bi-monthly research notes

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ENTOMOLOGY

Timing Cacodylic Acid Treatments to Kill Mountain Pine Beetles Infesting Lodgepole Pine.—Cacodylic acid (dimethylarsenic acid) introduced into the sapwood of host trees has been shown to cause mortality to adults and larvae of *Dendroctonus adjunctus* (Hopk.), *D. rufipennis* (Kirby), *D. pseudotsugae* Hopk., and *D. ponderosae* Hopk. while they are under the bark (Chansler and Pierce, J. Econ. Entomol. 59:1357-1359. 1966). Cacodylic acid has been applied both before and after beetle flight (Chansler et al. USDA Forest Serv. Res. Note RM-161, 1970). Living ponderosa pine (*Pinus ponderosa* Laws.) treated with cacodylic acid before beetle flight were intended to act as attractive trap trees, but attack densities were less on these trees than on untreated trees and, therefore, the treatment was not effective in controlling the beetle population. Postflight application of cacodylic acid was successful, causing almost 100% mortality of parents and brood under the bark.

In 1976, lodgepole pine trees (*Pinus contorta* Dougl.) were treated with cacodylic acid immediately after attack by mountain pine beetles in a pine forest in the Cariboo Forest District. In the spring of 1977 a random selection was made from these trees. Nineteen were sampled at 1.5 m height, eight at 3 m and seven at 6 m. Sampling consisted in taking two 10.16 cm diam samples at each height and counting live and dead parents and progeny. The data obtained (Table 1) show that, when the treatment was applied soon after attack, its lethal effect was not diminished with height on the boles of the trees up to at least 6 m, which, in many trees, included the attacked portion.

An experiment to determine the effective timing of cacodylic acid treatment to cause mortality of *D. ponderosae* in lodgepole pine was carried out in the Cariboo Forest District in the summer and fall of 1977. One hundred and fifteen naturally infested pines were selected for postflight treatment, and other surrounding attacked pines were used as checks. Twenty-five trees were treated on 10, 15, 22, and 29 August, and a further 15 trees were treated on 19 September. These dates represented 16, 21, 28, 35, and 56 days, respectively, after the main beetle flight and attack. Treatment for each tree consisted of 1 mL full-strength Silvisar 510^{R} (cacodylic acid, Ansul Co., Marinette, Wis., U S A) for each 2.5 cm circumference, applied in a continuous shallow ax frill around the bole about 25 cm above the ground. Care was taken to ensure that the cacodylic acid was concentrated in the outer sapwood that was adjacent to the cambium and inner phloem in the area where the beetles developed. In treatments of spruce (Dyer, Can. J. Forest Res. 3:486-494, 1973), poor results were obtained when the ax frill was cut unevenly into the sapwood.

On 29 September, nine trees, selected at random from the 25 trees of each of the first four groups of treated trees, and 20 untreated infested trees were sampled by taking two 10.16 cm diam circular bark samples from each tree at breast height. In mid-October, all 15 of the trees treated on 19 September were sampled in the same way. The numbers of attacks, live and dead adults, and live and dead brood were counted for all samples. There was no significant difference ($p < .05$) in attack or subsequent brood density among trees of any treatments.

TABLE 1
Mortality of mountain pine beetles at various heights in lodgepole pine trees treated with cacodylic acid immediately after beetle attack in 1976 and sampled in June 1977

Height of sample (m)	No. of trees sampled	No. of beetles[1]					
		Parent adults		Larvae		Pupae	
		Live	Dead	Live	Dead	Live	Dead
1.5	19	1	56	0	67	0	0
3.0	8	0	23	0	101	0	0
6.0	7	1	11	0	166	1	0

[1]Based on two 10.16 cm diam bark samples per tree at each height.

TABLE 2
D. ponderosae adult and larval mortality in lodgepole pine treated with cacodylic acid (Silvisar 510) after beetle attacks, 1977

Days after attack when treated	Days after attack when sampled	No. of bark samples[1]	No. of adults per sq m			No. of larvae per sq m		
			Mean	SE[2]	% dead	Mean	SE[2]	% dead
16	56	18	144	37	95	1906	177	96
21	56	18	116	27	100	1885	202	99
28	56	18	145	33	57	2618	168	25
35	56	18	226	39	58	1412	183	38
56	71	30	111	21	0	2213	42	0
Untreated	58	40	80	13	42	1934	159	3

[1]Two samples at breast height per tree.
[2]SE—Standard error.

Table 2 shows brood densities and percentage mortality for treatments and checks. Those trees treated up to 3 wk after the initial beetle attack showed 95 - 100% parent and brood mortality, but this rapidly decreased for treatments made during the next few weeks. Treatment after 5 wk produced no mortality in either parents or brood.

Treatment with cacodylic acid on infested lodgepole pine is effective in killing both adult and immature mountain pine beetles throughout the infested parts of the boles. However, application must be made within 3 wk after attack to be fully effective. Five weeks after attack application is partially effective but 8 weeks after attack it is ineffective.—E.D.A. Dyer and P.M. Hall, Pacific Forest Research Centre, Victoria, B.C..

PATHOLOGY

Stem Decay in Balsam Fir Damaged by Balsam Woolly Aphid.—Schooley (For. Chron. 52:143-144, 1976), describing the recovery of young balsam fir (*Abies balsamea* [L.] Mill.) damaged by the balsam woolly aphid (*Adelges piceae* Ratz.), pointed out that 40% of the tops of dominant and codominant trees were killed. Virtually all of these trees reestablished height growth on primary branches that turned upward to assume the leader position. Tree stems were not usually seriously deformed, but the dead leaders remained as potential sites for the development of decay, as Stillwell (Forest Sci. 2:174-180, 1956) has shown to be the case with leaders killed by the spruce budworm. The hypothesis that decay enters through dead leaders is supported by Lortie (Laval Univ., Forest Res. Found. Bull. II, 1968), who studied a young stand in which 75% of the trees showing evidence of leader replacement had decay. Aphid-killed leaders on young trees were thought to be favorable infection courts because they retain a near vertical orientation and could be subjected to high moisture conditions for many years. A study was therefore conducted to determine if decay actually occurs at this location on aphid-damaged balsam fir and what fungi are associated with the decay.