European Pine Shoot Moth

William E. Miller,[1] Arthur R. Hastings,[2] and Valentine M. Carolin [3]

In 1914 the European pine shoot moth (*Rhyacionia buoliana* (Schiff.)) was discovered to be in the United States attacking ornamental Scotch pine (*Pinus sylvestris* L.) on Long Island, N.Y. Surveys that year showed that it was present in nurseries and on estates in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, West Virginia, Ohio, and Illinois.

The shoot moth spread rapidly as a result of the movement of infested nursery stock in vigorous forest planting programs. Today the largest continuous area of shoot moth infestation covers the northeastern United States and adjacent Canadian Provinces (fig. 1). Its limited occurrence in Oregon, Washington, and British Columbia is chiefly outside the pine region, but movement of infested ornamentals poses an increasing hazard to natural pine stands.

Host Trees

The European pine shoot moth has caused much damage in young plantations of red pine and has been responsible for curtailed planting programs in some areas. Although attacked trees rarely die, their growth is inhibited and many become deformed. Ponderosa pine (*Pinus ponderosa* var. *ponderosa* Laws.) planted in the East has been injured to nearly the same extent as red pine. Susceptibility of ponderosa and lodgepole (*P. contorta* Dougl.) pines to shoot moth injury under natural stand conditions in the West is now being tested. Scotch Pine and Austrian pine (*P. nigra* Arnold) are usually not as badly damaged as red pine. Swiss mountain pine (*p. mugo* Turra) may be severely attacked, but the resulting dense, bushy growth does not seriously affect the appearance of this ornamental tree. White pine (*P. strobus* L.) jack pine (*P. oanksiana* Lamb.), and other

[1] Principal insect ecologist, North Central Forest Experiment Station, which is maintained by the Forest Service, U.S. Department of Agriculture in cooperation with the University of Minnesota.

[2] Entomologist, Northeastern Area, State and Private Forestry, Forest Service, U.S. Department of Agriculture.

[3] Principal entomologist, Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture.

U.S. DEPARTMENT OF AGRICULTURE
Forest Service
Revised November 1970

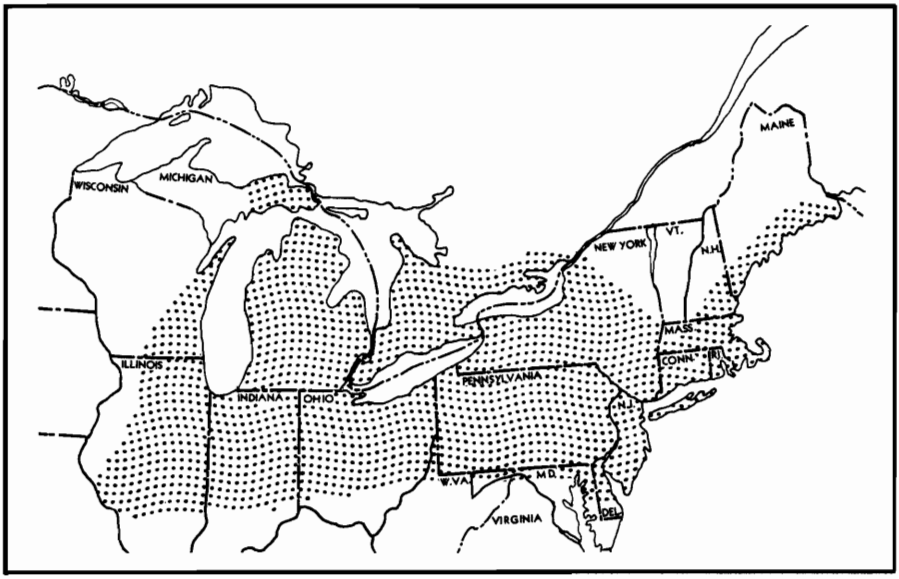

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Figure 1.—Distribution of the European pine shoot moth in northeastern United States and adjacent Canada.

pines are occasionally attacked when near infested plantings of the more susceptible pines.

Evidence of Infestation

Summer and Winter.—The newly hatched larva spins a minute, tentlike web, coated with resin and debris, on the current year's growth between a needle sheath and stem. The larva then bores through the needle sheath and mines the base of the needle. Damaged needles usually turn yellow or brown by late summer. As the larva grows, it moves to a bud for feeding, forms another tent there, and coats it with resin and debris. The fresh resin on tents may make them glisten on bright days. Later, the resin becomes the solidified, yellowish-white mass characteristic of shoot

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Figure 2.—Red pine tip with solidified resin mass broken open to show a partly grown larva.

moth infestations in late summer and during the winter (fig. 2).

Spring.—The larva spins still another, but larger, tent upon issuing from hibernation. The spring tent is spun between two or more buds or needle sheaths. It also is coated with resin and debris. In early spring it may glisten in the sunlight and thereby be conspicuous. The resin solidifies by late spring, forming a yellowish-white mass.

Other evidences of shoot moth infestation are the various types of damage discussed in the following paragraphs.

Damage

Severe infestation of trees by the European pine shoot moth inhibits height growth, causes deformations, and thereby lowers the value of future products. Value losses in red pine occur especially in the first and second commercial thinnings, but in time, many trees overgrow damage.

When the terminal and lateral buds on a leader are killed by the shoot moth, a dead spike top (fig. 3) may result. Fascicle buds often develop from the shoot below this point, forming a dense growth or bush (fig. 3) the following season. Sometimes when the terminal bud is killed, several lateral buds develop into competing leaders, resulting in a forked stem (fig. 4). When a new shoot is weakened to the point where it falls over yet continues to grow, a severe crook (fig. 5) develops. Larval feeding on only one side

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Figure 3.—Badly damaged red pine stand showing spiked and bushy tops.

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Figure 4.—Forked trunk of a red pine tree, caused by European pine shoot moth.

of a bud can also lead to crook formation.

Life History and Description

In June and July, disk-shaped eggs a little smaller in diameter than the width of a red pine needle are deposited, sometimes in overlapping groups, on the twigs, buds, and needles of the tree. At first the eggs are yellow, but later they turn orange and then brown. Hatching occurs a week or two after deposition.

After the summer's feeding the larva hibernates on the host tree

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Figure 5.—Recently developed crook in a a red pine tree.

inside a bud or mass of pitch. When hibernating, it is about 1/5 inch long and dark brown. The first signs of spring feeding are found during April, when the larva leaves its overwintering site and bores into another bud. By late May or early June, the larva is full grown and about 5/8 inch long. Its body is light brown, and the head and the plates just behind the head and near the tail end are black.

The larva changes to a pupa in late May or June inside its burrow or resinous tent. The pupa is reddish brown and about 3/8 inch long. Two or three weeks later the pupa forces itself part way out of its chamber just before emerging as an adult moth.

The orange forewings of the moth are marked with several irregular, silvery lines (fig. 6), and the hindwings are gray. The wingspread is about 3/4 inch.

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Figure 6.—European pine shoot moth adult resting on a shoot.

Usually within 24 hours after they emerge, the adults mate and the females begin laying eggs. The egg-laying period lasts for several weeks. During the day adults remain at rest on the trees, flying only when disturbed. They fly spontaneously and vigorously at dusk.

Control

Natural and Cultural.—Winter weather is an important regulator of shoot moth populations. Freezing temperatures may or may not kill a larva, depending on the previous temperatures to which the larva was exposed. However, temperatures below —22° F. for only part of a day are lethal to all overwintering larvae. Snow cover may nullify otherwise lethal temperatures by insulating larvae on the lower branches. If lower branches are removed to a height of 2 or 3 feet above ground—a practice termed "snow-depth pruning" (fig. 7)—winter mortality of the shoot moth will usually be increased, sometimes dramatically. Pruning every tree in a plantation is not necessary. The reduction in population is proportional to the number of trees pruned.

Less injury occurs on sites where pine growth is rapid (fig. 8). On sites where growth is expected to be slow, pines less susceptible to shoot moth attack should be planted. In the East, the less susceptible kinds include Austrian, Scotch, eastern white, and jack pines.

Clipping infested shoots after mid-June will reduce shoot moth populations. The incidental clipping of infested shoots in pine Christmas tree shaping or shearing operations achieves the same result. The longer this practice is delayed after mid-June, the more effective it is. Summer-clipped shoots may be allowed to remain on the ground with little danger that the larvae in them will move back to trees. Shoots clipped in the spring must be destroyed because the insect can complete its life cycle in them and contribute to a new insect generation.

Several parasitic wasps that normally attack other insects in eastern North America also attack eggs, larvae, and pupae of the shoot moth. In addition, several species that attack the shoot

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Figure 7. — Bottom whorls of branches being removed in a young red pine planting for shoot moth control.

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Figure 8.—Areas of good and poor growth of red pine in the same plantation. The taller trees (left) are growing more than 15 inches a year, and they show practically no European pine shoot moth damage. A number of the shorter trees (right and foreground), which are growing less than 15 inches a year, have been damaged.

moth in Europe have been introduced. However, none of these is yet considered important in control of the shoot moth.

Chemical.—Direct control of the European pine shoot moth is difficult and expensive. To be effective, heavy dosages are necessary to adequately deposit insecticide around needle bases and buds. Use a spray made by mixing into 100 gallons of water 1 quart of dimethoate emulsifiable concentrate containing 4 pounds of active ingredient per gallon.

Spraying may be done in the spring or summer. In spring, spray when the partly grown larvae start to feed (usually in mid-April). In summer, spray when the newly-hatched larvae start to feed (usually in late June or early July). The appearance of the resinous tents described earlier is a useful indicator of feeding in both seasons.

Control in Nurseries

Planting stock should be insect-free. Despite the most careful inspections, some infested seedlings may escape detection. Therefore, removal of infested stock should not be relied upon as the only control measure in the nursery.

To control the insect in nursery beds, spray stock with the dimethoate mixture already described. About 100 gallons of the mixture will treat an acre of nursery beds.

Methyl bromide has shown promise for fumigating red pine seedlings. Tests to date have not been complete enough to qualify this method for recommendation, however.

Caution

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or when they may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

Warning:

Recommendations for use of pesticides are reviewed regularly. The registrations on all suggested uses of pesticides in this publication were in effect at press time. Check with your county agricultural agent, State agricultural ex-

periment station, or local forester to determine if these recommendations are still current.

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☆U.S. Government Printing Office: 1970 O — 397-335

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