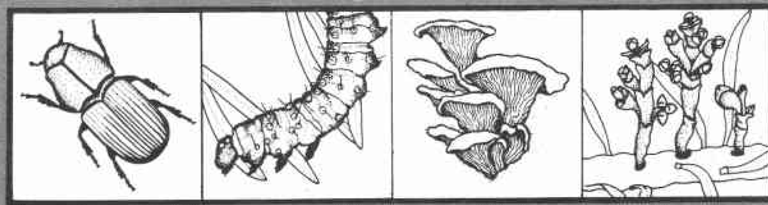
Forest Pest Management



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WESTERN SPRUCE BUDWORM 1/ CONTROL PROJECT ON THE BIG TIMBER RANGER DISTRICT GALLATIN NATIONAL FOREST, MONTANA

Wayne Bousfield 2/, Frank Cifala 3/, and Richard Kracht 4/

ABSTRACT

The microbial insecticide, *Bacillus thuringensis* (*Bt*), was applied from fixed-wing aircraft to approximately 700 acres of western spruce budworm host type at the rate of 12 billion international units (BIU's) per gallon of water per acre. The objective of this control project was foliage protection to insure future cone production for this timber sale area. Evaluations, 20 days after spray application, showed the adjusted defoliation was 38.2 percent in the sprayed areas and 66.4 percent in the unsprayed areas at the termination of the budworm feeding period. Population reduction, corrected for natural mortality at 20 days, was 68 and 81 percent at the time of moth emergence.

INTRODUCTION

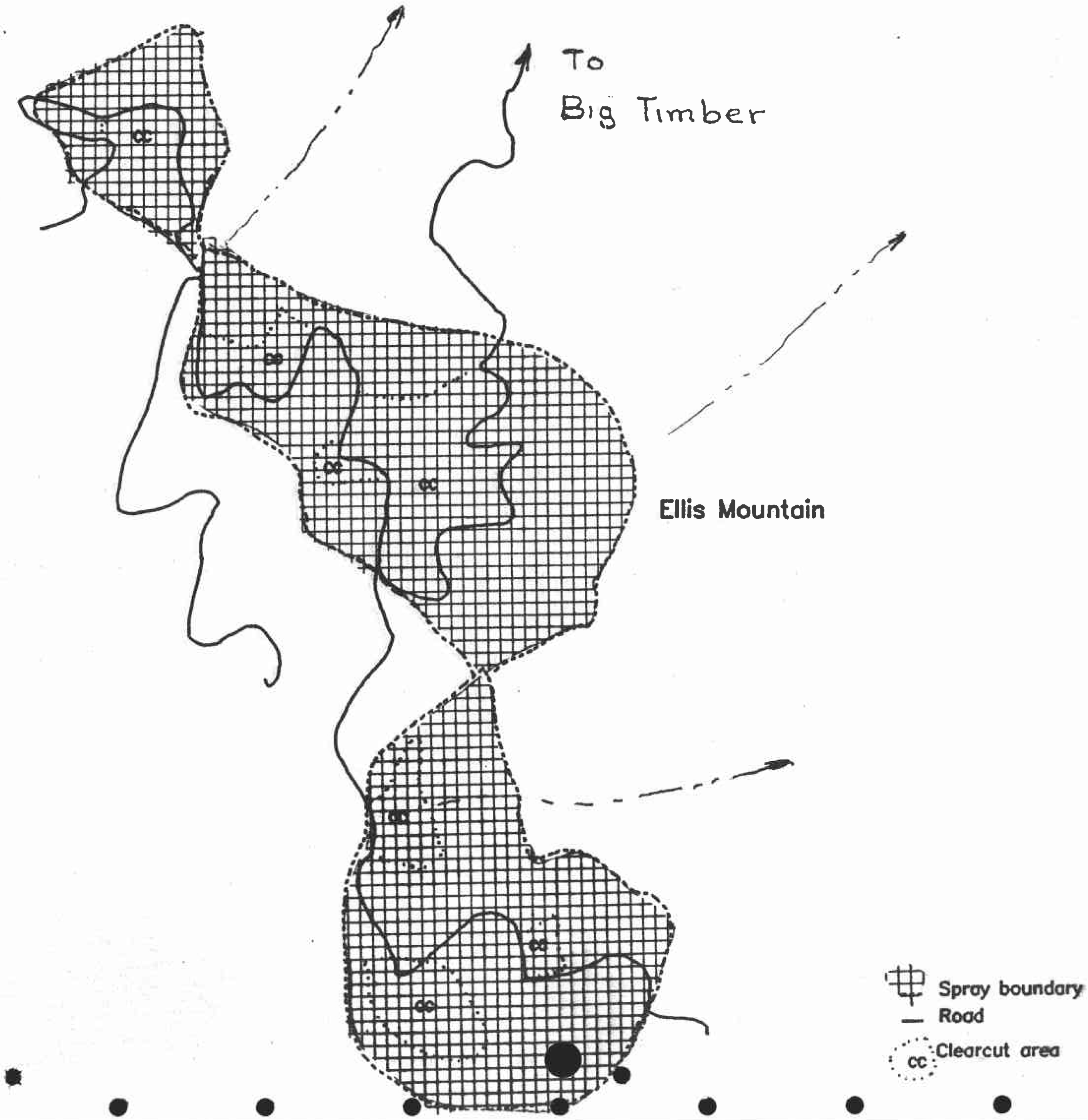
The Iron Mountain timber sale area is located in Douglas-fir host type about 15 miles south of Big Timber, Montana, at elevations of 6,500 to 7,500 feet, on the Big Timber Ranger District on the Gallatin National Forest (fig.1). The area has a history of spruce budworm, and has been defoliated for the past several years. Timber harvest roads have been completed. Harvesting is planned to start in 1987. Site preparation is scheduled for 1988.

The purpose of this control project is to enhance natural regeneration opportunities in the sale area. Natural regeneration does not occur in areas where budworm have destroyed cone production. Planting is the only alternative to achieve regeneration. Planting costs are about $250 per acre.

1/ Choristoneura occidentalis
2/ Entomologist, Cooperative Forestry and Pest Management, Missoula, MT
3/ Resource forester, Big Timber Ranger District, Gallatin National Forest, Montana
4/ Silviculturist, Gallatin National Forest, Bozeman, MT

United States Department of Agriculture
Forest Service
Northern Region
P.O. Box 7669
Missoula, Montana
59807

Figure 1.--B.t. project area



The Forest plans three consecutive annual applications of *Bt* to enhance crown development and encourage cone production. Following site preparation, an Acecap*(R)* 97 5/ treatment will be applied to selected trees along cutting unit boundaries to protect cones from budworm damage.

Bacillus thuringienses was the pesticide selected for the project because it will reduce populations and save foliage without degrading the environment. Acecaps have proven successful for increasing seed production in budworm-damaged areas.

MATERIALS AND METHODS

Prior to *Bt* application, the budworm population was monitored to determine larval development. Spray was applied when 60 percent of the larvae were in the fourth and fifth instars. At the time of spraying, there were no pupae in the prespray collection. However, 12 percent of the larvae had reached the sixth instar.

A contract was awarded to a local applicator for spray mixing and application for $1.72 per acre. Spraying was from a Cessna Ag Wagon spray plane calibrated to apply 1 gallon of spray mix per acre. *Bacillus thuringiensis* was applied to approximately 700 acres at 12 BIU's per gallon of water per acre the morning of June 26, 1986. Cost of the *Bt* was $4.50 per acre. Orientation and observation aircraft rental was $673 ($0.93 per acre). Total direct cost was $7.15 per acre.

Mixing and loading was done at the Big Timber airport. About 4 hours were required to complete spraying. Spray application was monitored by observers in the air and on the ground. There were reports of rain near the spray area during the afternoon and evening of spraying; however, the material had dried and adhered to the foliage before there was any rain in the spray area.

To evaluate the treatment, 10 three-tree clusters were located in the spray blocks and 10 three-tree clusters were located in adjacent unsprayed areas. Prespray and 20-day postspray population levels were determined by removing two midcrown 18-inch branches with a pole pruner and attached catch basket. Population counts were made of budworm larvae and number of new shoots on each branch. Population densities were converted to spruce budworm per 100 new shoots for analysis.

At the 20-day posttreatment evaluation period, most of the budworm had pupated. Defoliation counts were made on 25 apical shoots on each sample branch, starting at the tip and working toward the base. Each of the 25 shoots were rated for defoliation, using a 6-class system from 0 to 100 percent. Surviving larvae or pupae were collected and laboratory reared in petri dishes to compare survival rates in treated and untreated areas. The data was subjected to covariance analysis and Abbot's formula to correct for differences in treated and untreated prespray populations.

5/ Acephate 97 percent.

RESULTS

Population levels in the prespray sample, in the areas scheduled for spraying averaged 12.25 larvae per 100 shoots and 17.63 larvae per 100 shoots for the unsprayed areas. At the 20-day posttreatment evaluation period, populations were 1.73 larvae per 100 shoots in the sprayed areas and 7.87 larvae per 100 shoots in the unsprayed areas. Unadjusted defoliation levels were 34.89 percent in the sprayed areas, and 69.68 percent in the unsprayed areas (Table 1). Defoliation levels adjusted *6/* by covariance analysis were 38.17 percent for the treated areas and 66.40 percent for the untreated areas.

Population reduction was 68.4 *7/* percent at the 20-day evaluation, increasing to 81.1 percent at final emergence of adult moths. In the unsprayed area, 58.2 percent of the sample of larvae or pupae emerged as moths. Only 34.7 percent emerged as moths in the *Bt*-treated areas. Budworm rearing showed parasitism was 3.1 percent in the unsprayed areas and 11.6 percent in the sprayed areas. This difference might be partly attributed to the fact that parasitized larvae are less active than non-parasitized ones, hence they are less likely to feed on the *Bt*. As a result, a higher percent of the survivors are parasitized in treated areas.

SUMMARY

The project accomplished its objectives. Substantial foliage was saved and budworm populations were reduced. However, the spray blocks are small and reinvasion is expected next year. Subsequent treatments will be needed in following years.

Quality of the spray treatment was considered very good. The treatment cost was well within an acceptable range. Observations in the sprayed area disclosed that the upper tree crowns appeared greener than the lower crowns. Perhaps more material was deposited in the upper crowns, creating a filtering effect. The defoliation pattern is usually reversed: upper crowns are more heavily defoliated than the lower crowns.

6/ Covariance analysis will adjust the means to reflect prespray population differences between treated and untreated areas.

7/ Corrected by Abbot's formula.

$$Y = 1 \quad \frac{\text{Postspray treatment mean}}{\text{Prespray treatment mean}} \times \frac{\text{Prespray treatment mean}}{\text{Postspray control mean}}$$

Table 1.--Results of *Bt* application on budworm survival and defoliation levels.

Three-tree cluster	Prespray population 1/	20-day Postspray population 1/	Emerging population 1/	Percent 20-day defoliation
***Bt*-Treated Clusters**				
1	2.63	0	0	4.50
2	15.48	3.42	1.19	38.92
3	11.49	1.33	.46	27.08
4	4.70	1.25	.43	16.50
5	3.51	1.60	.56	19.25
6	27.88	.84	.29	54.17
7	12.90	2.64	.92	63.50
8	15.64	1.80	.64	61.75
9	5.53	3.57	1.24	41.25
10	22.76	.83	.29	22.02
Average	12.25	1.73	.60	34.89
Untreated Clusters				
1	16.83	10.24	5.96	83.50
2	13.95	3.24	1.88	92.67
3	21.54	17.66	10.28	63.50
4	26.39	14.23	8.28	79.25
5	23.77	9.81	5.71	76.67
6	29.15	6.78	3.94	81.58
7	9.81	1.59	.92	49.42
8	10.55	5.70	3.32	60.67
9	5.31	3.76	2.19	47.33
10	19.02	5.64	3.28	62.25
Average	17.63	7.87	4.58	69.68

1/ Larvae/100 shoots

2/ Survival rates from rearing were applied to the 20-day postspray population levels to calculate emerging population densities.