SUMMARY OF RESULTS OF SCREENING TESTS WITH INSECTICIDES FOR CONTROL OF GRASS-GRUB LARVAE

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Summary

A method used for laboratory evaluation of insecticides against grass-grub (*Costelytra zealandica*) larvae is outlined, and results presented for a number of organophosphates (and a few materials of unknown constitution) examined by this method. Good persistence in soil is considered to be as important as high initial toxicity to grubs. The best prospective materials examined to date are the Bayer compounds S.4400, S.4706, S.767, and Stauffer N-2790.

A PRELIMINARY REPORT on laboratory evaluation of insecticides against grass-grub larvae was presented at the 1963 meeting of the New Zealand Weed Control Conference (Fenemore, 1963).

Since that time a considerable number of toxicants have been examined in a similar fashion and some of the results obtained are summarized in the present paper. A full account of this work is being published elsewhere (Fenemore, 1965).

OUTLINE OF PROCEDURE

The test procedure adopted consists in essence of treating dry, sieved soil at a series of rates by intimate mixing with the insecticide under test, and confining grass-grub larvae in this treated soil in pots. After a stipulated period the larvae are removed and the effect of treatment assessed by their ability to burrow into soft moist earth, a reaction which healthy larvae produce rapidly.

Germinating ryecorn seed is now provided as a source of food for the larvae during tests, though slices of carrot were initially used. Larvae were formerly left in treated soil for four weeks before assessment, but this has been reduced to two weeks to enable more materials to be tested during a season and for some measure of their persistence in soil to be obtained.

Insecticides for test are first examined in a preliminary fashion by setting up single pots of soil treated at dosage rates up to the equivalent of 8 or 16 lb a.i. per 3 in. acre, and infesting with 10 larvae per pot.

Materials which then show sufficient promise, or which are of interest for other reasons (*e.g.*, very low mammalian toxicity) are then tested using 50 larvae at each of five dosage levels designed to give a range of effect from 0 to 5 up to 95 to 100%. Results obtained are then used to plot dosage/response lines. From these, materials may be compared as to dosages producing 50% effect (E.C.50) or at any other level of effect.

RESULTS

Although rates of use of insecticides may be expressed in terms of lb active ingredient per acre of soil to a selected depth (3 in.

in the present case) in tests of the type described, it is difficult to translate such rates to a meaningful figure for field use.

Tests of this type, where temperature and other conditions are not standardized, should always include a standard material and it is convenient to express the results of materials being tested in terms of this standard.

In the present work, diazinon has been adopted as the standard insecticide for comparison of other organophosphates. This material has been shown to be highly toxic to grass-grub larvae by contact, and has also been used sufficiently widely in field tests to provide a useful yardstick of effectiveness. From the generally marginal results produced by diazinon, when applied against grass-grub larvae in the field, any materials of lower effectiveness can be discarded.

Results are presented in Table 1 of materials compared with diazinon, using a 4-week test period. From the practical point of view, it seems better to compare the toxicity of materials at dosage levels producing nearly 100% effect (E.C.99) rather than at dosages producing 50% effect (E.C.50). The toxicity ratings given are therefore the ratio of the rate of a test material required to produce 99% effect compared with that of diazinon. Figures greater than unity represent materials more toxic to grass-grub larvae than diazinon, figures smaller than unity, materials less toxic than diazinon.

TABLE 1

(a) *Initial toxicity rating of some insecticides, compared diazinon=1, with 28-day test period.*

(*based on E.C.99*)

Toxicant	*Rating*
"Zinophos"	1.1
"Fitios B/77"	0.43
"VC-13"	0.16
Shg 1792*	0.09

(b) *Other insecticides examined in preliminary screening test which gave toxicity rating of 0.25 or less compared diazinon.*

Ethion
"Imidan"
Malathion
Phosphamidon
"Thiocron"
UC 20047†
"Zytron"

* Experimental insecticide of Cela Landwirtschaftliche Chemikalien GmbH.
† Experimental insecticide of Union Carbide Chemicals Co.

From a consideration of what an insecticide has to do when applied over pasture, in order to be effective against grass-grub larvae — namely, penetrate the soil without appreciable loss of toxicity — it becomes apparent that a simple measure of the toxicity of treated soil to grubs is unlikely to be a sufficient criterion as to likely performance in the field. This is confirmed by the disappointing results obtained by organophosphates in most field trials to date.

It seems likely that reasonable persistence of the insecticide in the soil environment is a prerequisite for successful soil penetration following surface application, though other factors, such as water solubility, may be involved. Some means of assessing persistence of test insecticides in soil was therefore sought in the present work.

It has been shown by Elliott and Perrott (1965) that, once 3rd instar grass-grub larvae complete their early rapid growth and reach fairly constant body weight, their response to topically applied DDT becomes, for all practical purposes, uniform. The same uniform response is given by larvae confined to soil freshly treated with diazinon at fortnightly intervals from May onwards.

A measure of the persistence of toxicity of treatments in soil has thus been obtained by re-infesting pots of soil at intervals following initial treatment. The effect produced can then be related to dosage, from the dosage/effect curve initially established, and this figure compared with the dosage originally applied to give an apparent percentage loss of toxicant.

Results are given in Table 2 of materials compared with diazinon for initial toxicity with a 14-day test period and also estimated persistence in soil as being equal to (=), less than (—), or better than (+) diazinon.

TABLE 2

(a) *Initial toxicity rating (based on E.C.99) and persistence in soil of some insecticides compared diazinon=1, with 14-day test period.*

Toxicant	*Rating*	*Persistence*
Bayer S.4400	2.1	+
Bayer S.767	1.9	—
Stauffer N-2790	1.6	=
Bayer S.4706	1.5	=
Phorate	1.3	=
Fenthion	0.88	—
Trichlorfon	0.34	—
Carbophenothion	0.3	—
Dow 181	0.29	—
Geigy GS-13005	0.29	—
"Bromophos"	0.22	—
Azinphos methyl	0.18	—
Geigy GS-13002	0.14	—
Azinphos ethyl	0.13	+

(b) *Other insecticides examined in preliminary screening test which gave toxicity rating of 0.25 or less compared diazinon.*

"Bidrin"
"FAC"
"Dition"
GC-4072
"Nellite"

CONCLUSIONS

In screening insecticides for effectiveness against grass-grub larvae, it is considered desirable to confine larvae in treated soil rather than to make direct application on to the insects. Data as to the persistence of materials in soil are also most desirable.

Of 30 organophosphates, or experimental insecticides of unknown constitution evaluated, only 6 gave higher initial effect than diazinon.

On the basis of initial toxicity and/or persistence in soil, the best prospective materials for field evaluation to date are the Bayer experimental compounds S.4400, S.767 and S.4706, and Stauffer N-2790.

REFERENCES

Elliott, R.; Perrott, D. C. F., 1965: *N.Z. J. agric. Res., 8*: 142–55.
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