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ENTOMOLOGY

Foliar Spray of Acephate Ineffective against Mountain Pine Beetle in Lodgepole Pine.—Lodgepole pine (*Pinus contorta* Dougl.) is being killed by the mountain pine beetle (*Dendroctonus ponderosae* Hopk.) in many parts of central and southern British Columbia. Except for a short flight period, all life stages of the beetle exist under the bark, where the broods are protected from all nonsystemic insecticides applied from the air and from surface-applied insecticides that also do not kill the tree. An effective nonphytotoxic systemic insecticide, applied to the foliage, could kill these insects and possibly keep the tree alive if the insecticide was translocated down the phloem from the crown in concentrations toxic to the beetles feeding on the inner bark.

Acephate (orthene: O,S-dimethylacetylphosphoramidothioate) is a water-soluble systemic insecticide that remains active for about 10-15 days (Chevron Chemical Co., technical information experimental data sheet on Orthene insecticide, October 1972), metabolizing to methamidophos (monitor: O,S-dimethylphosphoramidothioate), which is also an insecticide. Acephate, sprayed at 1 kg active ingredient/500 L, has been shown to be translocated basipetally from the crowns of loblolly pines (*Pinus taeda* L.) in sufficient quantities to kill beetles (Williams et al., Small scale field experiment to evaluate the phloem mobility of Orthene and Monitor in southern pines [unpublished], USDA, Pac. Southwest Forest and Range Exp. Stn., Berkeley, Calif., 1974).

In 1975, an experiment was undertaken in British Columbia, near Williams Lake, to determine whether a foliar spray application of acephate at medium-to-high concentrations would translocate from the foliage down the phloem of lodgepole pine immediately after attack by the first bark beetles and cause mortality of mountain pine beetle adults and larvae feeding in the phloem.

Six unattacked lodgepole pines, selected for treatment before beetle flight in an active mountain pine beetle infestation at Bull Mountain, were

baited with two polyethylene containers, each containing the aggregative pheromone *trans*-verbenol. Attacks began first on baited trees about 23 July. After flight, we found that there was no difference in attack density between baited and eight adjacent nonbaited attacked trees, and the distinction was dropped from the analysis. Within 3 days after the trees sustained the first few attacks, 11 trees were sprayed with acephate in water at the rates of either 1.12 or 5.60 kg a.i. per hectare. Three of the trees sprayed at 5.60 kg a.i. per hectare were resprayed at the same rate 14 to 18 days later, when attacking beetles had established galleries and laid eggs. The sprays were applied to all the foliage by a backpack mist blower, after the operator had climbed by ladders into the lower crowns. All sprays were carried out on warm, sunny days with little or no wind, days that are considered ideal for achieving maximum spray deposit on foliage.

At the end of August, 20 days after the second spray, all trees were felled and bolts were removed from the butt and crown to determine the effects of the pesticide. Bolts from the butt were cut in half: one half was kept at +21°C to allow completion of brood development; the other was debarked to assess brood and parent survival. The crown sections and inner bark of the second butt section were placed at -26°C to arrest metabolism of any remaining insecticide.

The initial assessment showed no significant difference in survival of parents or brood between any of the treatments and the checks. The same results were obtained from the second assessment, when broods were permitted to reach maturity, showing that acephate had no effect on beetle survival when applied to the foliage at either 1.12 or 5.60 kg a.i. per hectare.

Inner bark samples of butt and crown sections were analyzed on a gas-liquid chromatograph after the method of Leary (J. Assoc. Off. Agric. Chem. 57(1):189-191, 1974), with a few modifications to adapt the method to available equipment. Later, some samples were checked with glc-mass spectrometer by Dr. D. McGillivray, Chemistry Department, University of Victoria. No traces of acephate or methamidophos were found in any test samples, possibly because of the complete metabolic breakdown of both insecticides during the interval between spraying and felling.

The lack of differences of survival among treatments shows that acephate, applied at high spray concentrations to pine foliage immediately after stem attack by mountain pine beetle, was ineffective in controlling the beetle population.—P.M. Hall, E.D.A. Dyer, and E.E. McMullan, Pacific Forest Research Centre, Victoria, B.C.

The Multiplication of *Nosema fumiferanae* (Microsporidia) in Spruce Budworm Reared on Three Different Diets.—The development of synthetic diets has greatly simplified the rearing of insects for experimental studies. Availability of a suitable diet eliminates the need for growing or preserving natural food for use in the winter months. Although Bergold (Can. J. Zool. 29:17-73, 1951) demonstrated that quick-frozen balsam fir (*Abies balsamea* [L.] Mill.) buds are an acceptable food for rearing spruce budworm, *Choristoneura fumiferana* (Clem.), their use necessitates collection at appropriate growth stages, and suitable low-temperature storage space. Substitution of synthetic diets eliminates such difficulties.

If insects used in host-parasite studies are reared on synthetic diets, it is important to know the effects of such diets on the parasite. The synthetic diet (McMorran, Can. Entomol. 97:58-62, 1965) now in use usually contains antimicrobial agents (formalin, methyl parahydroxybenzoate, Aureomycin) to prevent the growth of contaminants such as fungi and bacteria, and these antimicrobial agents may also affect the parasite.

To determine the effects of the McMorran diet on the ability of microsporidia to develop, second instar spruce budworm larvae (from the

TABLE 1

The effects of a synthetic diet and a diet of balsam fir buds and white spruce buds on the number of *Nosema fumiferanae* spores produced in its host, the spruce budworm

Observations	Balsam	Spruce	Synthetic
Number of larvae	17	23	29
Mean spore count per mg dry weight ($\times 10^3$) \pm standard error	17.3 \pm 3.1 ^a	18.3 \pm 3.1 ^a	20.5 \pm 2.7 ^a

^a Means are not significantly different at the 5% level.