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Nantucket Pine Tip Moth: An Insect Pest of Young Pine Stands

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Take home message: Nantucket pine tip moth is an insect pest that damages the growing tips of young pine trees. Management can be very difficult, as it has numerous generations per year, and control options are currently limited.

What is a pine tip moth?

The native Nantucket pine tip motha (NPTM), is a regeneration pest with a range throughout much of the eastern United States (Figure 1). NPTM causes reduced tree growth and stem form defects in loblolly pine (*Pinus taeda L.*), the most commercially important pine species in the southeastern US.[1] NPTM is the only tip moth species in the eastern United States that causes economic damage to commercial pine trees.[2] In the southeast, preferred hosts of NPTM are loblolly, shortleaf (*Pinus echinata* Mill.), and Virginia (*Pinus virginiana* Mill.) pines.[3] However, most attention is focused on NPTM damage to loblolly pine, due to its financial importance. Plants grown in monoculture (single species plantings) can be especially susceptible to insect pests, because abundant host resources are in proximity. In addition, with monocultures in general, there is a decreased diversity of natural enemies.[4] Lobolly pine stands are typically harvested every 20 – 30+ years, depending on the desired product. Unlike agricultural crops, growers do not have an opportunity to try again the next year if trees are seriously damaged or have the benefit of year-to-year knowledge of the financial benefit of management tactics. These forestry-specific limitations make it difficult to determine when NPTM management is a financially desirable choice.

Figure 1. *Nantucket pine tip moth adult.*

What are the signs of pine tip moth damage?

Damage to seedlings and saplings occurs during the NPTM larval stages (instars). First instars mine the needles, causing little damage, and damage is then caused by older instars boring into the vascular tissue of the shoots.[3] Obvious evidence of pine tip moth infestation typically includes resin flow on the bud or near the shoot terminal (Figure 2). However, with careful observation, NPTM tenting and resin droplets at the base of needles from 1st instars mining may be viewed earlier in the infestation. Tenting is a bit of webbing on the very tip of the pine shoot that is produced by second instar larvae (Figure 3).[3] Resin can coat the webbing, giving the tent an iridescent appearance. Once the larva enters the bud or shoot it is protected within the tissue of the plant. NPTM damage will cause the fresh green pine tip to turn brown and die once the vascular tissue is damaged (Figure 4).

Figure 2. *Evidence of Nantucket pine tip moth infestation on new pine growth.*

What is the lifecycle of NPTM?

Pine tip moths overwinter as pupae within pine shoots and emerge as adults in December to April, depending on the location.[5] Adults are crepuscular, meaning that they are most active at twilight.[6] After mating, females will lay eggs on pine needles and shoots. Larvae are initially cream colored with a black head. More mature instars develop a yellow to orange color and are 9-10 mm long at full maturity.[3] First instars will mine needles, while second instars feed on bud axils and produce the tent, which will be the first obvious sign of NPTM feeding.[5] Later instars enter the pine shoots where they feed in a protected location and damage the apical meristem, killing the bud. The larvae then pupate within the stem before emerging.[5]

Depending on the region, NPTM can have anywhere from two to five generations annually.[3] Temperature influences the number of generations NPTM has in a year.[7] Numerous generations per year means that there are numerous times for NPTM to negatively affect the growth of new pine tips.

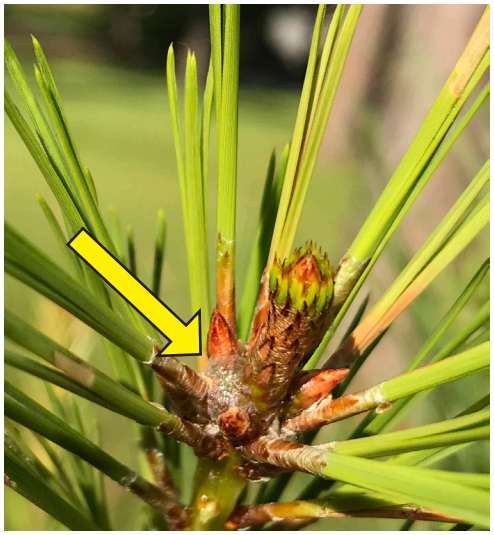

Figure 3. *Pine tip moth tenting.*

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Warnell School of Forestry & Natural Resources
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Figure 4. *Brown, dead pine tip.*

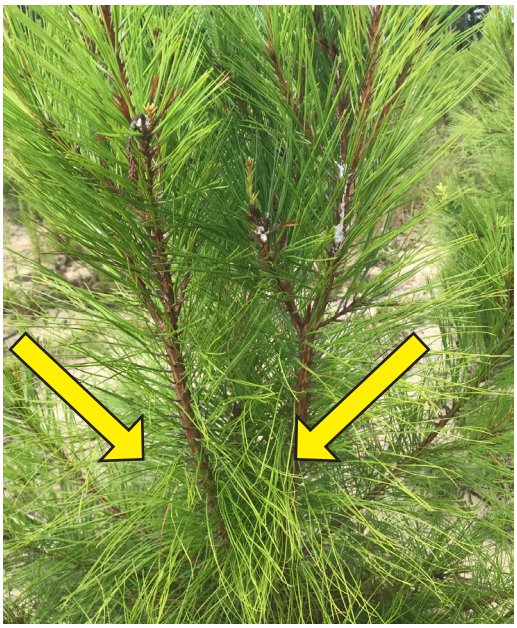

Figure 5. *Stem forking due to NPTM damage.*

Why is NPTM a problem?

Pine tip moth damage is problematic because once a tip is killed, the growth that was gained is lost. New tips will spring up during the next growth flush, but this can lead to less height and diameter growth and new shoots that are also susceptible to tip moth. A lateral tip may take apical dominance, but this can contribute to stem defects. Seedlings and saplings that are five years and younger are most susceptible to damage.[3] Symptoms from NPTM infestation include shoot die-back, reduced growth, stem forking (Figure 5), tree deformation, and in rare cases, tree mortality.[3,8] Decreased growth, volume, and wood quality can further decrease yields and profits for growers, adding to the need for suppression.[1,2,9] Over the years, there has been some debate over the long-term effects of early NPTM damage over the life of the tree crop.[2] However, the forest industry seems particularly concerned about potential NPTM impacts to profits from timber production.

Over the last 30-40 years, southern pine plantation management has become more complex with added investments like mechanical and/or chemical site preparation, herbicide treatments, fertilizers, and genetically improved seedlings to increase growth and yield of timber.[1,2,8] Heavily NPTM-infested pine plantations can therefore potentially incur significant economic damage by reducing growth and compromising the form of loblolly pines in high-investment plantation settings.

How can NPTM be controlled?

Effective suppression can be a difficult task, due to NPTM having numerous generations per year and feeding within the pine stem during part of their lifecycle. Contact insecticides have been used for NPTM suppression for decades. However, insecticide applications must be timed with the hatching of 1st instar larvae which feed unprotected on the needles. Although contact insecticides can be effective, timing can be very difficult, labor intensive, and costly.[10,11] Optimal spray time periods were developed to give land managers guidance on when to treat each NPTM generation based on location.[10] When this method was developed, the majority of predicted spray periods were effective in targeting the vulnerable stages of NPTM for each of the generations, subsequently improving volume gains of loblolly pine stands.[11]

The spray timing work was based on temperature data from 1950-2000, however, temperatures have increased since this time interval.[12] Thus, NPTM generation timing may now be shifting in response to climate variation. Little is known about how NPTM generation timing may be altered based on increases in temperatures.

One suggested tactic to make spray timing more effective is to only apply contact insecticides to the first NPTM generation each year. There is evidence that using this tactic for two consecutive years after pine planting can be as effective as spraying every generation throughout the year.[11] Later NPTM generations are less synchronous and can overlap, causing further issues with timing insecticide applications, making spray timing determination for multiple generations difficult.[13]

More recently systemic insecticides have been used for NPTM suppression. Systemic insecticides are applied to the soil, taken up through the roots, transported throughout the whole plant, and are effective longer than contact insecticides, thus removing some of the timing issues of contact insecticides. Imidacloprid and fipronil have been used for young pine trees and can be effective for NPTM suppression.[14,15] There is potential for systemic insecticides to enhance tree growth and vigor through the suppression of NPTM populations.[14,15] Despite having the option of both contact and systemic insecticides, definite thresholds for treatment have not been developed, and decisions on best management practices remain difficult.

How is University of Georgia working to assist growers with PTM management?

Pine tip moth control is currently an active area of research at the University of Georgia Warnell School of Forestry and Natural Resources. Current studies include: 1) assessing the effectiveness of four systemic insecticides, 2) environmental consequences of systemic insecticide use, 3) documenting changes in NPTM generation timing, and 4) susceptibility of different loblolly genetic lines to NPTM infestation. The results from these studies will provide timber managers, landowners, and scientists with the relevant and up-to-date information they need to responsibly manage NPTM and conserve the quality of loblolly pine trees.

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