bi-monthly research notes

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ENTOMOLOGY

Survival of European Pine Shoot Moth on Cut Christmas Trees.—The European pine shoot moth [*Rhyacionia buoliana* (Schiff.)] is a threat to native pine forests of British Columbia, and already is established in oranamentals and exotic nursery stock in southern coastal areas. Until this study was completed, the movement of cut Christmas trees, *Pinus* spp., into and within British Columbia was permitted without treatment on the assumption that the insect could not overwinter on cut trees. As there was no experimental evidence to indicate the behavior of *R. buoliana* on such material, a study was made to determine possible survival.

Twenty-two infested Scots pine [*P. sylvestris* L.], a typical commercial species, were cut 30 Nov 1971, near Seattle, Wash., and brought to Victoria. They were treated as Christmas trees, without benefit of preservative, nutrient or protection, and set upright outdoors on a northern exposure, with bases in about 8 cm (3 inches) of sand. These conditions were considered the optimum likely circumstances for trees remaining outside as decor, or discarded and partly buried in earth-fill or garbage. Trees averaged 1.2 m (4 feet) in height, and had about 350 tips, of which approximately 30% were infested at the time of collection. About one-quarter of larvae were third instar, the remainder fourth. Three control trees were checked twice-weekly for moisture stress by "bomb test" (Scholander *et al.* Sci. 148:339-346, 1965). Healthy potted lodgepole pine [*P. contorta* Dougl.] were placed with the Scots pine to determine if larvae could transfer.

Three trees, including one control, were taken indoors for the Christmas season (12 days) and kept without water at normal room temperature and humidity. Larvae on these trees began active feeding, and about 10% attained fifth instar. However, as the trees dehydrated, about half the larvae left the buds and died and most of the remainder, including those in fifth instar, died soon after they were returned outdoors. A few lived until March, by which time the trees had lost nearly all their needles, and the moisture stress had increased to 16 from 2 atm.

Two outdoor trees were dissected each month to assess the insect population (Table 1). By the end of January, most of the larvae had become fourth instar without significant mortality. During the winter's coldest 5-day period, 24-28 Jan 1972, the average minimum temperature was 18 F, and the wind chill factor for one day averaged −12 F. Although relatively cold for the area, this would have had little effect on normally overwintering *R. buolina* that may withstand temperatures of −20 F. By the end of February approximately 44% of larvae had died, while some of the living larvae had developed to fifth instar. No appreciable mortality occurred in March, but during April 83% of the remaining larvae died, leaving about 10% of the original population alive. During May, the larvae developed to ultimate instar with little further mortality. Final bud dissections in early June revealed 14 mature larvae and 27 healthy pupae on the five remaining trees, a 12% survival of the original larval population estimated for five trees. Eleven adults emerged before the material was destroyed to prevent possible contamination; they appeared normal and no check was made of their fecundity.

TABLE 1
Survival of *R. buoliana* on outdoor trees

Date	No. of trees examined	Avg no. living insects/tree	Instars present
Nov. 30	2	101	III, IV
Dec. 31	2	98	III, IV
Jan. 31	2	95	III, IV
Feb. 29	2	56	III, IV
Mar. 30	2	52	IV, V
May 1	2	10	V, VI
June 12	5	8	VI, pupae

The first significant larval mortality, during February, was likely due to the rapidly deteriorating food and shelter conditions that forced the larvae to leave the buds and subsequently succumb to the inclement weather. The second mortality crest in April probably resulted indirectly from warming daytime temperatures that encouraged the larvae to move about in a futile search for food and more adequate shelter, that normally would have been readily available. At that time, larvae moved onto adjacent potted lodgepole pine that had been included to test this possibility. Most of these "transferred" larvae survived on the living trees.

There is no doubt that *R. buoliana* may survive and successfully develop on cut trees left outdoors, even though the experiment coincided with local conditions relatively favorable for the insect, i.e., few dehydrating periods of wind or warmth. Larvae on cut trees can transfer to adjacent living pine. Insect survival might be higher in cooler regions where snow cover could provide added protection, and on less heavily infested trees that would presumably retain food-shelter value longer. Christmas trees taken indoors offer little chance for larvae to complete development. It must be stressed that any insect survival, no matter how minimal, is critical.

As a result of this study, quarantine regulations were adjusted to include mandatory fumigation and seasonal restrictions (Can. Dep. Agr., Plant Prot., Export Control Circ. No. 17C, 1972. B.C. Laws, Statutes, etc. 1972; Order in Council, minute No. 3748).—David Evans, Pacific Forest Research Centre, Victoria, B.C.

Evaluation of Residual Toxicity of Six Insecticides for Control of Sitka Spruce Weevil.—The most recent study on chemical control of Sitka spruce weevil [*Pissodes strobi* (Peck) (= *Pissodes sitchensis* (Hopkins)] was conducted in British Columbia during 1961-1964 by Silver (Can. Ent. 100:93-110, 1968). He suggested that control is possible but uneconomical on a large scale, unless applied as aerial spray. Accordingly, six candidate insecticides, Gardona®, propoxur, benzene hexachloride (gamma isomer), phosphamidon, Methyl Trithion®, and fenitrothion, were tested in 1970 and 1971 to determine the residual toxicity for weevil control under West Coast conditions. In laboratory tests, the latter four insecticides had previously shown promise for controlling Sitka spruce weevil (Nigam, Can. Forest. Serv., Inf. Rep. CC-X-3, 1969, 9 pp.).

Sitka spruce [*Picea sitchensis* (Bong.) Carr.] saplings, 1-2 m tall, were transplanted in February 1970 from the Port Renfrew area to a 1.5 x 1.8 m spacing outdoors at the Pacific Forest Research Centre, Victoria. The 1969 leaders averaged 50.3 cm in length (range 35-61 cm), 8.4 mm mid-point diameter, and 133 cm^2 bark surface area. Five trees were assigned randomly from each of the six test groups and a control.

Each leader was isolated by a polyethylene sheet and sprayed during still-air conditions during the morning of 6 July, 1970. Insecticides were formulated as water-based emulsions containing 10% active ingredient (a.i.), except benzene hexachloride (5% a.i.). Application was made with a "Spray on Jet-Pack Sprayer" (Sprayer Product Inc., Los Angeles, California), depositing about 0.01 ml/cm^3 (about to the point of run-off). Test weevils used until August 18 were field collected in May and June and held on fresh host material in a refri-