LIMITATIONS OF DDT ON VOLCANIC SOILS

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Summary

Evidence from 83 trials conducted since 1950 on the yellow-brown pumice soils and yellow-brown loams of the North Island indicates that DDT generally controls grass-grub (*Costelytra zealandica*) on these soils but larval numbers may not be reduced adequately till the third generation after application. Poor control is most serious on recently developed pumice soils where larval numbers as low as 1 to 2 per square foot may cause significant depression and loss of ryegrass (*Lolium* spp.). This effect is most serious under lower rainfall conditions (30 to 35 in.). Grass-grub is more serious on the immature phases of the yellow-brown pumice soils and yellow-brown loams than the more mature phases.

INTRODUCTION

FEW ASSESSMENTS based on trials have been made on the effectiveness of DDT for grass-grub (*Costelytra zealandica*) control on the yellow-brown pumice soils. These fall within a radius of 50 miles of Taupo, and extend northward to the Bay of Plenty and eastward to Gisborne. Under dry conditions, and in early stages of development, these soils are particularly prone to grass-grub attack.

The yellow-brown loams are also included in this review. These are derived typically from fine-textured andesitic and rhyolitic volcanic ash. These fine-textured ashes have spread over the North Island as recognizable deposits from near Feilding and Napier in the south to Auckland in the north. These soils and the pumice soils are regarded as problem soils for the control of grass-grub.

RESULTS

Table 1 shows the results of 83 trials conducted since 1950, where DDT has been used at 2 lb a.i. per acre. Another 36 trials have not been included as their results were not considered reliable. All but 22 trials were simple observational plots where pasture responses only were recorded, and in only 5 trials are statistical analyses available. Limitation of space precludes tabulating all data on which discussion of results is based.

SOILS

With but few exceptions, the trials were located on the immature stages of the soils considered. It is likely that grass-grub damage is more severe on these soils and where the carrying capacity is low. Grass-grubs are present in the semi-mature and mature stages of these soils but do not appear to cause as much damage. Where the trials were located on mature soils, the areas had been recently developed and were still low in carrying capacity. Furthermore, the overall results obtained suggest grass-grubs are less damaging on the yellow-brown loams than on the pumice soils.

PASTURE RESPONSE

Seldom was the initial pasture response to DDT treatment recorded in terms of an increase in ryegrasses (*Lolium* spp.), particularly for the pumice soils. The response was usually seen in clovers (*Trifolium* spp.) and browntop (*Agrostis tenuis*) on these soils. On the yellow-brown loams, clovers, browntop, *Poa trivialis* and Yorkshire fog (*Holcus lanatus*) were the first to respond. Only with improving carrying capacity and after a period of two to three years did ryegrass increase materially. In most trials if an initial response was recorded, and provided other factors were not limiting, this response was progressively greater for two to three years after DDT application. The responses recorded included resistance to pasture "pulling" by stock.

TIME OF APPLICATION

Applications of DDT made in spring did not result in a pasture response until the following late summer or early autumn. Applications made when second and early third instar larvae were present usually resulted in a pasture response in the season of application. Results from trials where DDT was applied at monthly intervals or at seasonal intervals indicated, though not conclusively, that the spring months gave the optimum results, especially for "proofing" an area against grass-grub attack.

FORMULATIONS

In the season of application there was little difference in effectiveness of the DDT formulations used. Dry-mix DDT superphosphate possibly gave a quicker pasture response, but there was little difference between wet-mix DDT and pelleted materials, although the response from pelleted materials varied somewhat with the form of pellet used. Applied in spring, there was possibly no difference between these pellets. The high rainfall experienced in most of the trial areas possibly reduced the chances of obtaining differences in effectiveness between the formulations used.

RESISTANCE OF GRASS-GRUB TO DDT

Only in more recent trials has resistance testing been conducted. Resistance, as yet, is not a major factor in this area.

THERMAL DECOMPOSITION TESTS

In several trials, accelerated thermal decomposition tests carried out by the Fertiliser Manufacturers Research Association, indicated that the effective life of DDT in the soil was shorter than normally expected and was limited to 1½ to 2 years.

EFFECTIVENESS

DDT has given much slower results than lindane, dieldrin, heptachlor and isobenzan. In the season after application heptachlor and isobenzan resulted in virtually complete control of grass-grub. Lindane and dieldrin were not quite as effective, but were superior to DDT. Fensulfothion, where effective, gave quick, spectacular results within a month of application.

"MILKY" DISEASE OF GRASS-GRUB

In a number of trials (not included in this review), "milky" disease gave spectacular reductions in larval numbers.

DISCUSSION

From the data available it must be concluded that DDT generally controls grass-grub on the yellow-brown pumice soils and yellow-brown loams of the North Island. Whether this control is economical is doubtful, particularly for the pumice soils. If DDT is applied at the second or third instar stage, the reduction in number of grubs in the season of application is not high. In five trials conducted by W. M. Kain, where the data could be statistically analysed, the reductions of larval numbers in the season of application were from 0 to 25%. A year later 50 to 75% of larvae were killed and only in the second year (third generation) were larvae reduced by more than 90% to a level which would be considered reasonable by the farmer.

The ryegrasses appear to be the most susceptible species to grass-grub attack, particularly on the immature pumice soils. Here larval numbers of 1 or 2 per sq. ft may eliminate ryegrass, hence it is doubtful if one application of DDT is adequate (even after three grass-grub generations) to allow ryegrass to establish. The lower-producing pasture species, provided nutrients, management and rainfall are not limiting, may respond to DDT treatment even with a 25% reduction in larval numbers. On the Taupo and Tokoroa sandy silt (18 c), reported failures are most likely owing to the fact that low numbers of larvae will depress the growth of both grasses and clovers, particularly under moisture stress. This severely limits the value of DDT treatment.

The results obtained confirm that DDT has low insecticide activity against grass-grub coupled with long soil persistence. Analyses of DDT in soil also confirm previous findings that DDT remains almost exclusively in the top inch (Gallagher and Evans, 1961) of these soils so that the larvae are unlikely to be affected until the pasture shows signs of being depressed. On available evidence, shallow soil incorporation of DDT has given better proofing than surface-applied material. The trial data suggest that, where the material is surface-applied, pasture damage occurs if the area is subsequently attacked by grass-grub.

The data presented would be more valuable if all trials were supplemented by resistance testing. However, most experiments were completed before the occurrence of resistance was demonstrated.

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REFERENCE

Gallagher, P. J.; Evans, L., 1961: *N.Z. J. Agric. Res.*, 4: 466.

TABLE 1: RESULTS OF TRIALS WITH DDT

Soil Type*	Total No. of Trials	No. of trials giving Pasture Response in Season of Application	% Larvae Reduction in Season of Application	After 1 yr	After 2 yr	No. Trials Not Effective
YELLOW-BROWN PUMICE SOILS						
<i>Kaharoa suite (immature stage)</i>						
14B Paengaroa sand on gravelly sand	4	2	—	—	—	2
14C Ohinepanea sand	2	1	—	—	—	1
<i>Kaharoa suite (semi-mature)</i>						
16 Oropi sand	3	3				
16A Oropi shallow sand	3	3				
<i>Taupo suite (immature stage)</i>						
18H Taupo sandy silt	5	2	35 0 30	—	—	2
18 Taupo sandy silt	7	3 (slight)			4 trials	3
18A Taupo shallow sandy silt	3	3	10	—	—	—
18h Taupo sandy silt	1	1 (slight)	25 20 25 75	30 50 90	—	—
18B Whenuaroa sand	2	2	75 70 25 0	25	0	3
18c Tokoroa sandy silt	5					
18E Rangipo sand	3	3 (slight)				

<i>Gisborne suite (immature stage)</i>									
21	Gisborne sandy loam	1	—	0	—	—	—	—	—
YELLOW-BROWN LOAMS									
<i>Horotiu suite (immature)</i>									
48	Waihou sandy loam	1	1	—	40	90	—	—	—
48A	Horotiu sandy loam	4	4	—	—	50	—	—	—
				—	20	60	—	—	—
				—	40	—	—	—	—
				—	40	60	—	—	—
<i>Waihi suite (immature stage)</i>									
54	Katikati sandy loam	3	3	—	—	—	—	—	—
54A	Katikati black sandy loam	13	7 (fair) 3 (slight)	—	—	—	—	—	3
55	Waitekauri sandy loam	1	1 (slight)	—	—	—	—	—	—
55H	Waitekauri sandy loam	1	1 (slight)	—	—	—	—	—	—
55b	Whakamarama sandy loam	1	1 (slight)	—	—	—	—	—	—
56	Te Manaia sandy loam	2	2 (slight)	—	—	—	—	—	—
56a	Waihi sandy loam	2	1 (slight)	—	—	—	—	—	1
<i>Tirau suite (immature)</i>									
57	Tirau sandy loam	6	6 (slight)	—	50	—	—	—	20

TABLE 1: RESULTS OF TRIALS WITH DDT—Contd.

Soil Type*	Total No. of Trials	No. of trials giving Pasture Response in Season of Application	% Larvae Reduction in Season of Application	Reduction in After 1 yr	After 2 yr	No. Trials Not Effective
57cH Maungatapu silt loam	1	1				
<i>Mairoa and Maihihi suites (immature)</i>						
59 Ohaupo silt loam	1	1				
59aH Ohaupo silt loam	1	1	50	65	—	—
59a Otorohanga silt loam	1	1		—	—	—
59c Otorohanga silt loam	1	1	40	70	90	—
60eH Pukerata silt loam	1	1 (slight)	5	—	—	—
<i>Mairoa and Maihihi suites (semi-mature)</i>						
62cH Hauturu silt loam	1	—	—	70	80	—
<i>Waitemata suite (immature and semi-mature)</i>						
72 Karaka complex	1	1				
<i>Takapau suite (immature)</i>						
75 Takapau silt loam and sandy loam	3		0			
			0			
			0			

* As per Soil Bureau Bulletin No. 5.