THE EFFICACY OF ORGANOCARBAMATE, ORGANOCHLORINE, AND ORGANOPHOSPHATE INSECTICIDES AGAINST TURNIP MAGGOTS AND RESISTANT CABBAGE MAGGOTS IN RUTABAGA IN BRITISH COLUMBIA[1]

D. G. FINLAYSON AND M. D. NOBLE

Introduction

In 1959, reports from the State of Washington (Howitt, 1959), indicated that strains of the cabbage maggot (*Hylemya brassicae* [Bouché]) had developed resistance to cyclodiene organochlorine insecticides. This warning was coupled with reports in 1959 of failure of existing control recommendations for root maggots attacking cruciferous crops in the Victoria area. Large scale tests were started to reestablish methods for preventing total losses in rutabaga crops.

In the fall of 1959, collections of puparia were made at Victoria, where resistance was suspected, and in the lower Fraser Valley on a farm where there had been poor control practice. Tests of these (Harris *et al.,* 1962) showed that the strain from Victoria was highly resistant to aldrin, and presumably to other cyclodiene insecticides, but not to organophosphates. Those from the Fraser Valley were highly susceptible to aldrin. However, subsequent collections and screening tests showed that resistant strains were already present in the Fraser Valley. The condition became widespread during 1961 and 1962.

Distribution studies (Forbes and Finlayson, 1957) of the root maggots of British Columbia show that three species account for the damage inflicted in rutabaga. These are: the cabbage maggot, (*Hylemya brassicae* [Bouché]); the turnip maggot, (*H. floralis* [Fall.]); and the seed-corn maggot, (*H. cilicrura* [Rond.]). The cabbage maggot predominates in the southern part of the province, the turnip maggot in the northern part, and the distribution of the seed-corn maggot is province-wide. Although some damage is caused by the seed-corn maggot, it is the cabbage and turnip maggots which render the crop unsaleable.

The development of resistance in cabbage maggots (Howitt and Cole, 1962) paralleled that in onion maggots in the region (Finlayson *et al.,* 1960). Based on experience with strains of resistant onion maggots, an investigation was initiated to determine if root maggots could be controlled in cruciferous crops by organocarbamates and organophosphates. This paper deals with investigations conducted in several locations under various climatic and soil conditions from 1960 through 1962.

Materials and Methods

The insecticides used in this investigation are listed alphabetically and identifed chemically in Table 1. Common names of the insecticides (Billings, 1963) are used in the text; where common names have not been assigned, registered names or numbers are used (Kenaga, 1963).

In 1960 experiments were conducted at Prince George on clay loam; Kamloops on sandy clay loam; Kelowna on muck soil; and Victoria on peat soil. The design was a randomized block consisting of 10 insecticidal treatments and one untreated check, each replicated five times at each site. A plot consisted of three 20-foot rows. The seed of variety Laurentian Swede was sown with a rod-row seeder at 0.25 g per 20 row-feet. The insecticides were applied as bands or in the furrow at seeding or as sprays.

[1] Contribution No. 76, Research Station, Research Branch, Canada Department of Agriculture, 6660 N.W. Marine Drive, Vancouver 8, B.C.

TABLE 1.—Chemical definitions of insecticides used for preventing root maggot damage.*

Aldrin	1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4-**endo-exo**-5,8-dimethanonaphthalene
B.25141	**0,0**-diethyl **0-p**-(methylsulfinyl)phenyl phosphorothioate
B.44646	4-dimethylamino-m-tolyl methylcarbamate
Calomel	mercurous chloride
Carbaryl	1-naphthyl methylcarbamate
Carbophenothion	**S**-[(**p**-chlorophenylthio)methyl] **0,0**-diethyl phosphorodithioate
Diazinon	**0,0**-diethyl **0**-(2-isopropyl-4-methyl-6-pyrimidinyl) phosporothioate
Di-Syston	**0,0**-diethyl **S**-[2-(ethylthio)ethyl] phosphorodithioate
E.I.43064**	2-(diethoxyphosphinothioylimino)-1,3-dithiolane
Endosulfan	6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,= 9-methano-2,4,3-benzodioxathiepin 3-oxide
Ethion	**0,0,0',0'**-tetraethyl **S,S'**-methylenebisphosphorodithioate
Fenthion	**0,0**-dimethyl **0**-[4-(methylthio)-**m**-tolyl] phosphorothioate
Guthion	**0,0**-dimethyl **S**-(4-oxo-1,2,3-benzotriazin-3(**4H**)-ylmethyl) phosphorodithioate
Heptachlor	1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene
Imidan	**0,0**-dimethyl **S**-phthalimidomethyl phosphorodithioate
Nemacide	**0**-(2,4-dichlorophenyl) **0,0**-diethyl phosphorothioate
Phorate	**0,0**-diethyl **S**-(ethylthio)methylphosphorodithioate
Telodrin	1,3,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanophthalan
Tetradifon	4-chlorophenyl 2,4,5-trichlorophenyl sulfone
Trichlorfon	dimethyl (2,2,2-trichloro-1-hydroxyethyl)phosphonate
Zectran	4-dimethylamino-3,5-xylyl methylcarbamate
Zinophos	**0,0**-diethyl **0**-2-pyrazinyl phosphorothioate

*A chemical name occupying two lines separated by an equal (=) sign is joined together without the equal sign if written on one line.

**Chemical name obtained from company brochure.

In 1961 the investigation was conducted at Prince George and Victoria, at Armstrong in sandy clay loam, and at Cloverdale in muck soil. The design was a split-plot randomized block consisting of 18 treatments and one untreated check, each replicated five times at each site. A plot consisted of four 20-foot rows. Two rows of each plot were treated by the band method, the other two were treated by applying the insecticide with the seed in the furrow. Seed was sown at 0.33 g per 20 row-feet.

In 1962 at Prince George and Victoria the experiment was a split-plot randomized block of six plots replicated five times. A plot consisted of eight 20-foot rows; two rows at each of the following rates: 0, 2.2, 3.3, and 4.4 oz of toxicant per 1,000 feet of row. This rate was equivalent to 2, 3, and 4 lb of toxicant per acre respectively based on 36-inch spacing between rows. Five of the six plots were treated with: diazinon, heptachlor, phorate, Nemacide, and Zinophos applied to the furrow with 0.4 g of seed. The sixth plot was used for screening eight candidate materials. One row in each replicate was treated with ethion, fenthion, Imidan, Guthion, B.25141, B.44646, and E.I.43064 applied in the furrow at 3.3 oz toxicant per 1,000 feet of row and calomel applied at 6.6 oz per 1,000 row-feet.

Furrow, band, and spray treatments were made as follows:

Furrow treatments: the insecticides were placed in the V-belt of the seeder with the seed and applied in the furrow as the seed was sown.

Band treatment: the insecticides were applied in 10-inch bands to the soil surface with a shaker or fertilizer cart, raked in to a depth of about one inch and the seed was sown down the centre of the bands.

Sub-furrow band treatment: the heptachlor granules were applied as a five-inch band, 1.5 inches below

TABLE 2.—Materials, methods, and rates of applications of various treatments against root maggots attacking rutabaga at several locations in British Columbia in 1960, 1961 and 1962.

Treatment		Method of application	Toxicant in ounces per 1,000 row-feet					
			1960	1961				1962
			All Sites	Pr. Geo.	Armstrong	Cloverdale	Victoria	Pr.Geo. & Victoria
Aldrin	5G	band	6.0	6.6	6.6	8.8	8.8	—
	5G	furrow	—	3.3	3.3	4.4	4.4	—
B.25141	10G	furrow	—	—	—	—	—	3.3
B.44646	10G	furrow	—	—	—	—	—	3.3
Calomel	4D	furrow	—	—	—	—	—	6.6
Carbaryl	10G	band	—	13.2	—	—	17.6	—
(Sevin)	10G	furrow	—	6.6	—	—	8.8	—
Carbophenothion	10G	band	6.0	6.6	6.6	8.8	8.8	—
(Trithion)	10G	furrow	3.0	3.3	3.3	4.4	4.4	—
	42%E	spray	4.0	—	—	—	—	—
Diazinon	10G	band	—	6.6	6.6	8.8	8.8	—
	10G	furrow	—	3.3	3.3	4.4	4.4	—
	5G	furrow	—	—	—	—	—	2.2, 3.3, 4.4
Di-Syston	5G	band	—	6.6	—	—	8.8	—
	5G	furrow	—	3.3	—	—	4.4	—
E.I.43064	10G	furrow	—	—	—	—	—	3.3
Endosulfan	4.6G	band	—	6.6	6.6	8.8	8.8	—
(Thiodan)	4.6G	furrow	—	3.3	3.3	4.4	4.4	—
Ethion	5G	band	6.0	6.6	6.6	8.8	8.8	—
	5G	furrow	3.0	3.3	3.3	4.4	4.4	3.3
	4E	spray	4.0	—	—	—	—	—
Fenthion	5G	band	—	6.6	—	—	8.8	—
(Baytex)	5G	furrow	—	3.3	—	—	4.4	3.3
Guthion	3D	band	—	6.6	6.6	8.8	8.8	—
	3D	furrow	—	3.3	3.3	4.4	4.4	—
	10G	furrow	—	—	—	—	—	3.3
Heptachlor	5G	band	—	—	—	—	—	6.6*
	5G	furrow	—	—	—	—	—	2.2, 3.3
Imidan	25WP	band	—	6.6	—	—	8.8	—
	25WP	furrow	—	3.3	—	—	4.4	—
	10G	furrow	—	—	—	—	—	3.3
Nemacide	5G	band	6.0	6.6	6.6	8.8	8.8	—
(V-C 13)	5G	furrow	3.0	3.3	3.3	4.4	4.4	2.2, 3.3, 4.4
	75%E	spray	4.0	—	—	—	—	—
Phorate	10G	band	—	6.6	6.6	8.8	8.8	—
(Thimet)	10G	furrow	—	3.3	3.3	4.4	4.4	2.2, 3.3, 4.4
Telodrin	5G	band	—	6.6	—	—	8.8	—
	5G	furrow	—	3.3	—	—	4.4	—
Tetradifon	25WP	band	—	6.6	—	—	8.8	—
(Tedion)	25WP	furrow	—	3.3	—	—	4.4	—
Trichlorfon	5G	band	—	6.6	—	—	8.8	—
(Dylox)	5G	furrow	—	3.3	—	—	4.4	—
Zectran	5D	band	—	6.6	—	—	8.8	—
	5D	furrow	—	3.3	—	—	4.4	—
Zinophos	10G	band	—	6.6	6.6	8.8	8.8	—
	10G	furrow	—	3.3	3.3	4.4	4.4	2.2, 3.3, 4.4
Untreated		—	—	—	—	—	—	—

*Applied in a sub-furrow band in ridged rows (See "Methods").

the seed trench in a ridged row. It was applied with a hand shaker, the soil was ridged over the band with a hoe, and the seed sown down the middle of the ridges with a V-belt seeder (Read, 1960).

Spray treatment: the insecticides were applied with a small portable sprayer at 13 gal per 1,000 row-feet immediately after thinning and again four weeks later.

Materials, rates, and methods of application for 1960, 1961, and 1962 are listed in Table 2.

The efficacy of the insecticides was assessed in several ways. Their

TABLE 3.—Average number of seedlings and percentage damage by root maggots after various treatments at several locations in British Columbia in 1960.

Insecticide	Method of application	Emergent seedlings per 20 row-feet				Average percentage damage			
		Pr. George	Kamloops	Kelowna	Victoria	Pr. George	Kamloops	Kelowna	Victoria
Aldrin	band	47	36	67	56	18 0	17.0	10.4	100
Carbophenothion	band	34	31	59	57	50.6	62.0	33.0	100
	furrow	48	37	59	57	40.0	36.8	24.0	100
	spray	30	31	59	60	60.0	50.8	27.2	100
Ethion	band	35	27	55	53	45.4	72.4	30.6	100
	furrow	46	30	59	49	33.2	44.8	28.2	100
	spray	31	28	61	55	61.0	69.2	31.4	100
Nemacide	band	48	27	62	53	46.6	53.0	31.8	100
	furrow	34	18	46	47	11.8	17.4	15.8	100
	spray	33	30	61	55	67.4	55.6	21.4	100
Untreated	—	39	36	60	56	52.8	68.0	29.0	100
Difference necessary for significance p=.05		10	N.S.D.	N.S.D.	N.S.D.	16.3	26.7	12.1	N.S.D.

effect on germination was measured by counting the number of seedlings which emerged in a given length of row. Their effect on plant growth was assessed by periodic examination of plants and comparing the growth and vigor of treated plants with those of untreated plants. Their effect in preventing damage was measured by examining and grading 25 roots from each plot and calculating the damage index (King and Forbes, 1954). The damage index is based on the severity of the damage to each root scored on an arbitrary grading as: clean, 0; light, 1; moderate, 2; and severe, 4. In this paper the damage index (maximum $25 \times 4 = 100$) is expressed as percentage damage.

Results

1960 Experiment (Table 3).—The number of emergent seedlings was reduced considerably in the mineral soil at Prince George and Kamloops, but not in organic soils at Victoria and Kelowna. At Victoria, band, furrow, and spray treatments of carbophenothion, ethion, and Nemacide did not protect rutabaga from a resistant strain of cabbage maggot. At the other locations, damage was significantly lowered when aldrin was applied as a band and Nemacide was applied with the seed in the furrow.

1961 Experiment (Table 4).—Furrow treatments with carbaryl, trichlorfon, and Zinophos caused a significant reduction in the number of emergent seedlings at all locations regardless of soil or the rate of application. Of the 9 insecticides tested, diazinon, phorate, and Zinophos applied in the furrow gave some protection against the resistant strain both at Victoria in peat soil and at Cloverdale in muck soil where a strain of maggots had also developed resistance to cyclodiene insecticides.

1962 Experiment (Table 5).—Extremely dry conditions at the Victoria site after planting reduced

TABLE 4.—Average number of seedlings and percentage damage by root maggots after various treatments at several locations in British Columbia in 1961.

Insecticide	Emergent seedlings per 20 row-feet								Average percentage damage							
	Pr. George		Armstrong		Cloverdale		Victoria		Pr. George		Armstrong*		Cloverdale		Victoria	
	Band	Furrow	Band	Furrow	Band	Furrow	Band	Furrow	Band	Furrow	Band	Furrow	Band	Furrow	Band	Furrow
Aldrin	42	49	35	36	71	78	79	80	24.0	6.0	1.2	1.0	76.8	49.6	100	100
Carbaryl	39	9	—	—	—	—	65	3	82.8	96.0	—	—	—	—	100	100
Carbophenothion	45	49	37	39	74	67	89	89	76.8	57.0	1.1	1.3	93.4	92.4	100	100
Diazinon	40	40	39	27	70	74	72	77	68.6	18.4	1.4	1.0	94.2	63.2	96.8	69.6
Di-Syston	38	36	—	—	—	—	97	79	74.8	51.4	—	—	—	—	100	99.0
Endosulfan	45	39	37	41	74	64	87	98	79.4	50.0	1.5	1.5	99.6	94.8	100	100
Ethion	48	49	39	37	82	78	79	77	80.6	70.2	1.1	1.1	91.0	94.8	100	100
Fenthion	43	51	—	—	—	—	75	83	91.4	50.8	—	—	—	—	100	100
Guthion	54	47	38	19	77	64	83	55	82.6	70.6	2.1	1.1	96.6	87.2	97.0	94.2
Imidan	37	45	—	—	—	—	79	80	81.6	77.8	—	—	—	—	100	100
Nemacide	33	30	36	2	74	44	88	34	67.8	22.4	2.0	2.3	97.0	81.4	99.2	100
Phorate	30	34	34	8	68	61	81	58	80.4	23.0	1.7	1.4	95.2	81.4	95.0	79.8
Telodrin	34	37	—	—	—	—	87	90	23.2	10.8	—	—	—	—	100	100
Tetradifon	40	34	—	—	—	—	88	91	71.2	65.2	—	—	—	—	100	100
Trichlorfon	50	5	—	—	—	—	61	4	79.0	94.2	—	—	—	—	100	83.0
Zectran	49	41	—	—	—	—	69	34	90.2	87.4	—	—	—	—	100	100
Zinophos	38	27	33	1	70	17	77	10	82.0	61.6	1.7	1.0	79.0	45.6	52.0	34.4
Untreated	42		40		67		76		88.4		2.2		92.2		100	
Difference nec. for signif. P=.05	N.S.D.	27	N.S.D.	7	N.S.D.	31	N.S.D.	14	21.5		0.9		12.8		17.0	

*Statistical analysis made with a $\sqrt{X+1}$ transformation.

germination to such a degree that the experimental area was disked. Seedling emergence per 20 row-feet at Prince George ranged from 10 seedlings with Zinophos to 99 when heptachlor was placed in a band below the furrow in ridged rows. As the rate of insecticide was increased the numbers of emergent seedlings decreased. With the exceptions of the ethion furrow and the heptachlor sub-furrow band treatments all other treatments grew significantly fewer plants than the untreated check. Damage by the turnip maggot ranged from 17.6% for the recommended furrow treatment with heptachlor to 91.8% for the furrow treatment with B.44646. The untreated plots had 85.7% damage. Several materials at various rates gave good protection. However, in general as the efficacy in protection increased the number of emergent seedlings decreased.

Discussion

The results summarized in Tables 3, 4, and 5 show that although furrow treatments afford greater protection from root maggot attack than band and spray applications, emergence of seedlings is reduced by the more effective insecticides. As in previous work (King *et al.*, 1955) it was noticed that reductions in the numbers of emergent seedlings resulted when the insecticides were applied in direct contact with the seed. This was more evident in the mineral soils than in the organic soils.

In 1961 when methods of application were compared at four locations with different soil types, there were no significant differences in the numbers of emergent seedlings when insecticides were applied by the band method. However, marked differences occurred when some of the insecticides were applied at half the rate in direct contact with the seed. The differences occurred at all sites with both organocarbamate and organophosphate insecticides. One plant survived in 20 feet of row when Zinophos was placed in the furrow but 33 plants when it was applied in a band. Reductions in stand of 75% were not uncommon. The organocarbamates, carbaryl and Zectran and the organophosphates, trichlorfon and Zinophos, caused the greatest reduction and to a lesser degree the phosphates Guthion, Nemacide, and phorate.

In 1962 when the effects were compared of several furrow dosages of promising insecticides, serious reductions were again recorded with Zinophos and less serious with diazinon, Nemacide, and phorate; as the rate of application increased the numbers of emergent seedlings decreased. Only furrow treatment with

TABLE 5.—Average number of seedlings and percentage damage by root maggots after various furrow treatments at Prince George, B.C., 1962.

Treatment		Percentage	Emergent	Treatment		Percentage	Emergent
Insecticide	Rate	damage	seedlings	Insecticide	Rate	damage	seedlings
Heptachlor	3.3	18	64	Zinophos	3.3	55	13
Heptachlor	2.2	21	68	Zinophos	2.2	61	20
B.25141	3.3	21	34	Heptachlor	6.6*	71	91
Phorate	4.4	30	34	Imidan	3.3	72	28
Nemacide	3.3	30	34	Fenthion	3.3	72	67
Phorate	3.3	31	40	Guthion	3.3	73	28
Diazinon	2.2	31	40	Ethion	3.3	73	73
Diazinon	4.4	34	26	Calomel	6.6	75	67
Nemacide	4.4	37	35	E.I.43064	3.3	83	44
Diazinon	3.3	39	35	B.44646	3.3	92	45
Nemacide	2.2	44	42	Untreated	—	86	81
Phorate	2.2	45	55	Difference necessary for signif. P=.05		16	12
Zinophos	4.4	54	10				

*Applied in a sub-furrow band in ridged rows (See "Methods").

ethion had significantly similar numbers of seedlings when compared with those of the untreated checks.

The protection afforded by the insecticides in 1960 indicated that the furrow treatment was the best method for preventing damage so long as cyclodiene-resistant flies were not present. However, at Victoria a resistant strain had arisen, and 100% damage was recorded for all treatments regardless of method or material.

In 1961 the degree of protection varied considerably between locations. At Prince George, where one generation of susceptible maggots must be controlled, the damage was correspondingly lighter than it was at Victoria or Cloverdale where three generations of a resistant strain occur. At Armstrong, even though two generations and a partial third occur, the damage was so small that to compare the amounts statistically it was necessary to transform the data using $\sqrt{X+1}$. Of the 17 insecticides tested only diazinon, phorate, and Zinophos gave any protection at Victoria. Telodrin, an organochlorine closely allied to aldrin, was very effective at Prince George, but allowed 100% damage at Victoria.

Based on results from the work in 1960 and 1961, the experiment in 1962 was designed to test the effects of various rates of the promising insecticides at Prince George and Victoria. Unfortunately the germination at Victoria was so poor that the land was disked and results could be obtained only from Prince George. Of the insecticides tested only diazinon, heptachlor, B.25141, Nemacide, phorate, and Zinophos can be considered for further experiments. Heptachlor applied in a band below the seed furrow in ridged rows had little effect against the maggots.

Since none of the soil insecticides has sufficient residual toxicity to control resistant strains of maggots, especially in organic soils, they will have to be supplemented with sprays to prevent oviposition by adult flies. To ensure early protection low rates in the furrow or in bands should be applied at seeding in combination with foliar sprays beginning before the emergence of second generation flies.

Summary

Experiments against turnip maggots and resistant cabbage maggots were conducted at six sites with different soil types in 1960, 1961, and 1962 to determine the insecticides, methods, and rates of application for preventing maggot damage in rutabaga. Three methods were tested at various rates with several formulations. In 1960 at Victoria band, furrow, and spray treatments did not protect rutabaga from a resistant strain of cabbage maggots. At three other locations the damage was significantly less when aldrin was applied in a band at seeding or when Nemacide was placed in the furrow. In 1961 only diazinon, phorate, and Zinophos applied in the furrow gave any protection from resistant maggots, but phorate and especially Zinophos caused a marked reduction in the number of emergent seedlings. In 1962 the effect of rates of application on seedling emergence was demonstrated. The three phosphate materials mentioned caused extreme reductions in numbers even at 2.2 oz toxicant per 1,000 row-feet. Zinophos was especially harmful. Damage at Prince George by the susceptible turnip maggot, *Hylemya floralis* (Fall.), ranged from 17.6% with heptachlor to 91.8% with B.44646 and 85.7% in untreated plots. Where resistant strains of maggots are present furrow or band treatments at seeding must be supplemented with foliar sprays.

Acknowledgements

Grateful acknowledgement is made for assistance by our colleagues H. R. MacCarthy and A. T. S. Wilkinson; and by J. Arrand, Assistant Provincial Entomologist; and for technical assistance by L. Chang, N. J. Filmer, G. McKee, of the Vancouver Research Station and I. Bergis, Canada Dept. of Agriculture, Research Station, Kamloops, B.C.

References

Billings, S. C. 1963. Consolidated list of approved common names of insecticides and certain other pesticides. Bull. Entomol. Soc. America 9(3):189-197.

Finlayson, D. G., H. H. Crowell, A. J. Howitt, D. R. Scott, and A. J. Walz. 1960. Chemical control of the onion maggot in onions grown from seed in various types of soil in northwestern North America in 1955 and 1956. J. Econ. Entomol. 52:851-856.

Forbes, A. R., and D. G. Finlayson. 1957. Species of root maggots (Diptera:Anthomyiidae) of cruciferous crops in British Columbia. Proc. Entomol. Soc. Brit. Columbia 54:25-28.

Harris, C. R., G. F. Manson, and J. H. Mazurek. 1962. Development of insecticidal resistance by soil insects in Canada. J. Econ. Entomol. 55:777-780.

Howitt, A. J. 1959 Personal communication.

————, and S. G. Cole, 1962. Chemical control of **Hylemya brassicae** in the Pacific Northwest. J. Econ. Entomol. 55:33-38.

Kenaga, E. E. 1963. Commercial and experimental organic insecticides (1963 Revision) indexed as to their scientific, common, and trade names, code designations, uses and manufacturers. Bull. Entomol. Soc. America 9(2):67-103.

King, K. M., and A. R. Forbes. 1954. Control of root maggots in rutabagas. J. Econ. Entomol. 47:607-615.

————, D. G. Finlayson, H. G. Fulton, and A. J. Howitt. 1955. Co-ordinated experiments on chemical control of root maggots in rutabagas in British Columbia and Washington, 1953. J. Econ. Entomol. 48:470-473.

Read, D. C. 1960. Control of root maggots in rutabagas, cabbages, and related plants in the Maritime Provinces. Processed Publication No. 1075. Research Branch, Canada Department of Agriculture.

Chrysophana placida infesting buildings in British Columbia (Coleoptera: Buprestidae)

In January, 1963, I received an enquiry from a lodge at McGillivray Falls, Anderson Lake, concerning beetles that were emerging from the walls of a fir log building. The accompanying specimens were **Chrysophana placida** Leconte, a beautiful golden green beetle with a purple stripe down each elytron and iridescent green on the underside. The females are one-half inch long, males slightly less. I had taken specimens at Salmon Arm, Kamloops, Chilcotin and Victoria, but knew nothing of their life history. In February owners of the lodge sent 36 more beetles with the information that three or four were emerging every day from the inside of the logs and actively running around. They came mainly from two logs on one side and from one log on the adjoining side of the room.

There is little published information on this species, but Doane, **et al.** suggest that there are evidences that they re-infest timber from which they have recently emerged. The lodge was 11 years old so the beetles had either been slowly developing during that time or the first ones that emerged had oviposited in the logs. To the owner's recollection it was the third year that the beetles had appeared. It is thus likely that with the slow drying of the logs, the larval development was correspondingly delayed. Emerging only on the inside of the logs, the larvae would appear to be attracted to heat before pupating.

This infestation almost parallels one that was reported in May, 1949, by a resident in Salmon Arm who claimed that "the beetles were working throughout the house . . . which is constructed of squared timbers with 1-inch strips nailed to the inside of same and then 2-ply of half-inch lumber with paper between; on top of that either gyproc or beaver board: the logs, lumber and the inside finish is being drilled throughout. The beetles are even boring through new gyproc." One living beetle was taken from an outside wall which had apparently been warmed by the sun.

According to Doane **et al.** the normal life history of this insect is several years so that 10 years would seem to be about the longest delay that can occur in the life of the larva before it pupates as opposed to the several-times-reported period of 50 years in the case of **Buprestis aurulenta.**

Reference

Doane, R. W., R. C. Van Dyke, W. J. Chamberlain, and H. E. Burke. Forest Insects. McGraw-Hill Book Co., Inc. 1936.

—*G. J. Spencer, University of British Columbia, Vancouver 8, B.C.*