

CONE AND SEED INSECT NEWSLETTER^{1/}

January 1967

1. General

The Department of Entomology, University of Arkansas, initiated a long term study on the insects affecting seed production of loblolly and shortleaf pines in 1966. The study will consist of the three phases survey, biology, and control. Arthropods other than insects will also be considered. Preliminary observations indicate that Diorystia clarioralis, D. amatella and D. disclusa are the most important pest species. (Yearian).

Douglas-fir cone crops were generally abundant in Oregon and Washington in 1966. Local late frost reduced cone yield on scattered seed production areas in Oregon and in a seed orchard in Washington. Spring sampling indicated that midge and cone moth populations would be light relative to the abundant cones. (Meso).

We had one of the best cone crops in history; probably even better than in 1959. Some cones had sectional counts of 14 or more filled seed. (Johnson).

The Douglas-fir cone crop in British Columbia was excellent on the Coast and in Interior regions. Frost which occurred in late May on the coast killed many young cones, some almost pendent. (Hedlin).

A new forest insect research project was initiated this year by the U. S. Forest Service, Southeastern Forest Experiment Station. The objective of the new project is to study all insects which directly or indirectly affect the quantity and quality of seeds produced in southern seed orchards. The project leader is E. P. Merkel with headquarters at Olustee, Florida. The project will have southwide responsibilities for seed orchard insect research. Other project scientists are Carl W. Fatzinger and Gary L. De Barr at Olustee and Harry O. Yates and Bernard H. Ebel at Athens, Georgia. (Merkel).

Robert G. Jones and John W. Dale are PhD. candidates under direction of John Schenk at Moscow, Idaho. Their theses will be conducted on cone and seed insect problems.

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2. Damage

Average losses (% of damaged cones) for the state of Arkansas in 1966 were:

	Loblolly	Shortleaf
1st year cones	10	2
2nd year cones	30	10

Most damage was caused by the three species of Dioryctria with D. clarioralis probably the most important. (Yearian).

An extensive cone and seed insect evaluation was carried out (Washington, Oregon) to determine the impact midges, moths and chalcids would have on the current seed crop and to find out what damaging insect species were indigenous to specific seed production areas and orchards. Twelve seed areas totalling 184 acres, both established and recently created, were sampled. Moths, particularly Dioryctria abietella were found damaging 19 percent of the cones. Contarinia oregonensis and Megastigmus spermotrophus each accounted for five percent seed loss (Maso).

The damage caused by insects to the Washington cone crop was low - probably less than five percent. However, in some areas in Oregon damage ran as high as 30 percent in spite of the large crop. We anticipate extremely heavy damage there next year. (Johnson).

Sucking Insects damaging longleaf and slash pine seed - Two sucking insects have recently been discovered causing damage to the seed of longleaf and slash pine in North Florida. One is a shieldbug, Tetyra bipunctata (H.-S.), (Hemiptera: Scutelleridae), and the other is a leaf-footed bug, Leptoglossus corculus (Say), (Hemiptera: Coreidae). The latter species is very similar to Leptoglossus occidentalis Heidemann, which T. W. Koerber reported on in 1963. Both species were quite common on the second-year cones of slash pine in seed orchards and seed production areas at the Olustee Experiment Forest during August 1966. Adults and late-instar nymphs of both species have been observed actually feeding on the seed within closed, nearly mature, second-year cones under field and laboratory conditions. Although the cone itself usually exhibits no external damage symptoms, the shrunken, spongy endosperm of the seed is indicative of damage. More intensive research on the economic importance of these and similar species is planned. If it is found that seed damage is significant, research will be expanded to include studies on their biology and control. (De Barr).

Damage to Douglas-fir in British Columbia was generally light in Coastal areas. In Interior localities damage was high in spite of a large cone crop, with up to 95 percent of cones being infested by Barbara colfaxiana (Kft.). A good cone crop on white spruce suffered loss to Laspeyresia youngana (Kft.) and Pegohylemia sp. in addition to the cone rust Chrysomyxa pyrolata. A relatively light cone crop on ponderosa pine was fairly heavily infested by Laspeyresia piperana (Kft.). (Hedlin).

3. Biological Studies

Field observations indicate one generation per year for Dioryctria disclusa and a minimum of three generations per year for D. clarioralis and D. amatella. Larval activity of D. disclusa was confined to 2nd-year cones in late spring and early summer. D. amatella larvae were primarily confined to 2nd-year cones while D. clarioralis were active in 1st-year cones, 2nd-year cones and terminals as the growing season progressed. All three species seemed to prefer loblolly pine. Incomplete data for a small number of D. clarioralis reared on 1st-year loblolly cones gave the following information on duration of stages:

<u>Stage</u>	<u>No. Days</u>
Egg	3 - 5
Larva	21 - 24
Pupa	13 - 16
Adult	10 - 12

(Yearian).

Barbara colfaxiana larvae were reared on an artificial medium in the laboratory at temperatures of 15°, 17.5°, 21°, 24° and 28°C. This was done in an attempt to determine if different temperatures during larval development affect pupal diapausing. Pupae were collected in the field from different widely-separated locations for which weather data are available, so comparisons can be made between laboratory- and field-raised insects. This phase of the study will be completed during the winter. (Hedlin).

Ultraviolet Light Traps for Study of Seasonal Activity of Adult Dioryctria and Laspeyresia.— A 5-year trapping study was initiated this year at Olustee, Florida. A 4-watt unidirectional U. V. light trap, patterned after the one described by Barnes, Wargo, and Baldwin in California Agriculture 19(10): 6-7, October 1965, has been found to be very effective in trapping Dioryctria and Laspeyresia moths. The trap is designed to catch arboreal insects primarily. Total moth catches with this trap have been much higher than with a 15-watt omnidirectional U. V. light trap. Daily moth-catch records, by species and sex, are being obtained throughout the year. It is felt that U. V. light traps might be a useful technique for determining the species of cone-infesting lepidoptera and their relative abundance in seed orchards and seed production areas. (Merkel).

Artificial Diets for Dioryctria abietella.— The artificial diet developed for D. abietella is being studied for possible long-term nutritional deficiencies by rearing the insect through successive generations. To date, three generations have been reared on this diet with an average of 85-percent survival per generation. The duration of each generation has been approximately 10 days shorter than when the insect is reared on pine cones.

Microorganisms growing on the surface of the artificial diet have been found to decrease the survival of larvae reared by forming a physical barrier between them and the diet. These microorganisms are also suspected of producing dietary factors during their own metabolic activities which interfere with nutrient deletion studies. To eliminate these interactions, an aseptic method for rearing D. abietella on the artificial diet has been developed which yields 78-percent survival. The method is presently being modified to produce a higher survival and will then be used to determine the nutritional requirements of this insect by nutrient deletion studies. (Fatzinger).

Evidence of Inherent Resistance to *Dioryctria* and *Laspeyresia* Infestation in Slash Pine.— Cone infestation by *Dioryctria abietella* and *D. amatella* were studied on 10 mature slash pines over a 3-year period. Covariance analysis revealed that some trees experienced either consistently low or consistently high cone attack from year to year independent of the total mature cone crop per tree.

Stem infestation of young trees by *D. amatella* was studied in a clonal plantation and two progeny tests. Large differences in the degree of infestation occurred among clones or progenies. These observations suggest that some degree of genetic control exists over cone and stem attack by *Dioryctria* spp., but progeny tests are needed to prove this.

Cone infestation data for *Laspeyresia anaranjada* were also analyzed for 15 additional slash pines on the Olustee Experimental Forest. Results obtained over a 3-year period were similar to the *Dioryctria* data, i.e., consistent year-to-year differences in the resistance or susceptibility of individual trees to seedworm infestation. (Merkel).

Taxonomic Study of the Pupae of the Genus *Dioryctria* in the Southeastern United States.— This study was completed in cooperation with Dr. H. H. Neunzig, Department of Entomology, North Carolina State University, Raleigh. A manuscript has been prepared which gives detailed descriptions and a key for identifying the pupae of the following species: *D. zimmermani* (Grote), *D. amatella* (Hulst), *D. disclusa* Heinrich, *D. clarioralis* (Walker), *D. pygmaeella* Ragonot, and *D. abietella* (D.&S.).

In comparing results of the present study with information in the literature, a difference was found in the number of setae present on pupae of so-called *abietella* of Florida and pupae of *abietella* (*abietivorella*) of the northern United States and Canada. It appears that this apparently isolated population in the South is not the same species as the more northern insect. (Merkel).

4. Chemical Control

Two limited chemical control projects were carried out this year. An 8-acre Douglas-fir seed production area was treated by helicopter. A two-percent dimethoate spray was applied at a rate of 10 gallons per acre. Merchantable Douglas-fir cones must have a minimum of five filled seeds per cut face. Two bushels of these cones will yield one pound of clean seed. Untreated cones of the helicopter spray site averaged 2.7 seeds per face while treated cones yielded an average of 6.0 seeds per face. (Meso).

An operational spray program was planned for the Dennie Ahl Seed Orchard to protect the largest Douglas-fir cone crop since 1962. Twelve acres of grafted trees were to be sprayed with Bidrin. The wheel-mounted hydraulic sprayer was modified and fitted with twin vertical booms to spray trees to a height of 15 feet. Each boom was filled with trip valves so that one man could operate the tractor and control the spray pattern for each boom. Because of late frost in June the cone crop was greatly reduced. Only four acres were sprayed with one-half percent Bidrin applied to the point of foliage runoff. Insect control was very good but trees showed phytotoxic signs. No bud mortality was found. Seed viability tests will be made to check the effects of Bidrin. (Meso).

A number of trees were sprayed with Bidrin, Meta-Systox-R and dimethoate with the express purpose of measuring any adverse effects of those materials on filled-seed count and germination. There was no significant reduction in filled-seed count, but germination tests are not complete. Some cones did not open readily and it is hoped this is not related to insecticide treatment. (Johnson).

Bidrin Trunk Implant In Slash Pine Seed Production Area.— On May 4, 1966, Bidrin (9 lb/gal.) technical liquid was implanted into large slash pines (average total ht.: 75 ft.; average d.b.h.: 13 in.) in a natural slash pine seed production stand at Olustee, Florida. Maugé tree injectors were placed every 4"-5" around the tree circumference at breast-height. Five trees received a dosage of 1.3 ml. Bidrin per inch of tree diameter at breast-height, five trees were given a 3.1 ml./inch tree diam. dosage rate, and eleven control trees received no treatment. The treatments were applied just prior to the heavy summer attacks period on cones by Dioryctria spp. and about 6 days prior to peak mating and oviposition by the slash pine seedworm, Laspeyresia anaranjada.

The total mature cone crop was collected in mid-September and numbers of Dioryctria-attacked cones recorded. When compared with cones on untreated trees, the low and high Bidrin dosages resulted in an 89-percent and 93-percent reduction in coneworm attacks, respectively, at the 5-percent probability level. Coneworm attacks on first-year cones were not evaluated. Percent reduction in seedworm infestation of second-year cones from 78-percent for the low Bidrin dosage and 99-percent for the high dosage. (Merkel).

Mist Blower Application of SD 8447 for Slash Pine Seedworm Control.— A 5-percent water emulsion of SD 8447 ("Gardona") was applied with a John Bean "Rotomist" mist blower to 7 40-foot-tall and 6 80-foot-tall slash pines at the rate of 2 gallons per tree. Originally it was planned to make only a single insecticide application, but due to heavy rains in May, applications were made on May 5, 13, and 16 during the peak oviposition and eclosion period of Laspeyresia anaranjada. The seedworm control on the shorter trees was virtually perfect whereas reduction of seedworm infestation as compared with 11 untreated control trees, was only 84-percent, but nevertheless encouraging. (Merkel).

Bidrin and SD 9129 Trunk-Implantation Offers Promising Control of Coneworms and Seedworms on Slash Pine Seed Orchard Trees.— Analysis of data is still not complete at this writing but SD 9129 (3.2 lb./gal.) and Bidrin (9 lb./gal.) technical liquid injected into trunks in 3/4" x 3" drill holes in 40-foot-tall (12" d.b.h.) slash pines on January 13 gave excellent full-season protection of first- and second-year cones from Dioryctria spp. infestation. The Bidrin was applied at the rate of 10 ml. per inch of tree diameter at breast-height.

Bidrin was also implanted at the rates of 5- and 10 ml. per diameter inch on April 29. These treatments also gave very good protection from Dioryctria spp. through cone harvest in September. A temporary yellowing of needle tips was noted following the heavier Bidrin dosage in late April. Tests will be conducted this winter to determine whether or not any of the systemic treatments had a deleterious effect on seed viability.

The mid-January applications of Bidrin and SD 9129, three months prior to seedworm infestation, did not control Laspeyresia anaranjada. However, both the 5- and 10 ml. per diameter inch dosages of Bidrin in late April resulted in near perfect control of this seedworm. (Merkel).

Dimethoate Applied by Mist Blower Controls Coneworms and Seedworms in Slash Pine Seed Orchard.— Dimethoate, a relatively safe systemic and residual-type insecticide, was applied with a John Bean "Rotomist" mist blower as follows: 2.5-percent by weight dimethoate water emulsion on April 5, May 4, and May 20, and 1.25-percent dimethoate emulsion on June 27 and July 27. The insecticide was applied at the rate of 100 gallons per acre throughout the study. Several rows of slash pines at opposite ends of the orchard were unsprayed. Fourteen trees were selected as checks from the unsprayed area and fourteen trees were used in the treated area. Tallies were made of the Dioryctria-attacked cones on 20 sample branches on all trees prior to the first mist application (April 5), on June 6, and at cone-harvest time (September 7). The cone-infestation tally on June 6 made it possible to evaluate the effectiveness of each of the dimethoate concentrations.

The three applications of 2.5-percent dimethoate between April 5 and June 6 resulted in a 71- and 73-percent reduction in Dioryctria attacks on first- and second-year cones, respectively, as compared with check trees. Percent reduction in cone infestation was statistically significant at the 5-percent probability level for first-year cones but was only significant at the 10-percent level for second-year cones.

The two applications of 1.25-percent dimethoate between June 6 and cone harvest resulted in a highly significant percent reduction in coneworm attacks of 88- and 85-percent on first- and second-year cones, respectively, as compared with checks.

Statistical analysis of seedworm infestation data has not been completed but cursory examination of the data shows that the dimethoate applications did result in very good seedworm control. (Merkel).

5. Work Currently in Progress

- (1) State-wide survey and assessment of damage.
- (2) X-ray inspection of seed.
- (3) Biology of Dioryctria clarioralis (Yearian).
- (1) Study of factors affecting diapause in Barbara colfaxiana. (Hedlin).

6. Work Planned

- (1) Biology of Dioryctria disclusa.
- (2) Laboratory and field screening of insecticides.
- (3) Continuation of work in progress. (Yearian).

Anticipated chemical control programs for 1967 include contracted hydraulic spray project on a 10-acre seed production area. Purposes include studies of selectivity of spray application, control efficiency and economics of a contracted project. Investigations will be carried out further to determine the effect of Bidrin, Meta-Systox-R and dimethoate at two concentrations on seed viability. (Meso).

We plan to follow up on some additional tests of the effect of pesticides on seed yield. (Johnson).

Plan to conduct investigations into the cone and seed insects of Douglas-fir with emphasis on the relationship between cone crops and insect populations. (Jones).

Plan to investigate cone and seed insects of ponderosa pine with emphasis on the parasites and predators of these insects. (Dale).

Plan to establish study on cone and seed insects of white spruce to determine what insects are involved, their relative importance and abundance and control measures if necessary. (Hedlin).

7. Recent Publications

Johnson, Norman E. and Stanley W. Meso. 1966. Effectiveness of three systemic insecticides for Douglas-fir cone and seed insect control. Weyerhaeuser Forestry Paper No. 10. 10 pp.

Buffam, Paul E. and Norman C. Johnson. 1966. Tests of guthion and dimethoate for Douglas-fir cone midge control For. Sci. 12(2): 161-3.

Johnson, Norman E. and John G. Zingg. 1966. Test of several systemic insecticides for postoviposition control of the Sitka spruce weevil. J. Econ. Entomol. 59 (3): 765-6.

Hedlin, A. F. 1966. Prevention of insect-caused seed loss in Douglas-fir with systemic insecticides. For. Chron. 42(1): 76-82.

Johnson, Norman E. and A. F. Hedlin. 1966. Douglas-fir cone insects and their control. Dept. of Forestry of Canada Leaflet. (In press.)

Hedlin, A. F. 1967. The pine seedworm Laspeyresia piperana (Kft.) (Lepidoptera: Olethreutidae) in cones of ponderosa pine. Can. Ent. (In press.)