

CONE AND SEED INSECTS AND THEIR CONTROL

by

E. P. Merkel and B. H. Ebel
Southeastern Forest Experiment Station
Forest Service, U. S. Department of Agriculture

At the Lake City Research Center we have been concerned mainly with the identification of insects affecting the seed production of slash and longleaf pines and the chemical control of the most destructive species on slash pine: Two groups of moths, the *Dioryctria* coneworms and the *Laspeyresia* seedworms, have been found to be the most serious pests of cones and seeds. A thrips, *Gnophothrips piniphilus* Cwfd., has also been found to kill and seriously injure the succulent flowers.

At least two other groups of insects attack the cones. These are flies of the family Itonididae (Cecidomyiidae) and scale insects of the *Toumeyella*, or tortoise shell group. The larvae of the flies kill cones, or parts of cones, by feeding between the cone scales. These insects are not common on cones in northeast Florida. The scales attack cone stalks, but usually only a few individuals develop on any one stalk, Several predators and at least one parasite appear to be quite effective in reducing the number of scales reaching maturity so that an infestation seldom affects the development of the host cones.

We shall devote the remainder of our discussion to the biology and control of the three groups of insects which we consider to be the most destructive: the coneworms, the seedworms, and the flower thrips.

THE PINE CONEWORMS

Three species of *Dioryctria* coneworms, the most omnivorous of the flower and cone insects of southern pines, are common in north Florida. As a group they attack flower buds, vegetative buds and growing tips (including flower-bearing shoots), and both first- and second-year cones, They are also common in conelets infected with cone rust, in fusiform rust cankers, and in both injured and apparently healthy tree stems. Each species produces several generations per year.

All studies on the chemical control of *Dioryctria* spp. at Lake City have been concerned with the protection of slash pine seed crops. In our tests we have used only high-pressure hydraulic sprays to apply insecticides to trees ranging in height from 30 to 50 feet. These tests were designed to determine whether or not we can obtain good control with equipment

that will give high-volume sprays with complete, or nearly complete, spray coverage. After this type of equipment has been thoroughly tested, we can study the effectiveness of mist-blower and aerial application.

During the past 2 years a 0.5-percent gamma BHC water emulsion was applied in two spray schedules for *Dioryctria* control. One schedule consisted of sprays applied every other month. The dates arbitrarily chosen were February 20, April 20, June 20, and August 20; applications were made in 1959 and 1960. The other schedule was based on our present knowledge of the biology of the three coneworm species. This biologically timed spray schedule consisted of four applications in 1959; i.e., on February 24, April 7, May 29, and June 26. In 1960, the biologically timed sprays were applied only three times, on March 29, June 1, and July 30. The February application was dropped because it was found that coneworm attacks during the winter and early spring were very light.

Both the arbitrary and biologically-timed spray schedules gave 95 percent or better protection to first- and second-year cones in 1959 and 1960. It appears, therefore, that precise timing of sprays may not be too essential for coneworm control. Based on our research to date, we are recommending hydraulic spray applications of 0.5-percent gamma BHC water emulsion for *Dioryctria* control as follows: (1) first application from mid- to late April; (2) second application from late May to early June; and (3) the last application from mid- to late July.

In 1959 and 1960 a 0.5-percent BHC emulsion was also applied on a special schedule for *Laspeyresia* control. In 1959, two applications, on May 4 and May 19, failed to control seedworms, but the protection from *Dioryctria* attacks were just as good as that obtained with the two coneworm spray schedules already discussed. In 1960, the BHC applications were increased to five between April 11 and June 1. Here again, as in 1959, no seedworm control was obtained, but *Dioryctria* control was excellent. These experiments bring out two points concerning the chemical control of *Dioryctria* spp. One is that the applications of BHC during the period from early April to early June appear to be most important for good control. Secondly, the results of the two May sprays in 1959 indicate that as few as two applications can give good coneworm control. Both of these hypotheses are being investigated.

THE PINE SEEDWORMS

Although *Laspeyresia ingens* Heinrich and *Laspeyresia anaranjada* Miller infest slash pine cones, *L. anaranjada* is by far the more common of the two species in north Florida. The female moth of *L. anaranjada* lays eggs on second-year cones only, from early to mid-May, and produces a single generation each year. The larva feeds within the developing seeds until cones mature. After normal seed fall, larvae bore into and overwinter in the cone axis. Pupation also occurs in the cone axis galleries and moths emerge through seeds which have been hollowed out the previous year. Generally, 1 to 3 larvae are found per cone and each larva destroys 5 to 7 seeds. There is no external evidence of seedworm infestation before cones mature, and because damaged seeds are retained in the cones after normal seed fall, cones must be cut open to evaluate seed losses accurately.

At Olustee, Florida, last year, a 49--percent sample, or 1,822 cones, were examined from the total cone crop on 28 slash pines. After bisecting the cones we found that 73 percent were infested by *L. anaranjada*. The estimated number of seeds destroyed by larvae was 10 percent of the potential, sound, full-seed yield of both infested and uninfested cones. The interesting point, here, is that the actual seed loss was considerably less than one might expect from the high percentage of infested cones. Percent cones infested, by itself, is not a good index of seed losses because seed loss is more dependent on the number of larvae per cone than on the number of cones infested.

The losses, just cited, were determined in an area containing open-grown pines which simulated seed orchard conditions. This single example may or may not be representative of the losses that might be caused by this insect in future seed orchards, but it does indicate the potential destructiveness of the species.

As mentioned earlier, the 0.5-percent BHC water emulsion failed to control *Laspeyresia anaranjada* in 1959 and 1960. Exploratory research in 1960 showed Guthion to be a very promising insecticide for seedworm control. Laboratory insecticide screening tests have shown that Guthion is also highly toxic to mature *Diorcyctria abietella* larvae. A word of caution, Guthion is highly toxic to humans as well. As a result of these studies we are presently conducting field experiments to determine whether Guthion treatments can be devised which will control seedworms and coneworms at the same time.

One interesting possibility for the control of seedworms in seed orchards lies in the complete removal of the total mature cone crop each year. Since the seedworm larvae are in the cones at harvest time, it might be possible to remove the entire seedworm population. The effectiveness of such a cultural control method would depend on (1) the

thoroughness of the cone collections each fall; and (2) the ability of *Laspeyresia* moths to reinvade seed orchards.

THE PINE FLOWER THRIPS

The pine flower thrips, *Gnophothrips piniphilus*, is a small (1/16-inch long), slender black insect which appears on and around developing female flower buds early in January as the twig bud stage becomes obvious on slash pine terminals. These thrips feed externally until the buds begin to unfurl. They then attack the tender flower parts and continue feeding until shortly after pollination is complete. Injury is first noticeable when excessive resinosis, in the form of beaded droplets, appears on the flowers. Some severely attacked flowers shrivel and die, others die as young conelets, and still others produce deformed cones because of the death of part of the cone scales.

An exploratory study for the control of this thrips was conducted in 1960. Several insecticides were used as recommended for thrips control on agricultural crops. From this study heptachlor was selected as the most likely material for further tests.

In 1961, heptachlor was applied as a 0.1 percent water emulsion spray to individual flower clusters. Two spray schedules were followed. In one the flower clusters were sprayed only when in early stages; i.e., twig bud stage through stage 1 of flower development. In the other schedule flower clusters were sprayed both in early and nearly mature (2 through 2+) stages of flower development. Reduction in flower attacks by thrips was highly significant for both spray schedules. No significant difference occurred between the two schedules.

Complete tree spraying with .05-percent water emulsion of heptachlor was also tested. This spray was applied by a hydraulic sprayer to flowers in both early and later stages of development. It was combined with a fermate spray schedule set up by the Division of Forest Disease Research for the control of cone rust. Control of thrips injury by this spray schedule was highly significant. Attacks recorded on about 1,500 sprayed flowers averaged only 47 percent as compared to 33.9 percent on a similar number of check flowers.

Although the pine flowers showed no obvious injury from the heptachlor or combination sprays, the yield and viability of seed from sprayed and unsprayed cones will be compared to determine if the sprays interfered with normal flower fertilization.

SUMMARY

A summary of our progress in the chemical control of slash pine cone and seed insects is as follows:

1. Hydraulic spray applications of 0.5-percent gamma BHC water emulsion have effectively controlled *Dioryctria* spp. , the most destructive group of insects affecting slash pine seed production. Research is continuing on the minimum number of sprays necessary for adequate cone protection. Tentative spray recommendations have been presented.
2. The 0.5 percent BHC emulsion failed to control *Laspeyresia anaranjada*. Guthion shows promise for the control of this pest.
3. Control of the flower thrips with heptachlor was significant in 1960 and 1961.