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STUDIES ON FOAMING ADJUVANTS FOR INSECTICIDE SPRAYS: Atplus 540 [R] in combination with dilute solutions of methomyl for control of spruce budworm on white spruce

by

L.M. Campbell and R.F. DeBoo

Chemical Control Research Institute
Canadian Forestry Service
Dept. of the Environment
Ottawa, Ont.

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Introduction

The constant need to improve the application of chemical pesticides has resulted in the development of many commercial spray adjuvants and emission equipment designed to alter the physical characteristics of the spray mixture. One of the most recent developments has been the application of pesticides in low-expansion foam sprays.

Several of these foam generating systems, consisting of air-induction nozzles and a compatible foam adjuvant, are commercially available for existing aerial and ground spray equipment at reasonable cost. Foam is produced as air is drawn through inlet ports of the nozzle into a chamber where it is entrained in the spray liquid. The nozzle expands the spray mixture with three to four parts air; thereafter the foam adjuvant holds the air within the spray droplets after they leave the nozzle. The resulting "air emulsion" is characterized by large white droplets which are highly visible to the operator. Primary use of foams has been in the agricultural application of herbicides where spray drift is a critical problem.

In 1972, while investigating the addition of adjuvants to water-based methoxychlor spray applied aerially for control of white pine weevil (DeBoo and Campbell 1972) the authors fitted a Piper Pawnee with foam generating nozzles. Treatment of 50 acres with .9 oz of the foam adjuvant Fomark [R] (Fisons Canada Ltd.) added per gal. of spray mixture indicated that drift losses were reduced and efficacy was significantly improved over standard water-based sprays with no adjuvant. However, due to the large droplet spectrum produced, the degree of protection achieved was not adequate for sound white pine weevil control.

Follow-up trials were initiated in 1973 in the Spruce Woods Provincial Park, Manitoba to investigate the use of foaming adjuvants with dilute applications of insecticides for control of the spruce budworm. All applications were made using a hydraulic sprayer and primary objectives of this pilot study were 1) to determine whether adequate coverage could be maintained, and 2) to determine whether the physical characteristics of foam sprays (ie, high visibility, lasting quality) would enable the operator to increase the speed of application and possibly decrease the volume of spray mixture applied per acre. Results from this Manitoba experience indicated that the highly visible spray stream produced showed potential as an aid to accelerating applications, although further testing was necessary to determine whether total volume requirements differed from conventional hydraulic sprays. Results also indicated that the addition of a foaming adjuvant to methomyl (Lannate 20L[R] manufactured by DuPont Canada Ltd) dilute sprays at 4 oz A.I./ac. increased efficacy from 82 - 95% when timed against peak fourth-instar (L_4) spruce budworm larvae.

In May, 1974, the authors conducted a small-scale trial near Grand'mère, Québec, to further evaluate the addition of a foaming adjuvant to methomyl dilute sprays applied for the control of the spruce budworm.

Objectives of this study were:

1) to determine the efficacy of hydraulic sprayer applications of methomyl applied by foam-generating and conventional spraying systems,

2) to determine the effect of the addition of a foaming adjuvant on the physical characteristics of the spray stream as a factor in possibly enabling the operator to increase "speed" of application,

3) to evaluate the potential of using a foam generating system to significantly reduce the amount of spray mixture required per acre.

Material and Methods

Formulations

Methomyl (Lannate 20L [R]) supplied by DuPont of Canada Ltd., was selected as the standard chemical treatment to be applied at a rate of 8 oz. A.I./acre. When applied as a conventional hydraulic spray 8 oz. of Chevron Sticker, supplied by Chevron Chemical Co. (Ortho Division), was added to each 100 gal. of spray mixture.

Foam applications were formulated using the adjuvant Atplus 540 [R], a "short life" foam (15 - 30 minute stability) supplied by Atlas Chemical Industries of Canada Ltd., at low and high concentrations of 0.5 and 1% respectively.

Treatment Area and Experimental Design

The area selected for treatment was located approximately 2 miles south of Grand'mère, Québec and consisted of 3 separate 0.75 acre planted white spruce blocks. Each block was further divided into 25 (5 x 5) sub-blocks arranged in a "latin square" design as part of an intensive fetilizer study program initiated by the Canadian Forestry Service in cooperation with the Consolidated Bathurst Paper Co. Unplanted strips approximately 15' wide separating the sub-blocks created 5 access roads from each side of the 3 larger main blocks. An area of 0.5 acres planted at the same time and located adjacent to the 3 treatment blocks was incorporated as an untreated check area. At the time of treatment there were approximately 925 surviving trees in each block averaging 12' in height.

Treatments were assigned as follows:

Block # 1 - Methomyl
2 - Methomyl + foam @ 0.5% conc.
3 - Methomyl + foam @ 1.0% concn.
4 - Untreated check.

Application Equipment

The C.C.R.I. experimental hydraulic sprayer (Fig. 1) mounted in the back of a 1 ton truck, in companion with two 50 gal. (U.S.) stainless steel barrels for batch mixing, was utilized for all applications. The central spray mixing area included a 500 gal. trailer-mounted "nurse" tank with appropriate mixing and safety equipment.

A John Bean Spraymaster Deluxe spray gun fitted with a # 4 disc was used for the application of conventional hydraulic sprays. The John Bean spray gun with the adjustable spray stream feature was incompatible with a foam-generating nozzle; therefore, a Spraying Systems Model 43H spray gun fitted with a FJ-0020 solid stream foamjet nozzle was used for the foam applications. Pump pressure for all applications was regulated at 200 p.s.i.

Spray Applications

The 3 treatment blocks received application during the period 1000 June 14 to 1700 June 15. One member of a two man team operated the spray gun while the second member assisted with hose and vehicle movement. Two rows of trees were sprayed on one side travelling away from the vehicle, then two rows were sprayed on the opposite side when returning to the vehicle. The spray operator then moved over two rows and repeated this procedure ensuring that all trees were completely covered from both sides. Meteorological conditions were recorded during batch mixing and for the two day period ranged as follows:

Temp. - 57^{o} - 78^{o} F

R.H. - 45% - 83%

Wind - 2 - 8 mph.

Treatment Assessment

Change in budworm population density was used to evaluate the effectiveness of each treatment. Two pre-spray samples were taken May 28 and June 2, by hand pruning 18" branches from the mid crown of randomly selected trees in each 0.75 acre treatment block and the check block. Larval counts were then obtained by processing the branches individually using the beating technique developed by DeBoo et al (1972) and the apparatus modified by Martineau and Benoit (1972). One post-spray sample, consisting of 10 randomly selected branches from each block, was taken 5 days after treatment (June 20) and similarly processed.

All larvae recovered by the beating process for the two pre-spray counts were L_2 and L_3. At these stadia of development, larvae are feeding in very tightly enclosed buds and sampling error using the beating system is at its greatest. For this reason pre-spray counts were adjusted upwards by a correction factor of 20%.

Abbott's formula (1925) was used to correct for differences due to natural mortality between pre- and post-spray larval counts. Results are given in Table II.

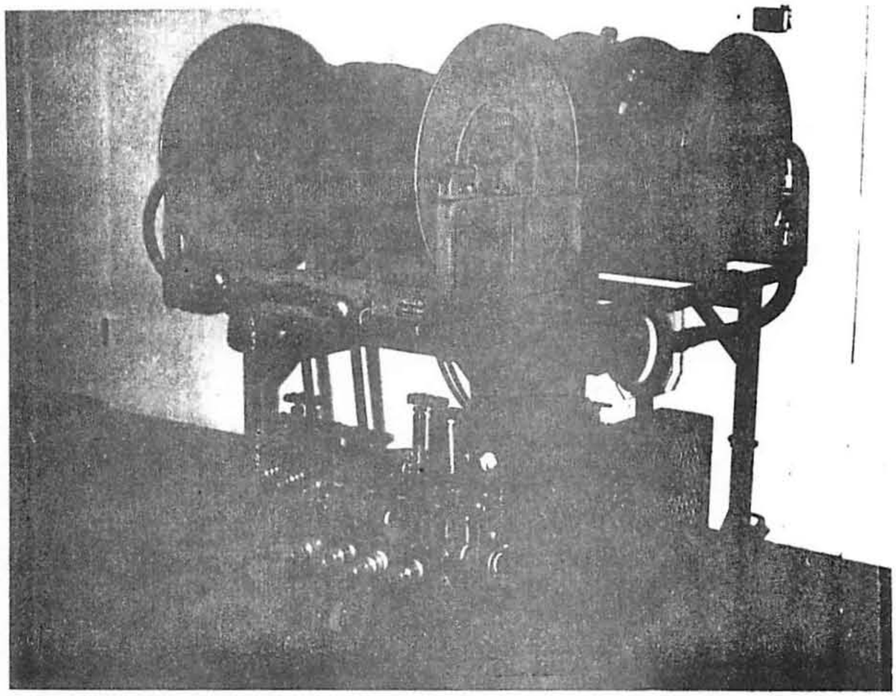

Fig. 1. The C.C.R.I. experimental hydraulic sprayer.

Fig. 2. Foam application of methomyl in a treatment block.

Results and Discussion

Hydraulic sprayer applications of methomyl at 8 oz. A.I./ac with and without the addition of a foaming adjuvant gave excellent protection against a moderate infestation (< 20 larvae/18" branch) of spruce budworm in a young white spruce plantation. Results indicate that this 8 oz. rate could very likely be reduced when thorough coverage is maintained as with hydraulic or mistblower applications.

Addition of a foaming adjuvant at 0.5 and 1% concentrations did not significantly change the total volume of spray mixture applied per acre despite the principle that entrained air replaces a portion of the carrier when using a foam - generating system. This result could well be attributed to the inexperience of the operators using foam emission equipment. Pump pressure, nozzle selection and application technique are highly variable factors affecting volume delivered and only further testing under more controlled conditions will determine whether, with experience, volume of spray material can be reduced using a foam generating nozzle system.

Conventional and foam applications both required approximately the same amount of time to treat a similar acreage but again it was felt that with further experience the operator should be able to utilize the highly visible spray stream to increase the rate of spraying , thereby reducing application time and spray volume.

Table I. Formulations, volumes emitted, and a time comparison between conventional and "foam" applications for control of spruce budworm at Grand'mère, P.Q.

PLOT NO.	TREATMENT	INGREDIENTS To MIX 100 U.S. gal/(approx)	VOLUME (US gal) EMITTED	Avg. Time (min) to emit 100 gal (US)
1	methomyl alone @ 8 oz. a.i./ac	100 gal water 16 oz Lannate 20L 8 oz Chevron Sticker	250	53
2	methomyl @ 8 oz. ai/ac + foam @ .5% concn.	100 gal water 16 oz Lannate 20L 64 oz Atplus 540	325	51
3	methomyl @ 8 oz. ai/ac + foam @ 1.0% concn.	100 gal water 16 oz Lannate 20L 128 oz Atplus 540	250	57

Table II. Results of hydraulic spray applications at Grand'Mère, P.Q. for control of spruce budworm on white spruce

PLOT NO.	TREATMENT	Avg. No. Larvae/18" branch tip Pre-spray[1]	Post-spray	% population reduction[2]
1	Lannate alone	10.6	0.2	98
2	Lannate + Atplus @ .5%	10.6	0.1	99
3	Lannate + Atplus @ 1%	10.6	0.3	97
4	Untreated Check	10.6	9.1	14

[1] No. larvae combined for all plots corrected by a sampling error of 20%

[2] Corrected by Abbott's Formula (1925).

Summary and Conclusions

The results indicate that methomyl applied as a very dilute spray (.02% concentration) at 8 oz A.I./ac. offered excellent protection and as the preleminary work in Manitoba indicated, this rate could very likely be reduced to 4 oz A.I./ac. or less while still attaining good protection.

While results did not indicate that the addition of a foaming adjuvant resulted in any saving of time or reduction in volume emitted to treat similar areas; variations within each treatment block such as tree size, stocking and obstacles encountered can influence results greatly.

Differences in spraying techniques by each individual operator likely accounts for the largest variation in volumes emitted and is not a true reflection of the equipment and adjuvant selected. The physical characteristics of foam generated sprays such as their high visibility and the large expanding type droplets produced should, with experience, allow the operator to control the application more accurately and reduce excessive spray coverage.

It is the opinion of the authors that foam applications definitely show potential as an aid to accelerating hydraulic spray applications and decreasing the volume of carrier required, but further testing and refinements in application technique are necessary before a true comparison can be made. Follow-up experimentation in 1975 is being planned to evaluate the importance of operator application technique, pump pressure, and nozzle selection as key variable factors affecting volume delivery and time requirements for hydraulic sprayer applications using foam-generating nozzle systems.

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