Southern Pine Coneworm, *Dioryctria amatella* (Hulst) (Insecta: Lepidoptera: Pyralidae)¹

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Introduction

The southern pine coneworm, *Dioryctria amatella* (Hulst), also commonly referred to as a pitch moth, is consistently one of the most damaging insect pests of pine seed orchard crops throughout the southeastern United States (Ebel et al. 1980). Less well-recognized is that this widespread and frequently occurring insect also attacks a variety of other parts of pines (*Pinus* spp.) besides cones. Caterpillars can be found feeding on and in buds, male and female flowers, shoots, branches and stems of all ages and sizes, as well as in conelets (i.e., first-year cones) and second-year cones (Ebel 1965, Ebel et al. 1980, Goolsby et al. 1972).

The prevalence and variety of *D. amatella* infestations on forest and shade trees pines throughout the state periodically generates concern over the nature and impact of its injuries. The most noticeable symptom of infestations is large external masses of pitch exuding from the feeding sites of caterpillars, hence the name "pitch moth." Reddish-brown frass may also be evident at feeding sites and is often mixed with resin. Pitch masses caused by *D. amatella*

Figure 1. Adult and larvae of the southern pine coneworm, *Dioryctria amatella* (Hulst), on loblolly pine cone. Credits: Photograph by: R. Scott Cameron, International Paper, www.forestryimages.org

may resemble those of the black turpentine beetle (BTB), *Dendroctonus terebrans* (Oliv.); however, the coneworm pitch masses are usually larger, more irregularly shaped and flow for months. BTB pitch masses are typically less than 25 mm in diameter, have an obvious entrance hole, solidify in weeks, and are concentrated on the lower bole of large trees (Barnard and Dixon 1983, Goolsby et al. 1972).

1. This document is EENY-325 (originally published as DPI Entomology Circular 393), one of a series of Featured Creatures from the Entomology and Nematology Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Published: May 2004. This document is also available on Featured Creatures Website at <http://creatures.ifas.ufl.edu>. Please visit the EDIS Website at <http://edis.ifas.ufl.edu>. Additional information on these organisms, including many color photographs, is available at the Entomology and Nematology Department website at <http://entnemdept.ifas.ufl.edu/>.

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In addition to reproductive structures, susceptible host material includes: trees under stress, mechanically injured stems or branches, elongating shoots of long leaf (*P. palustris* Mill.) and slash pine (*P. elliottii* Englem.) during the spring, graft and branch unions, conelets infected with the southern cone rust fungus (*Cronartium strobilinum* (Arth.) Hedge & Hahn) and especially galls caused by the fusiform rust fungus (*Cronartium quercuum* (Berk.) Miyabe ex Shirai f. sp. *fusiforme*) (Barnard and Dixon 1983, Ebel et al. 1981, Goolsby et al. 1972). Other than the potentially significant losses that can occur in seed orchards due to the destruction of flowers, conelets and cones, damage is rarely severe or lethal to trees. The girdling effect of caterpillar feeding, however, can cause dieback of branches, terminals and tree tops, and additional weakening of previously damaged stems (Barnard and Dixon 1983). Feeding injuries also serve as infection courts for the pitch canker fungus, *Fusarium subglutinans* (Wollenw. and Reinking) Nelson, Toussoun and Aararas (Foltz and Blakeslee 1989).

Distribution

D. amatella occurs throughout Florida and likely can be found wherever its pine hosts are growing. The natural range of the insect extends across the southeastern U.S., from Maryland south to Florida and west into Texas (Ebel et al. 1980).

Identification

D. amatella is one of six species of pine coneworms found in Florida. Others include: the blister coneworm (*D. clarioralis* (Walker)), the webbing coneworm (*D. disclusa* Heinrich), the south coastal coneworm (*D. ebeli* Mutuura & Monroe), the loblolly pine coneworm (*D. merkei* Mutuura & Monroe), and the lesser loblolly pine coneworm (*D. taedivorella* Neunzig & Leidy) (Ebel et al. 1980). A seventh species, the bald cypress coneworm (*D. pygmaeella* Ragonot), is only known on junipers and cypress. *D. amatella* can be distinguished from these other species by the distinct characteristics of adults and larvae, and often via differences in damage and biology.

Figure 2. Adult southern pine coneworm, *Dioryctria amatella* (Hulst). Credits: Photograph by: R. Scott Cameron, International Paper, www.forestryimages.org

Adult moths of *D. amatella* have a wingspan of 27 to 32 mm, with dark grey, to brown, to nearly black forewings boldly patterned with multiple contrasting white patches and zig-zag crossbands. The hindwings are nearly uniformly light grey to tan in color. Larvae range from 1.5 mm upon hatching, to ca. 25 mm at maturity. When young, their bodies are nearly white with seven longitudinal stripes and a brown head. Older larvae are colored a dark reddish to purplish brown above and are a paler whitish green on the underside. Abdominal segments exhibit obvious beadlike patterns of small black pits and dark elevated setal bases (Ebel et al. 1980).

Biology

In Florida, the southern pine coneworm produces from one to four generations per year, depending on whether larval diapause occurs during the spring, early summer, or at all. The resulting abundant overlap of life stages among generations typically yields varying degrees of adult moth activity from early April through early November in North Florida (Merkel and Fatzinger 1971). The insect overwinters predominantly as early instar larvae, at the base of persistent cones, under bud scales and in fusiform galls on branches and stems. As larvae become active in January, they may continue to feed in overwintering sites or often migrate to feed on developing male and female flowers and vegetative buds. Following flower and bud feeding, larvae usually migrate a second time, infesting expanding shoots or young second-year cones during early spring. Once in shoots, larvae may undergo diapause,

Figure 3. Mature larva of the southern pine coneworm, *Dioryctria amatella* (Hulst). Credits: Photograph by: Harry O. Yates III, USDA Forest Service, www.forestryimages.org

complete their development or migrate again to young second-year cones. When larvae eventually pupate, *D. amatella* is the only pine coneworm in the South that does so within infested material (Ebel 1965).

In April and May, the next generation of caterpillars readily infests conelets infected with southern cone rust, as well as healthy second-year cones. These larvae, as well as those of subsequent generations, also may migrate from infested to uninfested cones before pupating. Later generations continue to infest second-year cones from summer through fall (Ebel 1965). This relatively complex cycle is depicted in figure below.

Host Plants

All species of *Pinus* native to the state are utilized as hosts by *D. amatella*. This list includes: loblolly (*P. taeda* L.), longleaf, pond (*P. serotina* Michx.), sand (*P. clausa* (Chapm. ex Englem.)), shortleaf (*P. echinata* Mill.), slash and spruce (*P. glabra* Walt.) pines. Virginia pine, *P. virginiana* Mill., which is sometimes ill advisedly grown in Florida for Christmas trees, is often infested by *D. amatella*. Eastern white pine, *P. strobus* L., is the only *Pinus* spp. which occurs in Florida that is not a suitable host (Ebel et al. 1980). Within slash pine, and probably other host species, individual trees exhibit pronounced differences in their inherent degree of susceptibility or resistance to *D. amatella* infestations (Merkel et al. 1965).

Damage

In cones, larval feeding causes damage ranging from evident tunnels to wholly excavated cavities within, resulting in partial to complete seed loss of infested individuals (Ebel et al. 1980). Other forms of damage are pictured, in part, in images below. Foltz and Blakeslee (1989) found that the abundance of *D. amatella* infestations in young, experimental slash pine plantations increased with the intensity of applied cultural practices (e.g., fertilization, competition control, and irrigation); and in the late 1990s, a four year-old long leaf plantation on a scalped agricultural field in Lafayette County exhibited an estimated 5% terminal dieback due to shoot infestations. The unknown ramifications of trends towards more intensive, high-yield management of many loblolly, slash and long leaf plantations may alter the pest status and management considerations for *D. amatella* in the future.

Management

Various insecticides are currently registered for and routinely used in intensively managed pine seed orchards to successfully prevent and/or minimize seed losses due to coneworms. The presence and timing of *D. amatella* and most other coneworms can be determined by using commercially available pheromone lures and traps. Without the use of insecticides in an integrated pest management system,

Figure 4. Diagram of major aspects of complete life cycle of the southern pine coneworm, *Dioryctria amatella* (Hulst) On loblolly pine, the cones-to-gall cycle (left) is typical; in slash and longleaf pines, a variety of additional host plant parts may be fed upon in the spring (from Hedlin et al. 1981). Credits: Hedlin et al. 1981

Figure 5. Mature larva of the southern pine coneworm, *Dioryctria amatella* (Hulst), feeding in second year slash pine cone. Credits: Photograph by: Bernard H. Ebel, USDA Forest Service, www.forestryimages.org

Figure 6. Damage to a mature pine cone, caused by feeding of the southern pine coneworm, *Dioryctria amatella* (Hulst). Credits: Photograph by: Larry R. Barber, USDA Forest Service, www.forestryimages.org

seed orchards in North Florida could expect to annually lose between 20 to 40% of their crop to coneworms (Goolsby et al. 1972). In most conventional forestry and shade tree settings, there is

little practical potential for insecticide use due to: the random nature of attacks, the inability of most insecticides to control existing infestations, the

Figure 7. Damage to an immature pine cone, caused by feeding of the southern pine coneworm, *Dioryctria amatella* (Hulst). Credits: Photograph by: Harry O. Yates III, USDA Forest Service, www.forestryimages.org

relatively limited impact of damage, and the high cost-benefit ratio.

Insect Management Guide for Commercial Forest Trees (<http://edis.ifas.ufl.edu/IG058>)

Insect Management Guide for Pine Seed Orchards (<http://edis.ifas.ufl.edu/IG057>)

Recommended management strategies include promoting and maintaining tree health and vigor, and removal and destruction of seriously infested and/or rust infected stems and branches. Avoid mechanical injuries to branches and stems because of *D. amatella*'s attraction to volatiles emanating from wounds (Hanula et al. 1985). In Florida, eight species of Hymenoptera (three braconids, three ichneumonids and two eulophids) and two species of tachinid flies have been reported as natural enemies of *D. amatella* larvae or pupae. It appears, however,

Figure 8. Bud and shoot damage following male flower injuries on longleaf pine due to feeding by larvae of the southern pine coneworm, *Dioryctria amatella* (Hulst). Credits: Photograph by: Bernard H. Ebel, USDA Forest Service, www.forestryimages.org

Figure 9. Attack on pruning wounds in a loblolly seed orchard by larvae of the southern pine coneworm, *Dioryctria amatella* (Hulst). Credits: Photograph by: Andrew J. Boone, South Carolina Forestry Commission, www.forestryimages.org

that the combined impact of these parasitoids is not enough to substantially reduce or control populations of this coneworm (Belmont and Habeck 1983, Ebel 1965).

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