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Effect of Cut-And-Leave and Cut-And-Top Control Treatments on Within-Tree Southern Pine Beetle Populations

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SUMMARY

Effects of the cut-and-leave and cut-and-top treatments on within-tree populations of the southern pine beetle were evaluated in seven active infestations in central Louisiana. Beetle populations were significantly reduced only in December by felling freshly attacked trees.

Additional keywords: Control, sampling, ***Dendroctonus frontalis*** Zimmermann.

INTRODUCTION

In 1970, at the height of the most recent outbreak of the southern pine beetle (SPB) (***Dendroctonus frontalis*** Zimmermann), the pest was found on more than half the region's pine land. Records show that 8.5 million cords and 2.5 million board feet of beetle-damaged pine timber were salvaged from 1980 through 1978. This timber has been valued at $200 million (Price and Doggett 1978). It was estimated that only one-third to one-half of the beetle-affected timber was salvaged.

Currently, four suppression methods for SPB are recommended: (1) salvage removal, (2) cut-and-spray, (3) pile-and-burn, and (4) cut-and-leave. A fifth method, cut-and-top, has had limited use in Texas. Salvage removal is the most widely used of these methods. Often inclement weather conditions, administrative delay of sales, low volumes of timber, inaccessibility of spots, or a poor timber market severely limits the effectiveness of the salvage removal programs. During such times, the other suppression methods offer advantages.

Two alternatives that are relatively easy to apply are cut-and-leave and cut-and-top. It has been shown that cut-and-leave reduces SPB population survival (Ollieu 1969), disrupts natural aggregation behavior (Gara 1967), promotes dispersal, and reduces subsequent tree mortality (Billings and Pase 1979).

The cut-and-leave treatment involves felling all infested trees into an opening created by dead "black- and red-topped" trees. This usually results in a large pile of infested trees. When the crowns are left intact, the inner bark (phloem) molsture is naturally dissipated through transpiration.

The cut-and-top procedure is applied in the same way as cut-and-leave, except that the tops are **severed** from the bole. Proponents of the procedure believe that removing the top In the winter prevents transpiration and thus maintains abnormally high moisture levels that adversely affect developing broods.

In both the cut-and-leave and cut-and-top methods, a buffer strip of green pines (equal in width to the height of infested trees) is cut in front of recently attacked trees to prevent further attacks on adjacent trees (Coster and Johnson 1979). The disruption of the natural pheromone source apparently encourages beetles to disperse at a time when they may not be physiologically ready to do so (Hedden and Billings 1977).

This note describes the influence of cut-and-leave and cut-and-top on beetle numbers.

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METHODS

From 1975 to 1976, evaluations were conducted in Louisiana to determine the effect of the cut-and-leave and cut-and-top treatments on beetle numbers.

The study areas were in the Catahoula and Evangeline Ranger Districts of the Kisatchie National Forest, located in Grant and Rapides Parishes. All trees were loblolly pines (*Pinus taeda* L.) and ranged in diameter from 13 to 46 cm. Treatments were started on November 1, 1975, and ended on September 10, 1976. Seven separate spots were located and treated. In all cases, the cut-and-leave and cut-and-top trees were felled and exposed to full sunlight. The standing untreated trees were shaded on all sides, and none of the residual vegetation was removed. Treated and untreated trees were located within the same group of infested trees (spot).

The population sampling techniques and equipment used for taking the 100-cm² bark samples were similar to those reported by Coulson et al. (1975). The first set of bark samples was taken on the first day of treatment, prior to tree felling, from all the infested trees in that spot. Two sample disks (north and south) were collected at 1.4 m intervals, starting 1.4 m from the ground, along the infested bole. The cut-and-leave and cut-and-top trees were immediately cut after sampling and exposed to full sunlight. A second set of bark samples was taken just prior to beetle emergence. Two samples at each sampling interval (1.4 m) were taken on each untreated tree, and four samples were taken at each sampling interval from the cut-and-leave and cut-and-top trees. These samples were incubated in rearing cups for 30 days to collect emerging adults.

Total numbers of insects on each tree for each sample date were estimated' by the topological mapping technique (Pulley et al. 1976). Two variables were analyzed — survival and numbers of offspring per attacking adult. A one-way analysis of variance was performed using the actual data to conduct a multiple range test on the treatment differences. A two-way analysis of variance was done for the survival data. Duncan's Multiple Range Test was used to determine if pairs of plots were significantly different from each other.

RESULTS AND DISCUSSION

Survival

For trees with late brood stages (large larvae, pupae, callow adults), there were no significant differences ($P > 0.05$) in survival among treatments, dates, and treatment by date interactions. Survival means for different treatments were variable throughout the year. Table 1 presents average beetle survival by treatment and date. Overall averages show that the two treatments reduced survival 11 and 15 percent over survival in the untreated trees. However, survival in the untreated trees was greatest for only three of the five dates.

In cut-and-top trees, average beetle survival ranged from 8 to 48 percent. The largest survival percentages, in March and September, reflect a majority of pupae and callow adults in the study trees as compared to other treatment months, December and August, when primarily larvae were present. Beetle survival in untreated trees in July (32 percent) was similar to the July results (34 percent) of Palmer and Coster (1978).

Palmer and Coster found July survival in cut-and-leave trees to be 17 percent compared to this evaluation's 18 percent. In this evaluation, cut-and-leave beetle survival ranged from 13 to 52 percent. The high (September) and low (December) seasonal values in beetle survival were comparable to the findings of Hodges and Thatcher (1976), which had been completed 1 year prior to the present evaluation.

Cut-and-leave resulted in the lowest average survival for all seasons. Average survival was 24 percent for cut-and-leave, 28 percent for cut-and-top, and 39 percent for controls (table 1). This compares to the results of Hodges and Thatcher (1976), where survival was 32, 17, and 35 percent far cut-and-leave, cut-and-top, and untreated trees, respectively.

Number of Offspring

Instead of survival, the number of offspring per attacking adult was compared in the trees containing recent attacks. In this set of experiments, there were significant differences ($p < 0.05$) in offspring for treatments within treatment dates (table 2).

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Table I.-Average survival of southern pine beetle brood in untreated, cut-and-leave, and cut-and-top pines

Treatment	Dec. 1975			Mar. 1976			July 1976			Aug. 1976			Sept. 1976			Average	
	Trees sampled	Brood survival	SD[1]	Trees sampled	Brood survival	SD	Trees sampled	Brood survival	SD	Trees sampled	Brood survival	SD	Trees sampled	Brood survival	SD	Brood survival	SD
	number	*percent*		*number*	*percent*		*number*	*percent*		*number*	*percent*		*number*	*percent*		*percent*	
Untreated	4	20	7	3	76	13	3	32	11	3	34	26	5	39	23	39	24
Cut-and-top	4	8	3	3	36	10	3	36	31	3	10	1	4	46	21	26	22
Cut-and-leave	4	13	10	0	18[2]		3	16	4	3	16	21	3	52	30	24	22
Average	....	14	6		49	25	..	29	19		21	21	....	44	23	30	23

Standard Deviation.
[2]Data missing/not available: estimation done by regression analysis.

Table P.-Average number ot offspring per attacking adult trom recently attacked pines

Treatment	Dec. 1975			15 June 1976			29 June 1976			Sept. 1976			Average	
	Trees sampled	Offspring[1]	SD[2]	Trees sampled	Offspring	SD	Trees sampled	Offapring	SD	Trees sampled	Offspring	SD	Brood survival	SD
	......number......			.... number......			........number........			......number......			number	
Untreated	3	3.30	1.103	3	0.45	0.32	3	1.30	0.40	1	3.70		1.90	1.15a
Cut-and-top	1	1.29	b	3	.10	.04	3	.90	.07	2	.95	.35	.70	.15b
Cut-and-leave	3	1.60	1.10b	3	.04	.02	3	.90	.40	3	1.03	.49	.90	.80b
Average	. . . .	2.30	1.10a	.20		.26b	1 . 0	9	.35b	.	1.45	1.1 b		

[1]Per attacking adult.
'Standard deviation.
[3]Means followed by the same letter in each column are not significantly different ($P < 0.05$).

There was no significant treatment-by-month interaction at the 0.05 level. This greater effect on early broods supports the findings of Ollieu **(1969),** but not those of Hodges and Thatcher (1976).

When compared to untreated pines, the number of offspring per attacking adult was significantly less for the cut-and-top and cut-and-leave treatments. Either lower egg production or higher brood mortality accounted for this difference. The number of December offspring per adult was significantly larger than those of the other three sampling dates.

CONCLUSIONS

In this evaluation, cut-and-leave and cut-and-top treatments significantly reduced SPB populations only in limited situatlons. When the felled trees were freshly attacked In the winter, populations were adversely affected. It appears that **microenvironmental** changes have a greater opportunity to affect the beetle in these trees. Population survival is reduced by different amounts, depending on treatment and date of **application;** however, it is impossible to eliminate the entire brood.

It is not known how much beetle population must be reduced to prevent the breakout of a controlled spot. In the summer, controlled spots may break out but few new ones are initiated, **indicating** that **significant** beetle mortality can probably be attributed to the dispersal phase. This assumption is based on the belief that when cut-and-leave and **cut-and-top** are applied, the broods are placed in a less than desirable environmental situation and produce adult beetles that are not physiologically capable of flying for very long distances and thus are not able to initiate new spots (Billings and Pase 1979).

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