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EXPERIMENTS CONDUCTED

by

Warren T. Johnson

Under Contract Project OZSZ.KL007-6-0315

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O. N. Morris - Scientist in Charge

File Report 89 November, 1977

CONTRACT PROJECT WITH W.T. JOHNSON
O.N. MORRIS, SCIENTIST IN CHARGE
NARRATIVE REPORT

Bioassay studies were conducted in the laboratory on *Malacosoma disstria* and *Archips cerasivoranus*. *M. disstria* egg bands were collected from trembling aspen near the village of Kaladar, Ontario. Rearing took place in the laboratory on standard synthetic food media. Larvae of the 1st and 2nd instar did not utilize the food source as was expected and many died. Post mortem diagnosis indicated that death occurred from high levels of *Nosema disstriae* microsporidia identified by Dr. G.G. Wilson.

Even though there were microsporidia in the laboratory insects, bioassays were conducted using the insecticides Thuricide 16 B, Dipel 36 B, Sevin, Orthene and Dimilin. The data was computer analyzed. The analysis showed that the dosage concentration spread was too great resulting in no regression. The mortality curves and computer report are appended.

Likewise bioassay studies using 2nd and 3rd instar larvae of *Archips cerasivoranus* resulted in no regression. The same insecticides and dosages were used on *A. cerasivoranus* as on *M. disstria*. No microsporidia were found in *A. cerasivoranus*. The mortality curves are appended.

Field research on the forest tent caterpiller, *M. disstria* resulted in more confidence in the use of a cold fog generator for dispersing both microbial and chemical insecticides. Evidence from this study has helped to establish the advantage of B.t. and chemical insecticide mixtures. A complete report of this work is appended.

Field studies on spruce budworm *Choristoneura fumiferana* at Mattawa, Ontario and Ste. Anne des Mont, Quebec produced no significant control data. That a cold fog generator can be used for dispersing B.t. and B.t.-chemical insecticides mixtures has been established. Efficacy is considered sub-standard under the regimen followed. File reports are available for this work.

A fall webworm, *Hyphantrea cunea* control plot was established on the median of route 417 approximately 12 miles east of Ottawa. A preliminary test was conducted to determine whether bacteria-chemical insecticide laden fog would penetrate the nests and kill the caterpillars. The fog formulation contained Thuricide 16 B (950 ml), Orthene (108 gms, 85% sp) Volck oil (3800 ml) and Water (950 ml). It was dispensed by a Leco ULV cold fog generator and blown on to a natural stand of mixed hardwood. Target trees were up to 90 feet from the nozzle. The above fog mixture was applied to 3/10 mile of road side.

The treatment reduced the population by about 40%. Control was based upon deposit of insecticide to foliage outside of the web rather than by fog penetration of the nest. The caterpillars were in the 3rd and 4th instar at the time of treatment.

Ash is a major street tree in Ottawa. In some areas of the city there are severe infestations of borers, resulting in weakened trees and in some cases killing them. Twenty pheromone traps, provided by Dr. Chris Sanders (Sault Ste Marie), containing a synthetic sex pheromone, provided by Dr. Da~~niel~~vid G. Nielson (Ohio Agr. Res. and Development Center) were placed at selected sites around the city to attract and trap the ash borer, *Podosesia syringae fraxini*. Traps were checked two times each week over a 31 day period. The first moths were trapped on June 10, 1977. The peak of moth capture occurred during the week of June 13, species collected other than the ash borer were maple callus borer, *Sylvona* (Synanthedon) *acerni* dogwood borer, *Thamnosphecia scitula*, peach tree borer *Sanninoidea exitiosa*, and *Carmenta corni*. These were identified by A. Mutuura at the Biosystematics Research Institute in Ottawa.

The above data helps to establish the proper spray date for control of the ash borer in the city of Ottawa. The table of collections is appended.

Working together with Dr. John Cunningham (IPRI) a virus formulation was applied to pine trees with the Leco ULV Fog Generator for control of red-headed pine sawfly *Neodiprion lecontei*. A report of this work is appended, to be published in Bi Monthly Research Notes.

Black vine weevil *Brachyrhinus sulcatus* is an important pest of conifer seedlings as well as other nursery and agricultural crops. In cooperation with Dr. M.I. Timonin (Carleton University) black vine weevil eggs, larvae and adults were sprayed with a suspension of the fungus *Beauveria brassiana*. Conidiaspores were also wiped onto the eggs and larvae by means of a camels hair brush. Preliminary results indicate that the eggs are resistant to the fungus, but highly pathogenic to 1st and 2nd instar larvae. An unknown pathogenic fungus has also been found to kill the larvae but the fungus has not been identified.

The black vine weevil project will continue past the termination of this contract and will likely result in publishable research.

Warren T. Johnson
November 23, 1977

CONTROL OF *MALACOSOMA DISSTRIA* BY COMBINATIONS OF *BACILLUS THURINGIENSIS* AND LOW-DOSES OF CHEMICAL INSECTICIDES DISPERSED BY A FOG GENERATOR

by

W. T. Johnson and O. N. Morris

Forest Pest Management Institute

Ottawa, Ontario

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ABSTRACT

Tests were designed to determine the effectiveness of a fog generator in dispersing *Bacillus thuringiensis* in liquid formulation against the forest tent caterpillar, *Malacosoma disstria*. The fogger with some mechanical modifications, can be used effectively for application of microbial insecticides to trees. The addition of Volck oil to Thuricide suspensions resulted in a highly effective formulation for fog application. Thuricide 16B plus acephate was highly effective in reducing tent caterpillar populations.

INTRODUCTION

Evidence has been accumulating for over 20 years to document the effectiveness of *Bacillus thuringiensis* (B.t.), a bacterial pathogen, against a broad array of lepidopterous pests. The environmental acceptability of this pathogen as a pesticide is also well known. The work of several investigators has produced evidence that B.t. efficiency can be increased by the addition of sub-lethal doses of certain chemical insecticides, (Benz 1971, Morris 1972, Morris and Armstrong 1975, Morris 1977). The forest tent caterpillar, *Malacosoma disstria* is known to be sensitive to B.t. under field conditions (Abrahamson and Harper 1973, Wallner 1971). Most applied work, using B.t. against caterpillar pests, has made use of aerial, hydraulic and mist blower equipment. Recent investigations (Falcon *et al*, 1974; Frye *et al*, 1976) have demonstrated that fog generators can be useful tools for B.t. dissemination to field crops as well as trees.

As efficacy is a goal of most applied research, our objectives were to determine the effects of low dose B.t.-chemical pesticide mixtures on *M. disstria* when applied to ash trees through a U.L.V. cold fog generator.

METHODS AND MATERIALS

Test Area

A 2-acre block of green ash, *Fraxinus pennsylvanica*, a cultivar of red ash, was made available for this study at the Ottawa, Ontario city nursery. Tree size ranged between 6.2 to 7.5 cm DBH and 6.2 to 6.8 m high. Data was taken from 12 test plots containing a total of 108 trees. Each test plot contained 9 trees (replicates) in 3 rows. Each plot was separated from adjacent plots by 6 trees in 2 rows. All trees were in a low state of vigor because of their proximity to one another and lack of pest control maintenance. There was a low incidence of tent caterpillars during the previous year and less than 20 egg bands were found in the spring from the entire block of trees.

Introduced Population

A *Malacosoma disstria* population was introduced into the nursery from a forest site near the village of Kaladar, Ontario. Twigs with egg bands attached were collected in late March from trembling aspen (*Populus trembloides*) twigs and refrigerated in the laboratory at 6°C. On May 6, the egg bands were removed from storage and attached to the test trees. Four egg bands were attached to outer branches of each tree; one to each quadrant. These were attached with horticultural wire twistems. The egg bands were sized so that each tree had an average population of 382 living larvae. To obtain this number, the larvae from 60 egg bands were allowed to hatch in the laboratory and from the average (95.5 per band), we were able to estimate the larvae per tree at the beginning of the test. On the trees the larvae developed normally with the moult at the end of the 2nd instar occurring about May 21st. Fog treatments were applied while the larvae were in the 3rd instar.

Tree Phenology

The spring phenological development in the green ash nursery block was approximately one week later than trees inside the city limits due to a temperature differential common in large northern cities. Egg bands, from the Kaladar population, were attached to the nursery trees after the leaf buds had started to open. All flower buds, both male and female, had fully opened and a few of the stigmas had started to wither. Forest tent caterpillars naturally infesting the nursery trees began to hatch just as the flower buds began to break. This phenomenon started fully 1 week before there was evidence of leaf bud developments. The tiny caterpillars sought out the flower buds as a feeding site and utilized this source of food until the leaf buds started to open.

Meteorological Measurements

Temperature, relative humidity, precipitation, hours of bright sun, and wind speed were recorded both before and during the treatment period. Temperature over the 3 day treatment period ranged between 12°C and 23°C. Relative humidity during the fogging operation ranged between 28 and 83%. Wind velocity at treatment time was calm, never exceeding .8 km/hr, read at 160 cm above the ground.

Equipment and Fog Application

All insecticide mixtures were applied with a Leco ULV Fog Generator, Model HD, normally sold and used for mosquito abatement (Figure). Such machines with air shear nozzles produce droplet sizes that range from 5 to 30 microns with 90 percent between 15 and 20 microns (Fultz *et al*, 1972).

Spray tank agitation was necessary for most of the fogging mixtures, thus requiring modifications to the equipment. To accomplish this, the tank was mounted on a platform and adjusted to rest on a small laboratory magnetic stirrer. A 7.6 cm teflon-coated magnetic stirring rod was placed inside the tank. The power for the 110v a.c. stirrer was supplied from a 12 volt battery through an AC-DC converter. To allow particulate matter (B.t. and carbaryl) to flow into the dispersing head, a filter required for mosquito control operations, between the supply tank and pump had to be removed.

The fogger, weighing approximately 202 kg, was mounted on a trailer and towed by a ½ ton truck. Fogging took place over 3 consecutive days, taking advantage of early morning calm and higher relative humidity. The fogger was calibrated to deliver approximately 900 mℓ per minute. Each plot received approximately 61 mℓ of the fogging suspension. Kromekote® papers, cut to the shape of an ash leaflet, were hung in several trees to obtain a graphic interpretation of fog dispersion.

Formulation and Diluents

The pesticide ingredients used were *B. thuringiensis* (Thuricide® 16B, Dipel® 36B), Dimilin®, carbaryl and acephate. All fogging mixtures were made up in 2-gallon quantities and all mixtures containing *Bacillus thuringiensis* were prepared to contain the application equivalent of 2 BIU per acre. Carbaryl and acephate were applied at the rate of 37 grams actual per acre. Dimilin in all solutions was mixed at 100 ppm.

All fogging mixtures contained .2% Erio Acid Red XB (Ciba-Geigy) as a dye marker and all B.t. mixtures contained .2% Uvitex® (Ciba-Geigy) as an ultra-violet protectant. Thuricide mixtures contained 1 part Thuricide 16B, 1 part Volck oil, 2 parts water plus other ingredients mentioned above. Dipel mixtures contained 1 part Dipel 36B and 34 parts water containing 4 grams CMC (Carboxel R-295) made by Chemical Developments of Canada Ltd., and used as a suspending agent. We were unable to keep Dipel suspended in spray oils, substituting water as the carrier.

When carbaryl or acephate were the only active ingredients, water was the only carrier. All mixtures containing carbaryl were prepared from a sand-milled flowable formulation developed by the Agway Corporation of Syracuse, N.Y. This product was tested for B.t. compatability by a method described by Morris (   ) and found not to interfer with spore germination at field dosages.

Sampling

A census of the larval population was taken 5 and 12 days after treatment (see Table 1). Larvae were in the 3rd instar when the first count was made; mostly 4th instar at the time of the 2nd count. The caterpillars on each tree were easily counted at the first sampling. However, on the second sampling entire colonies in the untreated check plot had migrated to adjacent trees because the original host trees were nearly defoliated. The natural hazards of starvation wandering caused some interference with data analysis.

Spore viability counts were taken from leaves 6 hours and again at 4 days after treatment. In each plot two leaflets were randomly selected from trees in rows 1, 3 and 6. Two discs, 13 mm in diameter, were cut from each leaflet and a viable spore assay test was made by a method described by Falcon (   ).

BIOLOGICAL AND BEHAVIORAL OBSERVATIONS

Green ash is an acceptable oviposition tree for *Malacosoma disstia* based upon Sippell's (1957) definition of a host tree. While eggs hatch at least one week before leaf buds break, the larvae readily feed on the flower buds which develop earlier and which sustain them until the foliage buds open. As temperature remains cool during much of the 1st and 2nd stadia, growth is slow; however, the development of the insect is closely attuned to the phenology of ash trees.

Larval development on ash follows the pattern described by Sippell (1957). The larvae, after breaking out of their shells, move distally and/or upward until they find flower buds. The entire colony may find ample food in one large flower bud. Bud tissues grow rapidly, so rapidly that the larvae appear to be resting on the bud rather than eating it. Some colonies were observed to remain on flower buds for 7 days. If the food source is ample, a colony of 1st instar larvae will not move over 5 cm. When the first food source is exhausted, the larvae withdraw, rest, then seek another feeding site. If food is plentiful through the 3rd instar, a colony may not move over 100 cm. Moulting of first instar larvae often occurs on leaves and at a lower level than the feeding site. Subsequent moults occur on bark and at successively lower levels. Except for those periods of moulting and for the last instar, *Malacosoma disstria* is positively phototropic. They tend to remain high in the tree or with the most luxuriant foliage. Such behavior offers clues to the proper application of spray materials, such as, sprays directed to outer foliage.

RESULTS AND DISCUSSION

Fog generators, because of spray particle size, provide, for excellent pesticide dispersion. If the fog can be placed and kept on target, generators could become a major means of ground application to trees and shrubs. Guidance, impingement and adherance of fog particles are the key factors limiting the practical use of the generator. The present work confirms some of these problems and presents some data for their solution.

Table 1 summarizes the results of an experiment utilizing 11 pesticide mixtures, applied through a fog generator. In calculating the concentrations of active ingredient for fog mixtures, we attempt to develop mixtures in which the dosage rates of the separate active ingredient would likely be sub-lethal to the forest tent caterpillar if applied alone. This was not achieved. Thus, dosage levels used were apparently not low enough to show distinct additive effects when combined. One of the reasons for the high mortality from calculated "sub-lethal" doses was the matter of deposit. Trees closest to the fog nozzle received a greater quantity of the pesticide mixture than those trees in the 2nd and 3rd rows, as evident from mortality counts (Table 2) and from spore counts in the case of B.t. (Table 1). Leaves, then, appear to be filters and/or there is a critical velocity and partical size necessary for adhesion.

All B.t. mixutres were calculated to contain the same number of spores per unit volume. However, more caterpillars were killed by the Thuricide-acephate combination than by any other treatment (99.4% mortality 5 days after treatment).

When percent mortalities from Thuricide and Thuricide-acephate are compared, the addition of acephate increased Thuricide effectiveness by 28%. Dimilin was also highly effective mainly at the 12 day assessment.

Evaporation of the "fog" particle may have been a key factor in the variability of mortality, since all the pesticides had previously been tested by other investigators and shown effective against the forest tent caterpillar.

Spore counts from leaves "sprayed" with Dipel and Dipel mixtures were much lower than those with Thuricide, suggesting that evaporation may be a factor in distribution. Dipel mixtures contained water as sole carrier plus CMC as a suspending agent. The addition of a spray oil is believed to be the factor that resulted in Thuricide superiority. The writers have no knowledge about the effect of oil alone on *M. disstria*.

Kromekote cards, dangling from trees in the test plot as well as beyond the test plot, gave additional evidence that the "spray" material rarely impinged beyond 13.5 m when the fog mixture contained oil and rarely over 9 m when water was the sole carrier. Visually, the fog containing emulsified oil could be easily followed for more than 30 m; water-based fog could be followed about 12.0. Fog passing to and around the dangling, leaflet-shaped Kromekote cards resulted in a differential droplet pattern. The edge of the cards had approximately 25% more spots than the center of the card. If this phenomenon held true with the ash leaves, there would have been a higher concentration of insecticides on the leaf edges, a factor of greater importance on "edge" feeding insects.

Throughout the test period, sick and dead larvae from the treatment plots were collected to determine the cause of death. Only one dead larva was found in the check plot. We could make no diagnosis on the probable cause of its death. Nine dead caterpillars were found in the Dimilin plot. Eight were diagnosed as B.t. positive and one microsporidia positive indicating a low natural incidence of this pathogen. No dead larvae in the carbaryl and acephate plots were diagnosed as B.t. positive. There were several hundred dead larvae found in the B.t. and B.t. combination plots. About 5% were diagnosed and all were found to be B.t. positive.

The commercially available Leco fogger Model HD is not entirely satisfactory for application of fog to trees and the dispersion of particulate matter. Fog formulations with insoluable material may clog the flow value, particularly if the machine is shut down for a few minutes. To clean the valve and flow meter is a chore and especially so in a field operation. The nozzle assembly, as with mist blowers, must be easy to manipulate while the machine is in operation. Nozzle articulation on the Leco is awkward.

A large number of the caterpillars brought from Kaladar, Ontario and reared on synthetic media in the lab were heavily infected with a microsporidia, identified by Dr. G. G. Wilson as *Nosema disstriae*. Laboratory rearing was unsuccessful because of these microsporidia even though stringent sterilizing procedures were used. Hatching occurred normally, but within 5 to 8 days the larvae refused to eat. The microsporidia counts increased dramatically, likely because of some unidentified stress factor in the rearing technique. Caterpillars reared out of doors on natural food survived with no rearing problems.

ACKNOWLEDGEMENTS

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TABLE 2: MORTALITY DIFFERENTIAL BETWEEN ROWS

Treatments	Avg. No. Living Larvae From 3 Trees + 12 Days			% Mortality Row 1 vs Row 3
	Row 1	Row 2	Row 3	
Dipel	57	103	183	32
Thuricide-Dimilin	27	29	43	4
Dipel-Dimilin	65	80	73	2
Thuricide	36	33	54	5
Thuricide-acephate	1	0	.3	0
Dipel-carbaryl	62	220	190	33
Dimilin	69	200	179	29
Dipel-acephate	.6	26	235	61
Thuricide-carbaryl	0	15	35	35
Carbaryl	7.6	1	88	21
Acephate	0	27	120	31
Untreated check	109	65	132	6

WEATHER DATA IN RELATION TO FOREST TENT CATERPILLAR MORTALITY

TREATMENTS	LOWEST RELATIVE HUMIDITY	PRECIPITATION* AS RAIN IN ml	HOURS† BRIGHT SUNLIGHT	PERCENT CORRECTED MORTALITY
Dipel 36 B	30	0	14.2	70.6
Thuricide-Dimilin	28	0	14.2	95.2
Dipel-Dimilin	58	19.8	5.6	81.3
Thuricide 16 B	28	0	14.2	95.4
Thuricide-acephate	28	0	14.2	99.8
Dipel-carbaryl	33	0	14.2	54.9
Dimilin	46	0	14.2	77.8
Dipel-acephate	46	19.8	5.6	80.2
Thuricide-carbaryl	67	0	11.8	86.1
Carbaryl	67	0	11.8	82.4
Acephate	83	0	11.8	88.2

* < 12 hours after treatment

† on treatment day

	Treatments	Avg. No. Live Larvae° Pre Spray	Post Spray +5 Days	Post Spray +12 Days	Corrected % Pop. Reduction* +5 Days	Corrected % Pop. Reduction* +12 Days	Spores/mm² ~~Count~~† +6 hrs.	Spores/mm² ~~Count~~† +4 Days
	Dipel	382	115	42	19.7	70.6	21	16
6	Thuricide-Dimilin	382	37	7	74.6	95.2	55	27
	Dipel-Dimilin	382	72.6	26.8	49.3	81.3	71	4.95
	Thuricide	382	41	6.6	71.4	95.4	132.5	29.5
	Thuricide-~~Orthene~~ acephate	382	.8	.2	99.4	99.8	676.5	122.0
	Dipel-~~Sevin~~ carbaryl	382	157	64.6		54.9	10	9
9	Dimilin	382	127.6	32	10.9	77.8	11.5	4
	Dipel-~~Orthene~~ acephate	382	87.6	28.5	38.9	80.2	131.5	20
7	Thuricide-~~Sevin~~ carbaryl	382	16.6	20	88.5	86.1	78	27.5
10	~~Sevin~~ Carbaryl	382	32.5	25.3	77.3	82.4	5.8	2.1
11	~~Orthene~~ acephate	382	49	17	65.8	88.2	.3	.05
12	Untreated Check	382	143	121	.26	15.7	3	.35

* Correction by ~~Abbott's~~ Henderson's Formula

† Avg. of 4, 9 mm discs from 2 leaflets.

° Avg from 9 trees

Insect virus application using a cold fog generator. - Cold fog generators have been used successfully for the application of the bacterium, Bacillus thuringiensis, for insect control (Falcon et al, Calif. Agric. April 1974; Frye et al, U.S. Forest Service RM 35, Rocky Mt. Forest and Range Exp. Station 1976). A nuclear polyhedrosis virus has been used to control red-headed pine sawfly, Neodiprion lecontei (Fitch), and, to date, it has been applied with mistblowers (Anon., Can. For. Serv. Inf. Rept. DPC-X-1, 1970) and from aircraft (Kaupp and Cunningham, Dept. of Fisheries and the Environment, Inf. Rept. IP-X-14, 1977). It was decided to conduct a trial using a cold fogger and ascertain the feasibility of applying virus on small plantation trees with this equipment.

The trial was conducted in a mixed red and jack pine plantation (trees 1 to 1.5 m high) located in Lot 17, Con VIII, Rideau Twp, South of Ottawa on the morning of July 15th, 1977 when larvae were in the third and fourth instar. The infestation was moderate to severe with 132 colonies per 100 trees. On the same morning an aerial spray was applied on an 8 ha block in the same plantation.

A Leco ULV cold fog generator was used and 18.8 l of virus formulation containing 4.4 billion polyhedra, 9.4 l of water, 9.4 l Volck oil (Chevron Chemical (Canada) Ltd.) and rhodamine B dye was disseminated. Both sides of a 100 m roadway were treated and, with an effective dispersal range of 25 m, about 0.4 ha was covered.

In the aerial spray trial an aqueous spray formulation containing 250 ml/l molasses and 60 g/l IMC 90-001 sunlight protectant and half the dosage of virus, 5.5 billion polyhedra/ha, was applied at 9.4 l/ha. The droplet spectrum as analysed on Kromekote cards revealed sizes in the 15 to 30μ range with a density of over 5,000/cm^2 2m from the nozzle of

+ 3.7 l Volck oil + 3.7 l water + virus concentrate + dye the fogger and $390/cm^2$ 22m from the nozzle. The Cessna 180 was fitted with 4 Micronair AV 3000 units and a droplet density of $60 \pm 35/cm^2$ was obtained with 42% in the 50-100μ size range, 26% in the 101-150μ range and 20% in the 151-200μ range.

Microscopic examination of smears of guts of larvae collected 6 days after the application showed 43% with visible nuclear polyhedrosis virus infection in the area sprayed with the fogger, 13% in the block sprayed with the aircraft and none in an unsprayed check plot. As another measure of the efficacy 100 larvae were collected from each of these 3 plots and reared in the laboratory on foliage in lantern globes until pupation or death occurred. Mortality was recorded as 72% in the fogged plot, 53% in the aerial spray plot and 9% in the check.

These results indicate that cold fogging using an oil/water emulsion is a practical method of disseminating nuclear polyhedrosis virus in a plantation and that the coverage and swathe width are ~~most~~ impressive.

Warren T. Johnson is a visiting scientist from Cornell University, Ithaca, New York who is on sabbatical at Forest Pest Management Institute, Ottawa. - W.T. Johnson, J.C. Cunningham, W.J. Kaupp and C. Edwards, Forest Pest Management Institute, Sault Ste. Marie, Ontario.

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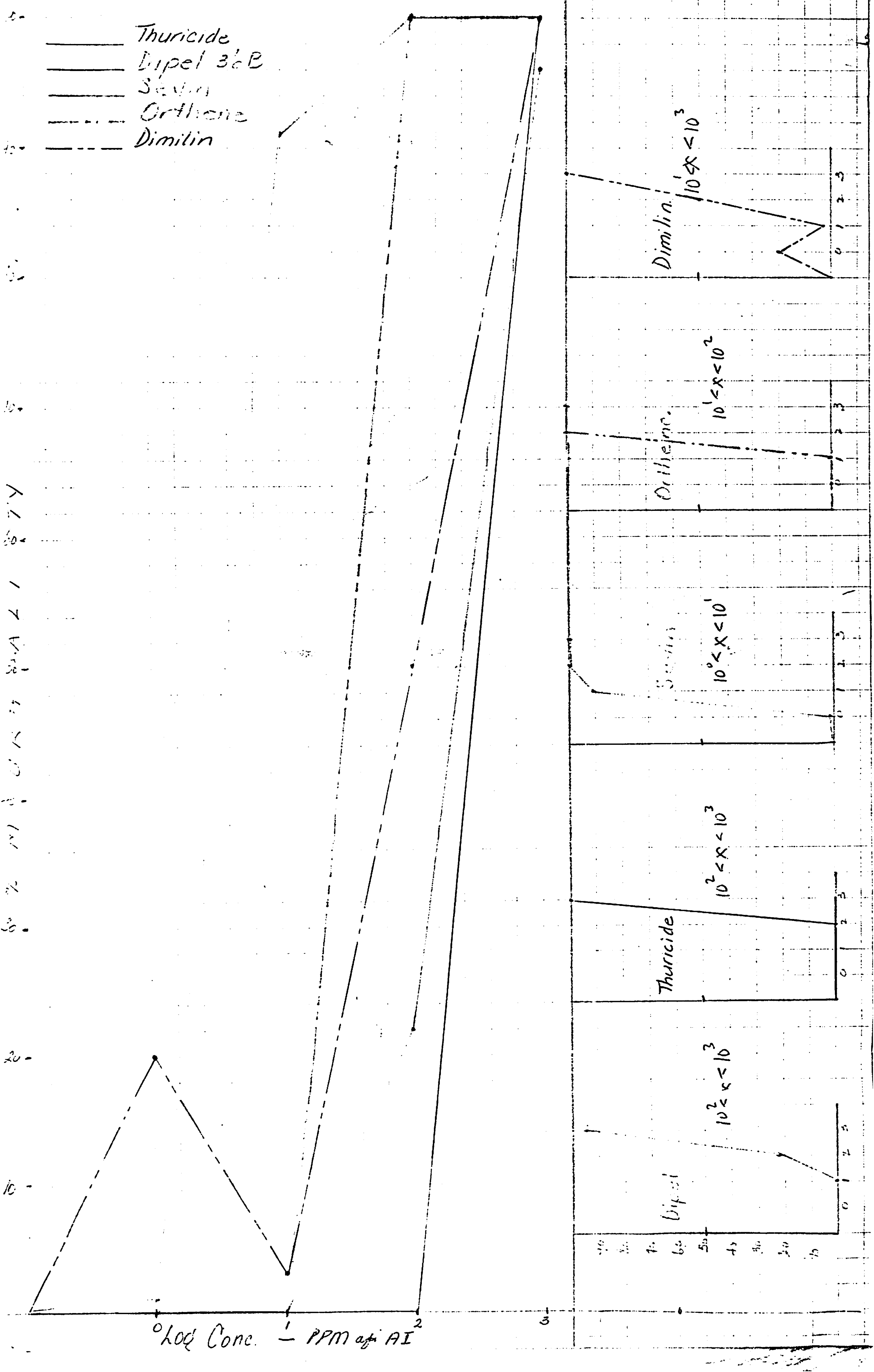
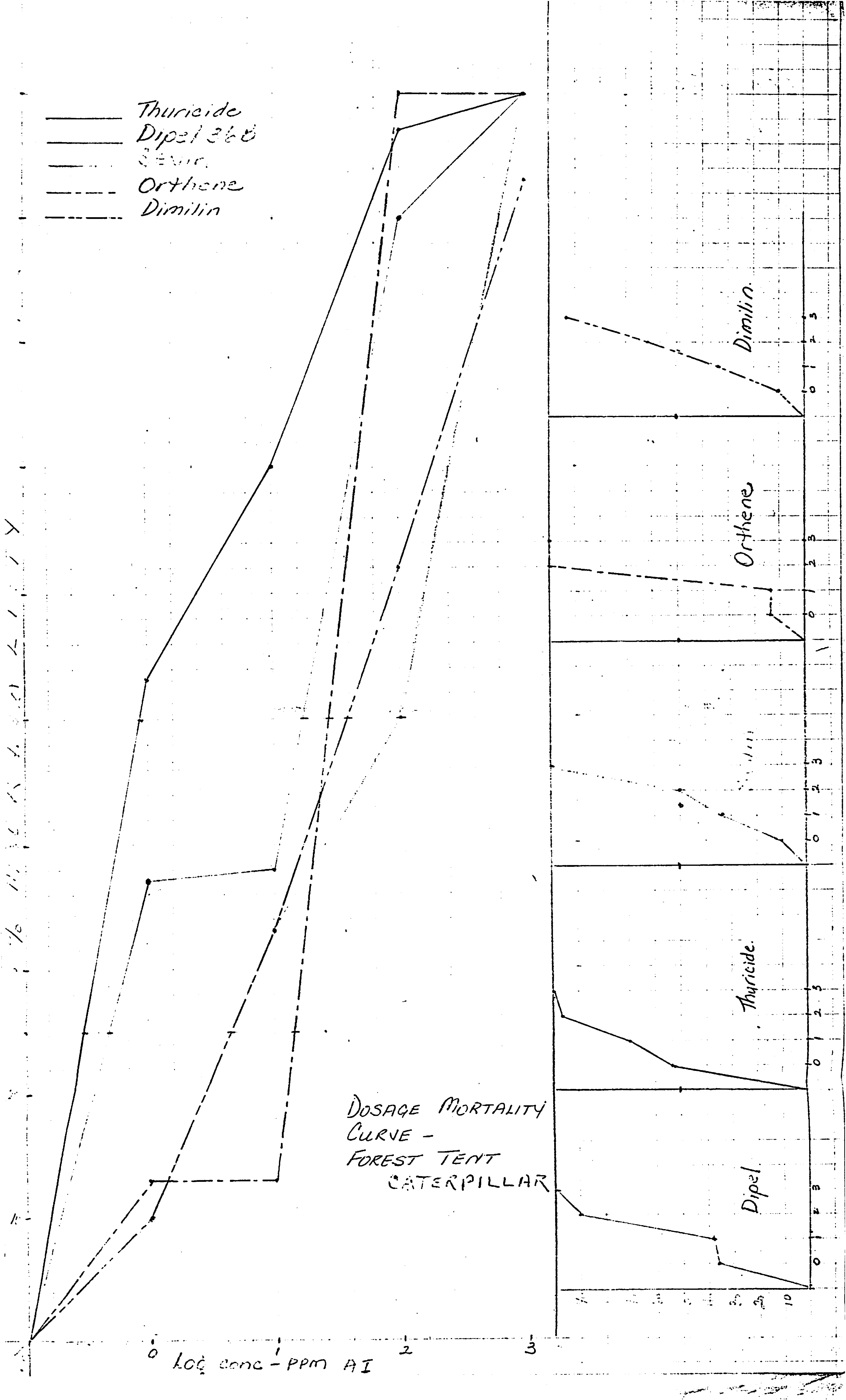
DOSAGE MORTALITY CURVE - UGLY NEST




Thuricide
Dipel 36B
Orthene
Dimilin
% MORTALITY
0
1
2
3
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Dimilin
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DOSAGE MORTALITY CURVE - FOREST TENT CATERPILLAR

MATTAWA 1977 Spruce Budworm - Leco Fog Generator

TREATMENT	Avg. No. Living Budworms: Pre Fog	Post Fog: + 6 Days	Post Fog: + 11 Days	Post Fog: + 16 Days	% Population Reduction: + 6 Days	% Population Reduction: + 11 Days	% Population Reduction: + 16 Days
Dipel (Plot 1)	19.6	21.1	12.8	11.6		65	59
Dipel-Sevin (2)	18.2	11.8	5.6	6.0		31	33
Thuricide (3)	18.5	21.3	10.1	9.2		54	50,
Thuricide-Sevin (4)	19	17.8	9.4	6.4		49	34
Untreated Check* (May 25)	(573/16) 35.8			(128/16) 8			22
	May 25			June 21			

* larvae from 16 trees; 8 each from WS and Bf.

Gaspé 1977 Spruce budworm - Leco Fog Generator

Treatment	TOTAL NO. Live Larvae* Pre Fog	Post Fog + 6 Days	Post Fog + 13 days	% Pop. Reduction + 6 Days	% Pop. Reduction + 13 days	Corrected† + 13 days
Thuricide (Plot #1)	221	131	61	41	72	60
Thuricide-Orthene (#2)	165	36	59	78	64	48
Thuricide-Sevin (#3)	113	79	69	30	39	22
Dipel (Plot #4)	219	98	43	55	80	72
Untreated check	144	———	99		31	31
Dipel-Sevin (Plot #5)	166	52	130	69	22	
Dipel-Orthene (#6)	237	37	40	84	83	66
Permethrin (Plot #7)	226	25	52	89	77	54
Untreated check	167	———	82		51	51.

* all stages - 3 trees sampled from each treatment.

† corrected by Henderson's formula

Fog Mixtures used at Ste Anne's (Gaspe 1977)

Plot #	Active Ingredients	Diluents	Additives	Total Volume in ml
1	Thuricide 16B 473 ml	Volck Oil 1900 ml Water 3800 ml	Uvitex 150 ml	6323
2	Thuricide 16B 473 ml Orthene 85% SP 54 gms	Volck Oil 1900 ml Water 3800 ml	Uvitex 150 ml	6377
3	Thuricide 16B 473 ml Sevin 4F 94 ml	Volck Oil 1900 ml Water 3800 ml	Uvitex 150 ml	6417
4	Dipel 36B 211 ml	Water 7230 ml	Uvitex 150 ml CMC 4 gms	7595
5	Dipel 36B 211 ml Sevin 4F 94 ml	Water 7230 ml	Uvitex 150 CMC 4 gms	7689
6	Dipel 36B 211 ml Orthene 54 gms	Water 7230 ml	Uvitex 150 CMC 4 gms	7649
7	Permethrin 50% ec 14 ml	Volck oil 7500 ml	None	7514

PHEROMONE TRAP COLLECTIONS of PODOSESIA SYRINGAE FRAXINI in (OTTAWA, ONTARIO 1977)

TRAP #	TRAPS SET JUNE 6th LOCATION	Total # of ADULTS/TRAP JUNE 10th	JUNE 14th	JUNE 17th	JUNE 23rd	JULY 4th	JULY 11th	FINAL CHECK JULY 19
1	PICKERING PLACE	1	5	7	9	9	11	11
2	COLDREY AVE 1370	ϕ	11	14	15	19	19	19
3.	LEITRIM NURSERY	ϕ	ϕ	ϕ	* ϕ	2	2	2
4.	KINGSTON AVE. 1175	2	4	6	7	9	9	9
5.	MATTHEWS AVE 1799	1	10	12	15	17	19	19
6.	WHITEHAVEN 2287	ϕ	1	2	4	4	5	5
7.	REGINA 2523	ϕ	1	5	7	10	11	11
8.	CLEMENTINE BLVD. 2420	1	1	3	3	3	3	3
9.	ULSTER 2737	ϕ	5	6	8	11	12	12
10.	HARTMAN CRES. 715	ϕ	2	2	9	11	14	14
11.	URBANDALE DR. 2330	ϕ	8	13	16	21	21	21
12.	WINGATE 850	4	19	19	21	21	21	21
13	BEAUSOLIEL	ϕ	3	5	6	6	6	6
14	MEADOW DR. 408	1	1	3	4	6	6	6
15	STONE CRES 2722	ϕ	6	13	15	16	17	17
16	TILLBURY opp 543	ϕ	2	2	3	6	6	6
17	SOUTHWOOD	ϕ	6	6	12	12	12	12
18	SECOND AVE 68	1	4	8	10	10	10	11
19	NORTHWEST - GRND opp 122	ϕ	3	5	11	13	13	13

* - new pheromone placed in the trap on June 25th.