Environment Canada | Environnement Canada
Forestry Service | Service des Forêts

Nigam, P. C.

CONTACT AND RESIDUAL TOXICITY OF PHOSPHAMIDON AND IODOFENPHOS AGAINST SPRUCE BUDWORM ADULTS, CHORISTONEURA FUMIFERANA (CLEMENS), DURING 1975

By

P.C. Nigam, W. Batsch and K. Bertrim

File Report No. 22 Nov.1975

Chemical Control Research Institute

Canadian Forestry Service

Environment Canada

Ottawa, Ontario

Confidential Report of Compounds
obtained from Ciba-Geigy of Canada Ltd

CONTACT AND RESIDUAL TOXICITY OF PHOSPHAMIDON AND IODOFENPHOS AGAINST SPRUCE BUDWORM ADULTS, CHORISTONEURA FUMIFERANA (CLEMENS), DURING 1975

By

P.C. Nigam, W. Batsch and K. Bertrim

INTRODUCTION

In order to protect Canadian coniferous forests from increasing populations of spruce budworm, an effort is underway to control budworms at larval and adult stages. Phosphamidon has been used as an adulticide against spruce budworm adults since 1972 in New Brunswick. In order to find a more effective adulticide, evaluation of iodofenphos as an alternate insecticide was carried out in 1975. This study describes the comparative contact and residual toxicity of phosphamidon and iodofenphos.

METHODS AND MATERIALS

SPRUCE BUDWORM ADULTS - Spruce budworm larvae, in the 3rd and 4th instar, were collected for rearing adults in the field from the Ottawa area. The larvae were kept at room temperature and young, green white-spruce foliage was provided as food until they reached the 6th instar. At this point, the larvae were placed on a synthetic diet and were kept in a growth chamber at 20-21°C, 70% R.H., and a photoperiod of 16 hours. Pupae were collected, sexed, and the date was marked daily, and the male pupae were placed for approximately one day into a cold room at 5°C and 70-80% R.H. The emergence took place in a cage, kept at room temperature (24°C), and from which the moths were removed daily. Adults used in experiments were 24 to 48 hours old.

TREES - Four to five year old white spruce, Picea glauca (Moench) Voss., were transplanted into pots, from the Kemptville Forest Tree Nursery of the Ontario Ministry of Natural Resources. The trees had an even, cone-shaped crown and a height of about 50-60 cm, and they were potted for at least two weeks before their use in the experiment.

INSECTICIDES AND THEIR FORMULATIONS - Phosphamidon, 90% A.I.; and iodofenphos (NUVANOL 20U), 20% A.I. EC, were used in the study. The details of their dilution for contact and residual toxicity study are as follows:

Contact Toxicity: The phosphamidon and iodofenphos were diluted to 0.5% and 1.0% A.I. concentrations, respectively, with solvent AR 60 G (an aromatic solvent) containing 0.5% Dupont oil red dye.

Residual Toxicity: Phosphamidon was diluted to 0.3125, 0.625, and 1.25% A.I. with a solvent solution that consisted of 80% ethylene glycol, 20% Dowanol and contained 0.1% of Rhodamin B dye. Iodofenphos was diluted with pure Dowanol to concentrations of 0.5, 1.0 and 2.0% A.I. and it also contained 0.1% of Rhodamin B dye. Insecticide solutions were stored in refrigerator right after mixing.

INSECTICIDE TREATMENT -

Contact Toxicity: The adults were sprayed under modified Potter's tower at different rates of application (0.1 to 1 GPA). A total of 30 adults per dose were used in three replications of 10 moths each. Each replication had 5 male and 5 female moths approximately 24 to 48 hours old in age. The moths were anaesthetized with CO_2 and placed on the filter

paper for spraying in the tower. The moths were covered with a ¼ inch mesh wire screen in order to keep them in position inside the tower. The dosages were calculated from deposits on filter papers sprayed prior to spraying of adults. The adults were transferred into transparent plastic cups (85 x 75 mm) for observations.

Residual Toxicity: The trees were sprayed and placed outside for weathering of residues. The bioassay of residues was done immediately after treatment, 0 days (approximately 4 ± 2 hr), 3, 5, and 10 days. One tree for each concentration of insecticide (or dose) was treated, three with phosphamidon and three with iodofenphos. The insecticides were applied to the trees in a spray tower equipped with a micron nozzle, from Ciba Turbair Hand Sprayer, that was calibrated to deliver a volume of spray that was equivalent to one gallon per acre. Phosphamidon was applied at a dosage that was equivalent to 2, 1, and 0.5 oz. A.I./acre and the dosages for iodofenphos were 3.2, 1.6, and 0.8 oz. A.I./acre. Following the spraying, the trees were carried outdoors for exposure to the weathering elements and small amounts of young foliage were clipped from each tree at the end of each weathering period (0, 3, 5, and 10 days) and placed into marked plastic dishes equipped with perforated, clear snap-on lids. Care was taken to avoid clipping of branch tips that were hidden or shadowed by other branches.

OBSERVATIONS -

Contact Toxicity: The treated moths in transparent plastic cups were placed in a growth chamber maintained at 24°C, 70% R.H., and a photoperiod of 16 hours. Mortality counts were taken at 24, 48, and 72 hours and corrected for check or control mortality according to Abbott's formula.

Residual Toxicity: The treated foliage was clipped for each weathering period and placed in marked plastic dishes equipped with a snap-on lid. The lids were perforated with a needle for aeration. Four samples for each weathering period were taken for each dosage, i.e. there were four replicates for each weathering period. Ten spruce budworm moths were used for bioassay of each replication, i.e., a total of 40 moths per dose for each weathering period were used except for 10 days observation, when only 5 moths were used due to poor availability of adults. The ratio of female and male moths was approximately 1:1. Mortality counts were carried out at 24, 48, and 72 hours after insect addition. The dishes containing treated foliage and the moths for observation, were kept at room temperature with no additional light.

RESULTS

The results for contact and residual toxicity are presented in Table 1-8.

Contact Toxicity: Table 1 & 2 give data on contact toxicity. It is clear from these tables that iodofenphos is approximately 4 times less toxic than phosphamidon to adult spruce budworm. Iodofenphos is also slow acting as compared to phosphamidon.

Residual Toxicity: Phosphamidon was applied at the rate of 2, 1, and 0.5 oz/acre (Table 3, 4, & 5) and iodofenphos was applied at the rate of 3.2, 1.6, and 0.8 oz/acre (Table 6, 7, & 8). There was high control mortality in experiments with iodofenphos. It is clear from these experiments that iodofenphos, even at lower dosages (0.8 oz/acre) gave higher residual toxicity than higher dose (2 oz/acre) of phosphamidon (Table 3 & 8). Residual life of phosphamidon is shorter than that of iodofenphos.

Taking into consideration both contact, and residual toxicity, and method of application in field, phosphamidon appears to be better than iodofenphos for air to air control of adult spruce budworm due to its higher contact toxicity. Iodofenphos may be better for the control of adults alighting and flirting on the trees, as this will afford longer residual toxicity than phosphamidon.

ACKNOWLEDGEMENT

The authors are grateful to Dr. J.J. Fettes, Director, Chemical Control Research Institute for encouragement and for extending facilities. Sincere thanks are due to Ciba-Geigy of Canada Ltd. for their cooperation and assistance.

TABLE 1

CORRECTED PERCENTAGE MORTALITY

Experiment Number SBA-15

Date Sprayed July 14, 1975

Insecticide Phosphamidon

Concentration 0.5 %

GPA	Dosage µg/cm²	24 HOURS			48 HOURS			72 HOURS		
		Dead/ Total	% Mort. (T)	Corr. % Mort.	Dead/ Total	% Mort.	Corr. % Mort.	Dead/ Total	% Mort.	Corr. % Mort.
.1		12/31	39	30	16/31	52	45	19/31	61	47
.2		6/30	20	8	9/30	30	20	13/30	43	22
.4		20/30	67	61	24/30	80	77	24/30	80	73
.6		30/30	100	100			100			100
.8		30/30	100	100			100			100
1.0		30/30	100	100			100			100
CONTROL (C)		4/30	13		4/30	13		7/30	27	

REMARKS:

Chk'd for computer analysis

(1) (2)

SBA = Spruce budworm adult from field collected material.

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

TABLE 2 — CORRECTED PERCENTAGE MORTALITY

Experiment Number SBA - 11 — Date Sprayed July 8, 1975

Insecticide Nuvanol (iodofenphos)

Concentration 1.0 %

GPA	Dosage µg/cm²	24 HOURS Dead/Total	24 HOURS % Mort. (T)	24 HOURS Corr. % Mort.	48 HOURS Dead/Total	48 HOURS % Mort.	48 HOURS Corr. % Mort.	72 HOURS Dead/Total	72 HOURS % Mort.	72 HOURS Corr. % Mort.
.1		3/30	10	3	4/30	13	6	10/30	33	28
.2		2/30	7	0	9/30	30	25	19/30	63	60
.4		1/31	3	0	7/31	23	17	22/31	71	69
.6		5/30	17	11	17/30	57	54	26/30	87	86
.8		8/30	27	22	23/30	77	75	29/30	97	97
1.0		20/30	67	65	27/30	90	89	29/30	97	97
CONTROL (C)		2/30	7		2/30	7		2/30	7	

REMARKS:

Chk'd for computer analysis | (1) | (2)

SBA = Spruce budworm adult from field collected material.

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

TABLE 4 (1975) RESIDUAL TOXICITY OF 0.625% phosphamidon TO SPRUCE BUDWORM ADULT

PERCENTAGE MORTALITY AFTER 24, 48, AND 72 HOURS EXPOSURE TO TREATED WHITE SPRUCE FOLIAGE

INSECTS RELEASED INDICATED NUMBER OF DAYS AFTER SPRAY * OR WEATHERING PERIOD IN DAYS	24	48	72
0	10.5	18.4	31.6
3	0.0	30.0	45.0
5	0.0	5.0	20.0
10	0.0	0.0	0.0

* Trees sprayed at the rate of 1 gallon per acre. The insecticide solution(s) had 0.625 % of active ingredient. Rate of Application 1.0 oz./a

CONTROL MORTALITY: 0.0% to 17.5 %

NUMBER OF TREES USED: 1 (+1 FOR ALL CONTROLS)

NO. OF SAMPLES FOR EA. WEATHERING PERIOD: 4 (+4 FOR CONTROL OF ALL 3 CONCENTRATIONS OF PHOSPHAMIDON)

NUMBER OF INSECTS USED: 140 (+ 140 FOR CONTROL OF ALL 3 CONCENTRATIONS OF PHOSPHAMIDON)

WEATHER DATA FOR 10 DAY TEST PERIOD	Average or Total	
Temperature	72°F	22.3°C
Dew Point	60°F	15.5°C
Rain	1.67 in	42.4 mm
Sunshine		79.4 hr

wb-

TABLE 5 (1975) RESIDUAL TOXICITY OF 0.312 % phosphamidon TO SPRUCE BUDWORM ADULT

PERCENTAGE MORTALITY AFTER 24, 48, AND 72 HOURS EXPOSURE TO TREATED WHITE SPRUCE FOLIAGE

INSECTS RELEASED INDICATED NUMBER OF DAYS AFTER SPRAY * OR WEATHERING PERIOD IN DAYS	24	48	72
0	5.0	10.0	30.0
3	2.5	20.0	35.0
5	0.0	0.0	20.0
10	0.0	0.0	0.0

* Trees sprayed at the rate of 1 gallon per acre. The insecticide solution(s) had 0.3125 % of active ingredient. Rate of Application 0.5 oz./acre

CONTROL MORTALITY: 0.0% to 17.5 %

NUMBER OF TREES USED: 1 (+1 FOR ALL CONTROLS)

NO. OF SAMPLES FOR EA. WEATHERING PERIOD: 4 (+4 FOR CONTROL OF ALL 3 CONCENTRATIONS OF PHOSPHAMIDON)

NUMBER OF INSECTS USED: 140 (+140 FOR CONTROL OF ALL 3 CONCENTRATIONS OF PHOSPHAMIDON)

WEATHER DATA FOR 10 DAY TEST PERIOD	Average or Total	
Temperature	72°F	22.3°C
Dew Point	60°F	15.5°C
Rain	1.67 in	42.4 mm
Sunshine		79.4 hr

wb- -

TABLE 6 (1975) RESIDUAL TOXICITY OF 2% iodofenphos ... TO SPRUCE BUDWORM ADULT

PERCENTAGE MORTALITY AFTER 24, 48, AND 72 HOURS EXPOSURE TO TREATED WHITE SPRUCE ..... FOLIAGE

INSECTS RELEASED INDICATED NUMBER OF DAYS AFTER SPRAY * OR WEATHERING PERIOD IN DAYS	24	48	72
0	37.5	82.5	92.5
3	10.0	37.5	47.5
5	10.0	22.5	22.5
10	0.0	0.0	0.0

* Trees sprayed at the rate of 1 gallon per acre. The insecticide solution(s) had 2.0 % of active ingredient. Rate of Application 3.2 oz./acre

CONTROL MORTALITY: 0.0% to 55.0 %

NUMBER OF TREES USED: 1 (+1 FOR ALL CONTROLS)

NO. OF SAMPLES FOR EA. WEATHERING PERIOD: 4 (+4 FOR CONTROL FOR ALL 3 CONCENTRATIONS OF IODOFENPHOS)

NUMBER OF INSECTS USED: 140 (+140 FOR CONTROL FOR ALL 3 CONCENTRATIONS OF IODOFENPHOS)

WEATHER DATA FOR 10 DAY TEST PERIOD Average or Total

Temperature	72°F	22.3°C
Dew Point	60°F	15.5°C
Rain	1.67 in	42.4 mm
Sunshine		79.4 hr

wb- -

TABLE 7 (1975) RESIDUAL TOXICITY OF .1% iodofenphos..... TO SPRUCE BUDWORM ADULT

PERCENTAGE MORTALITY AFTER 24, 48, AND 72 HOURS EXPOSURE TO TREATED WHITE SPRUCE..... FOLIAGE

INSECTS RELEASED INDICATED NUMBER OF DAYS AFTER SPRAY * OR WEATHERING PERIOD IN DAYS	24	48	72
0	22.5	65.0	87.5
3	7.5	35.0	65.0
5	2.5	7.5	20.0
10	0.0	0.0	5.0

* Trees sprayed at the rate of 1 gallon per acre. The insecticide solution(s) had 1.0 % of active ingredient. Rate of Application 1.6 oz./acre

CONTROL MORTALITY: 0.0% to 55.0 %

NUMBER OF TREES USED: 1 (+1 FOR ALL CONTROLS)

NO. OF SAMPLES FOR EA. WEATHERING PERIOD: 4 (+4 FOR CONTROL FOR ALL 3 CONCENTRATIONS OF IODOFENPHOS)

NUMBER OF INSECTS USED: 140 (+ 140 FOR CONTROL FOR ALL 3 CONCENTRATIONS OF IODOFENPHOS)

WEATHER DATA FOR 10 DAY TEST PERIOD	Average or Total	
Temperature	72°F	22.3°C
Dew Point	60°F	15.5°C
Rain	1.67 in	42.4 mm
Sunshine		79.4 hr

wb-

TABLE 8 (1975) RESIDUAL TOXICITY OF 0.5% iodofenphos... TO SPRUCE BUDWORM ADULT

PERCENTAGE MORTALITY AFTER 24, 48, AND 72 HOURS EXPOSURE TO TREATED WHITE SPRUCE..... FOLIAGE

INSECTS RELEASED INDICATED NUMBER OF DAYS AFTER SPRAY * OR WEATHERING PERIOD IN DAYS	24	48	72
0	10.0	55.0	82.5
3	0.0	20.0	42.5
5	2.5	15.0	20.0
10	5.0	5.0	5.0

* Trees sprayed at the rate of 1 gallon per acre. The insecticide solution(s) had 0.5 % of active ingredient. Rate of Application 0.8 oz./acre

CONTROL MORTALITY: 0.0% to 55.0 %

NUMBER OF TREES USED: 1 (+1 FOR ALL CONTROLS)

NO. OF SAMPLES FOR EA. WEATHERING PERIOD: 4 (+4 FOR CONTROL FOR ALL 3 CONCENTRATIONS OF IODOFENPHOS)

NUMBER OF INSECTS USED: 140 (+140 FOR CONTROL FOR ALL 3 CONCENTRATIONS OF IODOFENPHOS)

WEATHER DATA FOR 10 DAY TEST PERIOD — Average or Total

Temperature	72°F	22.3°C
Dew Point	60°F	15.5°C
Rain	1.67 in	42.4 mm
Sunshine		79.4 hr

wb- -