INSECTICIDES TO CONTROL SOLDIER FLY (*Inopus rubriceps* (Macquart)) IN PASTURE

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Summary

Results of determining the activity of parathion, carbofuran, phorate and fenamiphos against soldier fly larvae are presented. The last three, all systemic insecticides, were active, with carbofuran the most effective at low rates. Eighty per cent mortality was the best control obtained and a significant interaction between rates and method of application suggested there was a distribution problem.

INTRODUCTION

Preliminary screening of insecticides on pasture suggested that broad-spectrum systemic insecticides are active against soldier fly larvae, (Dixon and Grimmer 1973, Fellowes 1973). This is supported by results obtained where these materials have been sown with maize (Mackay and Rowe 1973).

The aim of the work reported here was to establish the degree of control that these materials achieve in the pasture situation and to determine how repeatable this is at different times and in different areas.

EXPERIMENTAL METHODS

The following factors were incorporated:

Insecticides — parathion 10%G; carbofuran 10%G, 75% WP; phorate 10%G; fenamiphos 10%G.

Rates 1.0; 2.5; 4.0; 5.0 kg/ha.

Methods of application — broadcast (granular formulations except carbufuran where 75% WP applied as a spray); undersown (granular formulations).

Times of application — early May 1973; early September 1973.

The experimental design was rather complex. The 64 individual treatments were replicated once in each of three regions using an experimental plot of size 4 m x 3 m. At each locality there were 32 treated and 8 untreated plots.

SITES

Region	*Locality*	*Soil type*	*% Ryegrass May 1973*	*Mean No. Soldier fly larvae/m² May 1973*
Bay of Plenty	Edgecumbe	Awakeri sandy loam on peat	15	3500
	Katikati	Te Manaia sandy loam	10	2850
Waikato	Matangi	Horotiu sandy loam	15	3900
	Paeroa	Ngatea clay loam	55	3850
Sth Auckland	Buckland	Pukekohe complex	60	3200
	Karaka	Karaka complex	15	3550

Granules were broadcast onto the plots using "pepper pots" or undersown approximately 3 cm deep in rows 15 cm apart, in slits cut with a spade. Soldier fly populations were sampled in late October using a 7.6 cm diameter corer to a depth of 10 cm and taking seven cores per plot. Larvae were extracted in the laboratory using a soil washing process.

RESULTS

Control of larvae

Tables 1 and 2 give the percentage mortalities compared with the untreated controls, as measured in late October 1973, for the different treatments. Since there were no fundamental treatment differences between sites, data for all sites are combined.

TABLE 1: PERCENTAGE MORTALITIES (RELATIVE TO UNTREATED) OF SOLDIER FLY LARVAE UNDER DIFFERENT INSECTICIDAL TREATMENTS

Insecticide	*Overall mean*	Rate kg a.i./ha							
		1.0		2.5		4.0		5.0	
		under-sown	*broad-cast*	*under-sown*	*broad-cast*	*under sown*	*broad-cast*	*under-sown*	*broad-cast*
untreated	0 dB								
parathion	9 cB	23*	–17	29*	–11	13	19	–11	19
carbofuran	48 aA	49***	7	54***	47***	52***	66***	40***	66***
phorate	34 bA	25*	7	30**	32**	50***	25*	38**	57***
fenamiphos	40 abA	18	21	12	45***	53***	58***	43***	67***
Mean untreated	0 cC	29 bB	5 cC	31 bAB	28 bB	42 abAB	42 abAB	27 bB	52 aA

Standard error of individual treatment mean is 10.7

Asterisks indicate significance of difference from zero (= untreated).

Treatments with different numbers of asterisks are not necessarily significantly different from each other.

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

Table 1 gives the result of combining the two times of application. The main effects of chemicals, rates and the interaction of rates x methods were all highly significant ($P < 0.001$). The chemicals x low/high rates x method interaction was also significant ($P < 0.02$), but interactions involving time were not significant. Thus apart from the main effect of time, Table 1 gives all the pertinent treatment effects.

Parathion, the only contact insecticide included in these experiments, was somewhat ineffective against soldier fly larvae, substantiating the results obtained from preliminary screening (Dixon and Grimmer 1973).

Increasing the rate of the systemic insecticides increased their effectiveness markedly more when they were broadcast than when they were undersown. Carbofuran was more effective than other materials when undersown at low rates. The effect of increasing rate with other factors held constant is seen to be reasonably consistent.

Table 2 presents comparisons of the best treatments. The highest mortality obtained was 80%, resulting from a high rate of insecticide being broadcast, a technique that would be undesirable and very expensive in practice. This figure represents the mean of the 12 plots treated with either broadcast carbofuran or fenamiphos at rates of 4 kg or 5 kg/ha. The multiple range test shows that these treatments are not significantly (5% level) more effective than carbofuran's 58% mortality when undersown at low rates at the same time.

TABLE 2: COMPARISON OF TREATMENTS WITHIN TIMES OF APPLICATION (VALUES ARE % MORTALITIES)

Insecticide	*Autumn application*				*Spring application*			
	low rate†		high rate†		low rate†		high rate†	
	under-sown	*broad-cast*	*under-sown*	*broad-cast*	*under-sown*	*broad-cast*	*under-sown*	*broad-cast*
parathion	32 bcBCD	−17 eF	14 cdDEF	14 cdDEF	19 abcdABC	−10 cdBC	−11 cdBC	25 abcABC
carbofuran	58 abABC	35 bcBCD	63 abAB	79 aA	45 abA	19 abcdABC	29 abABC	53 aA
phorate	31 bcBCD	25 cBCDE	44 bcABCD	59 abABC	24 abcdABC	13 bcdABC	44 abA	24 abcdABC
fenamiphos	17 cdCDEF	46 bcABCD	60 abABC	80 aA	14 bcdABC	20 abcdABC	36 abAB	45 abA
untreated	0 deEF				0 dC			

Treatments are compared within time of application only.

† low rate — mean 1.75 kg

† high rate — mean 4.5 kg

Effect of time of application

Because of a constraint in the design of the experiment, comparison of the direct effect of times of application is relatively insensitive statistically. However the average % mortality from May application of all insecticides was 15 ± 3 higher than from September application, an effect significant at the 1% level. It stems essentially from the lower untreated counts for the September treated blocks (i.e. Sepember treated blocks had on average 76% as many larvae in the untreated plots as in the May treated blocks). This effect is consistent between sites and presumably is the result of the September treated blocks having been grazed throughout the winter. The final (October 1973) larval populations on treated plots do not show any consistent effect of time of application but the above-mentioned "best treatments" still give the lowest final populations of 640/m² (mean of 12 plots).

Wildlife hazards

That birds were at risk from broadcasting these materials became apparent even though the area treated in this manner at each site was only 70m². A total of nine dead birds were found at three of six sites, eight of these being sylarks, and one a sparrow. Dissection and chemical analysis confirmed that granules of fenamiphos were present in their gizzards.

Effect on earthworms

Whilst washing and counting soldier fly larvae we also recovered and counted earthworms. The untreated plots had an average of 54 worms/m², fenamiphos 49, but parathion, carbofuran and phorate had significantly reduced the numbers to 32, 19 and 29 respectively. An anomalous result was given by the mean of the 5 kg/ha rates where the number of earthworms was not significantly less than in the untreated plots. This was not the case for the 1.0, 2.5 and 4.0 kg/ha rates. It would be prudent to point out that the small individual treatment plot size, 4 m x 3 m, could have permitted migration between plots.

Dry matter production

Because there were substantial differences in the levels of recorded dry matter production between sites, comparisons are made between the percentage increase of individual treatments as compared with untreated plots for that site, averaged over all sites. Fig 1 shows these treatment means plotted against percentage larval mortalities obtained from Table 2 after averaging out the effect of time.

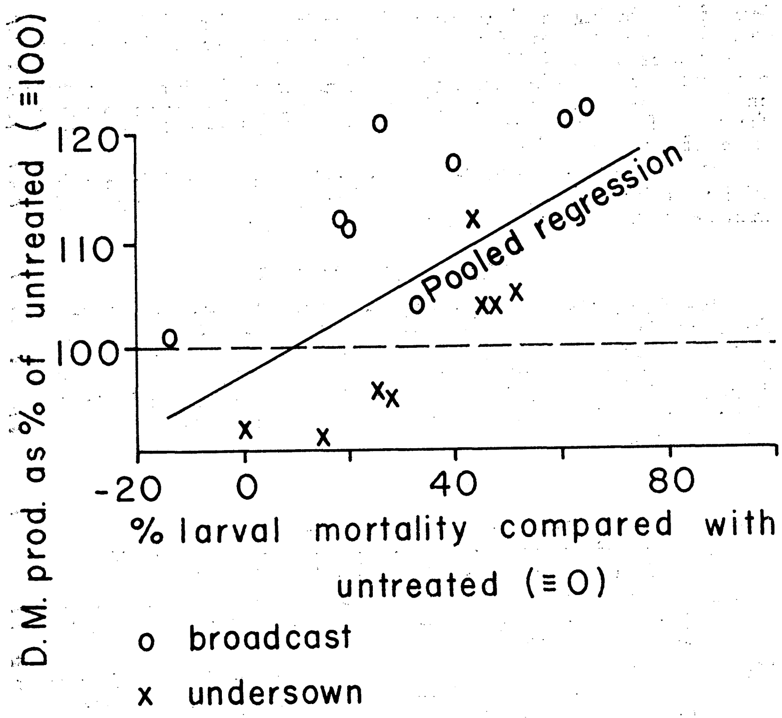

Fig. 1: Relationship between soldier fly larval mortality and dry matter production.

The slopes of the regression lines for undersown and for broadcast treatments were not significantly different (broadcast 0.34 ± 0.09, undersown 0.25 ± 0.08) whereas their intercepts were (undersown Y = 89 ± 3 broadcast Y = 106 ± 3), there being a depression in production associated with undersowing. Most likely this resulted from the mechanical damage caused by cutting the slits down which the insecticides were placed.

Pooled regression of these two lines suggested that for every 10% mortality of soldier fly larvae, there was a corresponding 2.75 percent increase in dry matter production. Thus at 60% larval mortality there was a corresponding 16.5% increase in dry matter production.

DISCUSSION and CONCLUSIONS

The results confirm that three systemic insecticides, carbofuran, phorate and fenamiphos, were active against soldier fly larvae. Increasing the rate of the insecticides increased their effectiveness markedly more when they were broadcast than when they were undersown. This suggests that high rates broadcast make a greater proportion of roots toxic to the larvae than low rates broadcast but that undersown treatments only make the same amount of roots toxic to the larvae irrespective of the rate of insecticide used.

Broadcasting high rates of these materials in the autumn could provide 80% mortality but would be undesirable and costly. The problem of distributing small amounts of toxic insecticides efficiently enough to make large volumes of root matter toxic to soldier fly larvae is real. Recent work by A. G. Mackay *et al* (1974) has shown that, after using paraquat to remove the existing vegetation, direct drilling, incorporating an insecticide with fertiliser and seed encourages the larvae to move to the rows of plants where the insecticide is placed and this results in a more efficient use of the insecticides.

Consistent increases in dry matter production resulted from reducing soldier fly larvae populations, a 60% larval mortality giving a 16.5% increase in dry matter production.

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