RESULTS OF LABORATORY SCREENING TESTS WITH INSECTICIDES FOR CONTROL OF WHITE-FRINGED WEEVIL LARVAE AND ADULTS

D. H. TODD

Entomology Division, Department of Scientific and Industrial Research, Palmerston North

Summary

The toxicities of 38 insecticides in soil were determined in the laboratory against white-fringed weevil (*Graphognathus leucoloma* (Boheman)) larvae. Only six (dieldrin, dyfonate, heptachlor, lindane, Sandoz 6538 and thionazin) were significantly toxic. Results of these studies demonstrate the improbability of being able to control white-fringed weevil larvae in established pasture with currently available insecticides. In laboratory foliar spray treatments against the adult weevil, low concentrations of fenitrothion, methidathion and parathion-methyl proved highly toxic. The possibility of securing control of the insect in pasture by applying spray treatments against the adult weevil warrants investigation.

INTRODUCTION

ALTHOUGH the white-fringed weevil (*Graphognathus leucoloma* (Boheman)) is perhaps one of our least publicized pests, it is often responsible for significant damage to crops and pastures in some areas in the North Island.

Principal damage is caused by the larvae which feed on the roots and underground stems of plants. Field crops grown in land ploughed out of infested pasture or lucerne stands are particularly susceptible to attack. Continued pressure of the insect in pasture causes a progressive thinning out of desirable species with a consequent drop in production. Generally, the insect is more abundant in well-drained, sandy loam soils.

In early trials against larvae in field crops, the organochlorine insecticides isobenzan, aldrin, dieldrin and heptachlor proved moderately effective when applied to the soil surface (Todd, 1964). Subsequently, mixtures of aldrin or dieldrin dust in fertilizers, surface applied, and worked into the upper 2 to 4 in. of soil before planting or sowing, was the procedure adopted by many growers to protect their crops against possible damage. Because of the high risk of drift of the insecticide during application of these mixtures, their employment is now prohibited, and only the pelleted formulations of aldrin and dieldrin may be used as pre-sowing or pre-planting treatments. These, unfortunately, are reported by some growers to be less effective.

In 1965, a programme of laboratory screening of chemicals was initiated to select materials for field evaluation. Since then, tests have been carried out with many different insecticides against both larvae and adults.

This paper describes the test procedure and summarizes results for 38 compounds against larvae (a full account is given elsewhere (Todd, 1968)) and 13 compounds against adults. Also, the prospect of controlling larvae in established pasture with currently available insecticides, and the feasibility of securing control in pasture by applying treatments against the adult are briefly discussed.

TESTS AGAINST LARVAE

EXPERIMENTAL

The test procedure was basically similar to that used by Fenemore (1965) in laboratory screening tests with insecticides against grass grub (*Costelytra zealandica* (White)) larvae. It consists of treating soil at a series of dosage rates, by intimate mixing with the insecticide and confining larvae in the treated soil in pots in the laboratory. After a stipulated period, larvae are removed and the effect of treatment assessed by their ability to burrow into fine, moist soil. Unaffected grass grub larvae rapidly bury themselves and white-fringed weevil larvae react similarly.

All experiments were conducted in plastic pots in the laboratory at an air temperature ranging from about 60 to 75° F.

Insecticides were applied to soil as 1% solutions of technical material in acetone except where indicated in the results. Initially, insecticides were all tested at dosages of ½, 1, 2, 4 and 8 lb (all dosages are expressed in terms of active ingredient per 3 in. acre) replicated 3 times using 90 larvae (30 larvae per pot). Because many chemicals in the early tests showed insignificant toxicity, even at the highest dosage, materials examined later were first given a preliminary test at 4 lb in a single pot using either 20 or 25 larvae. Those showing sufficient promise were then tested at the full range of dosages.

Larvae were introduced into pots by placing them on the soil surface and allowing them to burrow. Those remaining on top after 30 minutes were discarded and replaced with apparently more active ones.

Slivers of carrot were used as a source of food for the larvae.

During the tests, soil moisture was maintained at a reasonably constant level by covering pots with moistened strips of ¼ in. thick foam plastic attached to lengths of timber. When necessary, the foam plastic strips were re-moistened.

TABLE 1: RESULTS OF SOIL TREATMENT TESTS WITH INSECTICIDES AGAINST *G. LEUCOLOMA* LARVAE

Materials showing significant toxicity when tested at a range of dosages (3-weeks test period)

Insecticide	½	Percentage larvae affected (Dosage — lb per 3 in. acre)			
		1	2	4	8
dieldrin	11.1	31.1	54.4	68.9	93.9
dyfonate	2.2	6.7	51.1	87.8	100.0
heptachlor	30.0	66.7	86.7	98.9	100.0
lindane*	22.2	43.3	72.2	85.6	100.0
Sandoz 6538	11.1	25.6	71.1	97.8	100.0
thionazin	16.7	25.6	30.0	90.0	100.0

*3.125% granule

TABLE 2: RESULTS OF SOIL TREATMENT TESTS WITH INSECTICIDES AGAINST *G. LEUCOLOMA* LARVAE

Materials preliminary tested only, and those showing low toxicity when tested at a range of dosages (3-weeks test period)

<i>Insecticide</i>	<i>No. of Larvae</i>	<i>% Larvae Affected at 4 lb per 3 in. acre</i>
AC 47470	90	21.1
AC 52160	20	25.0
azinphos-ethyl	20	0.0
B 5900	20	50.0
B 5860	20	70.0
B 78182	20	15.0
dicrotophos†	20	5.0
bromophos†	25	12.0
carbaryl	90	3.3
CS 5421	20	45.0
chlordane	20	10.0
diazinon	90	10.0
"Dimetilan"	20	10.0
Dowco 179	20	10.0
methomyl	20	0.0
fenitrothion	20	10.0
fensulfothion	90	11.1
fenthion*	20	0.0
GS 13006	20	10.0
chlordecone	90	3.3
aminocarb	90	4.4
methiocarb	90	7.8
methidathion	25	20.0
"Mocap"	20	30.0
CP 40276	20	20.0
CP 56856	20	5.0
carbofuran	20	70.0
parathion*	25	16.0
parathion-methyl	25	8.0
phorate‡	20	20.0
SD 9098	20	55.0
trichloronate	90	8.9

* 2.5% granule

† 5.0% granule

‡ 10.0% granule

At assessment, soil from each pot was put through a sieve and larvae recovered by hand. Dead larvae were counted and discarded and the remainder placed on the surface of fine, moist soil. Effects were determined from the number of dead larvae plus those remaining on the surface after 1 hour.

RESULTS

Results with materials that showed significant toxicity when tested at a range of dosages are presented in Table 1. Results of preliminary tests

TABLE 3: RESULTS OF FOLIAR SPRAY TREATMENT TEST OF INSECTICIDES AGAINST *G. LEUCOLOMA* ADULTS

<i>Insecticide</i>	<i>Actual Toxicant (oz/ac)</i>	<i>% Mortality</i>	<i>Days after Treatment</i>
azinphos-methyl†	16	100.0	1
	8	100.0	2
	4	100.0	5
carbaryl†	16	96.7	7
	8	93.3	7
	4	56.7	12
diazinon†	16	66.7	12
dichlorvos*	16	96.7	7
	8	56.7	12
	4	36.7	12
fenitrothion*	16	100.0	1
	8	100.0	2
	4	100.0	2
	2	100.0	3
	1	93.3	7
fenthion*	16	100.0	2
	8	100.0	2
	4	100.0	3
	2	96.7	7
folithion*	16	100.0	2
	8	100.0	2
	4	100.0	3
	2	96.7	7
malathion*	16	93.3	3
	8	66.7	3
	4	33.3	3
methidathion*	16	100.0	1
	8	100.0	1
	4	100.0	2
	2	100.0	2
	1	96.7	7
parathion-methyl*	16	100.0	1
	8	100.0	1
	4	100.0	1
	2	100.0	1
	1	100.0	5
rotenone*	16	3.3	3
	8	13.3	3
“thiocron”*	16	93.3	7
trichlorfon†	16	93.3	12
	8	90.0	12
	4	56.7	12

*Emulsifiable concentrate

†Wettable powder

FIG. 1: Pots used in laboratory foliar spray treatment tests against *G. leu-coloma* adults. Right, water-filled glass vial embedded in soil; centre, treated lucerne stem tips positioned upright in vial; left, weevil enclosure in position.

with insecticides not evaluated further, and with materials showing low toxicity when tested at a range of dosages are shown in Table 2.

Probit analysis (Finney, 1947) carried out on data in Table 1 showed that there was no significant difference between heptachlor and Sandoz 6538 at the EC 99 level. With this exception, heptachlor was significantly more toxic than all other treatments at both the EC 50 and EC 99 levels. Five materials — B5900, B5860, CS 5421, carbofuran and phorate showed distinct activity at 4 lb (Table 2) but not sufficient to warrant further evaluation.

TESTS AGAINST ADULTS

EXPERIMENTAL

To examine the toxicity of chemicals to white-fringed weevil adults, lucerne stem tips were sprayed at a known concentration and adults confined in pots with the treated foliage.

All insecticides used were emulsifiable concentrate or wettable powder formulations. The spray volume was adjusted to provide the equivalent of 50 gal/acre.

Treatments were replicated 3 times using a total of 30 adults. For each replicate, a small hand-sprayer was used to treat a group of 5 lucerne stem tips positioned upright in a glass vial. Sufficient spray was applied to give adequate coverage with minimum run-off. Following treatment, stem tips were transferred to a water-filled glass vial embedded in soil in a 6 in. earthenware pot (Fig. 1) and stoppered with cotton-wool; test insects were introduced, and top of pot covered with galvanized wire gauze. Tests were carried out in the laboratory at an air temperature ranging from about 60 to 75° F.

Mortality was assessed at 24-hourly intervals after treatment up to a maximum of 12 days. Tests were discontinued before this where 100% mortality was attained, where the mortality level remained unchanged for several consecutive days, and where control mortality exceeded that of the treated group.

RESULTS

A summary of results with adult weevils is presented in Table 3. Results are not corrected for control mortality which ranged from 0.0% to 10.0%.

DISCUSSION

Of the large number of insecticides evaluated against white-fringed weevil larvae in laboratory soil treatment tests, only six (dieldrin, dyfonate, heptachlor, lindane, Sandoz 6538, and thionazin) showed sufficient toxicity to warrant their inclusion in field trials. When evaluated in pasture, these materials, formulated as pellets and applied at a range of dosages up to 8 lb/acre, had little or no effect after 3 months.

These studies amply demonstrate the non-susceptibility of white-fringed weevil larvae to chemicals, and the improbability of being able to control this stage of the insect with currently available insecticides that offer little residue risk.

In laboratory screening tests of insecticides against the adult weevil, a number of residue-safe materials proved highly toxic. With this knowledge, it is now proposed to explore the possibility of securing control in pasture by applying treatments against the adult weevil. The first step in the investigations will be to find out how persistent the insecticides are in the field as foliar sprays. This information is required in order to determine how frequent application will need to be. As the period of peak emergence of adults from the soil extends over something like 6 weeks (from the beginning of January to the middle of February), it seems likely that a number of applications might be necessary to ensure that egg laying is reduced to a minimum. Also, because the insect has a two-year cycle, control measures aimed at the adult would necessarily need to be carried out during two successive seasons. This may prove impracticable, but, in view of the non-susceptibility of the larvae to chemicals, there is no alternative but to test the method thoroughly.

REFERENCES

- Fenemore, P. G., 1965: *N.Z. J. Agric. Res.*, 8: 696-707.
Finney, D. J., 1968: *Probit Analysis*, 1st Ed. Cambridge Univ. Press. 256 pp.
Todd, D. H., 1964: *Proc. 17th N.Z. Weed & Pest Control Conf.*: 125.
———, 1968: *N.Z. J. Agric. Res.*, 11: 903-10.