Zimmerman Pine Moth

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The Zimmerman pine moth, *Dioryctria zimmermani* (Grote), is native to North America. It has been reported from the Mexican border to Canada but appears to be more common and more destructive in the northern half of the United States and the adjacent southern areas of the Canadian Provinces.

This insect infests the tips of pine branches and the main stem. The injury not only retards growth but deforms the tree.

Hosts

The Zimmerman pine moth attacks Scotch, Japanese red (*Pinus densiflora* Sieb. & Zucc.), red, ponderosa, eastern white, jack, mugo (*P. mugo* var. *mughus* [Scop.] Zenari), and Austrian (*P. nigra* var. *austriaca* [Hoess] Aschers. & Graebn.) pines. Attacks have been reported on a few less important species of pine.

Scotch and Japanese red pine are particularly susceptible to attack. Trees of all sizes are attacked, but young trees in plantations are most vulnerable. Poorly stocked stands receive heavier attacks than do well-stocked stands.

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Damage

Zimmerman pine moth larvae feed inside the terminal shoots and mine the inner bark anywhere on the main stem. Discernible signs of attack on terminals are accumulations of coarse "sawdust" in loose webbing at the bases of branches in the top whorl. Terminal shoots later turn brown and may break off (fig. 1). Extensive terminal feeding results in a dead top.

Attacks on the main stem are indicated by pitch masses at points where the larvae bore into the bark (fig. 2). Fresh pitch masses are shiny and sticky. Stem mining may kill a few adjacent branches or part or all of a tree, depending upon the degree, location, and duration of attack. A partially girdled whorl may be so weakened that the tree breaks off at the point of injury. The stem on a surviving tree may be constricted, crooked, or forked at the injured points. Heavily injured trees may have a burllike growth on the trunk above the girdled area (fig. 3). The wood of injured trees becomes densely impregnated with resin.

Description

The egg of the Zimmerman pine moth is ovoid, slightly flattened beneath, and lightly patterned above. It is about one thirty-second of an inch long. A freshly laid egg is creamy white. As the embryo develops, the egg turns pink and grad-

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Figure 1.—Zimmerman pine moth damage on the top upper whorl

ually becomes reddish brown before hatching.

The young larva is light reddish brown at first but turns darker with age. The full-grown larva (fig. 4) is three-fourths to 1 inch long and has a brown head. Body color, which varies among individuals, ranges from light gray to pink to greenish yellow. The color is related to the host species and food supply. Rows of dark spots, each with a single bristle, adorn the sides and top of the body.

The pupa is light brown when newly formed but darkens to deep brown or black at maturity (fig. 5). Its length varies from one-half to three-fourths of an inch.

The adult moth has a wing expanse of 1 to 1½ inches (fig. 6). The forewings vary from gray to black with red markings and light- and dark-gray zigzag lines. The hindwings are tan or pale yellow, the color intensifying at the margins.

Life History and Habits

Most information on the Zimmerman pine moth has been collected in the Northern United States. In this area there is only one generation per year.

Adults emerge from the tree between the end of June and mid-September. They are not often seen because they remain concealed in the foliage or vegetation near the tree during the day, becoming active in the evening after sunset. Mating occurs at night. After mating, the females lay their eggs singly or in pairs on the underside of bark scales, in cracks in the bark, and on

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Figure 2.—Pitch masses on main stem of pine at the point where larvae bore into the bark.

branch tips. Areas around wounds, cankers, galls, and sapsucker feeding sites appear to be preferred. Some females may lay as many as 80 eggs, but the average is around 20.

After 7 to 10 days on the tree, the eggs hatch. Some larvae may move to, and feed briefly on, the bark at the base of the terminal buds; but most immediately seek sheltered areas. There they spin silken hibernacula (protective winter coverings) and remain in them until the following spring. The larvae emerge from early April to early May and bore into the bark of stems and terminals, where they feed and mine until sometime in July. Although they feed singly, as many as 20 larvae may be found in a single whorl of a heavily infested tree. Pupation occurs between early and late July. The larva constructs a pupal chamber just under the bark and prepares an escape hole by chewing the bark to a very thin cap.

The adults appear about 15 to 23 days after pupation.

Figure 3.—A burllike growth on the trunk of a Scotch pine caused by extensive girdling of Zimmerman pine moth larvae. (Photo 26960–1, courtesy of Michigan State University.)

Similar and Associated Insects

Larvae of *Dioryctria abietella* (D.&S.) (=*abietivorella* (Grote)) resemble larvae of *D. zimmermani* and are often associated with them. Their life cycles differ, however; more fully developed larvae of *D. abietella* are found in the fall and winter. Another insect, *D. cambiicola* Dyar, is almost identical to *D. zimmermani* in most stages but has a slightly different hindwing coloration in the adult stage. Some entomologists consider *D. cambiicola* a race of *D. zimmermani.*

Damage caused by several other insects may be confused with Zimmerman pine moth damage. Terminals injured by the European pine shoot moth (*Rhyacionia buoliana* [Schiffermüller]) resemble terminals injured by *Dioryctria zimmermani.* The pitch mass borer (*Vespamima pini* (Kellicott)) and a beetle of the family Buprestidae produce pitch masses on the stems of pines. The pitch mass of the beetle is pink or reddish in contrast to the white mass of *D. zimmermani* and *V. pini.* The larvae of the European pine shoot moth, the pitch mass borer, and the Buprestid beetle differ considerably from those of *D. zimmermani.*

Natural Control Agents

Several species of hymenopterous parasites and a single dipterous parasite have been reported attacking the egg, larval, and pupal stages of the Zimmerman pine moth. Up to 45-percent parasitization by *Tricho-*

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Figure 4.—Full-grown larva of the Zimmerman pine moth.

gramma minutum Riley has been reported in the egg stage. The early larval stages, when the insects are protected inside the tree, are rarely parasitized. However, parasitization of full-grown larvae is comparatively high. One reason may be that, while preparing the pupal chamber and the adult escape hole, may larvae remove too much bark; thereby leaving a small hole that permits easy access by the parasites.

The two most prevalent parasites of the immature stages are *Exeristes comstockii* (Cress.) and *Hyssopus rhyacioniae* (Gah.). Parasitization of larvae or pupae has exceeded 40 percent in some localities, but generally it is much lower. At present, parasitization alone in any of the insect's stages has not been sufficient to control this pest.

Predators have rarely been observed attacking the Zimmerman

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Figure 5.—Pupa of the Zimmerman pine moth.

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Figure 6.—Adult of the Zimmerman pine moth.

pine moth. Spiders kill some adults, and woodpeckers have been reported to be efficient predators.

Some mortality of larvae from disease has been observed, but not enough to alter the general population level noticeably.

Chemical Control

Control of 95 percent or more of the larvae may be obtained by spraying with a mixture of 12 ounces of endosulfan (emulsifiable concentrate) in 100 gallons of water.

The solution is applied as a stem-drench spray with a hydraulic sprayer. Thorough wetting of the tree bark is absolutely necessary.

Spraying is timed to kill the young larvae before they penetrate the bark. It is most effective if solutions are applied just before the larvae emerge from hibernation in the spring. Emergence of larvae from their winter sheaths varies with locality but usually occurs between early April and early May in the North.

Pesticide Precautions

Pesticides used improperly can be injurious to man, animals, and plants. Endosulfan is poisonous to man and animals and should be handled with care. Wear rubber gloves when mixing the recommended spray. Do not let the insecticide contact the eyes, nose, or mouth. 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 experiment station, or local forester to determine if these recommendations are still current.

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