THE POTENTIAL OF INSECTICIDES AS A MEANS OF CONTROLLING SOLDIER FLY (*Inopus rubriceps*) (Macquart)

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Summary

Results of applying twenty two insecticidal treatments to the surface of soldier fly (*Inopus rubriceps*) infested pasture suggest that systemic materials warrant further consideration as a means of reducing soldier fly larval infestations.

In another experiment, eight insecticidal treatments were applied into the seed rows at the time of sowing maize. Seven of them reduced the amount of soldier fly damage to the seedlings and reduced the number of larvae on the roots. However, there was a considerable amount of damage even in the best treatments and yield differences were not significant.

INTRODUCTION

HEWITT (1964) screened eleven insecticides but found soldier fly larvae difficult to control. The very high rates of chlorinated hydrocarbons required to achieve control, induced an inferior sward.

In Australia dieldrin at the rate of 6.7 kg a.i./ha is worked into the soil prior to the planting of sugar cane ratoons to control soldier fly larvae. Current insecticidal screening has produced no satisfactory alternative to dieldrin (Wilson 1969, 1970).

Fellowes (1971) and Hewitt (1969) both reported that parathion incorporated with maize seed at the time of sowing gave some protection from soldier fly damage to the seedlings and this resulted in an increase in final yield.

With the change in emphasis over recent years from chlorinated hydrocarbons to organophosphate and carbamate insecticides, some preliminary screening of these materials in pasture and crop situations for soldier fly larvae control was undertaken.

A wide range of chemicals were used in an initial screening trial on pasture, all of which had exhibited some activity against pests not too different from soldier fly.

Damage to maize by soldier fly larvae has been described by Given (1973). Our efforts were directed towards looking for insecticides that may be able to protect the plants and kill the larvae.

Soldier Fly

METHODS AND RESULTS

Pasture Screening

On 25 May 1972, 22 insecticidal treatments were duplicated on 3 m x 4 m plots on a sandy loam soil near Te Aroha. Four 7.6 cm diameter soil cores were taken to a depth of 10 cm from each plot and hand sorted for larvae. Insecticidal treatments were applied at 4.5 kg/ha to the surface of the pasture which had been previously mown with a reel mower. A list of the insecticides used is given in Table I.

On July 20 the sampling procedure was repeated to obtain post treatment population counts. This procedure was repeated on 8 November before the spring emergence of adults. Results of these assessments are given in Table I.

TABLE I: THE EFFECT OF 22 INSECTICIDAL TREATMENTS ON SOLDIER FLY LARVAE IN PASTURE

Treatment	Number of larvae		Percent	Percent	Treatment arranged in order of % mortality (8 November)	
	25 May	Mortality	Mortality			
		20 July	8 Nov.			
(mean of 4 x 7.6cm cores/plot)						
fenamiphos G	83.5	67	72	carbofuran G		93 a
fenamiphos	53.5	62	66	phorate G		76 ab
diazinon G	58.0	-1	9	fenamiphos G		71 b
diazinon	69.0	8	17	fenamiphos		66 b
parathion G	63.5	25	26	thioxamyl		46
parathion	72.0	-10	22	fensulfothion		46
chlofenvinphos G	90.0	-2	19	dimethoate		40
chlorfenvinphos	85.5	56	18	chlorpyrifos		39
methamidophos G	68.0	21	4	formothion		38
disulfoton G	62.0	-30	-17	bromophos		29
fensulfothion G	87.5	35	46	parathion G		26
carbofuran G	46.5	28	93	parathion		22
phorate G	59.0	46	76	chlorfenvinphos G		19
thioxamyl G	73.0	56	46	chlorfenvinphos		18
thionazin	49.5	-26	-24	diazinon		17
trichloronate	52.0	-33	-32	diazinon G		9
chlorpyrifos	69.5	27	39	methamidophos G		4
formothion	67.0	16	38	methomyl		-1
methomyl	92.5	6	-1	disulfoton G		-17
bromophos	93.5	22	29	fenitrothion		-18
fenitrothion	110.0	9	-11	thionazin		-24
dimethoate	82.0	39	40	trichloronate		-32

G — granular formulation

Duncans multiple range test letters ignore treatments giving less than 50% mortality.

The post treatment assessment which was carried out 8 weeks after the treatments were applied indicated that none had given a satisfactory level of control, the best being the 2 fenamiphos treatments (67% and

62% mortality). Assessments on 8 November, 24 weeks after the treatments were applied indicated that carbofuran, phorate and fenamiphos had given a sufficiently promising kill of larvae (93%, 76% and 71%) to warrant further investigation. The reasons for this delayed response were not clear but it is possible that these materials persisted longer in the soil than previously thought and/or the larvae may have taken longer than eight weeks to die and disintegrate. Remaining treatments had too many live larvae in the soil at this time to warrant further consideration unless the method of application is to be altered.

Protection of Maize

PX 50 maize seed was sown on 24 October 1972 into a sandy loam soil in the Waikato in a paddock that had received preliminary cultivations from grass and where the soldier fly population was 4866 larvae/m² at the time of sowing.

Seven granular formulations of different insecticides were placed into the soil using a Planet Junior seed drill to sow them along the rows of seed. Each insecticide was applied at 2.2 kg/ha except for fensulfothion which was at 1.1 kg/ha. This was a slightly higher rate of parathion than that normally employed, the reason for this being that parathion was used as a standard against which other materials were being tested. Carbophenothion had been previously incorporated at 0.5% weight of seed as a seed coating, this was the eighth treatment. Plot size was 4 x 76 cm rows x 25 m. All treatments were replicated four times in randomised blocks.

Plant establishment counts were made on 7 November by counting 10 random 1 m lengths of row per plot. Poor plant establishment occurred in the carbophenothion seed coated treatments as a result of difficulty in getting the large seed through the maize planter. The seed coating tended to flake off blocking the plates in the planter.

On 22 November, 25 plants from each plot were washed and the number of "pits" in the mesocotyl caused by the feeding of soldier fly larvae were counted. (The mesocotyl is the internode between the scutellum and the coleoptile. Avery 1930). Results given in Table II show that some of the insecticides significantly reduced the amount of damage. During December this effect showed up in the vigour of the crop, plants in the parathion plots being the most vigorous.

During December black and decaying soldier fly larvae were found on the roots of some of the treated plants and on 31 January the root systems of five plants/plot were lifted and soil washed through a series of sieves in order to catch the soldier fly larvae. The number of live larvae root system were recorded (Table II). All insecticides except parathion had significantly ($P < 0.05$) reduced the number of larvae present, carbofuran more effectively than others.

The lowest yield was obtained from the untreated plots but significant differences were not obtained. The severity of the attack even on the best of the treatments suggests that there was considerable reduction of plant vigour throughout the whole experiment and this was reflected in yields.

The protection provided by the parathion early in the season and by the carbofuran later on was not reflected in higher grain yield.

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TABLE II: THE RELATIONSHIP BETWEEN INSECTICIDES, SOLDIER FLY LARVAE AND DAMAGE TO MAIZE

Treatment	Number of plants/ m length of row (mean of 40 x 1 m)	Percentage plants attacked	Number of "pits" /mesocotyl (Mean of 100)	Number of live larvae/ root system 31/1/73 (mean of 20)	Grain Yield kg/ha 85% DM
dimethoate	7.3	96	3.7 aABC	49.5 B	6387
diazinon	6.7	91	3.5 aABC	48.0 B	7102
carbophenothion	2.9	99	4.9 bcBC	—	—
carbofuran	7.3	93	3.7 aABC	25.3 A	6344
fonofos	6.9	92	3.2 aAB	43.8 B	6588
chlorfenvinphos	7.1	95	3.9 abABC	46.5 B	6533
fensulfothion	7.2	92	3.2 aAB	46.5 B	6822
parathion	7.2	90	2.8 aA	54.0 BC	6312
untreated	7.0	97	5.2 cC	68.3 C	6198

DISCUSSION AND CONCLUSIONS

Soldier fly belong to the Stratiomyidae which are characterised by having parallel jaws rather than horizontal moving mandibles. They feed on the roots of plants and obtain nourishment by suction (Irwin-Smith 1921). This process is not unlike that of ectoparasitic nematodes which pierce the roots with their stylets and suck juices from the cells of the roots.

Whitehead (1972) reported that diethyl phosphates were more successful in controlling the nematode *Heterodera rostochiensis* (Woll.) than dimethyl phosphates. Our results suggest that both types of insecticides can be equally ineffective against soldier fly larvae and that systemic insecticides are likely to be the most promising materials.

In a small duplicated plot experiment, carbofuran, fenamiphos and phorate, when applied to the surface of pasture have reduced soldier fly larval populations. These materials are all systemic and warrant further consideration as a possible means of controlling soldier fly.

The contact insecticides in these experiments had little effect on larval numbers. Parathion provided some protection to the maize seedlings during the initial stages of growth. Carbofuran reduced the number of larvae on the roots.

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