PROMISING SOIL INSECTICIDES FOR CONTROL OF GRASS-GRUB

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Summary

Nine organophosphorus insecticides were screened in 1964 on grass-grub (*Costelytra zealandica*) apparently resistant to at least three chlorinated hydrocarbons. Soon after laying down the trials, growth responses showed up on all replicates treated with fensulfothion 2½% granules at 2 lb. This response continued into the spring flush of growth when differences became less apparent but still significantly different at the 1% level at both the 1 lb and 2 lb application rates when herbage cuts were taken in October. Virtually no larvae were found in the 2 lb treatment (October, 1964, and August, 1965). Further trials on various soil types in different localities in 1965 and 1966 showed fensulfothion at 1 lb, 1.5 lb and 2 lb rates to be most effective in reducing the number of grass-grub larvae where DDT failed to give control whether there was a history of application or not. The earlier the application of fensulfothion, the more pronounced the response both as regards pasture production and control of larvae.

INTRODUCTION

There are many instances at present of DDT proving substantially ineffective for the control of grass-grub.

A number of alternative insecticides controlling DDT-resistant insects are available, but most are lacking certain requirements essential for the control of exclusively soil inhabiting insects.

In 1964, experiments were commenced with promising organophosphate insecticides.

EXPERIMENTAL

Blocks were chosen after preliminary sampling had established that relatively even counts could be assured throughout. Plots are 1/160th acre randomized and 5 times replicated. Parts of earthworms of over half an inch in length were counted as whole worms. Soil references to the trial sites are given in Table 1.

Pasture cover was assessed both visually and by mowing. The visual assessment was on a 0 to 5 rating where 0 was regarded as no growth response and 5 as optimum growth for the period. Herbage samples generally were sent for dry matter and/or dissection. Where there were big variations in dry matter owing to some samples containing earth particles, then results are not corrected. This is so for the April 19, 1966, mowing of Trial 6 and the April 21, 1966, mowing of Trial 5. The May 18, 1966, mowings of Trials 5 and 6 were somewhat similarly affected, but these are recorded as corrected for dry matter as well as being recorded as straight green matter weights (Table 4). The samples with

TABLE 1: TRIAL SITES WITH SOIL REFERENCE

<i>Trial No.</i>	<i>Site</i>	<i>Soil Set</i>	<i>Ref. No.*</i>	<i>Group</i>
1	Silver-hope	Kiwitea loam	76a	Yellow brown loam
1a				
5				
6				
2	Levin	{ Levin silt loam	76	Yellow brown loam
		{ Koputaroa sand	24	Yellow brown earth
3	Gladstone	Kourarau clay loam	25c	Yellow brown earth
4	Mauriceville	Matamau heavy silt loam	77b	Yellow brown loam

* These reference numbers apply to *Soil Bureau Bulletin (N.I.) No. 5*.

earth intermixed were higher in dry matter weight by almost one-third. To correct green weights with these distorted figures only increases the error and reduces the proportional advantage of the better treatment.

Where DDT granulated superphosphate (approx. 1.25% DDT) was a treatment, all other plots received superphosphate equivalent to 2 cwt per acre. Trials 2 and 5 were oversown immediately after treatment.

RANGITIKEI TRIALS 1 and 1a (Table 2)

These were the two trials in which the nine organophosphorus insecticides were screened. In the autumn of 1963, the farmer applied DDT 12.5% prills at 2 lb. Counts averaged 90 larvae per square foot. In July, 1964, DDT tolerance tests showed only 8% of the larvae were affected by a dose of DDT which would normally affect 100% of susceptible larvae.

HOROWHENUA AND WAIRARAPA TRIALS 2, 3 and 4 (Table 3)

After screening, it was decided to examine other soil types using the two most promising materials, namely, fensulfothion and S4400. DDT granulated superphosphate at 2 lb was used as the standard treatment in preference to DDT prills because of the disappointing result from the prills and the possibility of better results from the superphosphate combination. The Levin property was topdressed with DDT 12.5% prills the previous year on May 9, 1964. Both the Gladstone and Mauriceville farmers had never used DDT.

RANGITIKEI TRIAL 5 (Table 4)

The evaluation of fensulfothion at 0.5 lb and 1.5 lb was the basic reason for this trial. At the time of preapplication sampling on April 15, 1965, the grass-grubs were mainly 3rd instar larvae together with a few at the 2nd instar stage and all close to the surface.

TABLE 2: TRIALS 1 AND 1a (RANGITIKEI)
Treatment Mean for 5 Replicates

Treatment (lb)	Post-application Sampling			Pasture Recovery	
	Grass-grubs*	Worms†	Visual (rated 0-5)	Herbage† (lb/ac)	
	Jul. 17, '64	Oct. 1, '64	Aug. 11, '65	July 17, '64	Oct. 16, '64
TRIAL 1, SILVERHOPE:					
Ethyl parathion 2.5% G. 1.5	29.9 abA			1.8 bB	3059 bcB
Azinphos methyl 2.5% G. 1.0	23.2 bcAB			1.5 bcB	2396 bcB
Trichlorphon 2.5% G. 1.0	22.0 bcAB	12.2 aAB		1.6 bcB	3396 bAB
Bayer S4706 2.5% G. 1.0	32.5 abA			0.9 cB	2633 bcB
S4400 2.5% G. 1.0	31.8 abA	4.3 a	27.7 a	1.4 bcB	2475 bcB
Fensulfothion 2.5% G. 1.0	14.4 cB	4.4 a	38.7 a	3.2 aA	5079 aA
Fenthion 2.0% G. 1.0	40.7 aA			1.0 bcB	1643 cB
Bayer S1751 50% EC. 1.0	26.5 abAB			1.4 bcB	2703 bcB
Control	23.8 bAB	17.6 aA	29.1 a	1.5 bcB	2465 bcB
C.V.				35.8%	34.4%
TRIAL 1a, SILVERHOPE:					
Muscatox 2.5% G. 2.0	35.2 aA			1.6 bcBC	4544 bcdBC
Azinphos methyl 2.5% G. 2.0	29.4 abA			1.3 cBC	4148 cdBC
Trichlorphon 2.5% G. 2.0	25.0 abA	18.0 aA	32.8 a	2.3 bB	4673 bcdBC
Bayer S4706 2.5% G. 2.0	23.3 abA			1.1 cC	5663 bcBC
S4400 2.5% G. 2.0	16.6 bAB	8.5 bA	38.5 a	1.9 bcBC	6326 bB
Fensulfothion 2.5% G. 2.0	8.4 cB	1.4 cB	39.1 a	4.1 aA	8732 aA
Fenthion 2.0% G. 2.0	29.2 abA			1.4 cBC	3316 dC
DDT prills 12.5% 2.0	34.3 aA	16.0 aA	31.6 a	1.6 bcBC	5039 bcdBC
Control	24.3 abA	17.9 aA	34.7 a	1.2 cBC	3841 cdBC
C.V.				30.9%	26.9%

* log (x + 1) transformation on these figures before statistical analysis.

† Green weight. Area mown = 11 ft × 2 ft × 4 ft per plot.

TABLE 3: TRIALS 2, 3 AND 4 (HOROWHENUA AND WAIRARAPA)
Treatment Mean for 5 Replicates

Pre-application Sampling		Treatment (lb)	Post-application Sampling		Pasture Recovery	
Grass	grubs* Worms*		Repl. & Treatment	Grass-grubs Totals	Visual (rated 0-5)	Herbage† (lb/ac)
TRIAL 2, LEVIN:						
Mar. 20, '65	24.8 a	Mar. 20, '65	Jul. 15, '65	Sep. 1, '65	Oct. 7, '65	
19.4 a	Control		12, 25, 11, 7, 9, :	1.1 bA	500 a	
17.6 a	Fensulfothion 2½% G. 2.0		0, 0, 0, 0, 0, :	3.0 aA	663 a	
15.1 a	Fensulfothion 2½% G. 1.0		1, 2, 0, 0, 0, :	2.5 abA	479 a	
14.2 a	S4400 2½% G. 2.0		2, 4, 1, 6, 7, :	2.6 abA	511 a	
15.0 a	DDT gran. super 2.0		29, 6, 32, 35, 6, :	1.2 bA	547 a	
CV				53.0%	23.2%	
TRIAL 3, GLADSTONE:						
Apr. 9, '65	24.1 a	Apr. 9, '65	Aug. 13, '65	Jul. 2, '65	Jul. 22, '65	
30.3 a	Control		11, 15, 16, 28, 4, :	1.1 cA	1378 a	
34.6 a	Fensulfothion 2½% G. 2.0		7, 1, 0, 0, 0, :	2.5 aA	1421 a	
27.0 a	Fensulfothion 2½% G. 1.0		2, 4, 0, 4, 11, :	2.4 abA	1332 a	
22.9 a	S4400 2½% G. 2.0		3, 4, 23, 9, 1, :	0.9 cA	1495 a	
CV			4, 7, 23, 2, 13, :	1.2 bcA	1365 a	
				56.4%	12.2%	
TRIAL 4, MAURICEVILLE:						
Apr. 1, '65	56.7 aA	Apr. 1, '65	Jul. 22, '65	Jul. 2, '65	Oct. 27, '65	
20.3 abA	Control		24, 17, 14, 2, 25, :	1.6 a	683 a	
18.6 abA	Fensulfothion 2½% G. 2.0		0, 1, 0, 0, 0, :	1.7 a	779 a	
26.2 aA	Fensulfothion 2½% G. 1.0		11, 0, 3, 4, 2, :	1.8 a	696 a	
12.5 bA	S4400 2½% G. 2.0		21, 28, 9, 6, 6, :	1.5 a	790 a	
18.2 abA	DDT gran. super 2.0		22, 27, 3, 8, 12, :	0.9 a	692 a	
CV				41.9%	10.6%	

* log (x + 1) transformation on these figures before statistical analysis.

† Corrected for dry matter. Area mown: Trial 2 = 10 ft × 10 ft centre square per plot. Trials 3 and 4 = 16½ ft × 1½ ft × 3 per plot.

‡ Too many zeros make an analysis of variance invalid (1% significant by *t* test).

TABLE 4: TRIALS 5 AND 6 (RANGITIKEI)
Treatment Mean for 5 Replicates

Treatment (lb)	Post-application Sampling		Pasture Recovery			
	Grass-grubs*	Worms*	Herbage† (lb/ac)	Visual (rated 0-5)	Herbage‡ (lb/ac)	Herbage† (lb/ac)
TRIAL 5, SILVERHOPE:						
Apr. 15, '65	Jul. 29, '65		Nov. 10, '65	Apr. 19, '66	Apr. 21, '66	May 18, '66
Control	26.1 aA	36.7 aA	1000 a	1.9 bB	1556 cB	866 cB
Fensulfothion 2½% G. 0.5	16.9 aA	26.2 bA	1048 a	2.2 bB	1886 cB	208 cB
Fensulfothion 2½% G. 1.0	7.1 bB	32.9 abA	1124 a	4.1 aA	2891 bA	1035 cB
Fensulfothion 2½% G. 1.5	7.3 bB	37.7 aA	968 a	4.8 aA	3587 aA	1535 bA
DDT gran. super. 2.0	26.8 aA	35.0 aA	12.2%	1.3 bB	1313 cB	1915 aA
CV				25.8%	21.8%	19.5%
						20.0%
						19.4%
TRIAL 6, SILVERHOPE:						
Mar. 18, '66						
Apr. 21, '66	Jun. 28, '66					
(a) Fensulfothion 2½% G. 2.0	0.3 cB			4.0 aA	4108 aA	4232 aA
(a) Fensulfothion 2½% G. 1.0	3.0 bB	Not sampled		4.1 aA	4100 aA	3947 abA
Control	14.3 aA		N/A	3.3 abA	3111 bAB	3242 bcAB
(b) Fensulfothion 2½% G. 1.0	21.5 aA					2310 cB
(b) Fensulfothion 2½% G. 2.0	2.1 bB					517 cB
CV				19.9%	19.0%	19.3%
						20.1%
						16.7%

* log (x + 1) transformation on these figures before statistical analysis.

† Corrected for dry matter. Area mown = 16 ft × 4 ft per plot on Nov. 10, 1965, and 16½ ft × 1½ ft × 3 per plot on Apr. 21, 1966, and May 18, 1966.

‡ Green weight.

Fig. 2: Grass-grubs after treatment. Each column represents the total grubs in 15 spade squares (5 sq. ft).

RANGITIKEI TRIAL 6 (Table 4)

From results of trials carried out elsewhere, there appears to be some fall off in grass-grub control where fensulfothion is used late in the autumn and in winter. To endeavour to determine what differences there are between a March and an April treatment, a further trial was established at Silverhope.

RESULTS AND DISCUSSION

Where the 2 lb of fensulfothion 2½% granule has been used, grass-grub numbers have generally been reduced to zero and second year sampling of Trial 1a has shown they remain that way the following year. In Trial 5 the 1.5 lb rate brought grub numbers down to a low level in 1965 and in 1966 were almost as low while larvae in adjacent plots had increased two- and three-fold. These results are possibly consistent with Fenimore's findings, namely "slow grass-grub reinfestation of plots following high initial kill despite lack of any soil residual effect".

The control figures, second year Trial 1, could be confounding. In the October, 1964, sampling, the no treatment replicates harboured the highest number of grass-grubs. In the following year most controls recorded a zero. Assuming reinfestation is dependent on some margin of green cover, then perhaps the control plots were below this margin. In other words, perhaps the females on emerging from the control plots found the environment less favourable for mating and egg deposition. S4400 1 lb was disappointing and fensulfothion 1 lb was no better.

DDT was ineffective in the trials listed. There was no difference in effectiveness between the prill or granule formulations. Where DDT had not been used before, as at Mauriceville and Gladstone, the results were negative.

From herbage weight sampling in Trial 6, there is reason to believe that the March application is preferable to April. This also applies to the control of grass-grub larvae.

With S4400, emphasis might best be placed on the 2 lb rate.

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