THE EFFECT OF COMMERICAL *BACILLUS THURINGIENSIS* ON EASTERN HEMLOCK LOOPER *LAMBDINA FISCELLARIA FISCELLARIA*

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PAUL FAST

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Hemlock looper is presently infesting large areas of Newfoundland and projections are for moderate to severe defoliation of 700,000 hectares in 1985. A request was received from NeFRC to evaluate *Bacillus thuringiensis (B.t.)* as a possible foliage protectant. Very little information is available in the literature on susceptibility of this insect to *B.t.* Angus and Heimpel reported in 1959 that this insect is fairly susceptible in the lab and that field trials were moderately to reasonably successful. Smirnoff (1974)showed that *B.t.* var *thuringiensis* (Thuricide HPC) was more efficacious when applied to third instar larvae than when applied to 5th instar larvae - 50% of third instar larvae died at between 3-4 days whereas 5th instar larvae took 8-10 days to reach 50% mortality at constant 22 degrees. No tests have been conducted with preparations containing var. *kurstaki* which is the strain present in modern commercial preparations.

Bioassays were carried out at FPMI to ascertain whether *B.t.* could provide an adequate level of mortality and foliage protection when applied in the same manner as for spruce budworm. Last instar larvae of hemlock looper were received from K.P. Lim of the Newfoundland Forest Research Center. Two assays were attempted: a diet bioassay similar to that used for spruce budworm and a foliar assay where mature balsam foliage was sprayed to obtain a defined deposit of *B.t.*

Diet Bioassay

Dose IU/ml	Mortality #dead/#tested Day 5	Day 7	Day 9	Day 12
6000	17/24	24/24	24/24	24/24
1500	16/24	22/24	24/24	24/24
375	10/24	20/24	20/24	23/24
94	15/24	18/24	20/24	23/24
23	13/24	16/24	17/24	19/24
0 (control)	4/24	8/24	9/24	13/24

and exposed to the looper. The diet bioassay, using HD-1-S-1980 as the source of *B.t.*, was unsatisfactory since the budworm diet was unsatisfactory for the looper and much cannibalism occurred. Nevertheless, it is clear that considerable mortality due to treatment occurred by day 9. Both the time course for mortality and the dose response appear similar to that of spruce budworm.

For the foliar bioassay a 64 BIU/gal. preparation of *B.t.* was diluted to 32 BIU/gal and sprayed onto mature balsam foliage so that a deposit of 1 droplet/needle having a drop diameter of 40-60 microns was obtained. Such a deposit can reasonably be expected when *B.t.* is applied at 30 BIU/ha. Larvae were applied to such shoots (5 larvae/shoot) and held at 20 degrees and 16/8 light/dark cycle. 130 larvae were so exposed to treated foliage on 27 sprayed shoots. Defoliation was determined as % of foliage eaten. Positive controls had 30+ drops/needle and negative controls were unsprayed.

Foliar Bioassay

Day after exposure	1 drop/needle		Negative control		Positive control	
	% defoliation	%mortality	% defol.	%mort.	% defol.	%mort.
9	28		80		30	
12	31	52	100*	27	35	70
15	35	67	43**	33	35	90

*foliage changed in all controls

**defoliation due to 3 days' feeding

By day 9 larvae on unsprayed foliage had consumed about 80% of the available foliage whereas in the sprayed foliage larvae had consumed about 30% of the available foliage. Six days later (Day 15) only 35% of the sprayed foliage had been consumed and control larvae were showing signs of onset of pupation. Cumulative Mortality on Day 15 was 67%. Surviving larvae on treated foliage were only 1/3 the weight of larvae on unsprayed foliage. Larvae in the positive controls suffered 90% mortality and were about 10 mg lighter than those exposed to 1 drop/needle. Mortality development and effect of *B.t.* on feeding are not vastly different from spruce budworm.

The experiment reported here is unreplicated and should be viewed as suggestive rather than in any way definitive. The larvae were much older than appropriate for direct comparison with field conditions where spraying should begin when larvae are in the second or third instar. It appears from the incomplete data presented here that if spraying takes place during second or third instar with a 48 BIU/gal

preparation of *B.t.* sprayed neat from micronaires set to deliver the smallest possible droplets at a volume to deliver 30 BIU/Ha an adequate deposit and reasonable foliage protection and mortality might be expected.

REFERENCES

Smirnoff, W.A. 1974. Sensibilité de Lambdina fiscellaria fiscellaria (Lepidoptera: Geometridae) à l'infection par Bacillus thuringiensis Berliner seul ou en Presence de Chitinase. Can. Ent. 106: 429-432.

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A second shipment of larvae was received from Newfoundland and assayed on foliage essentially as already described. The larvae were third instar and the droplets were 100μ diameter as opposed to the 40-65μ droplets used previously. The larvae were younger, and therefore expected to be more susceptible, and the dosage somewhat greater than in the previous experiment.

days of exposure	1 drop/needle		neg. control		pos. control	
	% defol.	% mort.	% defol.	% mort.	% defol.	% mort.
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*35% of second shoot defoliated
positive control 9 drops/needle 25 insects, 5 cages
negative control unsprayed 50 insects, 10 cages
test 200 insects, 40 cages

The higher dose is reflected in the improved foliage protection over that reported for last instar larvae, particularly in the positive control. The degree of foliage protection is eloquently visible in the attached photos in which the negative control (N) larvae fed for only 3 days, the positive (P) and test (T) shoots were exposed for the entire 15 day period.

The previous recommendations can therefore be made less tentative. It is likely that a foliar deposit of 1 drop/needle of a 48 BIU/gal preparation will give significant foliage protection and mortality. Any field tests should be evaluated in such a way that defoliation and mortality can be related to foliar deposit. In that way a thorough evaluation of concentration can be made.

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ADDENDUM TO FILE REPORT #59

A second shipment of larvae was received from Newfoundland and assayed on foliage essentially as already described. The larvae were third instar and the droplets were 100μ diameter as opposed to the 40-65μ droplets used previously. The larvae were younger, and therefore expected to be more susceptible, and the dosage somewhat greater than in the previous experiment.

days of	1 drop/needle		neg. control		pos. control	
exposure	% defol.	% mort.	% defol.	% mort.	% defol.	% mort.
9	19	38	50	16	11	80
12	23	55	90	18	12	88
15	25	65	135*	18	13	96

*35% of second shoot defoliated
positive control 9 drops/needle 25 insects, 5 cages
negative control unsprayed 50 insects, 10 cages
test 200 insects, 40 cages

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