EVALUATION OF INSECTICIDES FOR LUCERNE FLEA CONTROL IN PASTURES

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SUMMARY

Several insecticides were evaluated in 1982 for control of lucerne flea (*Sminthurus viridis*) in pasture because of widespread farmer dissatisfaction with maldison, the only registered control. Fenitrothion, chlorpyrifos, dimethoate, diazinon, omethoate and phosmet all gave a longer period of control than maldison. Oxamyl gave similar results to maldison. The greater effectiveness of fenitrothion, chlorpyrifos and dimethoate was related to their residuality on treated foliage in bioassay tests. Diazinon and omethoate also exerted a reasonable period of control after application, contrary to results obtained from bioassay tests.

INTRODUCTION

During winter and spring 1982, severe infestations of lucerne flea were reported from Kaipara, Franklin County, Te Kauwhata-Huntly and Morrinsville, damage being most pronounced on dairy farms. Significant damage ceased in December, as lucerne flea entered a summer diapausing egg stage with the onset of warmer, drier soil conditions (Wallace 1968). Lucerne flea occurs widely in New Zealand (Dumbleton 1939; Somerfield and Burnett 1976), but has only been recognised as a locally important pest in the Te Kauwhata-Huntly area (Townsend *et al* 1979) prior to the current outbreaks.

Damage to clovers has been described by Dumbleton (1939). Both the nymphs and adults damage foliage by rasping off green tissue imparting a flecked appearance. Only the veins and withered tissues remain on badly damaged foliage. Severe damage limits clover production and can occur within weeks of lucerne flea becoming apparent. White clover (*Trifolium repens*) and other pasture legumes are preferred, although ryegrass (*Lolium* spp) and most pasture weeds are also attacked.

Because farmers were dissatisfied with the short length of control obtained with maldison, Townsend *et al* (1979) evaluated phosmet and omethoate, as alternatives. Despite effective control over 3-5 weeks at cost-competitive rates these products have never been registered for lucerne flea control in New Zealand. When further reports of poor control with maldison were received in 1982, it was decided to extend the search for alternative insecticides and evaluate those already with registrations against other pasture or lucerne pests in New Zealand. Oxamyl (Vydate L, 24 w/v non aqueous concentrate), diazinon (Dyzol, 80 EC), dimethoate (Rogor E, 40 EC), fenitrothion (Gramathion, 60 EC) and chlorpyrifos (Lorsban, 40 EC) were selected for trial and the effectiveness of maldison (Malapreme 100 E, 100 EC), omethoate (Folimat, 58 w/v non aqueous concentrate) and phosmet (Imidan, 75 WP) were re-evaluated. Application rates were chosen on a cost basis relative to maldison.

METHOD

All products were sprayed onto 4.8 x 10.0 m pasture plots. Applications were made with a hand-held 2.4 m boom fitted with Spraying Systems flat fan nozzles (No. 730154)

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operated at 210 kPa and delivering 300 litres/ha from a pressurised mistifier knapsack sprayer. Controlled droplet application treatments included in Trial 1 were applied using vehicle mounted Micromax units as described by Wrenn and Skinner (1982). CDA was used to assess whether a lower cost of application using the same rates of chemical as boom spraying, were possible. Maldison 150 g ai/ha was applied by two CDA treatments; 12 litres of spray mix/ha using 150 μ m droplets, and 45 litres/ha using 270 μ m droplets. As insect counts obtained subsequent to the two CDA treatments and the flat fan nozzle application were not significantly different pooled results are presented in Table 1.

TABLE 1: Trial 1. Comparison of diazinon with maldison, phosmet and omethoate for control of lucerne flea.

Insecticide	Rate g ai/ha	No. lucerne flea/sweep at intervals after spraying					
		Weeks after spraying					
		1	2	3	4	5	6
untreated	—	15	10	31	35	42	25
maldison	150	3	16	24	34	40	13
diazinon	150	1	2	5	15	29	10
diazinon	250	0	0	3	7	17	17
omethoate	150	1	0	2	4	13	7
phosmet	150	0	0	2	6	12	7
LSD 5% level		2.5	2.4	3.1	4.0	3.0	1.9

Four replicates of each treatment were included in Trial 1 at Te Kauwhata, Trial 2 at Ruawaro and Trial 3 at Aka Aka, whilst five replicates were included in Trial 4 at Waiuku. All trials were arranged in randomised block designs. Trial 1 was sprayed in April 1982, Trials 2 and 3 in June 1982, and Trial 4 in August 1982. All trials were grazed by dairy cows on a normal farm rotation, following a two week withholding period after application of treatments.

TABLE 2: Trials 2 and 3. Comparison of diazinon, dimethoate, fenitrothion, chlorpyrifos and oxamyl with maldison and omethoate for control of lucerne flea.

Insecticide	Rate g ai/ha	Mean % of lucerne flea surviving at intervals after spraying							
		Weeks after spraying							
		1	2	3	4	5	6	7	
maldison	100	4	14	39	42	84	87	—	
omethoate	100	2	14	33	47	97	93	—	
diazinon	125	1	8	21	29	33	55	—	
diazinon	250	0	3	6	9	42	38	—	
dimethoate	150	0	6	15	56	41	81	—	
dimethoate	300	1	7	9	20	31	46	—	
fenitrothion	300	0	2	8	9	12	59	79	
fenitrothion	600	0	2	8	6	14	21	49	
chlorpyrifos	100	0	5	8	6	13	15	50	
chlorpyrifos	200	0	3	5	8	6	18	43	
oxamyl	75	10	29	57	70	63	100	—	
oxamyl	150	6	26	58	60	64	65	—	
LSD 5% level		2.8	2.7	3.1	2.8	2.9	2.6	2.9	

Levels of lucerne flea infestation were assessed in all trials by sweeping foliage through an arc of 360°, with a 300 mm diameter net, held at a radius of 1 m. The contents from each sweep (one/plot) were killed in 70% alcohol and counts made in the laboratory with the aid of a binocular microscope.

A $\log_e x + 1$ transformation was applied to all field trial counts before analysis of variance tests. As counts in Trials 2 and 3 were similar the results for each treatment have been pooled.

A bioassay technique was used to assess the biological activity of the insecticides. Foliage samples were clipped from the high rate treatments in Trial 2, seven, 11 and 14 days after spraying and from all treatments in Trial 4, two, 5 and 9 days after spraying. A 5 g wet weight subsample of the foliage was placed in a small jar and 10 mature lucerne fleas added. The jars were then kept for 24 hours at room temperature before assessment of mortality. Four replicates of each treatment were evaluated. Springtails which jumped were considered 'alive' all others were classed as dead. Treatment details and the results are presented in Table 4. Insect counts were transformed before analyses of variance. Because mortality caused by chlorpyrifos, dimethoate and fenitrothion was significantly different from other treatments a logit analysis was used to estimate the day at which mortality declined to 50% (Table 4).

TABLE 3: Trial 4. Comparison of fenitrothion, chlorpyrifos, dimethoate and diazinon, each at two rates, for control of lucerne flea on pasture.

Insecticide	Rate g ai/ha	No. lucerne flea/sweep at intervals after spraying					
		Weeks after spraying					
		1	2	4	5	7	9
untreated	0	242	65	179	68	77	66
fenitrothion	300	4	9	43	37	24	10
fenitrothion	150	5	16	39	43	27	29
chlorpyrifos	100	2	6	38	25	35	18
chlorpyrifos	50	6	11	65	54	33	36
dimethoate	150	8	14	105	56	48	29
dimethoate	75	12	34	96	55	45	42
diazinon	125	18	19	63	31	35	30
diazinon	62	22	27	73	68	58	45
LSD 5% level		2.1	2.0	1.7	1.6	1.7	2.4

RESULTS

In this paper control is defined as mortality greater than 70%. Trials 1-3 confirmed the short term effectiveness of maldison which only gave good control for 1-2 weeks and lacked residual activity on foliage a week after application (Table 4). Oxamyl was comparable to maldison in persistency and effectiveness (Table 2 and 4). Phosmet and omethoate gave 4 weeks control when used at 150 g/ha, confirming the results of Townsend *et al* (1979) (Table 1). Diazinon, dimethoate, chlorpyrifos and fenitrothion all controlled lucerne flea for longer periods than oxamyl or maldison (Tables 1 and 2). Depending upon application rate diazinon and dimethoate were generally effective up to 4 weeks, whilst chlorpyrifos and fenitrothion were effective from 4-9 weeks (Tables 1-3). Dimethoate, chlorpyrifos and fenitrothion all exhibited residual biological activity in excess of 7 days when applied at 300 g, 200 g and 600 g/ha respectively (Table 4). Detectable residual activity in excess of a week was not found by bioassay for either omethoate (100 g/ha) or diazinon (250 g/ha), although both insecticides gave useful lengths of field control.

TABLE 4: The biological persistence of insecticide at selected application rates as determined by bioassay tests of lucerne flea on treated foliage.

Insecticide	Rate g ai/ha	Estimated day after spraying at which bioassay mortality reached 50%	Standard error of estimated day
maldison	100	<7*	—
omethoate	100	<7*	—
oxamyl	150	<7*	—
diazinon	250	<7*	—
diazinon	125	<2*	—
diazinon	62	<2*	—
dimethoate	300	7.6	0.3
dimethoate	150	5.5	0.6
dimethoate	75	2.7	0.3
chlorpyrifos	200	9.9	0.1
chlorpyrifos	100	4.2	0.3
chlorpyrifos	50	<2*	—
fenitrothion	600	10.3	0.8
fenitrothion	300	6.2	0.1
fenitrothion	150	3.6	0.6

*The day shown in these cases being the first test day.

DISCUSSION

The results demonstrate that all chemicals tested except oxamyl gave longer periods of control than maldison at cost competitive rates. The cost of chemicals used in these trials was less than \$10/ha.

Comparable results to boom spraying were achieved with CDA application of maldison in Trial 1, suggesting that CDA because much lower volumes of diluent are required, could provide a lower cost alternative to the former method.

Diazinon, chlorpyrifos and fenitrothion were all effective at much lower rates than the maximum quantities permitted against other pasture pests. Diazinon (250 g/ha), dimethoate (300 g/ha), chlorpyrifos (100 g/ha) and fenitrothion (150 g/ha) all gave good control but at lower rates the length of field control declined. The longer residuality of dimethoate, chlorpyrifos and fenitrothion on treated foliage is one of the reasons for their increased effectiveness. Diazinon, like maldison lacked biological persistency. Reasons for its longer period of control relative to maldison cannot be advanced. The enhanced control from the more persistent insecticides on foliage probably relates to their ability to kill nymphs hatching from eggs subsequent to application of the chemicals. Whether diazinon and omethoate have ovicidal action against lucerne flea is not known.

Since completion of these trials dimethoate and fenitrothion have been given full registration for use against lucerne flea.

Although diazinon gave inferior length of control compared to chlorpyrifos, dimethoate and fenitrothion, no withholding period is required when applied at low rates. This compares with withholding periods of 7 days for chlorpyrifos and dimethoate and 14 days for fenitrothion, an obvious advantage when control treatments are applied close to grazing. However, when withholding period is not limiting fenitrothion and chlorpyrifos are superior choices.

CONCLUSION

Trials reported in this paper have shown that several available alternative insecticides to maldison are effective against lucerne flea when applied at low rates.

Further research is required to elucidate the effect of time of application in relation to the life cycle pattern of lucerne flea, the best method of application of spray formulations and to clearly establish economic threshold levels.

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