49. Seed and Cone Insects

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Hosts

Seed and cone insects are not nursery pests in the strict sense; they are seldom found on nursery trees. They are important because they destroy seed available for planting in nurseries. These insects are mostly conifer pests, but some affect hardwoods. Most conifer nurseries rely on seed grown in managed seed orchards that are located in the South and Pacific Northwest; some are in the upper Midwest. Insects damage acorn crops in Southern oak orchards.

The major conifer seed and cone insects are the coneworms, *Dioryctria* species (fig.49.1); cone beetles, *Conophthorus* species (fig. 49.2); seed bugs, *Leptoglossus* species (fig. 49.3); seed worms, *Cydia* species; gall midges, *Contarinia* species; cone borers, *Eucosma* species; and cone moths, *Barbara* species. Weevils, *Curculio* species (fig. 49.4), and the filbertworm, *Cydia latiferranea*, attack oak acorns and other hardwood seeds.

In the South, loblolly, longleaf, slash, and shortleaf pines are hosts. The primary pests are the leaffooted pine seed bug, *L. corculus,* and five coneworm species. Additional pests include the shieldbacked pine seed bug, *Tetyra bipunctata*, and several seed worm species. Slash pine is also attacked by the slash pine flower thrips, *Gnophothrips fuscus*. A serious eastern white pine pest is *Conophthorus coniperda*, the white pine cone beetle.

In the Western States, Douglas-fir, western hemlock, western redcedar, and western larch are hosts, as are ponderosa, lodgepole, sugar, western white, and other pines. The western conifer seed bug, *L. occidentalis*, is a Douglas-fir, pine, and grand fir pest. Several coneworm species attack Douglas-firs, true firs, and pines. The Douglas-fir cone gall midge, *Contarinia oregonensis*, is a serious pest in Douglas-fir seed orchards, along with the Douglas-fir seed chalcid, *Megastigmus spermotrophus*.

Figure 49.1—*Larva and adult of the southern pine coneworm,* Dioryctria amatella*, on an infested loblolly pine cone. Larval feeding has partially destroyed the cone.* Photo by Larry R. Barber, USDA Forest Service, at http://www.bugwood.org.

Figure 49.2—*A female cone beetle,* Conophthorus *species, excavating a gallery along the axis of a developing pine cone. She will deposit eggs along the gallery.* Photo by Steven Katovich, USDA Forest Service, at http://www.bugwood.org.

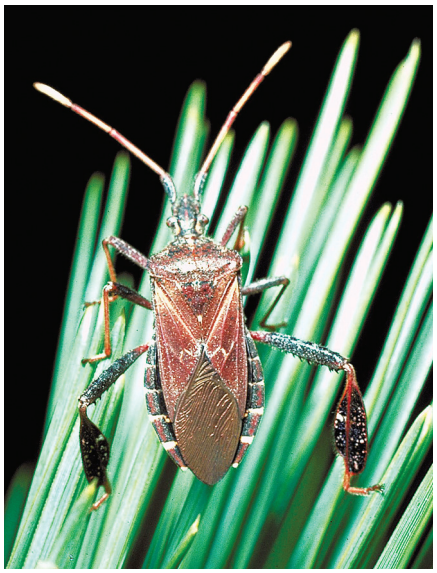

Figure 49.3—*An adult female leaffooted pine seed bug,* Leptoglossus corculus*, on pine needles.* Photo by R. Scott Cameron, Advanced Forest Protection, Inc., at http://www.bugwood.org.

Figure 49.4—*An adult female curculio weevil,* Curculio *species, on a young acorn. She will use her elongated mouthparts to excavate a hole in the acorn and deposit eggs.* Photo by Larry R. Barber, USDA Forest Service, at http://www.bugwood.org.

Distribution

Seed and cone insects are found wherever their host tree species occur. Some species are host-specific such as the Douglas-fir cone gall midge and Douglas-fir seed chalcid. Other species have a wide geographical distribution and feed on multiple hosts; for example, the western conifer seed bug.

Seed and cone insects can be divided into two geographic groups, those present in the Western and Northern States on pine, spruce, fir, and Douglas-fir and those found in the Southern and Atlantic-Coastal States, primarily on pines. For example, *L. occidentalis* is found in the West and *L. corculus* (fig. 49.3) inhabits the Southern States. Both species are similar in appearance and behavior but have disjunct distributions. Similarly, distinct coneworm species groups occur in the West and South.

The filbertworm is found throughout the country on various oak and hickory species. Several curculio weevil species are present across the country.

Damage

The damage is a lost or reduced seed crop. Damage occurs on either the cones, the seeds, or both. Most damage is done by the larval stages, which is particularly true for cone beetles, coneworms, seed worms, and cone borers. Some species feed on the developing cone and incidentally destroy seeds. Some species feed on cone and seed tissues as they move from seed to seed. Other pests develop entirely within a seed. Damage is either external or internal.

External damage includes dead or dying cones (fig. 49.5), dead or damaged flowers and conelets, galls, abnormal development, and feeding damage. Frass and webbing may be present. Male flowers can be damaged or deformed. Internal damage can be seen when the cone or conelet is cut or broken apart. Internal damage includes dead tissue, frass, or galls. Frass (solid larval excrement) and webbing may be present; the larva(e) may often be seen. Damaged seeds may be discolored, shrunken, or stuck to galls. Internally, seeds may be empty, or display shrunken or dead contents.

Diagnosis

Externally, look for dead and dying cones, discolored cones, dead flowers, and conelets and distorted or abnormal cones. Keep in mind the host species biology; insect life cycles are tied to host phenology, and damage can occur at specific cone development stages. Damage may occur in more than one host stage; for example, coneworms can damage both first-year and second-year cones in pines.

Figure 49.5—*Damage caused by* Conophthorus ponderosae*, a cone beetle. The white pitch tube at the bases of the cones indicates where the attacking female entered.* Photo from USDA Forest Service, Ogden Archive, at http://www.bugwood.org.

Look for specific indicators. Coneworms are indicated by frass and webbing presence on damaged cones or conelets (fig. 49.6). In southern pines, coneworm-killed conelets break apart easily to reveal frass and webbing. When cones occur in clusters, the coneworms will progressively kill each cone in the cluster. Cone borer damage is similar to coneworm damage but frass is more tightly packed. Cone moth damage is also similar to coneworm damage but pitch is more abundant in the frass. Cone beetles usually enter at the cone base; a pitch tube is often present. For the Douglas-fir cone gall midge, cone scales die and turn red in July or August.

To diagnose internal damage, one must cut open the cone, seed, or acorn. In some instances, seed can be radiographed to assess damage. Again, look for specific indicators. Seed bug damage results in empty or partially filled seeds. Empty seeds show up clearly in radiographs (fig. 49.7). Similarly, Douglas-fir seed chalcid larvae can be seen within seeds on radiographs. Also, a distinct exit hole is made by the emerging chalcid wasp. Cone beetles can be found in cones and appear as white, legless, C-shaped larvae with brown heads or as distinctive pupae. The filbertworm appears within acorns as a reddish larva surrounded by coarse frass and webbing. Curculio weevils appear as legless, C-shaped larvae with densely packed frass.

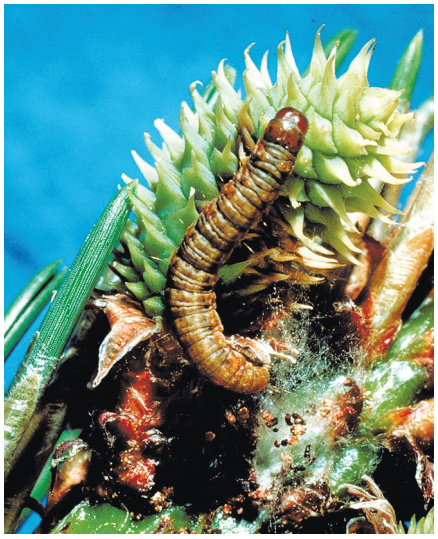

Figure 49.6—*A larva of the webbing cone worm,* Dioryctria disclusa*, that has been feeding on a pine conelet. Note the frass and webbing at the base of the conelet.* Photo by Larry R. Barber, USDA Forest Service, at http://www.bugwood.org.

Biology

Seed and cone insect biology is closely tied to the reproductive biology of the host tree. In general, larvae feed (and cause damage); adults disperse; the stage that overwinters is variable.

Coneworm adults are small moths with distinctive crossbands on wings. Females attract males with species-specific pheromones. Coneworm eggs are laid on branches. Several species overwinter as early instar larvae that feed externally before entering flowers, shoots, and cones. Larvae are elongate and yellow to purple in color with dark head capsules. As the larvae feed, they kill the cone and its seeds. Pupation is in the killed cones. Some species have only one generation per season (univoltine) and some have multiple generations (multivoltine).

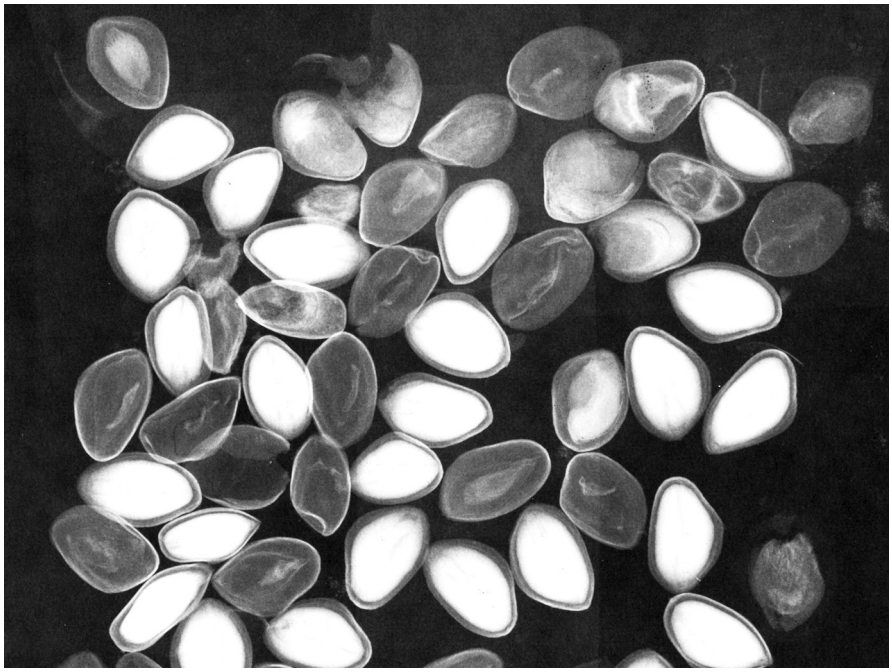

Figure 49.7—*A radiograph of longleaf pine seeds. Healthy seeds are white with visible embryo. Seeds damaged by seed bugs have shriveled contents; seeds damaged by seed worm have gray contents and broken seed coats.* Photo by Alex C. Mangini, USDA Forest Service.

Cone beetles are dark brown to black, shiny, stout beetles that are related to bark beetles. The female attacks the cone at the base and makes a tunnel along the cone axis. She deposits eggs along the gallery. Eggs are shiny and ovoid. The larvae are white, with brown heads, and feed on the developing cone, destroying the seeds. After pupation, new adults either overwinter in cones or enter pine shoots until spring. There is one generation per year.

Seed bug adults are elongate, 18 to 19 mm long, reddish brown with a distinctive zigzag pattern on the forewing (fig. 49.3). Seed bugs do not have larvae or pupae. Their immatures, called nymphs, are similar to adults but are smaller and without fully developed wings (fig. 49.8). The eggs are barrel-shaped and laid end-to-end on the needles. The western conifer seed bug and the leaffooted pine seed bug have similar life cycles, except that the former has only one generation per year while the latter may have several. Adults overwinter and become active in spring, feeding initially on male flowers. Eggs are laid in spring. Five nymphal instars exist. The second-instar leaffooted pine seed bug nymphs feed on conelet ovules causing conelet abortion (fig. 49.9). Later instars and adults feed on seeds in the developing cones leaving the seeds empty.

Douglas-fir cone gall midge adults are small, only 3 to 4 mm long. They emerge in early spring. The females oviposit near young ovules when Douglas-fir flowers are open for pollination. The eggs hatch in May and June. The tiny orange larvae tunnel into scale tissue near ovules and develop through three instars; during this development a gall forms around the larva. In the fall, the larvae drop to the ground and form an overwintering cocoon—often in old male flowers. Seeds may become fused to the midge galls; consequently the seed are not shed from the mature cone (fig. 49.10).

Figure 49.8—*A second-instar nymph of the leaffooted pine seed bug,* Leptoglossus corculus*, feeding on a pine conelet. Conelets often abort after the nymphs feed on them.* Photo by Tim Tigner, Virginia Department of Forestry, at http://www.bugwood.org.

Figure 49.9—*Ovules dissected from ponderosa pine conelet. The top ovule has been fed on by the western conifer seed bug and appears brown and shrunken. The bottom ovule is healthy.* Photo by Alex C. Mangini, USDA Forest Service.

Control

Biological control of seed and cone insects has not been fully explored. Cultural control consists of orchard sanitation. For example, white pine cone beetle populations can be reduced by running a controlled burn through the orchard in late fall or early spring. The beetles overwinter within the killed cones that drop to the ground. Burning these cones kills the overwintering beetles. Similarly, the Douglas-fir cone gall midge overwinters on the ground. It has been demonstrated that removing the duff from the orchard floor reduces the impact of this insect.

Seed orchard managers use integrated pest management (IPM) to optimize pest control efforts; all available tools are used—including cultural and chemical control. Chemical control of seed and

Figure 49.10—*Douglas-fir cones infested by larvae of the Douglas-fir cone gall midge,* Contarinia oregonensis. *The larvae cause galls to form on cone scales. Heavy infestations kill the cones.* Photo by Ward B. Strong, British Columbia Ministry of Forests, British Columbia, Canada.

cone insects is difficult because these species spend most of their life cycle within the conelet or cone sheltered from pesticide sprays. Managers must time applications appropriately and ensure good coverage. Research has led to degree-day models for the southern pine coneworm; sprays can be timed to coincide with early instar larvae presence before they enter cones. Using different pesticide chemistries during the season, avoids resistance and secondary pests. New pesticides, such as growth regulators, are safer, more specific, and have less nontarget impact.

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