

THE EFFECT OF DOSAGE OF ORGANOPHOSPHATE INSECTICIDES ON THE EMERGENCE OF RADISH SEEDLINGS AND ON DAMAGE BY CABBAGE MAGGOTS¹

D. G. FINLAYSON AND M. D. NOBLE

Introduction

With the development of a strain of cabbage maggot (*Hylemya brassicae* [Bouché]) resistant to the cyclodiene group of the organochlorine insecticides in the Pacific Northwest, it once again became virtually impossible to grow marketable root and stem brassicas on Vancouver Island and in the lower Fraser Valley. Work by Howitt and Cole (1962) and by Finlayson and Noble (1964) indicated that maggots attacking root crops might be controlled with

several organophosphates. However, reduced numbers of emergent seedlings when granular formulations were applied in the furrow indicated that further work was needed. This paper reports on the effects of various rates of several organophosphate insecticides in three soil types on emergence of seedlings and prevention of damage in radish by resistant strains of cabbage maggots.

Materials and Methods

The insecticides were in granular formulations as follows:

- Diazinon 0,0-diethyl 0-(2-isopropyl-4-methyl-6-pyrimidinyl) phosphorothioate; 5% on walnut shell; Fisons (Canada) Ltd., Toronto, Ont.
- Guthion 0,0-dimethyl S-(4-oxo-1,2,3,4-benzotriazin-3(4H)-yl)methyl phosphorodithioate; 10%; Chemagro Corp., Kansas City, Mo.
- Heptachlor 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene; 5%; Velsicol Chemical Corp., Chicago, Ill.
- Nemacide (V-C 13) 0,0-diethyl 0-2,4-dichlorophenyl phosphorothioate; 5%; Pennsalt Chemicals Corp., Tacoma, Wash.
- Zinophos 0,0-diethyl 0-2-pyrazinyl phosphorothioate; 10%; American Cyanamid Co., Princeton, N.J.

The Early Scarlet Globe variety of radish was used.

The investigation was conducted at three sites: at Essondale in muck soil; at Victoria in peat soil; and at the University Farm in Vancouver in sandy soil. The design, a split-plot latin square, consisted of five insecticides applied at four rates, 0, 7, 14, and 28 g of toxicant per 1,000 feet of row, replicated five times. A plot consisted of four 20-foot rows, each row treated at one of the above rates. The insecticides were applied with three grams of seed (approximately 300) sown with a V-belt seeder. The seedlings were counted

about 15 days after planting. At harvest random samples of 50 radishes per sub-plot were collected, washed, and inspected for maggot tunnels. A radish was considered damaged if there was any blemish caused by maggots. Percentage damage was calculated in terms of the number of radishes damaged.

Results and Discussion

Counts of emergent seedlings and percentage damage by root maggots are given in Table 1. Only Zinophos caused an appreciable reduction in emergence and this was more evident in light sandy loam than in organic soils. There was no maggot damage in any treatment nor in the untreated checks at Vancouver and Essondale. At Victoria damage rang-

¹ Contribution No. 77, Research Station, Research Branch, Canada Department of Agriculture, 6660 N.W. Marine Drive, Vancouver 8, B.C.

TABLE 1.—Materials and rate of application, average number of seedlings, and percentage damage by root maggots in radish in British Columbia, 1962.

Granular insecticide	Toxicant in g per 1000 row-feet	Emergent seedlings per 20 row-feet			Percentage damage Victoria
		Essondale (muck)	Victoria (peat)	Vancouver (sandy)	
Diazinon 5%	0	245	250	229	79
	7	232	252	223	60
	14	248	257	222	24
	28	252	253	212	31
Guthion 10%	0	218	249	230	82
	7	211	245	223	56
	14	202	262	236	48
	28	233	237	220	36
Heptachlor 5%	0	225	248	225	92
	7	210	257	232	93
	14	218	260	232	93
	28	208	262	214	92
Nemacide 5%	0	211	246	239	96
	7	222	244	233	75
	14	223	234	220	69
	28	216	238	221	55
Zinophos 10%	0	249	257	227	87
	7	225	237	152	12
	14	218	230	119	9
	28	225	199	61	4
Difference necessary for significance, $P=0.05$		N.S.D.	N.S.D.	14	13

ed from 4% in plots treated with 28 g of Zinophos to an average of 93% in treatments with heptachlor and 87% in untreated plots.

Howitt and Cole (1962) reported that cabbage maggots resistant to cyclodiene insecticides in Washington State appeared to be resistant also to organophosphates. Maggots of the strain at Victoria were susceptible however, especially to Zinophos. All treatments with organophosphate insecticides reduced the amount of damage. With the exception of a slight reversal at the 14 and 28 g rates with diazinon, the percentage damage decreased as the dosage increased.

Zinophos was the most effective insecticide. At 7 g per 1,000 row-feet only 12% damage was recorded, and this was very minor. Unfortunately, Zinophos caused some reduction in the numbers of emergent seedlings in the light soil. In peat and muck soils there was no appreciable reduction. At Victoria at the 28 g rate

emergent seedlings were reduced 20%. The reduction was not significant. At Vancouver on the light soil even at 7 g per 1,000 feet of row approximately 30% fewer radishes emerged; at 14 g about 50%; and at 28 g the emergence was only 27% of the numbers recorded for the untreated plots.

Summary

At Vancouver, Victoria, and Essondale, furrow treatments with granular formulations of diazinon, Guthion, heptachlor, Nemacide, and Zinophos were applied at 0, 7, 14, and 28 g toxicant per 1,000 row-feet. No maggot damage was recorded at Vancouver and Essondale. At Victoria damage ranged from 4% in plots treated with Zinophos at 28 g to 93% for heptachlor treatments and 87% for untreated checks. Only Zinophos caused any appreciable reduction in the numbers of emergent seedlings. This was more evident in light sandy soil at Vancouver than in organic soils at Victoria and

Essondale. At Vancouver the average number of seedlings per 20 row-feet at 0, 7, 14, and 28 g of Zinophos was 227, 152, 118, and 61 respectively.

Acknowledgements

Grateful acknowledgment is made for assistance from our colleagues, H. R. MacCarthy and A. T. S. Wilkinson, and for technical assistance by N. J. Filmer.

References

- Finlayson, D. G., and M. D. Noble. 1964. The efficacy of organocarbamate, organochlorine, and organophosphate insecticides against turnip maggots and resistant cabbage maggots in rutabaga in British Columbia. *Proc. Entomol. Soc. Brit. Columbia* 61:3-10.
- Howitt, A. J., and S. G. Cole. 1962. Chemical control of *Hylemya brassicae* in the Pacific Northwest. *J. Econ. Entomol.* 55:33-38.

EXPERIMENTS AGAINST CARROT RUST FLY (*Psila rosae* (F.)) RESISTANT TO CYCLODIENE ORGANOCHLORINE INSECTICIDES¹

D. G. FINLAYSON, H. G. FULTON, AND M. D. NOBLE

In July, 1961 reports from the Provincial Government's Colony Farm at Essondale, near Vancouver, to the effect that aldrin was no longer protecting carrots from damage by carrot maggots (*Psila rosae* [F.]), led to an investigation to determine: if strains of flies resistant to cyclodiene insecticides were present, and if suitable control measures could be developed.

The first spring seeding of carrots at Essondale was destroyed because the damage was so severe. Although recommended chemicals had been applied it soon became evident that the second crop also was heavily infested. Random samples in mid-August showed that at least 50% of the carrots were damaged. Collections of pupae were made at this time by sifting the soil for three inches on each side of the row to a depth of about six inches. Forty-five feet of row yielded more than 750 puparia plus an additional 1,200 from the maggots in the infested carrots. Samples of these puparia were shipped to the Entomological Laboratory at Chatham, Ont., for screening against

various insecticides. The results of these tests (Niemczyk and Harris, 1962) showed that the flies were highly resistant to aldrin but very susceptible to diazinon. The toxicity of malathion was about mid-way between the other two.

Based on results obtained during investigations to find effective insecticides against resistant strains of onion maggots (Finlayson, 1959 and Howitt, 1958); cabbage maggots (Finlayson and Noble, 1964a and b and Howitt and Cole, 1962); and carrot maggots (Howitt and Cole, 1959); experiments were designed to test the effective insecticides against the second generation of carrot rust fly at Essondale. This paper reports on the experiments in 1961, 1962, and 1963. A temporary method was developed for preventing damage and the effects are shown of several dosages of chemicals on seedling emergence in various soil types. In the lower Fraser Valley commercial carrots are usually grown in muck soil.

Materials and Methods

The pesticides used in the investigation are listed in Table 1 and are identified chemically in accordance with Billings (1963) and Kenaga

¹ Contribution No. 78, Research Station, Research Branch, Canada Department of Agriculture, 6660 N.W. Marine Drive, Vancouver 8, B.C.