EVALUATION OF THE SOLID STREAM APPLICATION TECHNIQUE FOR GRASS GRUB CONTROL IN THE NORTHERN NORTH ISLAND

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SUMMARY

In field trials carried out in the Waikato and on the volcanic plateau solid stream applications of liquid insecticides (2 kg/ha) at different times gave the following reductions of grass grub (*Costelytra zealandica*) populations: isazophos (3 trials) 49-85%, isofenphos (1 trial) 67-97%, diazinon (3 trials) 37-60%, compared to 64-89% reductions (4 trials) for surface broadcast fensulfothion granules (2 kg/ha). No significant effects on the level of control were observed for application times (December, February and April) or nozzle spacings (3.75, 7.5 and 15.0 cm). The practical value of the solid stream technique is limited at present by the lack of registration of suitable chemicals.

INTRODUCTION

The solid stream or "jet squirt" technique, which involves applying liquid insecticide formulations in lines through closely spaced solid stream, non-atomising jets close to the pasture surface, was developed successfully for grass grub control in Canterbury by Trought and Wood (1970). There is little published information on the effectiveness of this application technique for grass grub control in North Island pastures, although it was extensively evaluated in the early 1970s in the southern North Island and the Taupo region by J.S. Bircham (pers comm). Watson and Wrenn (1980) showed that insecticides applied by the solid stream technique can give a high level of control of black beetle (*Heteronychus arator*) in Waikato pastures.

The trials reported here were carried out to compare the effectiveness of the solid stream technique with surface broadcast applications of granular insecticide formulations against grass grub on volcanically derived soils in the Waikato and the pumice plateau.

METHODS

Trial 1 was carried out at Paewhenua on an Ohaupo-Otorohanga silt loam and compared diazinon applied by solid stream with surface broadcast fensulfothion granules at three application times, late December 1977, late February and late April 1978 (Table 1). Trials 2 and 3 were conducted at Rukuhia on a Horotiu sandy loam. Trial 2 compared three chemicals applied in March 1979 by solid stream at three nozzle spacings with a standard broadcast granular treatment (Table 2). Trial 3 included two chemicals applied by solid stream and fensulfothion granules applied by surface broadcast and by banding on the surface at two spacings with a modified Gandy applicator (Table 3); all treatments were applied in April 1979. Trial 4 was carried out on a Taupo ash soil at Tihoi and compared solid stream and surface broadcast granules applied in mid December 1979, late February and mid April 1980 (Table 4).

All insecticides were applied to pastures 2 to 7 cm in height after grazing by sheep. Moisture conditions at application were always adequate for the efficient activity of granular treatments (Udy 1977). The details of the solid stream technique were as described by Watson and Wrenn (1980). Surface broadcast granular formulations were

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applied by hand shaker. Plot size was 5 x 10 m with 6 replicates (4 in trial 1) in a randomized block design with buffers of at least 5 m between blocks.

Grass grub populations were assessed in mid to late winter (June to August), 3 to 4 months after the final insecticide treatment, either by taking twenty 10 cm diameter soil cores (Kain and Young 1975) per plot and extracting the grubs by hand sorting or by taking 4 1 m x 14 cm furrows per plot with a sampling plough (Kain *et al* 1979). Analyses were carried out on log transformed counts.

RESULTS AND DISCUSSION

The results are presented in Tables 1 to 4 as percentage reductions of grass grub numbers below the populations of the untreated plots. The level of control obtained with the standard recommended broadcast granular treatment, fensulfothion at 2 kg/ha, ranged from 64 to 87%, within the range 62 to 96% recorded by Kain and Atkinson (1968) and Maclean *et al* (1970) for this treatment. Diazinon applied by solid

TABLE 1: Reductions in grass grub numbers in trial 1 (solid stream applications at 7.5 cm nozzle spacings).

Chemical	Rate (kg/ha)	% reduction at 3 application times: Dec.	Feb.	April	Chemical x rate mean
Solid stream					
diazinon	2.0	37	60	60	52 bA
Broadcast granules					
fensulfothion	2.0	77	64	71	71 aA
fensulfothion	1.0	23	57	66	49 bA
Application time mean		46	60	66	

Untreated population = 49/m²
Main effects: Chemicals P ◄ 0.05; Application times P ► 0.05;
Interactions P ► 0.05.

TABLE 2: Reductions in grass grub numbers in trial 2.

Chemical	Rate (kg/ha)	% reduction at 3 nozzle spacings (cm): 3.75	7.5	15.0	Chemical x rate mean
Solid stream					
isofenphos	2.0	97	67	94	86 aA
isazophos	2.0	85	76	73	78 aA
isazophos	1.0	82	70	31	61 ab AB
diazinon	2.0	43	55	55	51 bc AB
diazinon	1.0	4	40	43	29 c B
Broadcast granules					
fensulfothion	2.0	-	-	-	85 aA
Spacing mean:		62	62	59	

Untreated population = 34/m²
Main effects: Chemicals P ◄ 0.01 Rates P ◄ 0.05 Spacings P ► 0.10
Interactions P ► 0.05

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TABLE 3: Reductions in grass grub numbers in trial 3.

Chemical	Rate kg/ha	Spacing (cm)	% reduction
Solid stream			
isazophos	2.0	7.5	78 aA
diazinon	2.0	7.5	40 bB
Banded granules			
fensulfothion	2.0	12.0	86 aA
fensulfothion	1.0	12.0	80 aA
fensulfothion	2.0	6.0	89 aA
fensulfothion	1.0	6.0	85 aA
Broadcast granules			
fensulfothion	2.0	-	87 aA
fensulfothion	1.0	-	77 aA

Untreated population = 38/m²
Main effects: Chemicals P ◄ 0.01 Rates P ► 0.10 Spacings P ► 0.10
Interactions P ► 0.10

TABLE 4: Reductions in grass grub numbers in trial 4 (all chemicals applied at 2 kg/ha; solid stream applications at 7.5 cm nozzle spacing.)

	% reduction at 3 application times			
Chemical	Dec.	Feb.	April	Chemical mean
Solid stream				
isazophos	53	49	62	55 bA
Broadcast granules				
isazophos	74	62	65	67 abA
fensulfothion	85	83	80	83 aA
Application time mean:	71	65	69	

Untreated population = 118/m²
Main effects: Chemicals P ◄ 0.01 Application times P ► 0.10
Interactions P ► 0.10.

stream gave inferior control (Tables 1, 2 and 3) and isazophos and isofenphos applied by solid stream gave a similar level of control (Tables 2, 3 and 4) to broadcast fensulfothion granules at the same application rate, except for isazophos in trial 4.

The 37 to 60% control obtained with diazinon applied at 2.0 kg/ha by solid stream is below the levels of up to 94% control reported by Trought and Wood (1970) for this treatment in Canterbury but is comparable to the 35 to 74% control with this treatment observed by Bircham (pers comm) in Hawkes Bay, Taranaki and the Taupo area. Carpenter *et al* (1981) also observed highly variable control with this treatment in the southern North Island. The generally poorer performance of diazinon in the North Island compared to Canterbury may reflect regional differences in rainfall and pasture growth. Trought and Wood (1970) noted greater control in a dry year in Canterbury when autumn solid stream applications were made to hard grazed pastures than in a wetter year when there was more pasture cover. They attributed the reduced control under moister conditions to failure of some of the insecticide to reach the soil before

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degradation by light, dilution of insecticide by rainfall and more rapid degradation by micro-organisms in moist soil. Reduced lateral movement of grass grubs under moist conditions more favourable for pasture growth may also be a significant factor. Isazophos, which was not available at the time of Trought and Wood's and Bircham's work, gave less control when applied by solid stream to wet pasture during light rain at the December and February applications in trial 4 (Table 4) than when applied to dry pasture in fine weather in trials 2 and 3 (Tables 2 and 3) and at the April application in trial 4. It is possible that the solid stream treatments may have been more effective if this study had been conducted under drier conditions less favourable for broadcast granular treatments. The performance of isazophos and isofenphos relative to other chemicals against grass grub in this study is similar to that observed by Watson and Wrenn (1980) against black beetle.

Solid stream application of isazophos gave greatest control of black beetle at a nozzle spacing of 7.5 cm (Watson and Wrenn 1980) but nozzle spacings (Table 2) and spacings of banded granules (Table 3) did not significantly affect grass grub control in this study. Trought (pers comm) observed no significant effect of 10, 14 and 18 cm nozzle spacings on grass grub control by solid stream insecticide applications in Canterbury.

The mean effect of application time on grass grub control was not significant (Tables 1 and 4). This suggests that solid stream applications against black beetle at the preferred time in December (East *et al* 1981) may also control grass grub when the two insects are present in mixed infestations, which occur commonly in Waikato pastures. Further work is necessary to confirm this since the results of trial 1 (Table 1) suggest that December applications of diazinon (solid stream) and broadcast fensulfothion granules (1 kg/ha) may be less effective than later applications.

This study has shown that solid stream applications of isazophos and isofenphos can give comparable control to broadcast granular treatments of fensulfothion at similar application rates in northern North Island pastures, but realisation of the potential advantages of the solid stream technique in cost and accuracy of insecticide application (Trought and Wood 1970, Watson and Wrenn 1980) is limited by the lack of registered chemicals. At present diazinon is the only insecticide registered for application against grass grub in a liquid formulation. While solid stream applications of diazinon (2 kg/ha) have given a lower level of grass grub control than surface broadcast fensulfothion granules (2 kg/ha) under North Island conditions, the current retail price of diazinon is about half that of fensulfothion. It may be a more cost-efficient strategy to avoid the use of expensive insecticide treatments which give a high level of control and make more frequent applications of cheaper, less effective treatments against grass grub (East and Kain 1981). In practice, granular formulations are now usually applied against grass grub by drilling rather than surface broadcasting to reduce both application rates (to 1.0 kg/ha or less) and withholding periods. The level of control obtained by drilling insecticides against grass grub is of the order 40 to 70% (W.M. Kain, pers comm; Carpenter *et al* 1981), which is similar to that obtained with solid stream applications of diazinon (2 kg/ha). The solid stream application technique may therefore have a useful role to play in grass grub control in the North Island even in the absence of alternative chemicals to diazinon.

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REFERENCES

Carpenter, A., Wyeth, T.K. and Allan, P.J.T., 1981. Chemical control of grass grub in the southern North Island: results of 1977-79 trials. *Proc. 34th N.Z. Weed and Pest Control Conf.*

East, R. and Kain, W.M., 1981. Prediction of grass grub *Costelytra zealandica* (Coleoptera: Scarabaeidae) populations. *N.Z. Ent. 7* (in press).

East, R., King, P.D. and Watson, R.N., 1981. Population studies of grass grub *(Costelytra zealandica)* and black beetle (*Heteronychus arator* (Coleoptera: Scarabaeidae). *N.Z. J. Ecol. 4* (in press).

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Kain, W.M. and Atkinson, D.S., 1968. Insecticide control of grass grub *(Costelytra zealandica)* in the mid North Island region of New Zealand. *Proc. 21st N.Z. Weed and Pest Control Conf.:* 263-71.

Kain, W.M. and Young, J., 1975. Population studies of *Costelytra zealandica* (White) 1. A soil sampler suitable for sampling pastureland. *N.Z. J. Exp. Agric. 3:* 177-80.

Kain, W.M., Holland, T.V. and Atkinson, D.S., 1979. Rapid methods of sampling soil-inhabiting insect pests of pasture. *Proc. 2nd Australasian Conf. Grassland Invert. Ecol.:* 108-12.

Mclean, L.E.R., Rough, B.F.A. and Proude, C.K., 1970. Six years' results with fensulfothion for the control of grass grub. *Proc. 23rd N.Z. Weed and Pest Control Conf.:* 163-8.

Trought, T.E.T. and Wood, A.C., 1970. The control of grass grub in pasture using liquid insecticides through special machinery. *Proc. 23rd N.Z. Weed and Pest Control Conf.:* 141-50.

Udy, P.B., 1977. Factors influencing the release of insecticides from granular formulations, and their subsequent diffusion into a range of New Zealand soils. *N.Z. J. Agric. Res. 20:* 79-85.

Watson, R.N. and Wrenn, N.R., 1980. An evaluation of the solid stream technique of insecticide application for control of black beetle in pasture. *Proc. 33rd N.Z. Weed and Pest Control Conf.:* 151-4.

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