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ENTOMOLOGY

Field Test of Furadan and Baygon against Balsam Woolly Aphid in British Columbia.—Field testing of promising systemic insecticides against the balsam woolly aphid (BWA), *Adelges piceae* (Ratz.), was conducted in British Columbia as a cooperative program between the Pacific Forest Research Centre and the Chemical Control Research Institute. Since Furadan® (carbofuran) and Baygon® (propoxur) had proven to be most effective in laboratory testing (Randall et al., Bi-mon. Res. Notes 2:18-19, 1967; Nigam, Can. For. Serv. Inf. Rep. CC-X-26, 1972), we decided to concentrate on these two materials.

The purpose of the stem injection test was to determine whether the two chemicals were sufficiently mobile in the xylem and phloem of larger trees to produce a toxic effect on aphids infesting the crown or stem. Consequently, the materials were injected directly into the xylem. Baygon (EC 12.8% a.i.) and Furadan (Technical grade 98% a.i.) were formulated at 1%, 5%, and 10% active (wt/vol) in a solvent containing 80% acetone, 15% benzene and 5% Tween 80 (vol/vol). Check treatments were solvent alone and untreated. Each formulation was injected into two trees. Baygon was tested on young amabilis fir, *Abies amabilis* (Dougl.) Forbes (10-15 m high), and Furadan on mature grand fir, *A. grandis* (Dougl.) Lindl. (over 40 m). All trees had stem populations of aphids. The crowns of the amabilis fir were also infested, but crown populations of grand fir were not studied owing to the difficulty of reliably sampling at the 30 to 40 m level.

Injection points were located at ca. 12 cm intervals around the stem at breast height; a 5-ml formulation was injected at each point with a Mauget applicator at a depth of 1-2 cm into the xylem. Treatments were done on August 8, 1973.

In the Baygon test, four BWA populations were delineated on the stem of each tree about 1 m above the injection points, and aphids were counted on August 7, before treatment. These populations were checked again 2 weeks after treatment, and aphids were classified as dead or live. Crown populations were assessed on August 21 by examining aphids on nodes at 15X magnification and classifying them as live or dead. One node (same one on each branch) was collected from ten 4-to-8-year-old branches on each tree. Two weeks after injection, mortality of aphids on all treated trees was similar to that in the check, indicating that none of the Baygon formulations were sufficiently mobile to affect BWA in the crown or on the stem.

In the Furadan test, only stem populations were observed. Four bark pieces (6 cm^2), located about 3 m above the injection points, were removed from each tree before treatment, and live aphids on each piece were counted. Two weeks after treatment, bark pieces were collected from locations adjacent to the earlier samples, and live aphids were tallied. Furadan at 10% and 1%, as well as the solvent, produced small increases in mortality. Most of this mortality was associated with the first instar, or neosistens, stage.

These tests provided some indication that Furadan was mobile enough to be translocated through the xylem and into the phloem and outer bark, where the aphids fed.

In 1974, Furadan was tested in the field, to determine whether it had systemic activity when applied to the ground. Each of three treatments was applied to two amabilis fir (10-15 m high) infested with BWA, at rates and formulations listed in Table 1.

TABLE 1

Effect of ground application of Furadan—N fertilizer formulations on balsam wooly aphid infesting the crowns of amabilis fir (overwintering generation)

Treatment	Tree	No. of BWA[1]	% Mortality
4.4 kg/ha Furadan[2] + fertilizer[3] (363 g Furadan + 7.9 kg crushed urea per tree)	600	6	100
	3,805	83	81
2.2 kg/ha Furadan + fertilizer (182 g Furadan + 7.9 kg crushed urea per tree)	602	16	88
	701	89	81
4.4 kg/ha Furadan (363 g Furadan + 7.9 kg sand carrier per tree)	700	25	48
	3,803	18	61
Check (no treatment)	NF1	52	56
	NF2	24	42

[1] Total population on 10 nodes/tree on June 17; live + dead.
[2] Furadan 10% granules.
[3] Forestry-grade urea applied at 448 kg/ha.

Each treatment was applied to the rooting zone (10 m diameter) around the trees on April 4. At this time aphids were in the diapausing neosistens stage of the overwintering generation. The application was followed by 19 mm of rain on April 4 and an additional 60 mm during the next 4 days.

Aphid populations in the crown and on the stem of each tree were examined in mid-June, about 10 weeks after treatment. At this time aphids were mostly adults of the overwintering generation. For crown populations, nodes were collected and examined as for the 1973 test. Results (Table 1) indicate that Furadan, when combined with fertilizer, increased the mortality of aphids infesting the crown; the mortality of crown populations was 30 to 50% greater than in the check treatment. Furadan applied without fertilizer was ineffective.

One might infer from these data that urea fertilizer, and not Furadan, caused the population decline. However, another field trial, with amabilis fir on the same site, indicated clearly that urea fertilizer (at 448 kg/ha) caused significant increases in aphid populations in the crown.

Stem populations were checked at the same time by removing four bark pieces (6 cm^2) from each tree and determining the percent mortality on each piece. Aphid populations were unaffected by any of the treatments, except for tree 602, which had ca. 30% higher mortality than untreated trees.

About 4 months after application, during the subsequent (summer) generation of aphids, crown populations were examined by the same sampling system as in June. On check trees, population levels were 42 to 67% lower than in the overwintering generation sampled in June; population reductions on Furadan-treated trees were less than on untreated trees. Furthermore, the level of mortality among all populations of the summer generation was similar. These observations indicate that the treatment-related mortality observed during the overwintering generation did not persist into the next generation. Apparently, Furadan had little if any systemic residual effect for the summer generation, and the reduction observed during the overwintering generation was nullified by recolonization of the crown by progeny of the overwintering generation.

In summary, Furadan applied to the ground at either the 2.2 or 4.4 kg/ha rate appears to be xylem-mobile and toxic to BWA infesting the crown, provided the chemical is applied in combination with urea fertilizer. However, the beneficial effect of the treatment lasts only one generation. The reproductive potential of the aphid is so high that populations can recover to pretreatment levels in one generation. Furthermore, Furadan appears to have insufficient residual life in the tree to affect recolonization by the subsequent generation.—J. R. Carrow and G. S. Puritch, Pacific Forest Research Centre, Victoria, B.C., and P. C. Nigam, Chemical Control Research Institute, Ottawa, Ont.