A NEW ABSORBED CLAY GRANULE FOR DIAZINON AND ETHOPROPHOS

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Summary

New 20% formulations of diazinon and ethoprophos using two sizes of a special absorbent clay LVM granule were compared with 10% coated granule formulations for grass grub control in two field trials in South Taranaki. There were no significant differences in grass grub control between the diazinon coated granule and the two diazinon absorbed clay granules. On the other hand, the absorbed clay granule of ethoprophos gave significantly better grass grub control than the coated granule in one trial and a significant pasture DM response in the other. Applied to moist soil with rain following, ethoprophos gave very similar results to fensulfothion, but in dry conditions fensulfothion was significantly better. The release characteristics of the new granule and the effect of granule density on grass grub control, are discussed.

INTRODUCTION

The organophosphates available commercially for controlling grass grub (*Costelytra zealandica* (White)) are usually sold as granule formulations. The most common granule formulation has the chemical coated on the outside of a calcite core. This type of granule is not ideal, since the amount of chemical which can be coated on the outside is limited, unless special procedures are adopted e.g. the Sorbie* process.

Previous attempts to produce a more versatile granule by using an absorbent clay core have failed, because of the instability of organophosphates on the clay granule available. However stability tests in the laboratory with a new, highly absorbent LVM (Low Volatile Moisture) clay granule have given very good results and the trials reported in this paper were conducted to test the efficacy of the new granule in the field.

Formulations Used:

Active Ingredient	Formulation	Granule Type (% a.i.)
diazinon	10G	— coated limestone 16/30* core (10%)
diazinon	20G 20/38 M	— absorbed LVM clay 20/38* core (20%)
diazinon	20G 16/28 M	— absorbed LVM clay 16/28* core (20%)
ethoprophos	10G	— 'Sorbie*' coated limestone core (10%)
ethoprophos	20G	— absorbed LVM clay 20/38* core (20%)
fensulfothion	5G	— coated limestone core (5%)

(* 16/28, 16/30 and 20/38 refer to the BSS mesh range)

EXPERIMENTAL METHOD

All the above formulations were applied at 2 kg a.i./ha. Each was diluted sevenfold with a matching inert core and broadcast on

* Sorbie is a Trade Mark of Farm Chemicals Company.

plots using a Gandy ground-propelled fertilizer spreader to give a 1 m wide swath. Grub density and soil moisture content were both determined when each application was made and the rainfall following application was recorded.

Trial 064 was laid at Matapu, South Taranaki on a Stratford sandy loam. Each plot was 20 x 3 m separated by a 1 m untreated strip. A random block design with eight treatments per block and three different times of application was replicated four times. Treatments were made on the 1 February, 5 March and 29 March, 1973.

On the 12 April the trial was closed to grazing and on the 22 June grub counts (5 random 0.02 m² cores/plot) and pasture yields (one 20 m mower strip/plot) were made. The untreated strips were also yielded and the average for each block of eight treatments was used for the analysis. The results were analysed for each time of application separately, since some treatments changed between applications.

Trial 068 was laid at Ngaere, South Taranaki. Plot sizes were 10 x 4 m. Each treatment was replicated twice and applied at three different times, viz. 11 March, 27 March and the 18 April, 1973. The trial was closed to grazing on the 2 June and grub counts and pasture yields were determined on the 12 September. Because conditions were similar for each treatment and a t-test for heterogeneity of variance was not significant, the results were analysed as six replications.

RESULTS

TABLE 1: GRASS GRUB NUMBERS/0.1 m²

Trial Treatment 2 kg a.i./ha	064 — Matapu			068 — Ngaere		
	1.2.73	5.3.73	29.3.73	11.3	27.3	18.4.73
diazinon 10G	12.4 a	6.9 bB	12.1 abAB		6.4 bc	
diazinon 20G 20/38 M	9.9 ab	5.8 bB	4.7 bcBC		5.1 bc	
diazinon 20G 16/28 M	11.8 a	7.2 bB	7.2 bcBC		6.9 bc	
ethoprophos 10G	11.6 a	7.2 bB	6.9 bcBC		10.1 b	
ethoprophos 20G 20/38M	—	—	0 cC		0.6 c	
fensulfothion 5G	1.9 b	1.7 bB	0.6 cC		2.6 c	
untreated	17.3 a	15.7 aA	17.6 aA		19.4 a	
<i>Application Conditions</i>						
Soil moisture %	17.1	27.2	41.6	38.0	53.2	48.1
1st Sign. rainfall days	32	7	14	3	15	7
Amount rainfall mm	22	63	27	58	6	29

The grub counts and pasture responses from the two trials are shown in Tables 1 and 2 respectively. The first application at Matapu was made in February in drought conditions and rain did not occur until 32 days after. Despite these dry conditions, fensulfothion significantly reduced grub numbers and increased pasture yield. None of the other treatments reduced grub numbers significantly. Ethoprophos 10G produced a small but significant pasture response.

By the early March application, soil moisture levels at Matapu had begun to rise and adequate rain occurred after application. Under these conditions the more transient organophosphates diazinon and ethoprophos were more effective, with the result that all treatments produced significant pasture responses and significantly reduced grub numbers. The best treatments were fensulfothion and the diazinon 20G 20/38 M formulation.

By the third application at the end of March, soil moistures were approaching field capacity and all treatments except diazinon 10G significantly reduced grub numbers. The absorbent clay formulation of etho-

Pasture Pests

TABLE 2: INCREASE IN PASTURE DM kg/ha AS A RESULT OF TREATMENT (Treated — Untreated)

Treatment 2 kg a.i./ha	Trial appln	064 Matapu			068 Ngaere
		1.2.73	5.3.73	29.3.73	11.3-19.4.73
diazinon 10G		210 bc	590 b	740 ab	350 ab
diazinon 20G 20/38 M		220 bc	1150 a	820 ab	250 bc
diazinon 20G 16/28 M		440 abc	930 ab	640 b	510 a
ethoprophos 10G		470 ab	810 ab	730 ab	420 ab
ethoprophos 20G 20/38 M		—	—	1450 a	380 ab
fensulfothion 5G		750 a	1160 a	1180 ab	590 a
untreated		0 c	0 c	0 c	0 c
Yield of untreated areas		1490	1390	1600	860

prophos was considerably better than the same ingredient on the 'Sorbie' granule. The correlation between pasture DM yield and grub density at Matapu was highly significant ($r = 0.85$; $n = 24$).

The moist soil and weather conditions which prevailed at Ngaere were probably largely responsible for the significant reduction in grub numbers obtained with all treatments. Nevertheless, as occurred at Matapu, the absorbed clay granule of ethoprophos gave results similar to fensulfothion, which were significantly better than the coated ethoprophos granule. All diazinon formulations produced similar results.

DISCUSSION

Granule Type:

The results of these trials indicate that diazinon and ethoprophos were satisfactorily released from the new absorbed clay granule under field conditions. A comparison between the two ethoprophos formulations indicates that the absorbed clay granule obtained consistently better grub mortalities and pasture responses than the 'Sorbie' coated granule. This difference did not occur to the same extent with the diazinon formulations.

These field results confirm the simulated rainfall release tests conducted in the laboratory (Table 3) which indicated that the release rate of the absorbed clay diazinon granule was approximately twice that of the coated diazinon granule; and that the release of ethoprophos from the absorbed clay granule was even faster and more complete. No doubt a contributing factor to the fast release rate of the absorbed clay granule was its ability to disintegrate with relatively low amounts of 'rain'. It is also possible that without the necessity of a 'sticker', required to adhere the chemical to coated granules, the chemical was leached more readily from the clay granule.

TABLE 3: % ACTIVE CONTENT LEACHED FROM GRANULES UNDER SIMULATED RAINFALL CONDITIONS

Rainfall equivalent (mm)	1.25	2.50	3.75	5.00	6.25	10.00
diazinon 10G	13	13	15	11	11	22
Total leached		26	41	52	63	85
diazinon 20G 16/28 M	20*	25	17	13	6	—
Total leached		45	62	75	81	—
ethoprophos 20G 16/28 M	69*	22	1	—	—	—
Total leached		91	92	—	—	—

* Point at which granule disintegration began.

Granule Distribution

The propensity of the new clay granule to absorb over 50% of its weight as liquid in the form of insecticide and solvents, and still remain free flowing and chemically stable, enables granules of relatively high percent active ingredient to be manufactured. Obviously, the more insecticide per granule the less granules per unit area that are needed and this has prompted discussion as to what is the minimum density of granules required on pasture.

In one appraisal, Taylor (1965) considered this to be 1 per 9 cm², for soil-inhabiting insects. The treatments included in the trials at Matapu and Ngaere all came within this estimate (Table 4), but the variation was from 1 per 1.48 cm² with fensulfothion 5G to 1 per 5.65 cm² with diazinon 20G 16/28 M.

Reference to Tables 1 and 2 however, shows that these granule densities appear to bear little relationship to grass grub control or pasture response. Instead, insecticidal activity tends to be related more to active ingredient, granule type and environmental conditions. Thus, the ethoprophos 20/38 M granule produced better results than the diazinon 20/38 M although their densities were similar; while the results from all diazinon formulations were similar despite large variations in density. The improved activity of the ethoprophos 20G may have, in part been due to the greater density of granules, although the current season's trials show little difference between ethoprophos 20/38 M and 16/28 M formulations.

TABLE 4: THEORETICAL DISTRIBUTION OF GRANULES USED IN TRIALS, BROADCAST at 2 kg a.i./ha

Formulation	BSS mesh	Bulk Density g/ml (Water=1)	Granules/ 0.1m ²	Area cm ² influenced by 1 granule
diazinon 20G	16/28M	0.80	177	5.65
ethoprophos 10G	16/25	1.39	202	4.95
diazinon 10G	16/30	1.36	315	3.18
ethoprophos 20G	20/38M	0.79	570	1.75
diazinon 20G	20/38M	0.73	620	1.61
fensulfothion 5G	16/30	1.57	676	1.48

CONCLUSIONS

These field trials confirm the laboratory tests which indicated that a new, absorbent LVM clay granule is a most effective carrier for diazinon and ethoprophos. They also indicate that the absorbed clay formulation of ethoprophos is more effective for controlling grass grub than the coated granule.

The treatments applied in the trials also enabled an indirect comparison of the same chemical broadcast at different granule densities on the pasture. From the grub mortalities and pasture responses obtained, it appeared that the active ingredient, application conditions and the release characteristics of the granule were better determinants than granule density, for insecticidal activity.

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