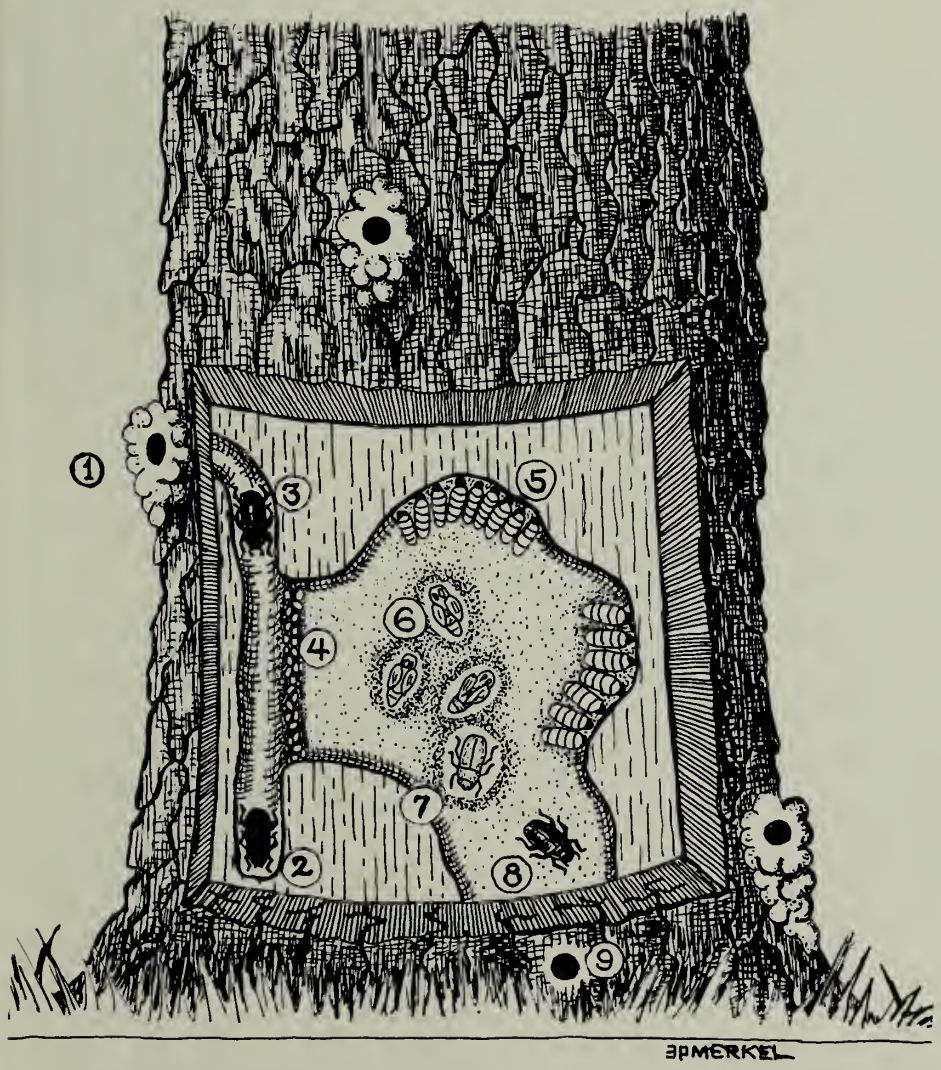

Figure 3. --Development of the black turpentine beetle in the inner bark of southern pines.

During construction of the egg gallery in the inner bark (Fig. 3), the attacking beetles must work to keep from being overwhelmed by the flow of gum; so this gum is continually pushed out of the entrance hole forming the pitch tube.

Pitch tubes resulting from successful BTB attacks are reddish brown in color and have a coarse granular texture due to the mixture of pitch and dark-colored bark particles; after a month or two the pitch tubes have a grayish color. Pitch tubes formed during unsuccessful beetle attacks are called "pitch-outs" and are characterized by their pinkish-white to yellow color and their composition of mostly pitch mixed with few bark particles giving them a smoother texture.

Pines attacked by BTB are also commonly attacked by other bark beetles such as the southern pine beetle and pine engraver beetles. Pitch tubes made by these other bark beetles occur higher on the trunk and are usually much smaller than BTB pitch tubes, i.e., diameter of a dime or smaller. Fine-textured, reddish-brown bark particles, called boring dust, are often produced when other bark beetles attack and can accumulate in noticeable amounts around the base of the tree, in bark crevices, and in naval stores cups and gutters.

Fluffy, yellowish-white piles of finely-shredded wood particles usually appear at the base of trees attacked by BTB and other bark beetles. These piles are produced by the ambrosia beetle, *Platypus flavicornis* (F.) which bore directly into the wood at the base of the tree. Ambrosia beetles do not kill the pines, but usually attack after successful bark beetle attacks when the tree's foliage has begun to fade. When ambrosia beetle boring dust encompasses at least half the circumference of the tree's base, the tree almost invariably dies.

More positive identification of the BTB can be made by peeling back the bark down to the wood surface with a hatchet to expose the insect feeding galleries. The first hatchet cut should be made just above a pitch tube and then the bark should be steadily pried from the wood working downward for about 12 inches; if no galleries or insects are found after the first piece of bark is removed, remove sections of bark from either side of the first piece removed. The beetles or their immature stages, i.e., eggs, larvae pupae (Figs. 1 and 3), will usually be found on the inner surface of the removed bark section or on the exposed wood surface. Assistance in identifying bark beetles can be obtained at an office of the Georgia Forestry Commission or County Agricultural Extension Agent.

HOW BLACK TURPENTINE BEETLES PRODUCE NEW BROODS

As in the case of all bark beetles, the BTB passes through an egg, larval or grub, and pupal stage (Fig. 1) in the inner bark before transforming into a beetle (Fig. 1). The newly-formed beetles emerge from stumps and infested trees that have died and attack additional fresh-cut stumps and green trees to start the life cycle over again. The life history of the BTB is illustrated in Fig. 3 and differs from other pine-infesting bark beetles in the following ways: (1) clusters of eggs are laid in one or more narrow elongated pockets, usually on one side of the egg gallery (Fig. 3-(4)); and (2) groups of larvae feed side by side excavating a large continuous area or cave-like gallery which increases in size as the larvae grow and move away from the egg pocket: sometimes an area of one to two square feet of inner bark is consumed by the larvae.

The black turpentine beetle takes three to four months to complete a single generation, that is, from the time the parent beetles enter a tree or stump until the newly-formed beetles emerge. In contrast, other southern bark beetles complete a single generation in twenty to forty days. In the warmer climate of south Georgia the BTB may complete two and one-half to three complete generations per year and adult activity slows down only during the colder months (November through February).

Fig. 3 is a graphic presentation of the development of a single generation of the BTB from the time that the attacking parent beetles enter the bark until the new-generation beetles mature and emerge from an infested tree or stump. One rarely finds all life stages of the BTB under the bark at any given time; but beetle development follows the numerical sequence as shown in figure 3. For example, the large pitch tube (Fig. 3 - (1)) is formed at the hole where female (Fig. 3 - (2)) and male (Fig. 3 - (3)) parent beetles enter the bark and begin egg gallery construction. It should be noted that larvae or grubs, (Fig. 3-(5)) after hatching from the eggs (Fig. 3-(4)), shed their body covering ("skins") several times increasing in size after each molt. When larvae mature they leave their group feeding sites along the edge of the irregular-shaped gallery and back-track into the previously-consumed area of inner bark containing dry, fine, granular boring material and form eliptical-shaped cells in which to pupate (transform to beetles) (Fig. 3 - (6) and (7)). One or more new adults (Fig. 3 - (8)) may emerge through a single exit hole (Fig. 3 - (9)).

Attacking beetles after depositing one or more egg clusters may emerge through the bark and attack elsewhere on the same tree or attack other trees. Also, attacking beetles may be repelled by large flows of pitch and may attack elsewhere on the same tree or attack other trees. Numerous pitch tubes on a tree do not always mean successful attack and tree death (See "How To Recognize BTB Attacks").

ATTACK BEHAVIOR OF THE BLACK TURPENTINE BEETLE

Although beetle attacks (pitch tubes) commonly occur to a height of six feet above ground, the majority are found within the basal three feet of attacked trees. It is important to note that the first attacks usually occur within the basal 18 inches of the tree and subsequent attacks increase in height on the tree trunk as infestation progresses. BTB attacks on individual trees may last for four to seven months. It has been observed that as the number of pitch tubes increases above ground, additional attacks occur beneath the soil surface on tap and large lateral roots larger than one inch in diameter. Successful BTB brood development in roots has only been observed within the upper 18 inches of soil. It is not known whether first attacks on a tree occur on the roots; but it is not unusual to find early attacks in the root-collar area beneath the needle litter.

Black turpentine beetle attacks are not always fatal to the tree, but when they are, the green color of the healthy foliage fades from yellow-green to pale yellow and finally to a brick red. Fading of foliage may begin four to eight months after the initial attacks. In contrast, southern pines attacked by other bark beetles usually begin to fade within three to four weeks after initial attack.

Black turpentine beetle infestations are difficult to detect from the ground or air because of the long attack period and the long, but highly variable, time interval between initial attacks and foliage fading. Stands infested by BTB generally contain trees in all stages of attack, foliage discoloration, and crown deterioration. The groups of faded trees so characteristic of other bark beetle infestations will not be seen. One is more likely to find a majority of green trees under attack with dead and dying trees scattered sporadically throughout the stand.

INSECTICIDAL CONTROL OF THE BLACK TURPENTINE BEETLE

There are two courses of action which can be followed if trees are attacked by BTB: (1) Salvage all infested trees and spray stumps with an insecticide registered for control of BTB; or (2) when salvage is impractical, spray all attacked trees up to the height of the highest pitch tube with a registered insecticide. Spraying should continue as long as additional trees continue to be attacked in the stand. By so doing, many attacked trees will be saved, additional attacks will be prevented on trees already under attack, and subsequent beetle activity reduced. Don't be fooled by only a few pitch tubes at the base of the tree! BTB works long and persistently and will eventually kill the tree; so act promptly if you want to save trees!

Preventive spraying, i.e., the application of an insecticide before BTB attacks the tree, is expensive but effective where the timberland owner wants to protect high-value trees. Preventive spraying can be used in areas cut back to seed trees, in seed orchards, and on street and yard trees. Water emulsions of insecticides should be used instead of oil solutions in situations where lawns and ornamental shrubs might be damaged by the fuel oil.

MIXING AND APPLYING INSECTICIDES

Before purchasing an insecticide check with your local County Agricultural Extension Agent or State Forestry Commission office to determine what insecticides are registered currently for BTB control. When this publication was prepared, only two insecticides, lindane and chlorpyrifos, were registered for BTB control.

After the insecticide is purchased, read the label on the container carefully for dilution, mixing, and application instructions. Other recommendations on the label, concerning the use of special safety equipment, should be followed closely!

Insecticides for bark beetle control are usually sold as water emulsifiable or oil soluble concentrates. The water emulsifiable concentrates are diluted with water and the oil soluble concentrates are diluted with No. 2 fuel oil.

The insecticide, lindane, can be used for BTB prevention or control as a 0.5% concentration in either water or No. 2 fuel oil; whereas the insecticide, chlor-

pyrifos, is used at a 1% concentration in water only. The Appendix will show you how to properly dilute any insecticide concentrate.

For remedial control, that is when you want to kill beetles after they have entered the tree, oil solutions will give better bark penetration and a longer residual effectiveness than water emulsions in preventing additional BTB attacks on the same tree. If large numbers of trees or stumps require spraying, it would be much less expensive to use a water emulsion. Water emulsions are also preferable for use in urban areas and near dwellings where oil solutions may damage lawns, flowers and shrubs.

Spraying is easily accomplished with an ordinary, hand-pump, compressed air sprayer of one to three gallon capacity. Use a spray nozzle that will give a fan-shaped or cone-shaped spray pattern of coarse droplet size. When a fine mist is used to spray, too much time is required and it is more difficult to achieve penetration of deep bark crevices. A nozzle that produces a solid stream will give good bark coverage but normally there is waste of spray material because of excessive run-off.

On infested trees begin spraying about a foot above the highest pitch tube on the tree trunk. On uninfested trees, where prevention of BTB attacks is desired, begin spraying the trunk at waist-height. Spray one side of the tree first, starting at the highest point on the trunk, moving the nozzle back and forth horizontally, and gradually working toward the tree base. Sufficient spray material should be applied so that it forms small rivulets that run into the bark crevices. Then move around the tree, again starting at the highest point on the trunk, and proceed as just described making sure your spray overlaps slightly the portion of the trunk sprayed previously. Do this until the entire bark circumference has been covered thoroughly. Finally make one pass around the entire base of the tree, directing the spray at the root collar, that is, the junction between the tree and the soil. On mature trees, particularly on low, poorly-drained sites, there is often a thick accumulation of loose bark scales and needle litter at the base of the trees. Better spray coverage of the root collar will be obtained if the litter is scuffed away from the base of the tree.

INSECTICIDAL CONTROL IN NAVAL STORES OPERATIONS

Spraying individual trees is a procedure well-adapted to gum naval stores operations and need not be costly and time-consuming if the following procedures are followed:

1. Chippers should learn to recognize BTB attacks; and since they visit all worked trees throughout the chipping season, they can scout for and report locations of BTB attacks when they first appear. Provide each chipper with a roll of brightly-colored plastic flagging tape to be tied around the tree trunk at breast height, or at eye level on a nearby bush, when BTB pitch tubes are encountered. BEWARE! - some of the first pitch tubes are hidden from view under or behind the turpentine cup and in deep bark crevices near the ground line.
2. Spray attacked trees as soon as possible after the chipper flags them. Spraying trees promptly prevents additional BTB attacks on the same trees. When BTB populations are high, other trees, in addition to those sprayed initially, may become attacked throughout the summer and fall. Therefore, keep up with the newly-attacked trees and spray them each month if necessary. Don't allow the number of infested trees to accumulate to the point where you must contend with a large, costly, spray job.

INSECTICIDAL CONTROL IN THINNED AND HARVESTED STANDS

Even though BTB breed in freshly-cut stumps, it is not necessary to routinely spray stumps with an insecticide as a preventive measure. Spraying numerous stumps is costly. Furthermore, there is no certainty that BTB will breed in the green stumps and spread to residual trees. Instead, periodically examine the residual stand for about six months after logging to determine whether the BTB is aggressively attacking trees, particularly trees damaged by logging. Spray attacked trees as soon as BTB activity is observed. If a sharp increase in attacked trees occurs, all attacked and unattacked damaged trees should be sprayed to the height of the highest pitch tube or to the height of logging damage on the trunk such as "skinned" bark.

APPENDIX

The following is a hypothetical label for a concentrated water emulsifiable insecticide showing the chemical ingredients:

INSECTICIDE BRAND X

Active Ingredients	By Wt.
Name of Insecticide.	20%
Aromatic Petroleum Derivative Solvent.	59%
Inert Ingredients.	21%

*Contains 1.65 pounds of active insecticidal ingredient

*All pesticide labels must contain a statement about the weight (pounds) of active insecticide per gallon of concentrate. With this information, and the following formula, one can readily calculate how much concentrate is required to mix with the desired amount of water, or No. 2 fuel oil, to obtain the percent spray solution needed.

$$\text{Formula} = \frac{(\text{gals. of spray wanted}) \times (\%\text{ active ingredient wanted}) \times 8.3}{(\text{lbs. of active ingredient per gal. of concentrate}) \times (100)}$$

= gals. of emulsifiable concentrate needed

$$\text{Example} = \frac{(10\text{ gals. spray wanted}) \times (1.0\%\text{ active ingredient wanted}) \times 8.3}{*(1.65\text{ lbs. active ingredient per gal. concentrate}) \times 100}$$

$$= \frac{1.0 \times 1 \times 8.3}{1.65 \times 100} = \frac{83}{165} = 0.5\text{ gal. or 2 quarts of "Brand X" concentrate}$$

Note: To prepare the final spray mixture place the ½ gallon of concentrate into a mixing container and add sufficient water (9½ gals.) to make a total of 10 gallons of water emulsion.

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