THE EFFECT OF DOUGLAS-FIR LOG AGE ON ATTACK BY THE AMBROSIA BEETLE, *TRYPODENDRON LINEATUM* (OLIV.)[1]

by

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Trypodendron lineatum (Oliv.), which flies in the first warm days of spring, prefers to attack trees felled the preceding autumn or winter rather than those freshly cut. Gaumann (1) showed that in Europe, spruce and fir felled from March to August were free from attacks by this species Attacks were heaviest on trees cut in October, November and December, although January-felled spruce was also heavily attacked. Observations by Hadorn (2) supported these findings. Among a 24-month series of hemlock cuttings conducted by Mathers (5), only logs older than five months were attacked by *Trypodendron*. Patterson (6) found from a series of hemlocks felled in different months, that average density of attack progressively diminished from 60, in December-felled, to 0.5 holes per square foot in April-felled trees. The same preference for autumn-winter felled trees was also shown for Douglas-fir, grand fir and western hemlock by Prebble and Graham (7). Exceptions have been recorded where trees felled as late as March and April have been attacked (4, 7), but in general, freshly cut trees are least attractive. The reason for *Trypodendron* preference of logs cut in autumn or winter is not yet clear. We recently conducted an experiment to determine the relation of attack density to time between felling and attack.

It is probable that both the quantity and quality of food reserves and other organic materials in the sapwood undergo changes after felling. If these changes are brought about by the continued functioning of living cells, it should be possible to arrest them by killing the cells. Wilson (8) demonstrated that prolonged functioning of the sapwood cells after cutting depleted starch in the sapwood of oak and ash. In contrast, the early death of these cells resulted in the maintenance of the starch reserve and therefore of susceptibility to *Lyctus* beetle attack.

Jover (3), in the Ivory Coast, increased ambrosia beetle attacks on Avodire eightfold by boiling the wood for 48 hours soon after felling. He suggested that the heat, by suppressing enzymatic action, prevented the depletion of stored starch which would occur under natural conditions.

Methods

In planning the experiment, the following variables had to be considered in relation to the log aging process: (a) seasonal temperature fluctuations; (b) changes in log moisture; and (c) inter- and intra-tree variability in attractiveness to beetles. To minimize the effects of these variables, the following procedure was used. Two Douglas fir were felled February 7, 1956, and each cut into twenty-four 18-inch blocks. The blocks from each tree were then divided into six groups of four adjacent sections. One section from each group served as a control for the other three which received various treatments. The controls were essentially maintained as they were at time of felling by storing them in plastic bags at 0°F., after first waxing the cut ends.

Four series were aged as described below. From each tree, a set of blocks with the ends waxed were aged. Another series from Tree "A" was aged without waxing the ends. The fourth series, from Tree "B" was autoclaved at 20 pounds pressure for two hours before aging. This was done to simulate Jover's (3) boiling treatment and it undoubtedly arrested the cellular or enzyme activity in the

1. Contribution No. 400, Forest Biology Division, Science Service, Department of Agriculture, Ottawa, Canada.

sapwood. The bark was loosened on most of these blocks but it was tacked onto the sapwood immediately after autoclaving and the cracks coated with wax. Weight measures before and after autoclaving showed an average water loss of about one pound per block (blocks averaged 33 pounds).

All sections to be aged were placed in the basement of the laboratory where the temperature remained near 72°F. Moisture changes were minimized by standing the sections on moist sand and covering them with plastic bags. Every fortnight for 12 weeks, one block from each age-series was moved to refrigerated storage (0°F.), thus preventing further change.

On May 17, during a period warm enough to initiate *Trypodendron* flights, the blocks were taken from refrigerated storage to Cowichan Lake, where they were set out in a partly shaded clearing near a recently logged area where numbers of *Trypodendron* were likely to appear. All blocks were weighed just after they were cut, and again when they were placed in the forest. Most of them showed little change in weight, although the unparaffined, aged sections from Tree "A" had gained weight slightly. This increase can be attributed to water absorbed into the wood from the damp sand during aging. On July 16, the blocks were debarked and all *Trypodendron* attacks counted.

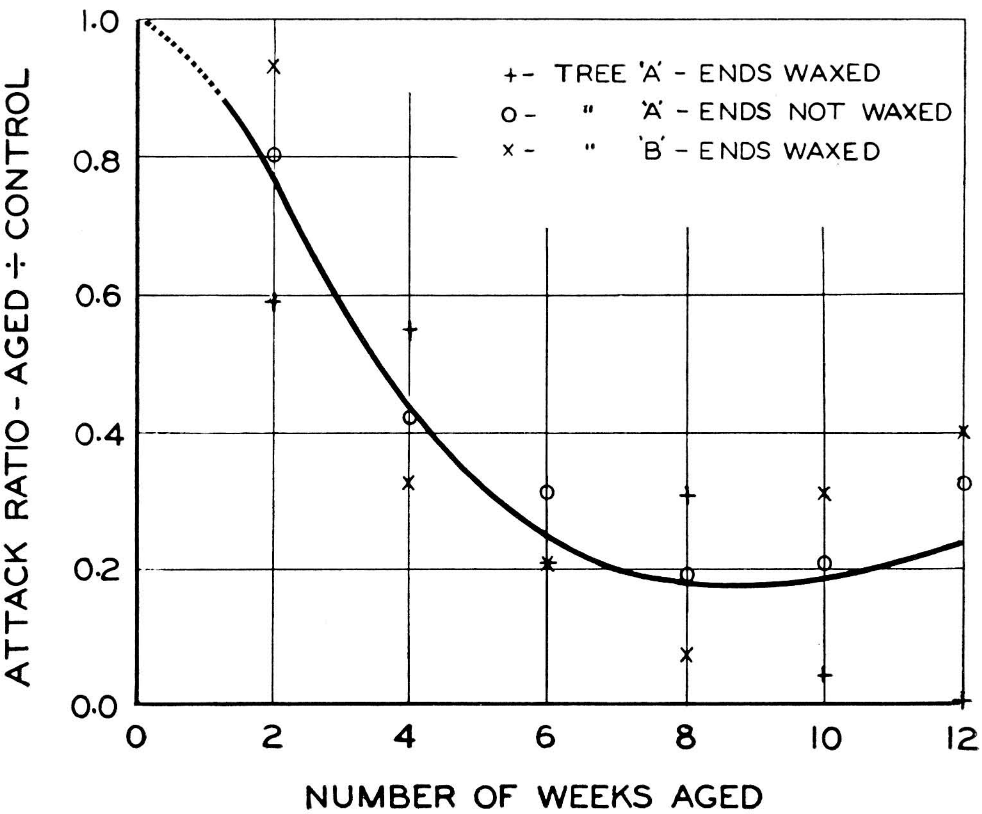

Fig. 1.—Individual values and free-hand curve showing the relation of attack on aged blocks (expressed as a proportion of attack density on corresponding control blocks) to length of time aged. The autoclaved series is not shown.

Results

Trypodendron were noted flying near the logs during the first few days they were in the field, but after six days, only six attacks could be found, and five of these were on control sections. By May 29, however, 155 attacks were counted, 138 of which were on control blocks. The final examination, in July, also showed that the beetles preferred the un-aged wood (Table I). Among the groups that were not autoclaved, density of attack varied inversely with time of aging. This relationship is illustrated in Figure 1, where the attack preference is expressed as the ratio of aged-block to corresponding control-block attack density. The aged, waxed series from Tree "A" show a constantly declining attractiveness to the beetles for the entire 12-week aging period. Unparaffined blocks from Tree "A" and the waxed Tree "B" series show attack density decline for only the first six weeks of aging; blocks of these series aged longer showed no further decline in attractiveness.

It should be noted in Table I that the average attack values are almost identical for the aged and control logs of the first three series. One may conclude from this that differences between trees, and waxing of cut ends had little influence on attack.

In comparison with the other logs, those that were autoclaved received much less attack. Attack on the autoclaved-control blocks was less than half that on the other controls, and the autoclaved-aged series was almost free of attack.

The basal four-foot section of Tree "A" was not used for the experiment, but was left in the forest near Victoria where the trees were cut. It was interesting to find in July that this section had received 14.1 *Trypodendron* and 12.7 *Gnathotrichus* attacks per square foot. The combined attack density of the two ambrosia beetles was thus equivalent to that on the experimental control blocks at Cowichan Lake.

Discussion and Summary

Although there was a high *Trypodendron* population present, and favourable weather persisted, the experimental logs were not attacked for several days after they were set out. This suggests that some change took place in the blocks after they were placed in the forest but before they were attacked. Any change which did take place however, did not obscure the treatment effects. The lighter attacks on the treated blocks indicate that both aging and autoclaving prevented the formation of,

TABLE I.—Density of *Trypodendron* attack on aged and control Douglas-fir blocks.

No. weeks aged	Tree "A" Ends waxed	Tree "A" Ends not waxed	Tree "B" Ends waxed not autoclaved	Tree "B" Ends waxed autoclaved
	(Number of entrance holes per square foot)			
2	19.9 (33.3)[1]	9.2 (11.4)	25.3 (26.0)	2.9 (2.5)
4	22.5 (40.6)	11.8 (27.7)	9.0 (27.8)	2.9 (16.3)
6	9.8 (46.0)	6.7 (21.2)	4.3 (20.4)	0.7 (17.3)
8	7.9 (25.3)	12.5 (62.8)	3.1 (42.4)	0.7 (12.3)
10	0.6 (13.3)	5.0 (23.7)	10.1 (32.3)	0.0 (13.8)
12	0.0 (16.5)	15.2 (45.7)	10.4 (25.9)	1.9 (23.0)
Treatment Means	10.1 (29.2)	10.1 (32.1)	10.4 (29.1)	1.5 (14.2)

[1] Density of attack on corresponding control blocks

or depleted some attractive substance. It is probable that the heat treatment destroyed or inhibited attractant formation. On the other hand, lessened attack on the unautoclaved aged wood may be attributable to continued cellular activity. Conditions duiing aging were similar to those described by Wilson (8) as favourable for prolonging the life of sapwood cells of oak and ash. Under such conditions, the living cells deplete starch reserves that reach a maximum during midwinter in these species. It is reasonable that this depletion principle applies to our aged Douglas-fir, but iodine tests both at the time of felling and after aging failed to reveal the presence of starch.

The experiment was limited in scope but it serves to point out the need for more information on the occurrence and seasonal fluctuations of various sapwood constituents in relation to ambrosia beetle selectivity.

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On the iniquity of blanket sprays and dusts

One afternoon in 1946 as soon as DDT became available, I treated several quarter-acre plots on the Lac du Bois range north of Kamloops, with 3% DDT in diatomaceous earth, put out with a rotary hand duster, in the hope of controlling grasshoppers. Vegetation on the plots consisted of mixed grasses from 12" to 18" high and Russian thistle, and harbored several species of grasshoppers of mixed instars (hereafter caller groppers).

The plots were examined next forenoon. The effect on the groppers was negligible and continued so, but on some other insects it was literally shocking. Leafhoppers and mirids were wiped out and many dead and dying beetles, for the most part harmless, lay on the ground. Mr. Hugh B. Leech identified the beetles as: *Percosia extensa* Casey, *Harpalus basilaris* Kby. (*obesulus* Lec.), *Amara* (Celia?) *subaenea* Lec., and *Amara* sp. (Carabidae); *Cicindela longilabris montana* Lec. (Cincindelidae); *Coniontis oblita* Casey (Tenebrionidae); *Serica anthracina* Lec. (Scarabeidae); and *Brachyrhinus ovatus* (Linn.) (Curculionidae). *B. ovatus*, the strawberry root weevil is an important pest elsewhere but is harmless on a cattle range five miles from the nearest cultivated plants.

This dust tested again on Canada blue grass without weeds, killed off the large population of leafhoppers present and a few ground beetles. It was 12 days before the area began to be repopulated centripetally from the surrounding vegetation.