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AGAINST SPRUCE BUDWORM,CHORISTONEURA FUMIFERANA (CLEMENS),

DURING 1975

By

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STOMACH AND RESIDUAL TOXICITY OF PH 60-40 AGAINST  
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INTRODUCTION

PH60-40 is under study against spruce budworm since 1974 for evaluation of stomach and residual toxicity. In 1975 residual toxicity experiments were conducted to confirm the 1974 findings and to improve the spraying technique of wettable powder for residual toxicity study. This report presents results of 1974 and 1975 experiments.

METHODS AND MATERIALS

LABORATORY REARED SPRUCE BUDWORM -

Stomach Toxicity: Laboratory reared spruce budworm larvae were used for stomach toxicity. Second instar diapausing spruce budworm larvae were received from the Insect Pathology Research Institute, Sault Ste. Marie, Ontario. The larvae were transferred onto a synthetic diet and were reared inside environmental chambers at 20-22°C, 70% R.H., and a photoperiod of 16 hours. Fourth and fifth instar larvae were selected for the stomach toxicity study.

FIELD COLLECTED SPRUCE BUDWORM -

Residual Toxicity: Field collected larvae were used. Third to fourth instar larvae of spruce budworm were collected in the field from the Ottawa

area. The larvae were, at first, kept in a cold-room at 5°C and 70-80% R.H. until they were sorted for different instars and were placed into jelly jars. Tender buds of white spruce and balsam fir were given as food. The larvae were reared in environmental chambers at 20-21°C, 70% R.H., and a photoperiod of 16 hours. Fourth instar larvae were then selected for residual toxicity studies.

TREES - Four to five year old European larch, Larix decidua Mill., of about 60-90 cm in height, and white spruce, Picea glauca (Moench) Voss, approximately of same age and 50-60 cm in height, were transplanted into pots from the Kemptville Forest Tree Nursery of the Ontario Ministry of Natural Resources. All trees were potted at least for two weeks prior to their use and only the trees that showed normal growth and condition were used in these studies.

INSECTICIDES AND THEIR FORMULATIONS -

PH 60-40, WP, 25% A.I. was used to prepare a 2% and 1% A.I. solution in distilled water containing 0.1% Rhodamin B dye.

INSECTICIDE TREATMENT -

Stomach Toxicity: During September and October, fresh larch foliage was sprayed in a modified Potter tower, calibrated to deliver volumes of dyed 2% PH 60-40 resulting in deposits of 0.1, 0.2, 0.4, 0.6, 0.8 and 1.0 gallon per acre (GPA). The calibration of the tower was carried out in time units, using a micro syringe for a standard deposit on the required surface area (plastic Petri dishes, Fisher brand # 8-757-12, 100 x 15 mm, using larger half of 9 cm I.D.). The spray deposits were determined by using a Bausch and Lomb Spec. 20 at 550 m $\mu$ . Thirty larvae per dosage, in replicates of 10, were placed on the sprayed foliage inside clear plastic cups. The deposit

was read from separately sprayed dishes at equivalent times and calculated in  $\mu\text{g}/\text{cm}^2$ .

Residual Toxicity: Potted white spruce trees were sprayed with insecticide in a spraying tower that was equipped with a micron nozzle from Ciba Turbair Hand Sprayer, and placed outside for weathering of residues. The bioassay of residues was done immediately after treatment for 0 days (approximately  $4 \pm 2$  hr), 3, 5 and 10 days. A replication of two trees for each concentration of insecticide (or dose) and each weathering period was treated. The rate of application was equivalent to 1 GPA, or 1.6 oz A.I./acre for the 1% solution, and 3.2 oz A.I./acre for the 2% solution.

#### OBSERVATIONS -

Stomach Toxicity: Fourth and fifth instar spruce budworm larvae were placed on treated larch foliage in cups which were kept in a growth chamber at  $24^{\circ}\text{C}$ , 75% R.H., and a 16 hour photoperiod. Mortality counts were taken at 2 day intervals, up to 25 days for 5th instar larvae and 16 days for 4th instar larvae. Treated foliage was replaced with fresh foliage after three days, and thereafter it was added as required. The mortality counts were corrected for check or control mortality according to Abbott's formula.

Residual Toxicity: The treated and check or control trees, after each weathering period, were carried inside the greenhouse for bioassay of residues. Thirty fourth instar larvae were released on two branches of each tree. Fifteen larvae per branch were confined by means of nylon-mesh sleeves. Observations were taken every 24 hours and the number of dead and living insects and their respective instars were recorded. Parasitized insects were not included in the calculations.

## RESULTS

The results of contact and residual toxicity tests are presented in Tables 1 - 5. The mortality response of insects is in direct proportion to dosages.

Stomach Toxicity: Stomach toxicity to 4th and 5th instar larvae is presented in Table 1 and 2 respectively. The toxicity to 4th instar was completed in approximately 10 days, while action was prolonged up to 25 days when 5th instar larvae were used. A very rough LD<sub>50</sub> to 4th and 5th instar larvae is 0.448 µg/cm<sup>2</sup> after 10 days. These experiments were of very preliminary nature and need further confirmation. There was very high control mortality (32%) in 4th instar larvae experiments on 10 day observation.

Residual Toxicity: In 1974 trees were sprayed approximately 8.0 oz/acre of active PH 60-40, this gave 91% mortality up to 10 days (Table 3). When dosage was reduced in 1975 to 1.6 oz and 3.2 oz/acre, mortality was very inconsistent. The results were further confounded due to high percentage of parasitism of spruce budworm larvae (Table 4 and 5).

It is very difficult to make any conclusion from the present findings. The wettable powder formulation is not very stable and breaks down quickly in the spraying system. The measurement of accurate deposit on the treated surface is difficult due to instability of spraying system. The parasitism of insects has further complicated the results.

## ACKNOWLEDGEMENT

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TABLE 1

CORRECTED PERCENTAGE MORTALITY TO LAB. REARED LATE 4<sup>th</sup> INSTAR SPRUCE BUDWORM

Experiment Number SBL-154-St

Date Sprayed October 24, 1974

Insecticide PH 60-40

Concentration 2%

GPA	Dosage µg/cm <sup>2</sup>	4 DAYS			6 DAYS			8 DAYS		
		Dead/ Total	% Mort. (T)	Corr. % Mort.	Dead/ Total	% Mort.	Corr. % Mort.	Dead/ Total	% Mort.	Corr. % Mort.
1	.2316	4/28	14	7	8/28	29	19	15/28	54	45
2	.4449	1/28	4	0	7/28	25	16	14/28	50	40
4	.8892	2/30	7	0	10/30	33	24	21/30	70	64
6	1.2616	3/26	12	4	11/26	42	34	22/26	85	82
8	1.64	3/27	11	3	14/27	52	45	18/27	67	61
10	2.0949	2/28	7	0	11/28	39	31	22/28	79	73
CONTROL (C)		2/25	8		3/25	12		4/25	16	

REMARKS:  
Chk'd for  
computer analysis

(1) (2)

SBL = Laboratory reared 4<sup>th</sup> instar spruce budworm.  
St = Stomach toxicity.  
PH 60-40 sprayed larch foliage used and changed

Note: Corr. % Mort.  
=  $\frac{T-C}{100-C} \times 100$   
(Abbott's Formula)

TABLE 1 (cont'd)

CORRECTED PERCENTAGE MORTALITY

Experiment Number SBL-154-St (Cont'd)

Date Sprayed October 24, 1974

Insecticide PH 60-40

Concentration 2%

GPA	Dosage µg/cm <sup>2</sup>	10 DAYS			Dead/ Total	% Mort.	Corr. % Mort.	Dead/ Total	% Mort.	Corr. % Mort.
		Dead/ Total	% Mort. (T)	Corr. % Mort.						
"1		17 28	61	43	/					
"2		16 28	57	37	/					
"4		29 30	97	96	/					
"6		25 26	96	94	/					
"8		26 27	96	94	/					
"10		25 28	89	84	/					
		/			/					
		/			/					
		/			/					
		/			/					
		/			/					
CONTROL (C)		8 25	32		/					

REMARKS:

Chk'd for  
computer analysis

(1) (2)

Note: Corr. % Mort.  
=  $\frac{I-C}{100-C} \times 100$   
(Abbott's Formula)

CORRECTED PERCENTAGE MORTALITY TO LABORATORY REARED 5<sup>th</sup> INSTAR SPRUCE BUDWORM

TABLE 2

Experiment Number SBL-142-St

Date Sprayed October 8, 1974

Insecticide PH 60-40

Concentration 2%

GPA	Dosage µg/cm <sup>2</sup>	3 DAY			5 DAY			7 DAY		
		Dead/ Total	% Mort. (T)	Corr. % Mort.	Dead/ Total	% Mort.	Corr. % Mort.	Dead/ Total	% Mort.	Corr. % Mort.
1		0/30	0	0	1/30	3	0	2/30	7	0
2		0/29	0	0	0/29	0	0	1/29	3	0
4		1/29	3	0	4/29	15	9	5/29	17	11
6		3/27	11	8	3/26	12	5	4/26	15	9
8		3/30	10	7	6/30	20	14	13/30	43	39
10		1/30	3	0	4/30	13	6	5/30	17	11
CONTROL (C)		1/29	3		2/29	7		2/29	7	

REMARKS:  
Chk'd for  
computer analysis

(1) (2)

SBL = Laboratory reared 5<sup>th</sup> instar spruce budworm  
St = Stomach toxicity  
Larch foliage sprayed. First check after 3 days.

Note: Corr. % Mort.  
 $= \frac{T-C}{100-C} \times 100$   
(Abbott's Formula)



TABLE 2 (cont'd) CORRECTED PERCENTAGE MORTALITY

Date Sprayed October 8, 1974.

Experiment Number SBL-142-St (cont'd)

Insecticide PH 60-40

Concentration 2%

GPA	Dosage µg/cm <sup>2</sup>	9 DAYS			11 DAYS			13 DAYS		
		Dead/ Total	% Mort. (T)	Corr. % Mort.	Dead/ Total	% Mort.	Corr. % Mort.	Dead/ Total	% Mort.	Corr. % Mort.
.1		8/30	27	15	10/30	33	22	15/30	50	42
.2		4/29	14	0	9/29	31	20	14/29	48	40
.4		11/29	38	28	14/29	48	40	18/29	62	56
.6		9/26	35	24	11/26	42	33	14/26	54	47
.8		19/30	63	57	20/30	67	62	25/30	83	80
1.0		9/30	30	19	12/30	40	30	19/30	63	57
CONTROL (C)		4/29	14		4/29	14		4/29	14	

REMARKS:

Chk'd for  
computer analysis

(1)	(2)
-----	-----

Note: Corr. % Mort.

$$= \frac{I-C}{100-C} \times 100$$

(Abbott's Formula)

TABLE 2 (cont'd)

CORRECTED PERCENTAGE MORTALITY

Experiment Number SBL-142-St (Cont'd)

Date Sprayed October 8, 1974

Insecticide PH 60-40

Concentration 2%

GPA	Dosage µg/cm <sup>2</sup>	15 DAYS			17 DAYS			19 DAYS		
		Dead/ Total	% Mort. (T)	Corr. % Mort.	Dead/ Total	% Mort.	Corr. % Mort.	Dead/ Total	% Mort.	Corr. % Mort.
-1		16 30	53	45	18 30	60	53	20 30	67	62
-2		17 29	59	52	20 29	69	64	21 29	69	64
-4		20 29	69	64	22 29	76	72	22 29	76	72
-6		15 26	58	51	22 26	85	83	23 26	88	86
-8		25 30	83	80	28 30	93	92	29 30	97	97
-10		20 30	67	62	24 30	80	77	27 30	90	88
CONTROL (C)		4 29	14		4 29	14		4 29	14	

REMARKS:  
Chk'd for

(1) (2)

Note: Corr. % Mort.  
=  $\frac{I-C}{100-C} \times 100$

TABLE 2 (cont'd)

CORRECTED PERCENTAGE MORTALITY

Experiment Number SBL-142-St (Cont'd)

Date Sprayed October 8, 1974

Insecticide PH 60-40

Concentration 2%

GPA	Dosage µg/cm <sup>2</sup>	21 DAYS			23 DAYS			25 DAYS		
		Dead/ Total	% Mort. (T)	Corr. % Mort.	Dead/ Total	% Mort.	Corr. % Mort.	Dead/ Total	% Mort.	Corr. % Mort.
1		20 30	67	62	21 30	70	65	22 30	73	69
2		21 29	72	67	21 29	72	67	21 29	72	67
4		22 29	76	72	23 29	79	76	23 29	79	76
6		23 26	88	86	23 26	88	86	23 26	88	86
8		29 30	97	97	29 30	97	97	29 30	97	97
10		27 30	90	88	27 30	90	88	27 30	90	88
CONTROL (C)		4 29	14		4 29	14		4 29	14	

REMARKS:  
Chk'd for

(1) (2)

Note: Corr. % Mort.

$$= \frac{I-C}{100-C} \times 100$$

(Abbott's Formula)

TABLE 3

SUMMARY OF RESIDUAL TOXICITY OF PH 60-40 TO 5th INSTAR SPRUCE BUDWORM (1974)

Corrected Percentage Mortality After Exposure to White Spruce Foliage Treated with 5% Solution.

Insects Released Indicated Number of Days After Spray*	Instar						Total for Larvae	Pupae	Adults	Total Mortality	Percentage of Parasitism	Weathering Data
	IV	**	V	**	VI	**						
0			47	8	46	12	93	0	0	93	7	Av. Temp. Av. Dew Point Tot. Rain Tot. Sun
1			22	8	67	15	89	0	0	89	11	Av. Temp. 72°F 22.2°C Av. Dew Point 65°F 18.3°C Tot. Rain trace Tot. Sun 4.4 hr
3			14	9	75	20	89	2	0	91	9	Av. Temp. 70°F 21.1°C Av. Dew Point 61°F 16.1°C Tot. Rain trace Tot. Sun 16.4 hr
5			26	9	62	20	88	0	0	88	12	Av. Temp. 65°F 18.3°C Av. Dew Point 54°F 12.2°C Tot. Rain .48 in 12.2 mm Tot. Sun 30.2 hr
10			4	7	87	19	91	0	0	91	9	Av. Temp. 64°F 17.8°C Av. Dew Point 54°F 12.2°C Tot. Rain 1.25 in 31.8 mm Tot. Sun 58.2 hr

Trees sprayed at the rate of GPA (Gallon per Acre). The solution contained 5 % of ACTIVE INGREDIENT. RATE OF APPLICATION: OZ/ACRE IN GPA

Number of days required to reach optimum toxicity level.

Number of Trees used: 10 TREATED + 2 CONTROL

Number of Insects used: 360

Number of Trees per Observation: 2

Number of Insects per Tree: 30

TABLE 4

SUMMARY OF RESIDUAL TOXICITY OF PH 60-40 TO 4th INSTAR SPRUCE BUDWORM (1975)

Corrected Percentage Mortality After Exposure to White Spruce Foliage Treated with 1% Solution

Insects Released Indicated Number of Days After Spray*	I n s t a r						Total for Larvae	Pupae	Adults	Total Mortality	Percentage of Parasitism	Weathering Data
	IV	**	V	**	VI	**						
0	32	10	21	9	3	11	56	0	0	56	44	Av. Temp. Av. Dew Point Tot. Rain Tot. Sun
1	10	6	29	13	4	18	43	0	0	43	57	Av. Temp. 63°F 17.2°C Av. Dew Point 48°F 8.9°C Tot. Rain 0 in 0 mm Tot. Sun 10.4 hr
3	25	7	27	11	0		52	0	0	52	48	Av. Temp. 58°F 14.4°C Av. Dew Point 51°F 10.6°C Tot. Rain 1.33 in 33.8 mm Tot. Sun 5.5 hr
5	9	20	25	12	0		34	8	0	42	58	Av. Temp. 57°F 13.9°C Av. Dew Point 48°F 8.9°C Tot. Rain 1.46 in 37.1 mm Tot. Sun 25.1 hr
10	11	8	15	7	9	27	35	0	0	35	65	Av. Temp. 56°F 13.3°C Av. Dew Point 51°F 10.6°C Tot. Rain 1.66 in 42.2 mm Tot. Sun 56.7 hr

\* Trees sprayed at the rate of 1 GPA (Gallon per Acre). The solution contained 1.6% of ACTIVE INGREDIENT. RATE OF APPLICATION: 1.6 OZ/ACRE IN 1 GPA

\*\* Number of days required to reach optimum toxicity level.

Number of Trees used: 10 TREATED + 10 CONTROL

Number of Insects used: 600

Number of Trees per Observation: 2

Number of Insects per Tree: 30