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Black Turpentine Beetle

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Black turpentine beetle, *Dendroctonus terebrans* (Olivier), is the largest native pine bark beetle in the southeastern United States. This beetle is usually considered a secondary pest, as it typically colonizes freshly cut pine (*Pinus* spp.) stumps or trees stressed by natural and/or anthropogenic factors. Trees weakened by drought, fire, or other stresses, as well as pines wounded during storms or logging operations are susceptible to attack. It is generally less aggressive than the closely related southern pine beetle (*D. frontalis* Zimmermann), and populations are often found cohabiting pines previously infested by southern pine beetle and/or pine engraver beetles (*Ips* spp.). Populations occasionally increase to levels in which apparently healthy pines may be successfully colonized.

Distribution and Hosts

The range of the black turpentine beetle extends from New Hampshire and Maine in the northeast United States southward to Florida, and westward to Missouri, Arkansas, and eastern Texas (Figure 1). Its distribution corresponds with the range of four of its major host species: pitch pine, *P. rigida* Mill.; loblolly pine, *P. taeda* L.; shortleaf pine, *P. echinata* Mill.; and slash pine, *P.elliottii* Englm. All southern pines within the range of the beetle may be attacked, as well as red spruce (*Picea rubens* Sargent). Historically, the most severe infestations of black turpentine beetle in the southeast

Figure 1. Distribution of black turpentine beetle in the U.S. as based on historical records, current surveys, and distribution of known host species.

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have occurred in loblolly and slash pine stands, although longleaf pines (*P. palustris* Mill.) have been attacked in high numbers. In the northeastern United States, the range of the black turpentine beetle overlaps with that of the red turpentine beetle, *D. valens* LeConte, which is a slightly larger species. In addition to pitch pine, Japanese black pine (*P. thunbergii* Parl.) and Scots pine (*P. sylvestris* L.) are frequent hosts in this region.

Figure 2. Black turpentine beetle adult.

Description

The black turpentine beetle is relatively easy to distinguish from other bark beetles because of its large size, dark color, rounded abdomen, and habit of attacking near the base of a tree. Adult beetles have a stout, cylindrical shape and are 5-10 mm in length (Figure 2). The head is visible from above, the antennae are clubbed, and the pronotum tapers anteriorly. The elytra are rounded posteriorly, and the abdomen does not have spines like that of pine engraver beetles. The body ranges in color from dark reddish-brown to black.

There are four larval instars, and the final instar may reach 12 mm in length. The larvae are yellowish-white with a reddish-brown head and no legs (Figure 3). Dark, well-developed anal cerci distinguish the larvae from other cohabiting bark beetle species. The pupa is waxy-white and similar in size to the adult (Figure 4).

Tree Colonization Behavior

Black turpentine beetle infestations are usually confined to the base of the tree, and most attacks are concentrated in the lowest 2-3 feet of the trunk. Scattered attacks may extend to a height of 6 feet, and loblolly pines can have attacks up to 15 feet above ground. Beetles also may bore into the root collar if the tree has root damage caused by flooding, and occasionally may attack the large lateral roots beneath the soil.

As is characteristic of the genus *Dendroctonus*, the female is the initial colonizer, and attacks are usually initiated

Figure 3. Black turpentine beetle larvae.

Figure 4. Black turpentine beetle pupa (top) and larva (bottom).

in bark crevices. Once a female begins boring, the tree responds defensively by releasing copious amounts of resin (tree sap), and a "pitch tube" develops.

The characteristic pitch tube of the black turpentine beetle is large (about 1 inch in diameter), and a large hole in the center often is indicative of a successful attack (Figure 5). In unsuccessful attacks, adults may become trapped in the resin.

Fresh pitch tubes are composed of a mixture of resin, boring dust and frass, resulting in a white to reddish color. Older pitch tubes turn grayish-red. Red and white boring dust and hardened resin often accumulate around the tree base (Figure 6).

These pitch tubes should not be confused with those produced by larvae of the southern pine coneworm, *Dioryctria amatella* (Hulst), which generally are higher on the trunk and usually much larger, with sap running down the trunk. The coneworm pitch tubes often are associated with callus tissue such as a fusiform rust canker.

Black turpentine beetles are attracted to potential hosts primarily by host odors, and turpentine is very attractive to the beetles. Once a female has located a suitable host and initiated boring, she releases frontalin. Males responding to the host odors orient to a female via her

Figure 5. Close-up of a black turpentine beetle pitch tube.

Figure 6. Pitch tubes and boring dust created by the black turpentine beetle.

release of frontalin, indicating frontalin serves as a sex pheromone. Males subsequently release endo- and exo-brevicomin. Though the role of these two pheromones in attack behavior has yet to be defined, they may signal other males that the female has a mate. Both sexes also produce trans-verbenol, verbenone, and myrtenol, which may be used in intra- and inter-specific communication. None of the beetle-produced pheromones appear to produce significant responses in the absence of host odors. However, previously infested trees are 12 times more likely to receive new attacks than are uninfested pines. The pheromones utilized by the black turpentine beetle are also produced by the southern pine beetle, and cross-attraction may occur. Black turpentine beetles often quickly attack pines recently colonized by the southern pine beetle, as well as pines on the periphery of active southern pine beetle infestations.

Females responding to host odors may bounce off the tree and onto the ground. This behavior may explain why the initial attacks are near the base of the tree. Attacks occur over a period of 4-7 months, with a mean of 28.6 attacks per tree. Only about 20% of the total attacks are generated in the first month. Not all attacks are successful, and up to 75% of beetles may be pitched out. Attacks by beetles increase in number and height on the trunk in subsequent months, with a majority occurring during the second and third months following initial tree colonization.

Life History

After mating, the nuptial pair (led by the female) begins construction of the egg gallery in the phloem layer on the face of the sapwood. Galleries may extend upward for a very short distance, but quickly turn downwards toward the roots, resulting in a question mark- or reverse J-shape (Figure 7). The galleries are typically about 0.5 inches wide, but may reach nearly 1 inch in width and 8-12 inches in length. Eggs are laid in clusters in grooves on one side of the gallery. Oviposition lasts about two weeks, and approximately 100 eggs are deposited. Larvae hatch in 10-14 days and begin constructing feeding galleries in the phloem. Gregarious feeding soon obscures individual galleries, and a fan- or D-shaped larval feeding area (up to 10 inches in width) is created (Figure 8). When the larvae are near maturity, they construct pupal chambers, often by backtracking into the area of consumed phloem (Figure 9). The pupal cells are usually located between the bark and the sapwood, but may lie completely within the corky bark. Pupae mature in 10-14 days, transforming into light tan "teneral" adults. The exoskeleton darkens and hardens within a few days, and the brood adults bore through the outer bark to locate a new host or re-infest the same pine tree. Parental adults also may reemerge and initiate new attacks.

The beetle can complete its life cycle in 2.5 to 4 months. The black turpentine beetle is univoltine in its northernmost range, while there are 2.5-3 generations per year in the southeastern United States. Generations overlap, and all life stages may be present in a tree or stand. The black turpentine beetle does not have a dormant phase, and adults may be captured year round. The majority of new attacks occur from spring through fall. Beetle development slows in cooler months, but activity continues whenever temperatures are sufficiently warm. All life stages may overwinter.

Figure 7. An egg gallery created by a female black turpentine beetle.

Adult flight typically peaks at dusk or in the early evening. During the warmer months, adults also may fly in the early morning. Rainfall and high winds may inhibit flight.

Impact

A small number of attacks may only weaken the tree. If the number of successful attacks increases over time, the gregarious larval feeding can girdle the phloem, obstructing nutrient flow. Moreover, infested pines often are inoculated with the blue-stain fungus *Leptographium terebrantis* Barras and Perry, carried by the beetles. The fungal growth interferes with nutrient and water transport. Heavily-infested trees typically die within 3-6 months, with foliage fading 3-7 months after initial attacks, depending upon environmental conditions.

Black turpentine beetle infestations are most frequent in areas affected by outbreaks of other insects and/or disturbed by logging operations, fire, or adverse climatic conditions such as drought or storms. Tree mortality generally is scattered, though small clusters of pines may be killed. During periods of high beetle populations, about 10% of a pine stand may be attacked, although many of the attacks are not fatal. Up to 25% of trees may be infested in areas of extensive logging or storm damage. Outbreaks usually subside after 1-2 years, although they can last 3-5 years.

In the past, the black turpentine beetle was a principal pest in slash and longleaf pine stands that were used for naval

Figure 8. Larval feeding area.

Figure 9. Pupal chambers of the black turpentine beetle.

store production, and the associated tree mortality had serious economic consequences. Over 30,000 ccf of timber was reportedly killed between 1951-1956. With the decline of the naval store industry, the black turpentine beetle has become primarily an urban problem. High-value, ornamental pines affected by soil compaction, drought, pollution, and/or other common stresses are susceptible to attacks. The costs for beetle control and the removal of infested trees may be substantial. In addition, the beetle has become a primary invader of landscape Japanese black pines in the northeast, causing widespread damage on Long Island and Cape Cod. Over 70,000 pines have been infested and removed in the region, causing significant economic and aesthetic impacts.

Natural Controls

Little information is available about the impacts of natural enemies on black turpentine beetle populations. Adults of the clerid beetle *Thanasimus dubius* (Fabricius) have been observed attacking the beetles, but the large size of the prey limits their success. Larvae of *T. dubius* probably prey on black turpentine beetle larvae present under the bark. Another common predator of black turpentine beetle is *Temnochila virescens* (Fabricius) (Coleoptera: Trogositidae). Nematodes, mites, ants, and other potential predators are present, but their contribution to beetle mortality has not been well documented. Black turpentine beetle larvae also must compete for food with other insects such as wood borers, pine engraver beetles, weevils, and termites. Periods of extended flooding may cause heavy beetle mortality as most of the population infests the lower portion of the tree. Under such conditions, infested pines may ferment or "sour", also leading to an unfavorable environment for brood.

Management Recommendations

Prevention

As the black turpentine beetle prefers weakened or damaged pines, prevention is the recommended strategy for reducing impacts. In forest settings, landowners should manage stands to reduce stress and enhance tree health. The appropriate species for the site should be planted, overstocking avoided, and damage to the residual stems during the thinning operations minimized. Thinning and other harvesting should be conducted during the cooler months if possible, and delayed when bark beetle activity is moderate to high. Damaged and declining pines should be harvested quickly. Prescribed burning should be conducted in a manner and on a schedule that lessens the likelihood of tree damage.

In urban environments, homeowners, arborists or urban foresters can help maintain tree vigor by providing good cultural conditions, including adequate watering during droughts and avoiding excessive watering at other times. Trees should be grown in areas with good drainage, avoiding soil compaction, root damage, or disturbance. Fertilizing should be done based on soil test results. Care needs to be taken while using mowers and string trimmers to not damage the base of trees. Provide adequate spacing between pines and keep turf or other competing vegetation away from the tree root zone; mulch or other ground covers are good alternatives. Trees should be planted so the root flare shows at ground level and soil is not piled on the roots of existing trees.

Direct Control

In the past, large-scale direct control efforts included spraying all stumps after harvesting with a combination of insecticide and diesel oil, plus the removal of all infested trees. In most instances the control costs exceeded the actual or potential economic losses caused by the beetle, so routine widespread spraying has been discontinued. Presently, the preventative measures detailed above are implemented, and infestations in forest stands are generally allowed to run their course. During severe outbreaks, large groups of trees may be harvested. The removal of scattered infested trees is discouraged due to the potential damage to residual pines during logging operations.

Since attacks occur at the tree base, homeowners or urban foresters may use chemical control to prevent or suppress infestation of high-value pines. An insecticide labeled for use against pine bark beetles should be selected. Some insecticide treatments may require a certified pesticide applicator. To prevent attack, two bark spray applications one month apart in the spring are suggested, starting just prior to the initial period of adult activity. The lower six feet of the trunk and buttress roots should be thoroughly sprayed; follow-up treatments may be needed if adults are active in summer. Sprays should penetrate to the root collar if possible, as some beetles may attack below the soil surface. On currently-infested pines, spray to the height of the highest pitch tube. Insecticide should be applied as soon as attacks are observed, before the larvae girdle the tree and the wood is heavily inoculated with bluestain fungi.

If only a few fresh pitch tubes are observed on high value pines, the parent adults may be removed before the female has laid eggs. Scrape away the pitch and expose the gallery until the adults can be located and removed. Temporary barriers can be installed around the base of pines vulnerable to infestation (stressed or with previous attacks) in urban situations to inhibit further attacks until tree vigor can be increased.

Additional Information

Private landowners can get more information from County Extension Agents, State Forestry Departments, or State Agriculture Departments. Federal resource managers should contact USFS Forest Health Protection (www.fs.fed.us/foresthealth/). This publication and other Forest Insect and Disease Leaflets can be found at www.fs.fed.us/r6/nr/fid/wo-fidls/.

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