EVALUATION BY TOPICAL APPLICATION OF SELECTED INSECTICIDES AGAINST ADULT GRASS GRUB

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Summary

Five organophosphates and two synthetic pyrethroids were compared in topical tests against grass grub adults (*Costelytra zealandica*). Two pyrethroids were also compared for their effect on manuka beetle (*Pyronota festiva*). The pyrethroids, notably decamethrin, proved to be extremely effective.

INTRODUCTION

The control of grass grub by the application of insecticides to kill the adult beetle is not a new idea. Fenemore (1964) gave serious consideration to this method and in subsequent work (Fenemore and Perrott 1970) numerous insecticides were investigated for this purpose. In these trials, however, none of the insecticides available at that time, even at very high rates, gave control of the pest. The authors ascribed the failure to adult females having limited contact with insecticide deposits under field conditions and concluded that ".....even at exposure times of 40 min. impracticably high rates of (organophosphorous) insecticides would be required to produce a worthwhile effect".

At present, chemical control measures for grass grub are directed at the larval stage. The grub is soil inhabiting and therefore difficult to reach with insecticidal applications. This method is made even more unsatisfactory by the property of some soils to bind the insecticide and thus reduce its activity.

With the advent of the synthetic pyrethroid insecticides which have very rapid knockdown action and are active at rates up to ten times lower than those used for the most effective organophosphorous insecticide (Ruscoe 1977), renewed interest was taken in the approach of adult control. Henzell and Lauren (1977) as well as Pottinger *et al* (1977) reported encouraging results with conventional sprays of pyrethroids directed at adult grass grub.

Other insecticides such as diflubenzuron (Marx 1977) have also been reported to be effective against other insects at very low doses. With more potent insecticides available and an understanding of spray timing which is becoming increasingly clearer (Henzell and Lauren 1977; Pottinger *et al* 1977), grass grub control through the killing of adults is becoming feasible.

A search has recommenced for the most effective insecticides for this purpose and the present paper reports on tests where three phosphorothioates, one phosphate and three pyrethroids were evaluated under controlled laboratory conditions as candidate insecticides for control of adult grass grub.

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METHOD

Promising insecticides are routinely screened by topical application against grass grub adults at Ruakura. From these, a few that showed quick knockdown activity at low rates were selected for inclusion in similar trials at even lower rates. They are listed in Table 1. Chlorpyrifos was included as this was the most effective material in the trials of Fenemore and Perrott (1970).

The grass grub adults were field collected young males caught in sex attractant traps. Within one hour of being caught, they were put into plastic buckets containing moist soil and willow foliage. They were held overnight in this way in the laboratory and transferred the next morning to clean plastic ice cube trays. Only the most active beetles were selected and only one was placed into each cubicle of a tray. At this time, the mean body mass was determined from a group of 20 randomly selected beetles.

Using a Burkard Arnold hand micro applicator a 0.82 microlitre drop of the appropriate rate of insecticide, diluted in acetone, was placed on the scutellar region of each beetle. The dosage of insecticide is given in Tables 1 and 2. Thirty insects were used for each treatment.

The insects were left in their trays for a 10 minute exposure period and then placed onto damp soil in plastic pots. After one hour and again after two hours and 17 hours, the number that were not buried beneath the soil surface was counted and recorded.

Decamethrin, so far probably the most potent of the synthetic pyrethroids (Elliott 1974), became available only at the end of the grass grub flight season when young adult males could no longer be found. However, an infestation of manuka beetle, a related cockchafer, was found on manuka (*Leptospermum sp.*) scrub and it was decided to compare the activity of this insecticide with that of the most potent pyrethroid used in the previous test. Test procedures were mainly the same as with grass grub, the only differences being that the freshly hand-collected beetles (males and females) were held overnight in containers with manuka foliage and that after the 10 minute post application exposure period, they were placed in glass dishes on manuka leaves. Recordings of affected insects were made after two hours and of moribund ones after 24 hours.

RESULTS

The mean body mass of the grass grub adults used was 68.35 mg; that of the manuka beetles was 40.0 mg. Results of the effect of insecticidal applications on the grass grub adults are presented in Table 1 and those on manuka beetle in Table 2.

DISCUSSION AND CONCLUSION

From the results (Table 1) obtained with the insecticide coded CO2138, the LD₅₀ value against adult grass grub was calculated to be 1.83 micrograms/gram. Of the organophosphates tested, this was the quickest acting and most active insecticide.

As expected, cypermethrin was more than 66 times as potent as CO2138 and has a calculated LD₅₀ value of 0.027 micrograms/gram. This insecticidal activity is considerable. Even more potent however, is decamethrin although, admittedly, the comparison was made using manuka beetle instead of grass grub adults.

With insecticides of this order of potency against adult grass grub there are strong indications that the control of this pest by severe reduction of adult numbers could become a practical possibility.

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TABLE 1: Mortality of adult male grass grub at various times after topical treatment with insecticides.

Insecticide and rate in micrograms per insect		Number of adults affected out of 30 after		
		1 hour	2 hours	17 hours
cypermethrin	0.125	30	30	30
	0.0125	28	28	28
	0.0025	20	22	22
permethrin	0.125	30	30	30
	0.0125	22	22	22
	0.0025	19	13	7
CO2138*	0.25	17	17	17
	0.125	12	16	15
quinalphos	0.25	5	10	13
	0.125	5	5	6
diazinon	0.25	0	4	13
	0.125	0	0	3
chlorpyrifos	0.25	2	4	6
	0.125	0	0	5
triazophos	0.25	1	1	4
	0.125	0	0	1
control (acetone only)		0	0	0

* 2,4,4-trichloro-butadienyl-1-diethyl-phosphate

At equal rates cypermethrin and permethrin were significantly better ($P < 0.01$) than all the other treatments (based on the estimated rate at which 50% of adults were affected). Cypermethrin was significantly better ($P < 0.01$) than permethrin 2 and 17 hours after application.

TABLE 2: Mortality of manuka beetles (male and female) at various times after topical treatment with two pyrethroid insecticides.

Insecticide and rate in nanograms per insect		Number of beetles out of 30	
		affected (after 2 hrs)	moribund/dead (after 24 hrs)
cypermethrin	7.75	30	30
	1.55	29	21
	0.78	30	22
	0.16	23	17
decamethrin	1.55	30	30
	0.78	30	29
	0.16	29	27
	0.08	26	24
	0.02	3	15
control (acetone only)		1	1

Decamethrin was significantly better ($P < 0.01$) than cypermethrin 2 and 24 hours after application.

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