LIFE HISTORY OF THE SLASH PINE SEEDWORM.
LASPEYRESIA ANARANJADA MILLER
(LEPIDOPTERA: OLETHREUTIDAE)

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INTRODUCTION

The initiation of forest tree improvement programs in the South has led to the establishment of numerous intensively managed pine seed orchards since the early 1950's. These orchards, composed of genetically superior trees, will some day provide most or all of the seed needed for reforestation.

Coincident with the new tree improvement programs have been intensified studies of insects which directly and indirectly affect the seeds of southern pines. Because of the high cost of silviculture and protection required in pine seed orchards, many insects that were formerly considered as mere nuisances in natural forested areas have now become recognized as economic pests. Such an insect is the slash pine seedworm, Laspeyresia anaranjada Miller. It is estimated that seed losses caused by this insect on open-grown slash pines in northeast Florida vary from 2 to 10% annually.

Slash pine seedworm appears to be an appropriate common name for L. anaranjada because extensive rearings from cones of major southern pines showed that it occurs principally on slash pine, Pinus elliottii Engelm.; occasionally on longleaf pine, P. palustris Mill.; and rarely on loblolly pine, P. taeda L. Merkel (1963) found that L. anaranjada occurs in the southern United States throughout the natural range of both typical slash pine and the South Florida variety, P. elliottii var. densa Little & Dorman.

DESCRIPTION OF STAGES

Egg.—Eggs are flattened dorso-ventrally and ovate in shape, averaging 0.78 mm in length and 0.52 mm in width. The surface of the egg has very fine, shallow, irregular, surface sculpturing. Eight eggs, held in an incubator at 21° C and 70 to 85% relative humidity, hatched 7 days after deposition. These eggs turned from a creamy white to a bright pink color on the third day after deposition. By the fourth day, the dark larval head capsule was discernible through the chorion.

Larva.—Larvae are cylindrical-elongate in shape. The mature larva, in particular, resembles a cerambycid wood borer larva because of the large fleshy prothorax, which nearly conceals the head (Fig. 1A). The last instar larva has a yellowish-brown head with brown to black coloration of mouth parts and adfrontal region. The dorsum of the prothorax is often colored with irregularly shaped patches of very pale yellow or brown. The mesothorax, metathorax and abdomen are white. Except for almost colorless setae on the head and last abdominal segment, setae are sparse on the mature larva.

The head capsule width of 11 first instar larvae averaged 0.162 mm (± 0.004 mm), whereas similar measurements of 26 last instar larvae averaged 1.321 mm (± 0.064 mm). The total number of larval instars was not determined for this insect.
Fig. 1—Laspeyresia anaranjada Miller: (A) mature larva; (B) pupa—dorsal view; (C) pupa—ventral view.
Pupa.—The pupa (Fig. 1B, 1C) is slender, pale amber, 8.5 to 10.5 mm long, with rows of posteriorly directed spines on the dorsal surface of the abdomen. The row of spines along the posterior edge of the dorsum of each abdominal segment is more or less umiordinal, whereas the row of spines near the anterior dorsum of each segment is multiordinal. There are long, hooked setae on the terminal abdominal segment.

Adult.—The adult of *Laspeyresia anaranjada* (Fig. 2), described by Miller (1959), has a wing expanse of 14 to 16 mm, and the fore wings are yellowish orange to rusty orange. This wing color is unique among known North American species of the genus.

**Life History and Habits**

*L. anaranjada* requires 1 full year to complete its life cycle (Fig. 3). Larval diapause for 1 or more years has been reported for *L. youngana* (Kft.) (Tripp 1954), *L. toreuta* (Grt.) (Lyons 1957), and *L. ingens* (Hein.) (J. F. Coyne, Personal communication).

Fig. 2.—*Laspeyresia anaranjada* Miller adult.
The time and duration of moth emergence was determined by collecting mature slash pine cones of the previous year's crop in March and placing them in screened cages on the ground under trees where they would lie normally. Emergence data were obtained for consecutive years, 1959-1962, in Baker County in northeast Florida. The dates of earliest moth emergence did not vary by more than 5 days during the 4 observation years; the earliest date being 27 April and the latest 1 May. In 1959 and 1962, moth emergence was completed in 21 days; in 1960 and 1961, emergence was completed in 26 days. In 1959, peak moth emergence occurred 10 days later from cones held in an insectary than from cones in field rearing cages.

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Fig. 3.—Life cycle of *Laspeyresia anaranjada* Miller on second-year slash pine cones in North Florida.

In the field, moths emerged between 10:00 AM and sunset. Males and females emerged in almost equal numbers throughout the emergence period. In 1961, the first eggs were found 4 days after the start of moth emergence, and moths in the insectary rarely lived longer than 4 days. Mating was not observed in the field or laboratory. Based on the above observations, however, it was hypothesized that mating and oviposition occur within a day or two after moths emerged. At the height of moth emergence, adults were observed resting during the day on pine needles and the sides of field rearing cages.

In field rearing cages that received 4 hours or less of direct sunlight per day, moth emergence occurred later in the day (late afternoon), was of longer duration, and resulted in fewer moths than the total emergence found in cages that were exposed to more than 4 hours of direct sunlight. The differences in moth emergence between exposed and shaded cages were probably caused largely by excessive moisture in the shaded cages. The scales of slash pine cones on the ground close almost completely each night because of high humidity. Cone scales are completely opened by 10:00 AM when cones receive direct morning sunlight, thus permitting the newly emerging moths to escape between the opened scales. The scales of shaded cones, however, will remain closed after a heavy rain for as long as 2 or 3 days. Thus high humidity and direct wetting of cones not only delay moth emergence during the day but also extends the overall emergence period.

Eggs are usually laid singly on second-year cones, but when clusters of three or four eggs are laid, they overlap like roof shingles. Most eggs are
found in the middle third of the cone. Specifically, eggs are deposited in the shallow groove near the blunt spine on the cone scale between the umbo and apophysis, or at the point where scales commence growth during the second year of development (Fig. 4).

Fig. 4.—Single egg (at arrow) of the slash pine seedworm laid near apical spine on surface of cone scale.

After eclosion, first instar larvae wander over the surface of the cone. The duration of the wandering period has not been determined precisely, but it is probably less than 24 hours. It is during this relatively short time on the cone surface that the insect is most vulnerable to parasites, predators, and insecticides.

The first instar larva bores into the cone, either in the crevice between two adjacent cone scales, or through the green portion of the scale apophysis. Larvae make a zigzag gallery along the upper or lower scale surfaces and enter the seed. The seeds have a leathery but still succulent seed coat in mid-May when the first seed is entered. After the endosperm of the first seed is completely consumed and filled with frass, the larva bores laterally into an
adjacent seed. Sometimes larvae bore from one seed to another seed, above or below the last one fed upon, rather than from one adjacent seed to another. The tunnels between seeds are lined with tightly woven silken threads. Each larva consumes from five to seven seeds during its development.

Hollowed-out seeds are usually attached firmly to the cone axis by tough, silk-lined larval tunnels. These damaged seeds can be seen between the opened cone scales (Fig. 5) from the time normal seeds fall until the cones deteriorate, sometimes up to 2 or 3 years later. This is the only visual, external evidence that a cone is, or has been, infested.

Soon after slash pine cones have ripened and released their seeds in mid-September, the mature larvae bore directly from the last seed eaten into the woody cone axis (Fig. 6). The larva remains inactive in this gallery until early April of the following year.

In early April, larvae prepare for pupation. The mature larva first removes the frass from the seed from which the axis (overwintering) gallery
originated. The frass is transferred to the distal end of the axis gallery. Then a circular exit hole is cut through the seed coat, but the hole is kept closed with the circular section of the seed coat. This circular cap is held firmly in place by silk threads from within, and it is difficult to locate on the external surface of the seed, even with the aid of a microscope.

Just prior to moth emergence, the pupa forces its way up the axis gallery, a process which is facilitated by the numerous, dorsal, caudally directed, abdominal spines. The pointed head of the pupa pushes aside the circular cap in the seed, and about two-thirds of the pupa's length projects out of the exit hole in the seed. After splitting the pupal exuvia along the mid-dorsal line of the head and thorax, the moth emerges between the open cone scales.

**Natural Enemies**

No intensive studies were made of the effects of insect predators and parasites on populations of *L. anaranjada*. Microscopic examination of 174

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**Fig. 6.**—Mature slash pine cone bisected longitudinally to show overwintering galleries of mature larvae in cone rachis. Note that gallery originates at last seed (A) hollowed out by larva—the exit hole for the pupa is also made in this same seed by the mature larva in early April.
eggs during the 1962 oviposition period, however, showed that 15% had been parasitized by an unidentified chalcidoid wasp.

The parasite encountered most frequently was the braconid, Phanerotoma fasciata Prov. It has not been determined whether the host egg or larva is parasitized, but P. fasciata pupates immediately prior to pupation of the host. Fig. 7 shows how precisely the emergence of P. fasciata adults is timed with host moth emergence. Even though this parasite undoubtedly exerts some influence in regulating seedworm populations, it does not prevent seedworm larvae from destroying seed.

Fig. 7.—Daily adult emergence of Laepyrodes anaranjada and its larval parasite, Phanerotoma fasciata, from infested slash pine cones at Olustee, Florida, 1959-1960.
Literature Cited


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