Further Evaluation of Insecticides against Fourth-Instar European Pine Sawfly larvae *Neodiprion sertifer* (Geoff.)

Project No. CC-006 (Formerly CC-4)

by

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CONTENTS

CODES

Mort.	=	Mortality
Corr. Mort.	=	Corrected Mortality by Abbott's formula
D/T	=	Dead/Total
gpa	=	gallons per acre
EPS	=	European pine sawfly
$\mu g/cm^2$	=	Microgram per square centimeter
b	=	Slope
FL	=	Fiducial limits (95%)
ld-p	=	Log dosage-probit mortality regression line

Introduction

In order to replace chlorinated hydrocarbon insecticides, a search for alternate and more effective insecticides to control sawflies has been continuing since 1965 (Randall & Nigam 1966; Nigam 1968a and b; 1969b; 1970a, b, and c; 1971a). Nigam, in 1970, reported the laboratory studies carried out against European pine sawfly, Neodiprion sertifer (Geoff.) during 1968 and 1969 and reviewed the existing control practices (Nigam 1970b). The present study describes the results of contact toxicity tests carried out with eight insecticidal compounds against fourth-instar European pine sawfly larvae during 1970 and compares the relative toxicity of these insecticides to that of the seven insecticides tested during previous years. The results of the 1968 Sumithion experiment are used as a standard to compare the toxicity of the insecticides tested in 1970 so that a direct comparison could be made with the data obtained in the past.

Methods and Materials

The details of the methods and materials are described in earlier reports (Nigam 1970a and b). The insecticides and their formulations used in this study are given in Table 13 with their chemical names, sources and common names. Original designation of insecticide used by the supplier is referred in the report for simplicity. The spraying of insecticide was carried out as described in previous reports (Nigam 1968a, 1969a and 1970a). The technique

for maintaining fourth-instar larvae cultures was the same as described in 1970 (Nigam 1970b). The plan of each experiment is described individually. The post-treatment observations were carried out at 24, 48 and 72 hour intervals (Tables 1-9). The mortality data were analyzed by probit analysis using a Univac 1108 computer and program S103 prepared by Canada Department of Agriculture (Nigam 1969a). The relative potencies and toxicity indices of the insecticides were calculated using Sumithion as the standard insecticide (Expt. Code EPS-4-68).

Experiments and Results

Bassa, Baygon, Dursban, Dylox, Hopcide, Matacil, methomyl and Surecide were used against fourth-instar larvae of European pine sawfly during 1970 and the Sumithion experiment was carried out in 1968 (Expt. 5). The concentration of insecticides and their rates of application are presented in the plan of each experiment (Expts. 1-9). The mortality data are presented in Tables 1-9 and were subjected to probit analysis. The summary of probit analysis for each period of observation is tabulated at the end of each experiment giving LD_{50} and LD_{95} values with their fiducial limits and slopes (Expts. 1-9). The regression lines for 24, 48 and 72 hours of each insecticide are presented in Figs. 1-9 and comparative regression lines of different insecticides for each period of observation are presented in Figs. 10-12. The insecticides and the experiments are arranged in descending order of toxicity on the basis of LD_{50} values. The comparative contact toxicity

study of different insecticides at 24, 48 and 72 hours is presented in Tables 10, 11 and 12, along with their relative potency and toxicity index taking LD_{50} and LD_{95} values of Sumithion as one.

At the LD_{50} level the toxicities of the insecticides have slightly increased from 24-hour observation to 72-hour observation periods in all the insecticides except Hopcide; at the LD_{95} level, the same trend was observed with the exception of Dursban where the value remained constant at 13 $\mu g/cm^2$ (Tables 10-12). These differences at various periods of observations are not significant because the 95% fiducial limits in most cases overlap. Fiducial limits for Matacil and Hopcide for 24 hours could not be compared since probit regression lines are not significant due to uneven mortality response at this period. Similar response was observed for Bassa after 48 hours and Hopcide and Dylox after 72 hours. The relative potency of these insecticides varies at LD_{50} and LD_{95} levels because the probit regression lines of the insecticides are not parallel to one another.

Matacil is approximately 3 times more toxic than Sumithion at the LD_{50} level for the three periods of observations. At the LD_{95} level Matacil is approximately 3 times more toxic at 24 hours and approximately 6 times more toxic at 48 and 72 hours than Sumithion. During 1970 tests, Matacil at its LD_{95}, was the most toxic compound followed by Baygon. Methomyl and Surecide were more effective than Sumithion, while Dursban, Hopcide, Dylox

and Bassa were less toxic. Bassa was the least effective of all the insecticides tested.

The relative potencies for 72-hour observation periods for insecticides tested during 1968-1970 that proved more effective than Sumithion are tabulated below:-

Insecticide	Relative Potencies at 72 hours	
	LD_{50}	LD_{95}
Baygon	3.2	2.8
Matacil	2.8	6.0
Zectran	2.5	2.4
Methomyl	1.9	2.9
Surecide	1.3	2.0
Dibrom	1.2	1.8
S4084	1.1	2.0
Sumithion	1.0	1.0

Baygon is the most potent insecticide tested against this sawfly at LD_{50} level followed by Matacil and Zectran, while at LD_{95} level Matacil is better than Baygon. Zectran is at third place at both LD_{50} and LD_{95} level. Baygon was also found effective against Neodiprion pratti banksianae Roh. and N. swainei Midd. (Nigam 1970a). Among the carbamate insecticides Baygon and Matacil appear to be quite effective against this sawfly, while among organophosphorous compounds Surecide and S4084 appear better than Sumithion.

Sumithion has given good protection against N. swainei Midd. in Quebec (McLeod and Desaulniers 1969) and is being used extensively in large scale operations against spruce budworm and other insects (Nigam 1971b). However, other insecticides, such as Baygon, Matacil and S4084 should also be tested in the field as possible substitutes for future requirements.

Summary

Eight insecticides were tested against N. sertifer Geoff. during 1970 and results were compared with insecticides tested during 1968 and 1969. Matacil and Baygon appeared to be very effective insecticides for sawfly control, while Bassa was the least effective. Some of the carbamate insecticides are superior to organophosphorous compounds.

Acknowledgement

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EXPERIMENT NO. 1

Object: To determine the contact toxicity of Matacil against fourth instar European Pine Sawfly.

Plan of Experiment:

Treatment: Seven (six rates of application - 0.1, 0.2, 0.4, 0.6, 0.8, 1.0 gpa and control)

Concentration of insecticide: 0.025%

Replications: Three

No. of larvae per treatment: Thirty

Total No. of larvae utilized: Two hundred and ten.

Exptal Code: EPS-28-70 Computer Code: EPS-MAT (61-63)

Table No. 1

Insecticide		Mortality Counts After								
		24 Hours			48 Hours			72 Hours		
gpa	Dosage ug/cm^2	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.
0.1	.0030	1/30	3	3	1/30	3	0	1/30	3	0
0.2	.0050	0/30	0	0	1/30	3	0	1/30	3	0
0.4	.0120	5/30	17	17	5/30	17	14	5/30	17	14
0.6	.0170	11/30	37	37	14/30	47	45	14/30	47	45
0.8	.0210	24/30	80	80	26/30	87	86	28/30	93	93
1.0	.0270	24/30	80	80	29/30	97	97	29/30	97	97
Control		0/30	0		1/30	3		1/30	3	

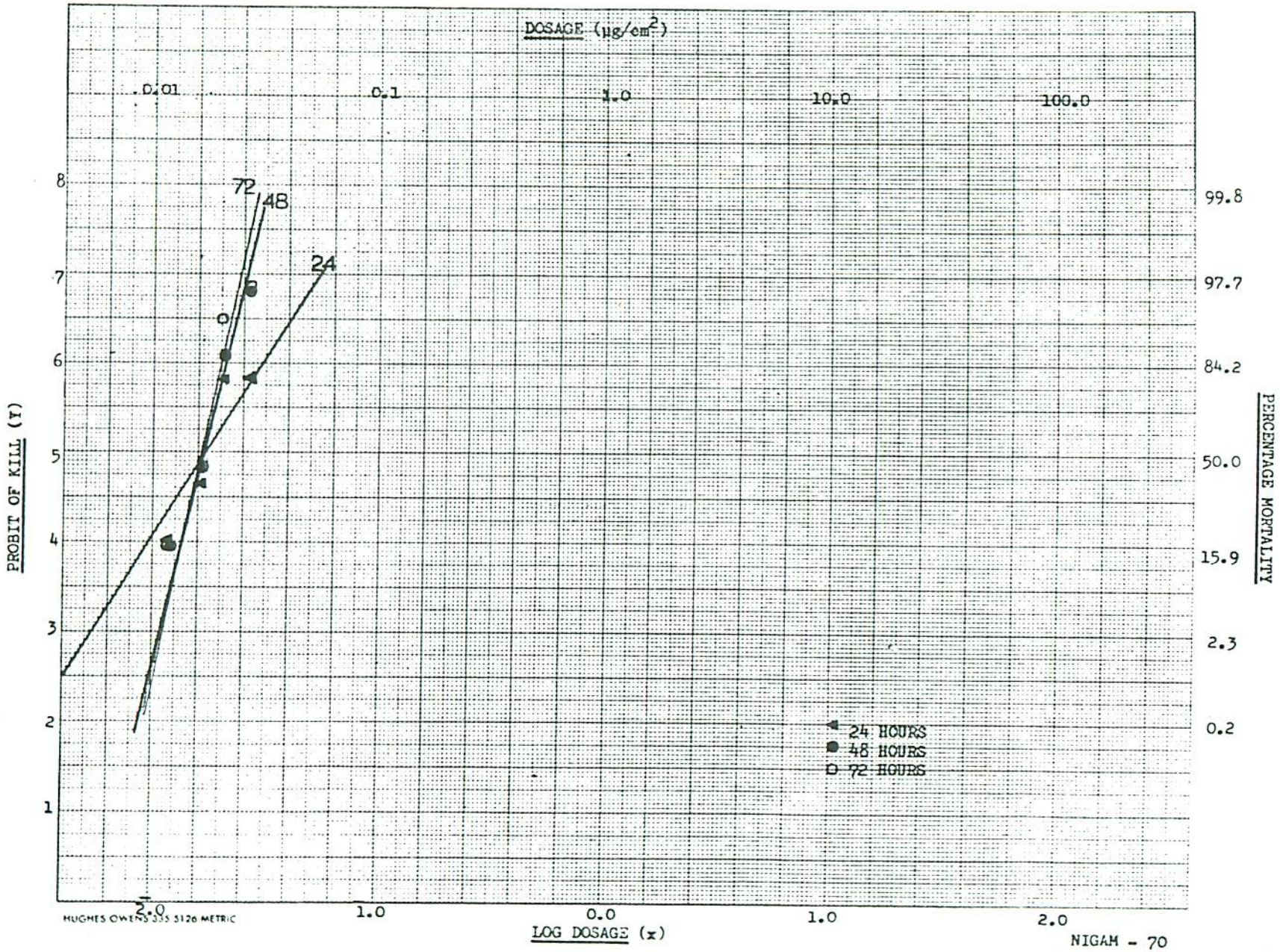
Findings: The summary of probit analysis is as follows:

Period	b	LD 50 ug/cm^2	FL	LD 95 ug/cm^2	FL
24 hours	3.96	.17-01		.45-01	
48 hours	11.23	.17-01	.16-01-.18-01	.24-01	.22-01-.28-01
72 hours	12.06	.17-01	.16-01-.18-01	.23-01	.21-01-.27-01

Remarks:

The regression lines are given in fig. 1.

FIG. 1. Ld-p LINES OF MATACIL AGAINST FOURTH INSTAR NEODIPRION SERTIFER GEOFF. (EUROPEAN PINE SAWFLY) FOR 24, 48 AND 72 HOURS AFTER TREATMENT



EXPERIMENT NO. 2

Object: To determine the contact toxicity of Baygon against fourth instar European Pine Sawfly

Plan of Experiment:

Treatment: Seven (six rates of application - 0.1, 0.2, 0.4 0.6, 0.8, 1.0 gpa and control)

Concentration of insecticide: 0.05%

Replications: Three

No. of larvae per treatment: Thirty

Total No. of larvae utilized: Two hundred and ten

Exptal Code: EPS-20-70 Computer Code: EPS-BAY-A1-A3-(49-51)

Table No. 2

Insecticide		Mortality Counts After								
		24 Hours			48 Hours			72 Hours		
gpa	Dosage ug/cm^2	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.
0.1	.0050	1/31	3	0	1/31	3	0	1/31	3	0
0.2	.0100	7/30	23	21	8/30	27	24	11/30	37	34
0.4	.0230	20/30	67	66	21/30	70	69	21/30	70	69
0.6	.0340	23/30	77	76	24/30	80	79	27/30	90	90
0.8	.0440	27/30	90	90	27/29	93	93	28/29	97	96
1.0	.0580	24/30	80	79	24/30	80	79	28/30	93	93
Control		1/30	3		1/30	3		1/30	3	

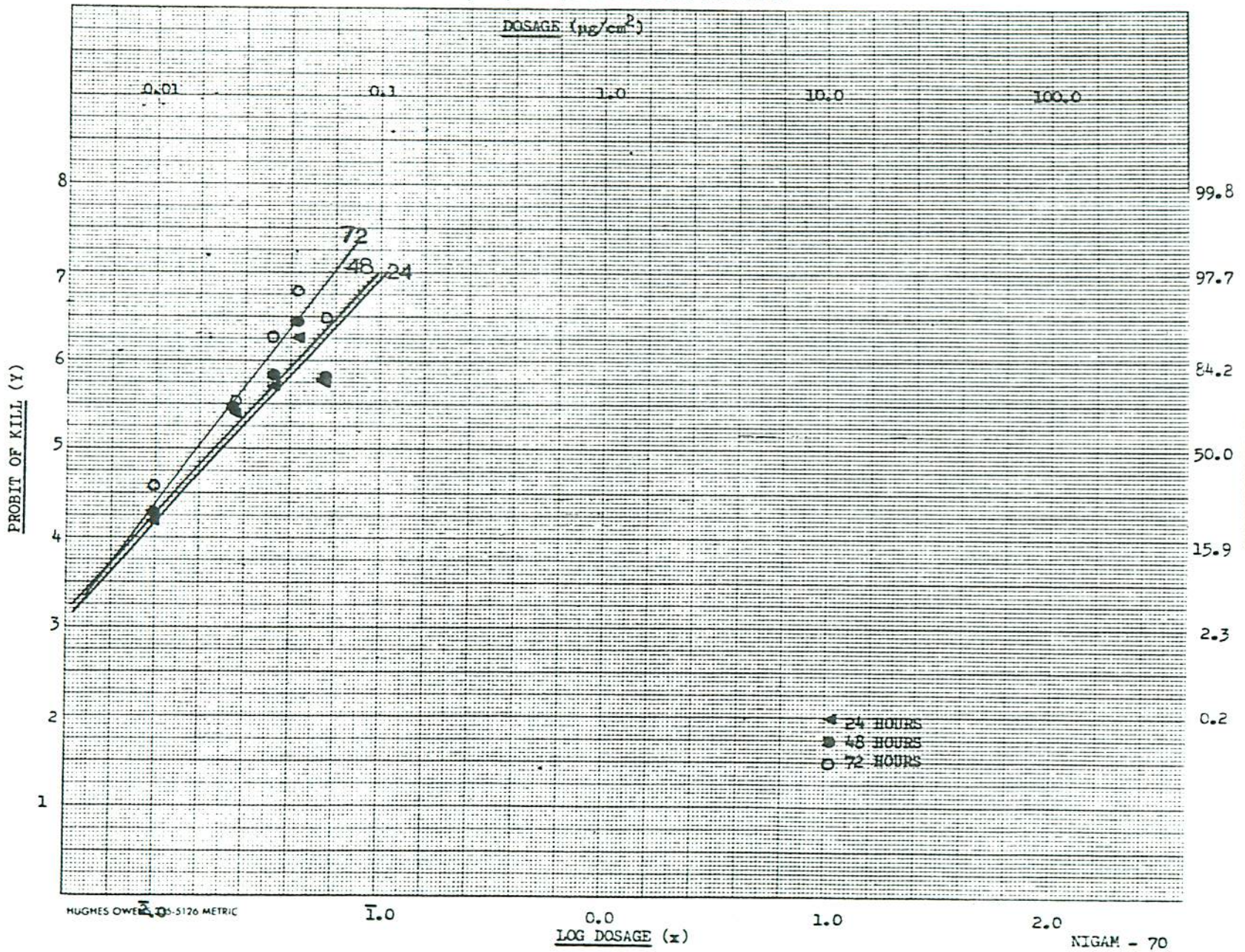
Findings: The summary of probit analysis is as follows:

Period	b	LD 50 ug/cm^2	FL	LD 95 ug/cm^2	FL
24 hours	2.756	.20-01	.16-01- .24-01	.78-01	.58-01 - .13
48 hours	2.76	.18-01	.15-01 .22-01	.73-01	.54-01 - .12
72 hours	3.28	.15-01	.12-01 .18-01	.49-01	.38-01 .70-01

Remarks:

The regression lines are given in fig. 2.

FIG. 2. Ld-p LINES OF BAYGON AGAINST FOURTH INSTAR NEODIPRION SERTIFER GEOFF. (EUROPEAN PINE SAWFLY) FOR 24, 48, AND 72 HOURS AFTER TREATMENT



EXPERIMENT NO. 3

Object: To determine the contact toxicity of Methomyl against fourth instar European Pine Sawfly

Plan of Experiment:

Treatment: Seven (six rates of application - 0.1, 0.2, 0.4, 0.6, 0.8, 1.0 gpa and control)

Concentration of insecticide: 0.05%

Replications: Three

No. of larvae per treatment: Thirty

Total No. of larvae utilized: Two hundred and ten

Exptal Code: EPS-16-70 Computer Code: EPS-MML-A1-A3-(43-45)

Table No. 3

Insecticide		Mortality Counts After								
		24 Hours			48 Hours			72 Hours		
gpa	Dosage ug/cm^2	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.
0.1	.0040	0/30	0	0	0/30	0	0	0/30	0	0
0.2	.0100	0/30	0	0	0/30	0	0	0/30	0	0
0.4	.0170	4/29	14	14	6/29	21	21	6/29	21	21
0.6	.0290	20/30	67	67	20/30	67	67	23/30	77	77
0.8	.0370	15/28	54	54	16/28	57	57	23/28	82	82
1.0	.0480	19/29	66	66	21/29	72	72	26/29	90	90
Control		0/30	0		0/30	0		0/30	0	

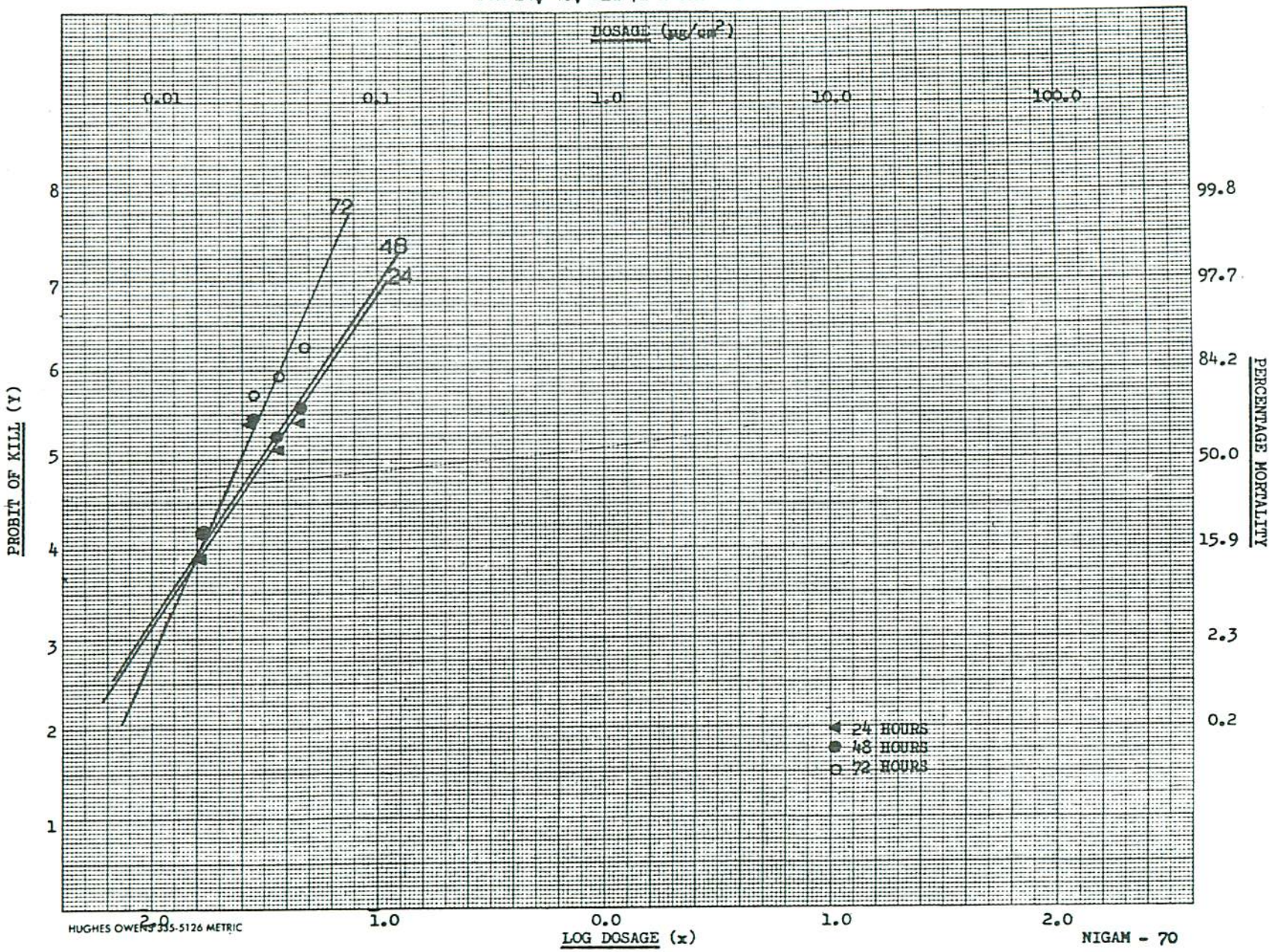
Findings: The summary of probit analysis is as follows:

Period	b	LD 50 ug/cm^2	FL	LD 95 ug/cm^2	FL
24 hours	3.71	.32 - 01		.88 - 01	
48 hours	3.74	.29 - 01	.25-01 - .34-01	.81 - 01	.61-01 - .13
72 hours	5.61	.25 - 01	.22-01 - .27-01	.48 - 01	.42-01 - .60-01

Remarks:

The regression lines are given in fig. 3.

FIG. 3. Ld-p LINES OF METHOMYL AGAINST FOURTH INSTAR NEODIPRION SERTIFER GEOFF. (EUROPEAN PINE SAWFLY) FOR 24, 48, and 72 HOURS AFTER TREATMENT



EXPERIMENT NO. 4

Object: To determine the contact toxicity of Surecide against fourth instar European Pine Sawfly.

Plan of Experiment:

Treatment: Seven (six rates of application - 0.1, 0.2, 0.4, 0.6, 0.8, 1.0 gpa and control)

Concentration of insecticide: 0.15%

Replications: Three

No. of larvae per treatment: Thirty

Total No. of larvae utilized: Two hundred and ten

Exptal Code: EPS-36-70 Computer Code: EPS-SUR-(67-69)

Table No. 4

Insecticide		Mortality Counts After								
		24 Hours			48 Hours			72 Hours		
gpa	Dosage ug/cm^2	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.
0.1	.0210	0/30	0	0	0/30	0	0	1/30	3	3
0.2	.0330	12/30	40	40	13/30	43	43	16/30	53	53
0.4	.0690	26/30	87	87	27/30	90	90	27/30	90	90
0.6	.1030	29/30	97	97	29/30	97	97	30/30	100	100
0.8	.1300	30/30	100	100	30/30	100	100	30/30	100	100
1.0	.1610	30/30	100	100	30/30	100	100	30/30	100	100
Control		0/30	0		0/30	0		0/30	0	

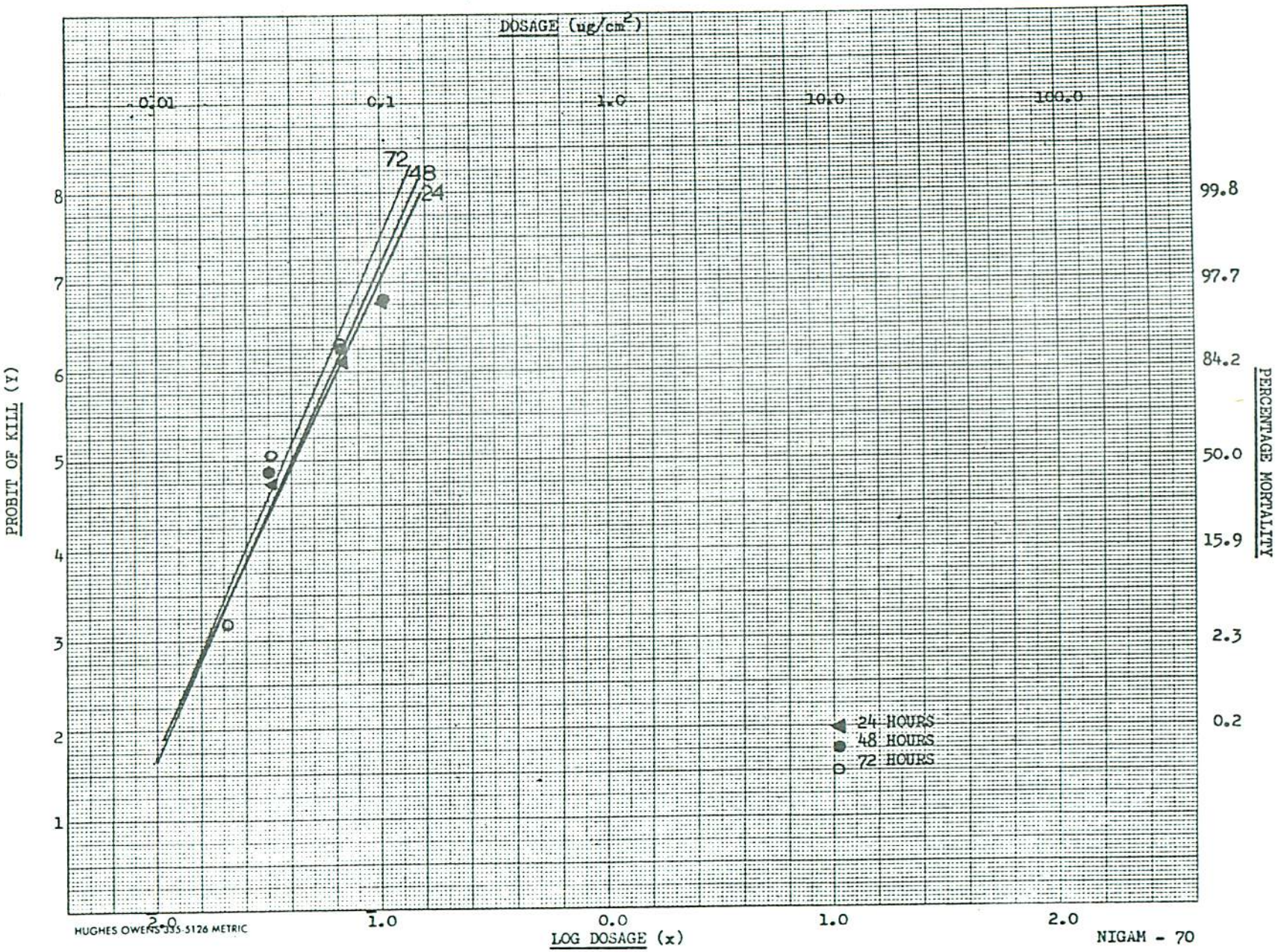
Findings: The summary of probit analysis is as follows:

Period	b	LD 50 ug/cm^2	FL	LD 95 ug/cm^2	FL
24 hours	5.41	.42-01	.36-01-.48-01	.84-01	.70-01-.112
48 hours	5.52	.40-01	.35-01-.46-01	.80-01	.66-01-.10
72 hours	5.69	.36-01	.32-01-.41-01	.70-01	.58-01-.96-01

Remarks:

The regression lines are given in fig. 4.

FIG. 4. Ld-p LINES OF SURECIDE AGAINST FOURTH INSTAR NEODIPRION SERTIFER GEOFF. (EUROPEAN PINE SAWFLY) FOR 24, 48 AND 72 HOURS AFTER TREATMENT



EXPERIMENT NO. 5

Object: To determine the contact toxicity of Sumithion against fourth instar European Pine Sawfly larvae.

Plan of Experiment:

Treatment:	Seven (six rates of application - 0.1, 0.2, 0.4, 0.6, 0.8, 1.0 gpa and control)
Concentration of insecticide:	0.1 per cent
Replications:	Three
No. of larvae per treatment:	Thirty
Total No. of larvae utilized:	Two hundred and ten
Expt. Code: EPS-4-68.	Computer Code: EPS-SUM-(142-144)

Table No. 5

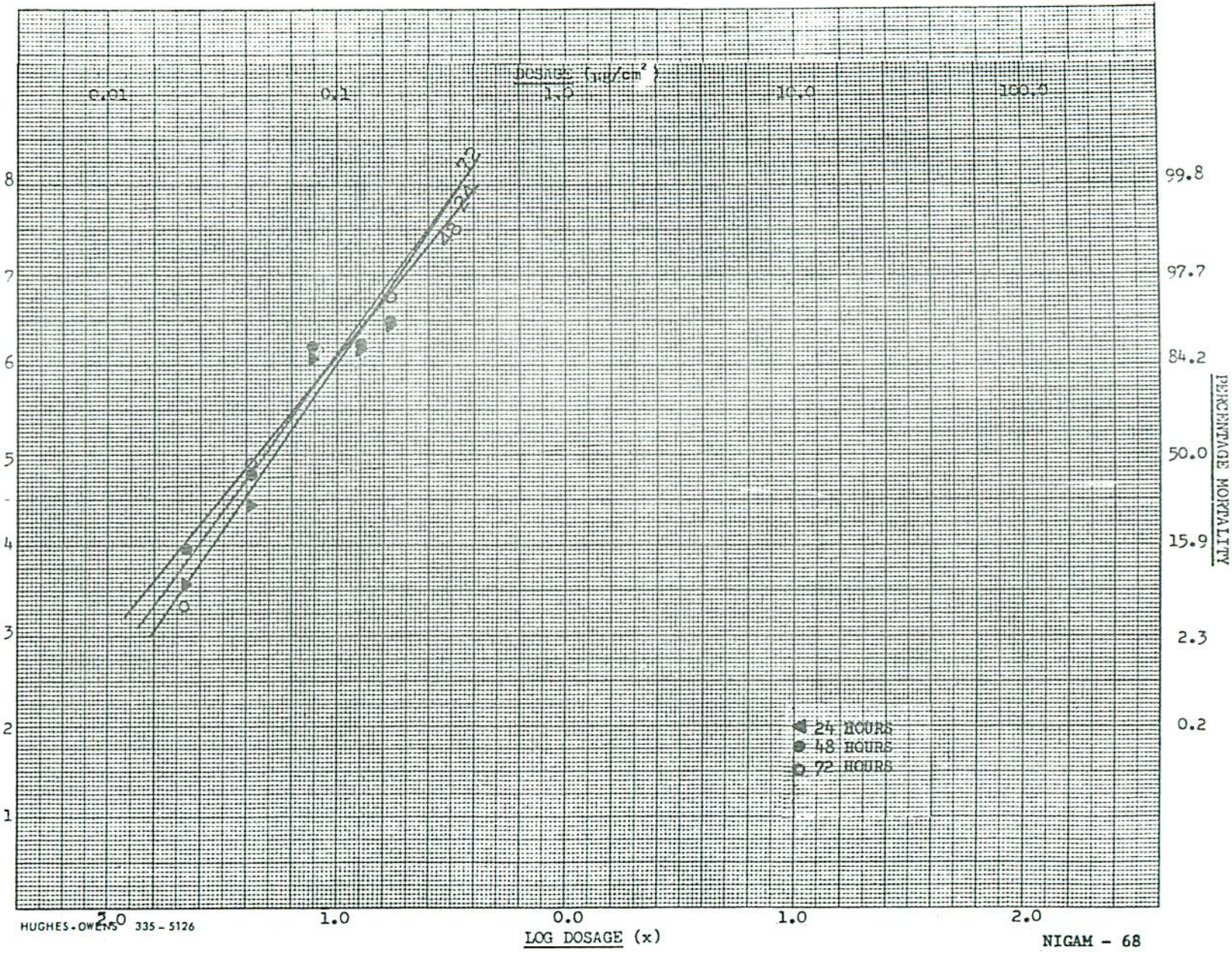
Insecticide		Mortality Counts After								
		24 Hours			48 Hours			72 Hours		
gpa	Dosage ug/cm^2	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.
0.1	.011	1/30	3	0	2/30	7	0	3/30	10	8
0.2	.022	3/29	10	7	6/29	21	15	6/29	21	5
0.4	.042	9/29	31	29	13/29	45	41	16/29	55	46
0.6	.077	25/29	86	86	26/29	90	89	26/29	90	88
0.8	.127	27/30	90	90	27/30	90	89	27/30	90	88
1.0	.168	28/30	93	93	28/30	93	93	29/30	97	96
Control		1/30	3		2/30	7		5/30	17	

Findings: The summary of probit analysis is as follows:

Period	b	LD 50 ug/cm^2	FL	LD 95 ug/cm^2	FL
24 hours	3.638	.534-01	.44-01-.64-01	.151	.109-.222
48 hours	3.140	.460-01	.36-01-.56-01	.153	.115-.240
72 hours	3.516	.476-01	.36-01-.59-01	.140	.109-.223

Remarks: The regression lines are given in fig. 5.

FIG. 5. CONTACT TOXICITY OF SUMITHION AGAINST FOURTH INSTAR NEODIPRION SERTIFER GEOFF. (EUROPEAN PINE SAWFLY)
24, 48 AND 72 HOURS AFTER TREATMENT



EXPERIMENT NO. 6

Object: To determine the contact toxicity of Dursban against fourth instar European Pine Sawfly.

Plan of Experiment:

Treatment: Seven (six rates of application - 0.1, 0.2, 0.4, 0.6, 0.8, 1.0 gpa and control)

Concentration of insecticide: 0.10%

Replications: Three

No. of larvae per treatment: Thirty

Total No. of larvae utilized: Two hundred and ten

Exptal Code: EPS-25-70 Computer Code: EPS-DUR-(55-57)

Table No. 6

Insecticide		Mortality Counts After								
		24 Hours			48 Hours			72 Hours		
gpa	Dosage ug/cm^2	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.
0.1	.0150	0/30	0	0	0/30	0	0	0/30	0	0
0.2	.0260	0/29	0	0	0/20	0	0	0/29	0	0
0.4	.0530	4/30	13	13	6/30	20	20	7/30	23	23
0.6	.0740	14/30	47	47	16/30	53	53	16/30	53	53
0.8	.094	28/30	93	93	30/30	100	100	30/30	100	100
1.0	.1180	24/30	80	80	24/30	80	80	24/30	80	80
Control		0/29	0		0/29	0		0/29	0	

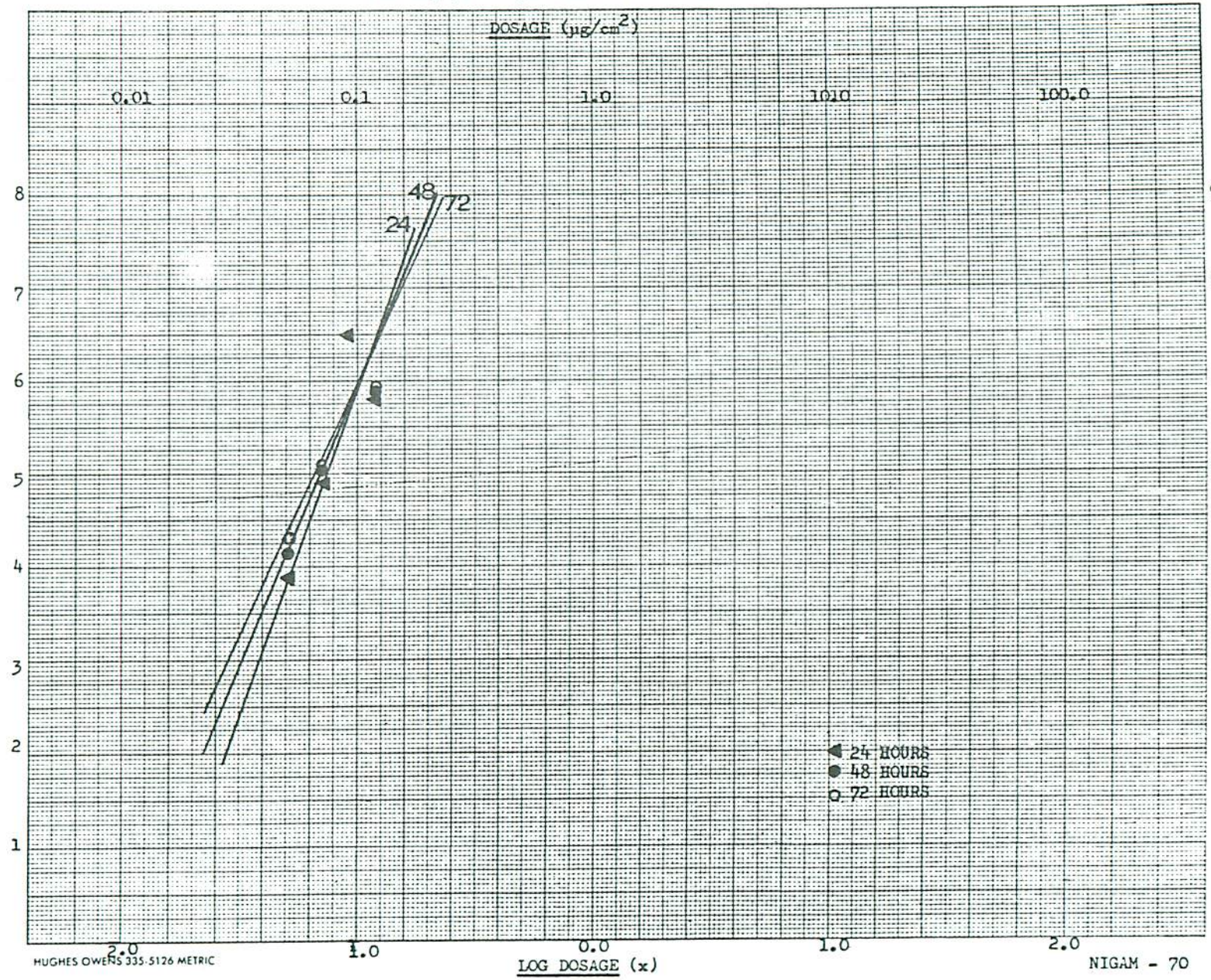
Findings: The summary of probit analysis is as follows:

Period	b	LD 50 ug/cm^2	FL	LD 95 ug/cm^2	FL
24 hours	7.07	.75-01	.68-01-.81-01	.13	.11-.16
48 hours	6.18	.70-01	.62-01-.76-01	.13	.11-.17
72 hours	5.98	.69-01	.61-01-.76-01	.13	.11-.17

Remarks:

The regression lines are given in fig.6.

FIG. 6. Ld-p LINES OF DURSBAN AGAINST FOURTH INSTAR NEODIPRION SERTIFER GEOFF. (EUROPEAN PINE SAWFLY) FOR 24, 78 AND 72 HOURS AFTER TREATMENT



EXPERIMENT NO. 7

Object: To determine the contact toxicity of Hopcide against fourth instar European Pine Sawfly.

Plan of Experiment:

Treatment: Seven (six rates of application - 0.1, 0.2, 0.4, 0.6, 0.8, 1.0 gpa and control)

Concentration of insecticide: 0.10%

Replications: Three

No. of larvae per treatment: Thirty

Total No. of larvae utilized: Two hundred and ten

Exptal Code: EPS-26-70 Computer Code: EPS-HOP-(58-60)

Table No. 7

Insecticide		Mortality Counts After								
		24 Hours			48 Hours			72 Hours		
gpa	Dosage ug/cm^2	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.
0.1	.0150	0/30	0	0	0/30	0	0	1/30	3	0
0.2	.0250	0/30	0	0	0/30	0	0	0/30	0	0
0.4	.0490	1/29	3	3	2/29	7	4	4/29	14	11
0.6	.0710	4/29	14	14	5/29	17	14	6/29	21	18
0.8	.0920	6/30	20	20	6/30	20	17	7/30	23	21
1.0	.1110	22/32	69	69	23/32	72	71	24/32	75	74
Control		0/30	0		1/30	3		1/29	3	

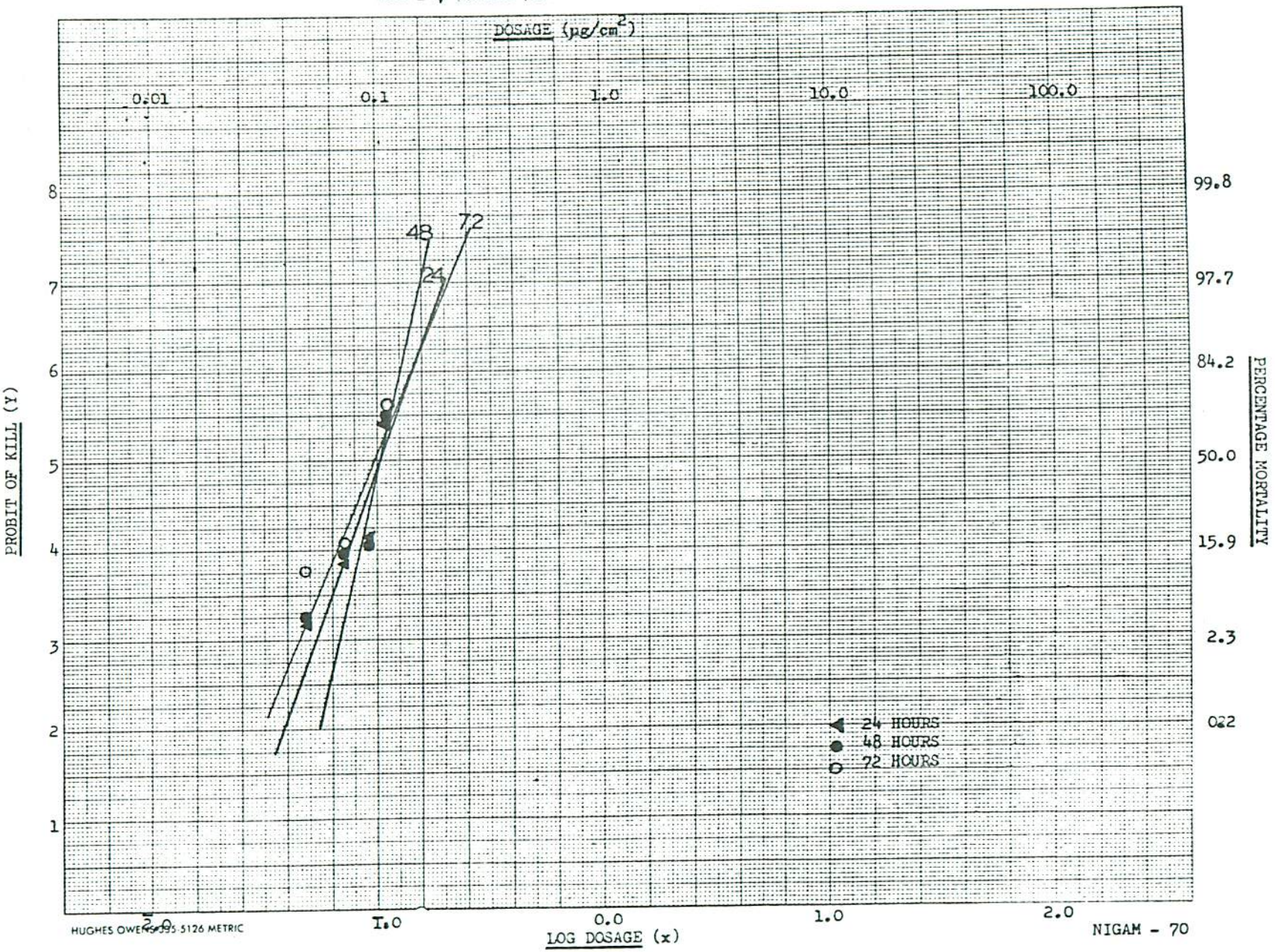
Findings: The summary of probit analysis is as follows:

Period	b	LD 50 ug/cm^2	FL	LD 95 ug/cm^2	FL
24 hours	6.91	.10	.95-01-.11	.18	.13-.19
48 hours	10.82	.101		.14	
72 hours	6.41	.10		.18	

Remarks:

The regression lines are given in fig. 7.

FIG. 7. Ld-p LINES OF HOPCIDE AGAINST FOURTH INSTAR NEODIPRION SERTIFER GEOFF. (EUROPEAN PINE SAWFLY) FOR 24, 48 AND 72 HOURS AFTER TREATMENT



EXPERIMENT NO. 8

Object: To determine the contact toxicity of Dylox against fourth instar European Pine Sawfly.

Plan of Experiment:

Treatment: Seven (six rates of application - 0.1, 0.2, 0.4, 0.6, 0.8, 1.0 gpa and control)

Concentration of insecticide: 0.25%

Replications: Three

No. of larvae per treatment: Thirty

Total No. of larvae utilized: Two hundred and ten

Exptal Code:- EPS-15-70. Computer Code: EPS-DLX-A1-A3-(37-39)

Table No. 8

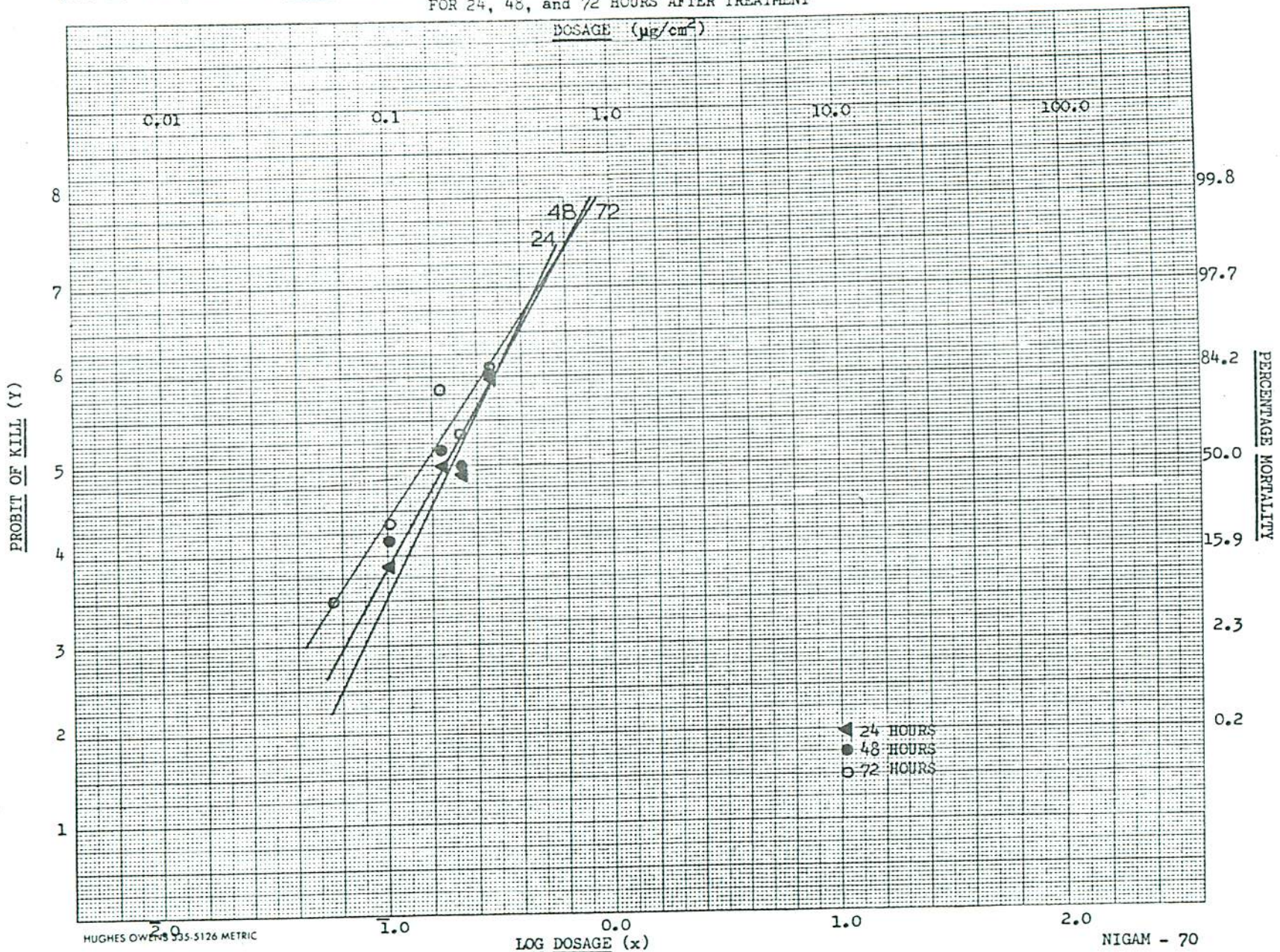
Insecticide		Mortality Counts After								
		24 Hours			48 Hours			72 Hours		
gpa	Dosage ug/cm^2	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.
0.1	.0320	0/30	0	0	0/30	0	0	0/30	0	0
0.2	.0570	0/28	0	0	0/28	0	0	2/28	7	7
0.4	.1120	4/30	13	13	6/30	20	20	8/30	27	27
0.6	.1740	15/30	50	50	17/30	57	57	24/30	80	80
0.8	.2140	14/30	47	47	15/30	50	50	19/30	63	63
1.0	.2890	25/30	83	83	26/30	87	87	26/30	87	87
Control		0/30	0		0/30	0		0/30	0	

Findings: The summary of probit analysis is as follows:

Period	b	LD 50 ug/cm^2	FL	LD 95 ug/cm^2	FL
24 hours	5.24	.19	.17 - .22	.40	.33 - .58
48 hours	4.59	.18	.16 - .20	.41	.33 - .61
72 hours	3.85	.15		.39	

Remarks: The regression lines are given in fig. 8.

FIG. 8. Ld-p LINES OF DYLOX AGAINST FOURTH INSTAR NEODIPRION SERTIFER GEOFF. (EUROPEAN PINE SAWFLY) FOR 24, 48, and 72 HOURS AFTER TREATMENT



EXPERIMENT NO. 9

Object: To determine the contact toxicity of Bassa against fourth instar European Pine Sawfly

Plan of Experiment:

Treatment: Seven (six rates of application - 0.1, 0.2, 0.4, 0.6, 0.8, 1.0 gpa and control)

Concentration of insecticide: 2.50%

Replications: Three

No. of larvae per treatment: Thirty

Total No. of larvae utilized: Two hundred and ten

Exptal Code: EPS-31-70 Computer Code: EPS-BSA-(64-66)

Table No. 9

Insecticide		Mortality Counts After								
		24 Hours			48 Hours			72 Hours		
gpa	Dosage ug/cm^2	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.	D/T	% Mort.	Corr. Mort.
0.1	0.3670	0/30	0	0	0/30	0	0	0/30	0	0
0.2	0.5280	2/29	7	7	2/29	7	7	2/29	7	7
0.4	1.3040	19/30	63	63	19/30	63	63	19/30	63	63
0.6	1.8380	23/30	77	77	27/30	90	90	29/30	97	97
0.8	2.3270	22/30	73	73	24/30	80	80	28/30	93	93
1.0	2.7890	25/30	83	83	27/30	90	90	28/30	93	93
Control		0/30	0		0/30	0		0/30	0	

Findings: The summary of probit analysis is as follows:

Period	b	LD 50 ug/cm^2	FL	LD 95 ug/cm^2	FL
24 hours	3.51	1.30	1.10-1.51	3.82	3.03-5.47
48 hours	4.05	1.18		3.00	
72 hours	4.84	1.08	.93-1.24	2.37	2.02-2.97

Remarks: The regression lines are given in fig. 9.

FIG. 9. Ld-p LINES OF BASSA AGAINST FOURTH INSTAR NEODIPRION SERTIFER GEOFF. (EUROPEAN PINE SAWFLY) FOR 24, 48 AND 72 HOURS AFTER TREATMENT

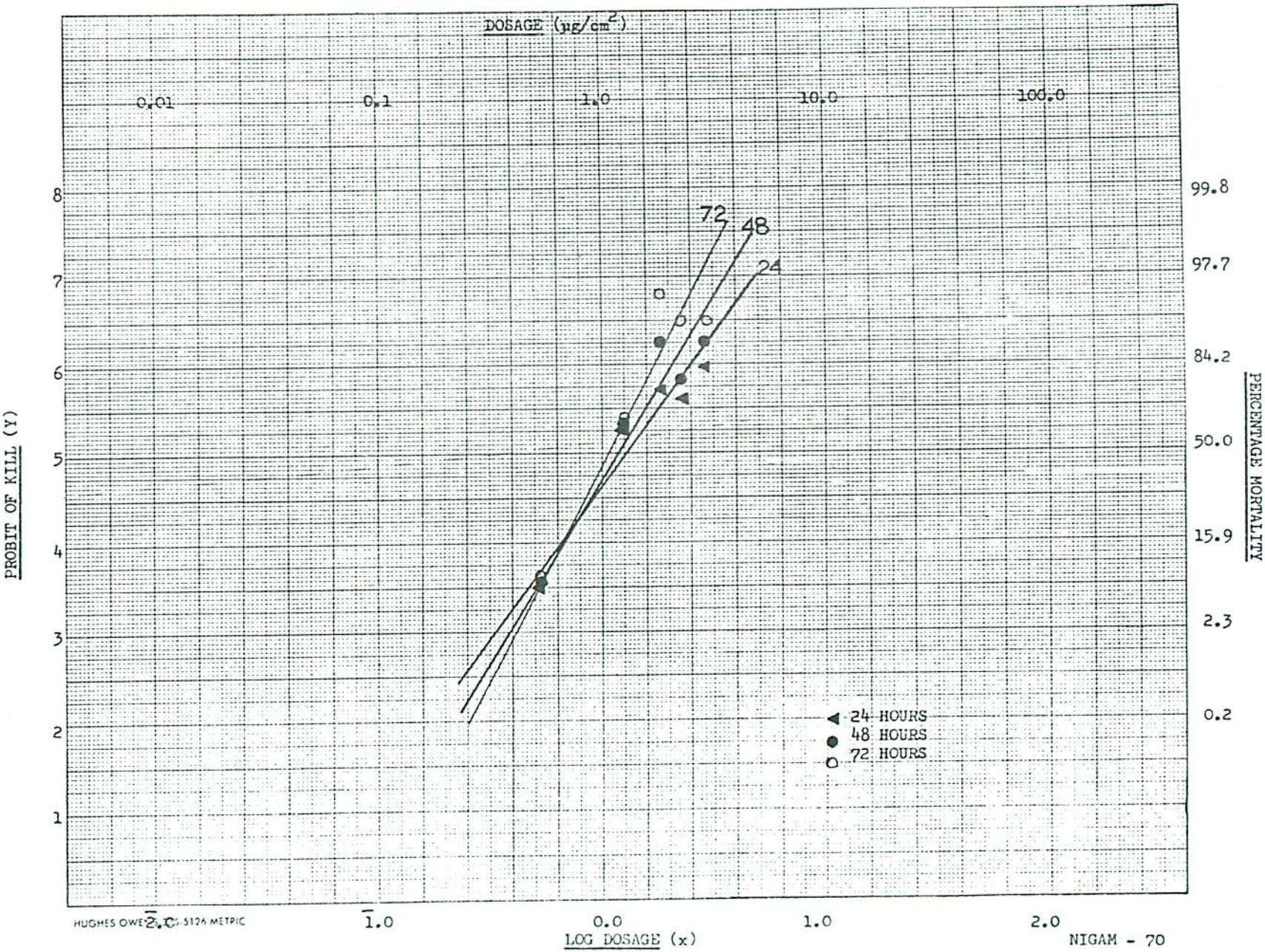


Table 10: Toxicity of Insecticides to Fourth Instar Neodiprion sertifer (Geoff.)

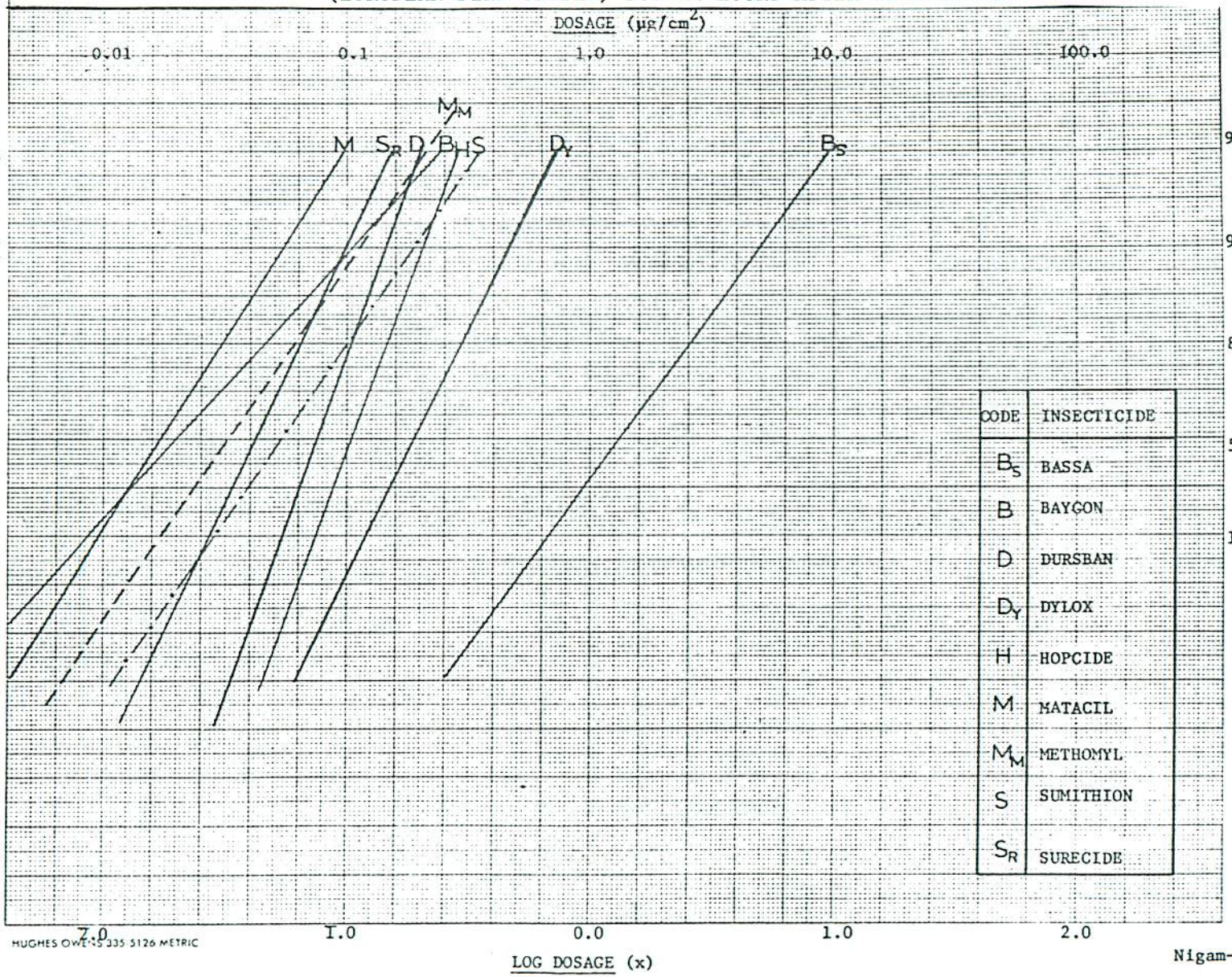
at 24 Hours After Treatment

Insecticide	LD 50_2 ug/cm^2	Fiducial Limits	Relative Potency	Toxicity Index	LD 95_2 ug/cm^2	Fiducial Limits	Relative Potency
Matacil	0.017	-	3.118	311.80	0.045	-	3.378
Baygon	.020	0.016 - 0.024	2.650	265.0	.078	0.058 - 0.13	1.949
Methomyl	.032	-	1.656	165.60	.088	-	1.727
Surecide	.042	.036 - .048	1.262	126.2	.084	.070 - .112	1.810
Sumithion	.053	.044 - .064	1.0	100.0	.152	.109 - .222	1.0
Dursban	.075	.068 - .081	0.707	70.70	.13	.11 - .16	1.169
Hopcide	.10	-	.530	53.0	.18	-	0.844
Dylox	.19	.17 - .22	.279	27.9	.40	.33 - .58	.380
Bassa	1.30	1.10 - 1.51	.041	4.10	3.82	3.03 - 5.47	.040

Fig. 10

24 hrs.

COMPARATIVE ld-p LINES OF INSECTICIDES AGAINST FOURTH INSTAR NEODIPRION SERTIFER GEOFF. (EUROPEAN PINE SAWFLY) FOR 24 HOURS AFTER TREATMENT.



Nigam-70

Table 11: Toxicity of Insecticides to Fourth Instar Neodiprion sertifer (Geoff.) at 48 Hours After Treatment

Insecticide	LD 50 ug/cm^2	Fiducial Limits	Relative Potency	Toxicity Index	LD 95 ug/cm^2	Fiducial Limits	Relative Potency
Matacil	0.017	0.016 - 0.018	2.706	270.6	0.024	0.022 - 0.028	6.417
Baygon	.018	.015 - .022	2.556	255.6	.073	.054 - .12	2.110
Methomyl	.029	.025 - .034	1.586	158.6	.081	.061 - .13	1.901
Surecide	.040	.035 - .046	1.150	115.0	.080	.066 - .10	1.925
Sumithion	.046	.036 - .056	1.00	100.0	.154	.115 - .240	1.00
Dursban	.070	.062 - .076	0.657	65.70	.13	.11 - .17	1.185
Hopcide	.101	.095 - .11	.455	45.5	.14	.13 - .19	1.100
Dylox	.180	.16 - .20	.256	25.6	.41	.33 - .61	0.376
Bassa	1.18	-	.039	3.9	3.00	-	.051

Fig. 11

48 hrs.

COMPARATIVE ld-p LINES OF INSECTICIDES AGAINST FOURTH INSTAR NEODIPRION SERTIFER GEOFF. (EUROPEAN PINE SAWFLY) FOR 48 HOURS AFTER TREATMENT.

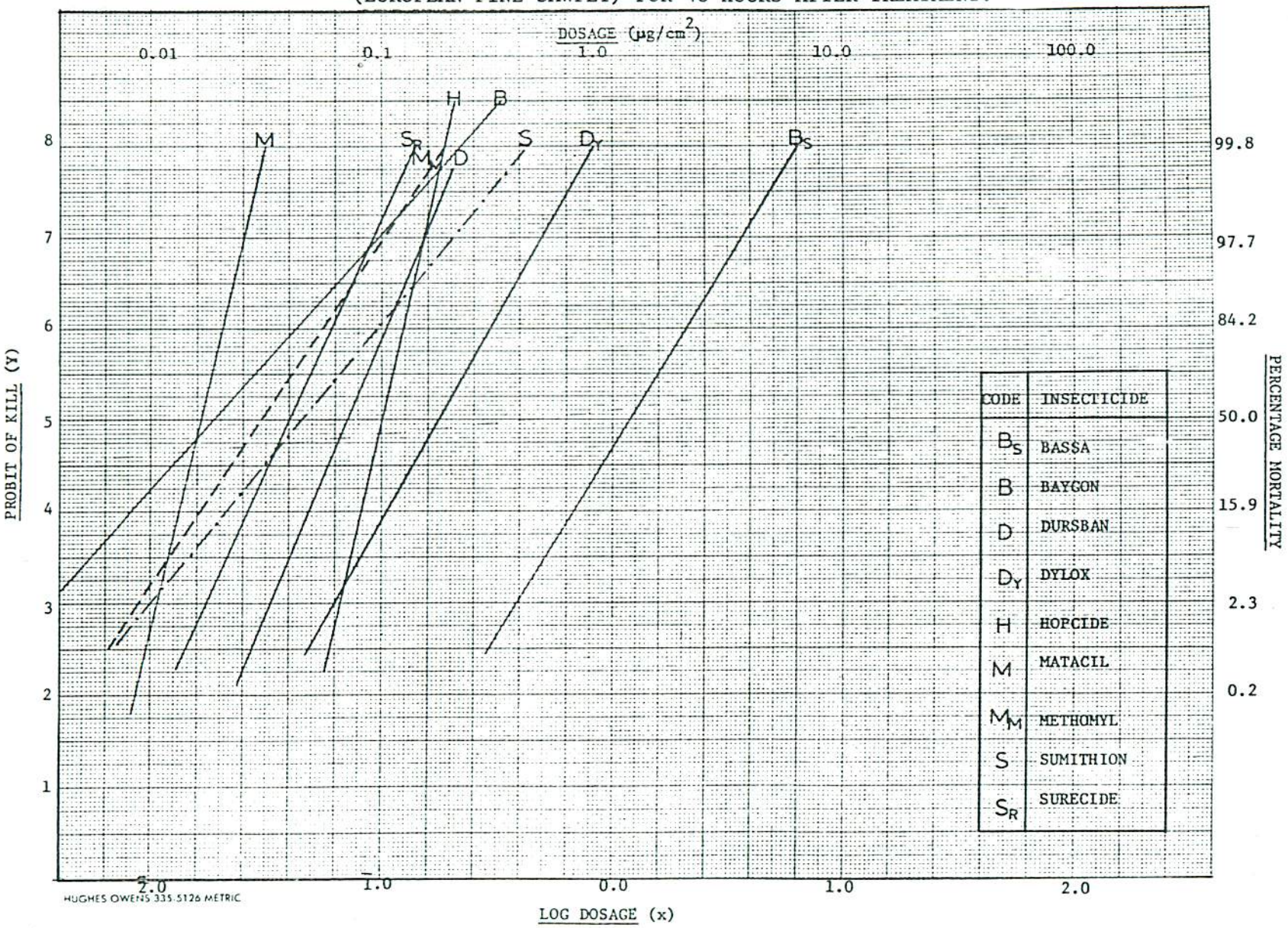


Table 12: Toxicity of Insecticides to Fourth Instar Neodiprion sertifer (Geoff.)

at 72 Hours After Treatment

Insecticide	LD 50_2 ug/cm^2	Fiducial Limits	Relative Potency	Toxicity Index	LD 95_2 ug/cm^2	Fiducial Limits	Relative Potency
Baygon	0.015	0.012 -0.018	3.20	320.9	0.049	0.038 -0.070	2.857
Matacil	.017	.016 - .018	2.824	282.4	.023	.021 - .027	6.087
Methomyl	.025	.022 - .027	1.920	192.0	.048	.042 - .060	2.917
Surecide	.036	.032 - .041	1.333	133.3	.070	.058 - .096	2.00
Sumithion	.048	.036 - .059	1.0	100.0	.140	.109 - .223	1.0
Dursban	.069	.061 - .076	0.696	69.6	.13	.11 - .17	1.077
Hopcide	.10	-	.480	48.0	.18	-	0.778
Dylox	.15	-	.320	32.0	.39	-	.359
Bassa	1.08	.93 - 1.24	.044	4.4	2.37	2.02 - 2.97	.059

Fig. 12

72 hrs.

COMPARATIVE ld-p LINES OF INSECTICIDES AGAINST FOURTH INSTAR NEODIPRION SERTIFER GEOFF. (EUROPEAN PINE SAWFLY) FOR 72 HOURS AFTER TREATMENT.

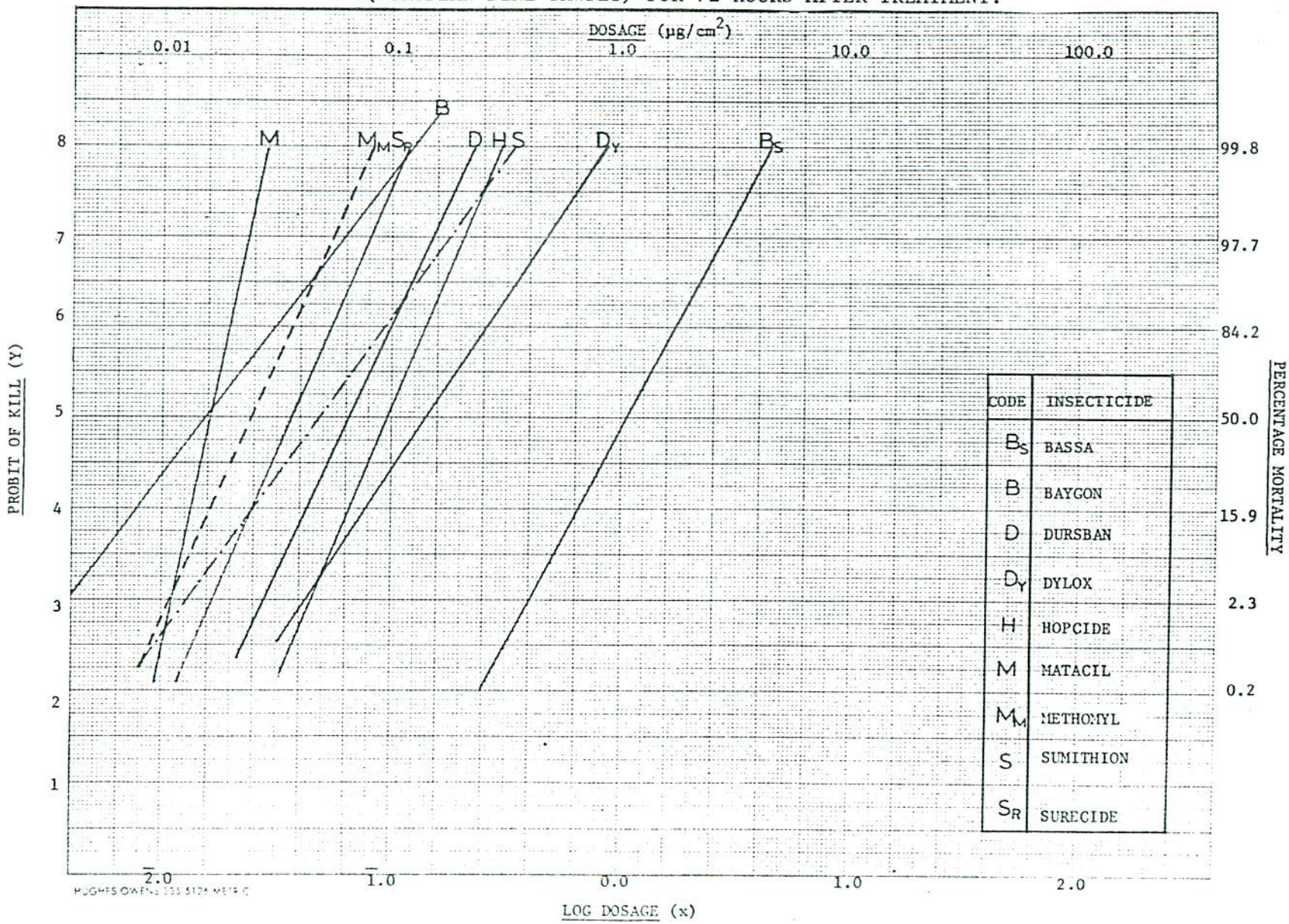


Table 13: List of insecticides and their sources

INSECTICIDE	TYPE	CHEMICAL NAME	SOURCE
Bassa® 50% E.C.	Carbamate	o-sec-butylphenyl methyl-carbamate	Kumiai
Baygon® (propoxur) 13.9% E.C.	Carbamate	o-isopropoxyphenyl methylcarbamate	Chemagro
Dursban® 48% E.C.	Organophosphorus	0,0-diethyl 0-(3,5,6-trichloro-2-pyridyl) phosphorothioate	Dow
Dylox® (trichlorfon) 39% E.C.	Organophosphorus	dimethyl (2,2,2-trichloro-1-hydroxyethyl) phosphonate	Chemagro
Hopcide® 20% E.C.	Carbamate	o-chlorophenyl methylcarbamate	Kumiai
Matacil® (aminocarb) 34% Sol	Carbamate	4-dimethylamino-m-tolyl methylcarbamate	Chemagro
Methomyl 99% tech	Carbamate	methyl N-[(methylcarbamoyl) oxy] thioacetimidate	DuPont
Sumithion® (fenitrothion) 50% E.C.	Organophosphorus	0,0-dimethyl 0-(4-nitro-m-tolyl) phosporothioate	Sumitomo
Surecide® 25% E.C.	Organophosphorus	0-p-cyanophenyl 0-ethyl phenylphosphonothioate	Sumitomo

E.C. - Emulsifiable concentrate

Sol. - Solution

tech. - Technical grade