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1. General

The Douglas-fir cone crop was light to moderate in Oregon and Washington; a few cones were collected and processed in some areas (Johnson).

In British Columbia the cone crop was very light on Douglas-fir and white spruce, and heavy on ponderosa pine (Hedlin). It appears that the 1966 crop on Douglas-fir will be good (Johnson, Hedlin).

In Idaho work on western white pine is completed and Douglas-fir is presently receiving attention (Schenk).

In California the cone crop on ponderosa pine was light to medium (Koerber).

2. Damage

In Washinton and Oregon, in general Douglas-fir suffered less damage than usual. C. oregonensis was high, B. colfaxiana low, and M. spermotrophus increased in numbers for the second year, destroying up to 20 per cent of the seed (Johnson). In British Columbia the situation was similar (Hedlin).

1/ Compiled from information submitted by workers conducting research on cone and seed insects. Not to be published without the consent of the contributor. Assembled by A.F. Hedlin, Forest Research Laboratory, Victoria, B. C.

In Idaho, Eucosma rescissoriana accounted for 81 and 96 per cent of the white pine seed losses in 1963 and 1964, or when expressed as a proportion of total seed 12 and 0.5 per cent respectively. Dioryctria abietella, Conophthorus monticolae and a cecidomyiid, possibly Rubsaamenia keeni were relatively unimportant. A highly significant relationship was shown between damage on longitudinal cone sections and total counts in white pine cones. Highly significant differences in seed losses were found between 9 x 9, 20 x 20, and 30 x 30 foot tree spacings, with losses increasing with decreasing density. Losses in mixed natural stands were comparable to those in 9 x 9 foot spacing (Schenk).

In California, damage to ponderosa pine seed ranged from moderate to severe with Conophthorus ponderosae and Laspeyresia spp. causing nearly all the damage. Conophthorus damage amounted to less than 25% of the crop but on some trees as high as 85% of the cones were infested. Laspeyresia larvae in cones after beetle attack reduced seed yields 14% (Koerber). In British Columbia damage to ponderosa pine, due almost entirely to Laspeyresia piperana, ranged from light to severe. Up to 47% of the seed was destroyed. Conophthorus did not occur in any cones examined (Hedlin).

3. Biological Studies

In northern Idaho, biologies of four important parasites of the white pine cone moth, Eucosma rescissoriana were studied from 1963 to 1965. Pimplopterus n. sp. (Ichneumonidae), Chelonus petrovae McComb, Apanteles starki Mason (Braconidae) and Psalidopteryx psilocorsiphaga Brooks (Tachinidae) accounted for about 95% of the parasitism of the cone moth. Bracon rhyacionicae (Mues.) occurred locally in small numbers. Rate of parasitism increased from 9.4% to 40.9% in one plot during the three years of observation (Goyer).

A cone bagging experiment conducted on ponderosa pine near Placerville, California at 3,500 feet elevation showed the oviposition period of Laspeyresia spp. extended from April 9 to May 18 in 1965. The adult emergence period coincided with this. Dissection of beetle-damaged cones showed that successful broods of Conophthorus were established in about 50% of the aborted cones. The largest brood produced 11 beetles, while most had one to three per cone (Koerber).

At Lytton, B. C. hatching of Laspeyresia piperana on ponderosa pine cones occurred in late May and early June, 1965. Larvae passed through five instars feeding almost entirely on seeds, migrating into the cone axis in late July to overwinter in the fifth larval instar (Hedlin).

4. Chemical Control

Bidrin, dimethoate and Meta-Systox-R were applied with a mist-blower from a truck-mounted ladder at 0.5 and 1.0 per cent concentrations to Douglas-fir cones which had just turned down. Good control of the cone midge Contarinia oregonensis and cone moths was obtained when materials were applied to run-off. The study was conducted by Weyerhaeuser Company and the U.S. Forest Service at Corvallis, Oregon, and Centralia and Elma, Washington (Johnson). Small-scale studies with Bidrin, dimethoate, Azodrin and Meta-Systox-R indicate that 1.0% concentration is optimum for killing C. oregonensis in Douglas-fir cones. Higher concentrations may be phytotoxic. Translocation from foliage into the cone is good, but at low concentrations materials do not translocate well from one side of the cone to the other, from the tip to the base or vice versa, or from the cone into the foliage (Johnson). Radioactive dimethoate was injected into small cone-bearing trees and the rate of translocation and distribution of the material determined. This study is not completed and indicates the need for further

work on translocation of systemics (Johnson).

A 10-acre Douglas-fir seed production area was sprayed by helicopter in 1965 for control of C. oregonensis. Data are not fully analyzed but indications are that control is good in upper one-third of tree crowns (Meso).

Trunk implantation of methyl demeton in Douglas-fir (9 - 15" dbh) at 1 gm. per diameter inch by means of "Mauget Tree Injector Units" failed to produce consistent significant reductions of seed loss in all six collections made in 1965. It is speculated that one or more of the following events influenced the results: (a) unequal and light infestations in the replicates; (b) loss of cones to squirrels; (c) the absence of sufficient cone producing Douglas-fir throughout the region, which forced carrying out the study in a less than favorable situation; and (d) the possible breakdown and dissipation of the small amount of toxin. Significant mortality and reduced seed losses by B. colfaxiana were obtained in a few collections where sufficient data were available for analysis. Studies on the effects of the insecticide on test rodents fed treated seeds, and on phytotoxicity are in progress (Schenk).

In California a small-scale spray test was conducted using DDT diazinon, Zectran, and Guthion at 1.0% of concentration to individual cone clusters near the end of the oviposition period of Laspeyresia. Cone examinations are not complete but it appears that protection against Laspeyresia is not sufficient. Guthion and Zectran apparently gave effective protection against Gonophthorus (Koerber).

5. Work Currently in Progress

Johnson and Hedlin are writing a guide for control of Douglas-fir cone and seed insects. They are also working on the description of a species of midge in Douglas-fir cones.

Schenk is working on insects infesting Douglas-fir.

Hedlin reared B. colfaxiana larvae at 10 hr. and 16 hr. daylengths and 60° and 75° F. temperatures. This is an attempt to obtain information on factors affecting diapause in cone insects. The study is not completed.

Werner has started a study to determine the uptake, translocation and deposition of systemic insecticides for the control of cone and seed insects in loblolly pine.

6. Work Planned

Johnson may do some project scale spraying of Douglas-fir cones in 1966.

Schenk plans further investigations into biologies of cone and seed insects in Douglas-fir followed by those in ponderosa pine. Also plans to study sampling in an attempt to relate cone crops and insect populations.

Meso plans field testing of dimethoate and Meta-Systox-R in 1966 to establish a cost base for application with helicopter and hydraulic equipment.

Hedlin plans to continue temperature-daylength studies in an attempt to obtain further information on factors affecting diapause. Studies on white spruce cone insects are planned.

7. Recent Publications

- Ebel, Bernard H. 1965. The dioryctria coneworms of North Florida pines (Lepidoptera: Phycitidae). Ann. Ent. Soc. Amer. 58: 623-630, illus.
- Ebel, B.H. 1965. Control of thrips on slash pine female strobili. Jour. Forestry 63: 287-288.
- Ebel, B. H. 1964. The occurrence of Ernobius granulatus LeConte in aborted first-year cones of longleaf pine. Jour. Forestry 62: 404-405.
- Neunzig, H. H., Rabb, R. L., Ebel, B. H., and Merkel, E. P. 1964. Larvae of the genus Dioryctria (Lepidoptera: Phycitidae) in the southeastern United States. Ann. Ent. Soc. Amer. 57: 693-700, illus.
- Merkel, E.P. 1964. Hydraulic spray applications of insecticides for the control of slash pine cone and seed insects. Southeast. Forest Expt. Sta. U.S. Forest Serv. Res. Paper SE-9, 7 pp.
- Hedlin, A. F. 1964. Life history and habits of a midge Phytophaga thuja Hedlin (Diptera: Cecidomyiidae) in western red cedar cones. Canad. Ent. 96: 950-957.
- Johnson, Norman E., and J. H. Rediske. 1965. Systemic pesticides in woody plants. Translocation. Bull. Entomol. Soc. Am. 11(3): 190-195.
- Johnson, Norman E., and J. H. Rediske. 1965. A test of systemic insecticides to control Douglas-fir cone and seed insects. J. Econ. Entomol. 58(5): 1020-1021.
- Rediske, J. H., and Norman E. Johnson. 1965. The absorption and translocation of the systemic insecticide Schradan in Sitka spruce and grand fir. Weyerhaeuser Forest. Paper No. 5, 9 p.
- Werner, R. A. 1964. White spruce seed loss caused by insects of interior Alaska. Can. Ent. 96(11): 1462-1464.

8. Proposed Publications

- Hedlin, A. F. Preventing insect caused seed loss in Douglas-fir with systemic insecticides For. Chron. (in press).
- Johnson, Norman E. and A.F. Hedlin. Douglas-fir cone insects and their control. Dept. of Forestry Leaflet in preparation.
- Johnson, Norman E. and A. F. Hedlin. A new species of Camptomyia infesting cones of Douglas-fir. Canad. Ent. (In preparation).
- Hedlin, A. F. The cone moth Laspeyresia piperana (Kft.) in ponderosa pine cones. In preparation.
- Hedlin, A. F. Cone and seed insects of Abies grandis.
- Johnson, Norman E., William H. Lawrence, and Irwin Ellis. 1965. Seasonal occurrence of ground beetles in three habitats in southwestern Washington. Ann. Entomol. Soc. Am.
- Johnson, Norman E., and Stanley Meso. Control of cone and seed insects of Douglas-fir using systemics that are sprayed on the foliage. Weyerhaeuser Forest. Paper.
- Johnson, Norman E., and John Zingg. Optimum concentration and distribution of sprayed on systemics for control of Douglas-fir cone and seed insects.
- Rediske, J. H., and Norman E. Johnson. Distribution of radioactive dimethoate in young, cone-bearing Douglas-fir.
- Goyer, R. A. The parasite complex associated with Eucosma rescissoriana Heinrich (Lepidoptera: Olethreutidae) in northern Idaho. M. S. Thesis (in preparation), Univ. of Idaho Library.

- Merkel, E. P. (in press) Individual slash pines differ in susceptibility to seedworm infestation. Jour. Forestry.
- Merkel, E. P. Mist blower applications of insecticides for cone insect control on slash pine. Southeast. Forest Expt. Sta., U. S. Forest Serv. Res. Note.
- Merkel, E. P., and C.W. Fatzinger (in press) Rearing methods for Diorycetria spp. (Lepidoptera: Phycitidae). Chapter of book titled, "Insect Colonization and Mass Production", to be published by Academic Press, Inc., New York.
- Merkel, E. P. The life history and habits of the slash pine seedworm, Laspeyresia anaranjada Miller, (Lepidoptera: Olethreutidae). Ann. Ent. Soc. Amer. or Florida Entomologist.
- Merkel, E. P. The slash pine seedworm Laspeyresia anaranjada Miller. U.S. Forest Service, Forest Pest Leaflet.
- Ebel, B. H. (in press) Rearing and occurrence of xyelid sawflies on slash and longleaf pines. Ann. Ent. Soc. Amer.
- Fatzinger, C.W. An artificial food medium for rearing Diorycetria abietella (D. & S.). Southeast. Forest Expt. Sta., U. S. Forest Serv. Res. Note.
- Koerber, T.W. Studies on the Insect Complex affecting seed production of ponderosa pine, in California. Southwest For. Exp. Sta. U.S. For. Ser. Res. Paper.
- Williams, D.L., J.A. Schenk, W. F. Barr. The biology of Conophthorus monticolae Hopk. in northern Idaho (Coleoptera: Scolytidae). For. Sci. ... (in press).
- Ollieu, M. M. & J. A. Schenk. The biology of Eucosma rescissoriana Hein. in western white pine in Idaho (Lepidoptera. Olethreutidae). Canad. Entomol. ... (in press).

Schenk, J. A. & R. A. Goyer. Cone and seed insects of western white pine
in northern Idaho: Distribution and seed losses in relation to
stand density. (Submitted to J. For., November, 1965).