AN INVESTIGATION INTO THE POSSIBILITY OF USING LINDANE FOR GRASS GRUB CONTROL ON DAIRY FARMS

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SUMMARY

Milkfat residues were compared in early lactation from cows that had been grazing pastures over winter to which lindane had been applied in May at 2 kg/ha broadcast or 1 kg/ha drilled. The drilling of lindane reduced the residue level to approximately one fifth that of the broadcast treatment but the level was still above 0.2 ppm and unacceptable in New Zealand dairy products. A small plot insecticide trial run in conjunction with the grazing trial gave unsatisfactory levels of control by lindane (< 30%). Considering both aspects, lindane could not be recommended for grass grub control on dairy pastures.

INTRODUCTION

The organochloride pesticide, lindane, has for many years been effectively used for the chemical control of grass grub (Kain and Atkinson 1968; Taylor 1968) on sheep and cattle farms. The possibility of harmful residues accumulating in dairy products has precluded its use for dairy farms. However, the drilling of insecticides for grass grub control has now become an accepted method of application and as there is no systemic uptake of lindane by plants (Collett and Harrison 1968) this technique may prevent residues in milkfat occurring. Also with the drilling of insecticides the application rate may be reduced considerably but with some reduction in the level of control (East *et al* 1981).

The possibility of reducing lindane residues in dairy products to below the minimum acceptable level set by Codex (1978) would mean that the dairy farmer and farmers grazing dairy replacement stock would have the use of an alternative and effective insecticide for the control of grass grub at a much lower cost than the currently much used fensulfothion.

EXPERIMENTAL

Grazing trial

Four grazing treatments were established in May 1981 to evaluate the hypothesis that by drilling lindane soon after factory supply cows had been dried off (late May) undesirable residues in milkfat may be diminished to an acceptable level at the subsequent lactation. The grazing treatments consisted of:—

- (1) control — dairy cows continually grazed on untreated pasture.
- (2) Broadcast — dairy cows continually grazed on pasture treated with lindane broadcast at 2 kg/ha using a "Sisis" spreader.
- (3) Drilled — dairy cows continually grazed on pasture drilled with lindane at 1 kg/ha (a Duncan 730 triple disk drill set at a 15 mm depth was used).
- (4) Drilled 33% — dairy cows grazed for only 7 in every 21 days on pasture drilled with lindane.

Each grazing treatment comprised three, 0.33 ha paddocks to which four cows were allocated giving a stocking rate of 4 cows/ha. Insecticide treatments were applied on May 28, 8 days after the cows had been dried off and grazing of the experimental areas commenced 2 weeks later (June 11, 1981).

Grazing management was similar for all treatments and throughout the trial maintained as near as possible to common practice. Through winter cows were strip
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grazed on an 80 day rotation and fed supplements to 30% of daily requirements while after calving a 12 day rotation was adopted and no supplements fed. The objective of pasture management and supplementary feeding was to achieve a grazing pressure for both dry and lactating cows as similar as possible to a herd stocked at 4 cows/ha. As the cows were on an 80 day winter rotation approximately 20% of the available area was not grazed by dry cows and for the first week following calving cows grazed pasture which had not been grazed since the application of lindane.

The 16 cows selected for the trial had similar production records and calving dates but for simplicity of trial management they were induced to calve within a week (August 10-18). Milk samples were collected by a proportional sampling of the p.m. and a.m. milking (500 ml collected), initially 3 days after calving then once weekly. Three weeks after calving commenced all cows were removed from the treatments and milk sampling was continued for a further 4 weeks.

Samples of pasture were collected at days after treatment (D.A.T.) 0, 1, 4, 7, 13, 82 (calving) and 126. Each sample comprised 24 sub-samples which had been selected at random from within a paddock and cut to grazing height using hand shears. The analysis for lindane residues in pasture and milkfat were conducted on fresh samples using standard procedures in the Dairy Division Laboratory, MAF, New Plymouth.

The original groups of trial cows were removed from the experimental areas on September 2 and all paddocks were given a hard grazing using dry stock and allowed to recover. On October 1, 1981 a new group of 8 cows were randomly allocated to treatments 2 and 3 and grazed continually on these for a further 2 weeks. Pasture and milk samples were collected on the day before cows were placed on the treatment paddocks (D.A.T., 126) and milk samples were collected from all cows at weekly intervals. For simplicity, information on lindane levels in pasture at D.A.T.; 0, 13, 82 and 126 only will be presented.

Small plot insecticide trial

On the same day as lindane treatments were applied to the grazing trial a small plot trial was laid down to investigate the effectiveness of lindane applied in late May for the control of grass grub. Lindane was compared, by two methods of application, broadcast at 2 kg/ha and drilled at 1 kg/ha, with similar methods and rates of application of fensulfothion. The same machinery used to lay down the grazing trial was used for the insecticide trial. Grass grub numbers were estimated by counting 6, 0.5 m mini-plough furrows per plot on the control plots at laying down and on all plots 2 and 10 months later.

RESULTS

Lindane levels in pasture

Over the duration of the trial the lindane levels in pasture were variable, (CV 40%) thus making interpretation of the results difficult. Pasture on the broadcast treatment (Table 1) contained high levels of lindane for the first 2 weeks and these dropped sharply over the latter period of the trial. Whereas lindane levels on the drilled pasture were relatively high on the day after application, but had declined to a low level 13 days later and remained low for the duration of the trial. On all samplings made after day one the residue levels on drilled pasture were one fifth or less those of the broadcast treatment.

TABLE 1: Lindane levels in pasture (ppm dry weight).

Treatment	Days after treatment				
	0	1	13	82	126
Broadcast	0.09	29.4	39.6	1.9	1.0
(S.E.)	±0.10	± 8.82	±25.3	± .98	± .46
Drilled	0.02	10.5	2.3	0.4	0.2
(S.E.)	±0.01	± 3.03	± 0.32	±0.18	±0.09

Lindane residues in milkfat

The levels of lindane in milkfat were high in all treatments at the commencement of lactation with levels in the broadcast treatment being significantly higher ($P < 0.01$) than either of the drilled treatments (Figure 1). After cows were removed from treated pasture lindane residues declined rapidly (approximately 70%) in the first 2 weeks, but the rate of decline slowed considerably over the following fortnight. When two new groups of cows were placed on treatment, lindane residues in milkfat rose immediately. Relative differences between the broadcast and drilled treatments were similar to that recorded in the first grazing period although the actual levels were 50% lower.

Fig. 1: The effect of application method and grazing management on lindane residues in milkfat. (The bracketed areas show the period and treatment group that cows were grazing treated pasture).

TABLE 2: Effect of treatment on grass grub control.

Treatment (applied 25.5.81)	Rate kg/ha	No. of grass grub/m ²	
		23.7.81	18.3.82
control		49	139
fensulfothion (broadcast)	2	33	130
fensulfothion (drilled)	1	30	116
lindane (broadcast)	2	36	154
lindane (drilled)	1	38	149

Pre-treatment grass grub No. 110/m²

Insecticide trial

Grass grub numbers in the control plots at laying down were 110/m². Two months later this number had declined to 49/m² (Table 2) and the application of insecticide by either method caused only a small and non-significant effect on this population. The average level of control achieved with fensulfothion was 36% and with lindane 25%. Ten months after treatment populations had increased approximately threefold on control and fourfold on the insecticide treated plots, nullifying all treatment effects.

DISCUSSION**Grazing trial**

On pasture over the early stages of the trial the lindane levels for the broadcast treatment were lower than those reported by Collett and Harrison (1968), but over the later stage of the trial the levels were higher than reported by these authors. Levels in the drilled treatments were, however, very much lower, only 20% of the level recorded for the broadcast treatment. The relatively high level of lindane on pasture after 126 days (all pastures grazed three times since insecticides applied) for both methods of application, indicated that pasture contamination must have been caused by splash of contaminated soil onto pasture as lindane is not systemic (Collett and Harrison 1968).

Ideally, there should have been no insecticide contamination of pasture with drilling but some spillage occurred from the drill which could not be avoided. However, considering the relatively low lindane residues on drilled pasture 13 days after application this form of contamination may have had little effect on subsequent milkfat residues.

The minimum level for lindane as laid down in Codex (1978) is 0.2 ppm and in the first week of lactation the level in all treatment groups were at or above this and unacceptable to the Ministry of Agriculture and Fisheries (Watts pers comm). Lindane residues in milkfat were much higher on the broadcast than either of the drilled treatments. Cows on drilled pasture for only one third of their time had lower levels than those grazed exclusively on drilled pasture. When cows were withdrawn from treated pasture the residues in milkfat from the drilled treatments dropped within a week below the Codex (1978) minimum whereas for cows grazing broadcast pasture the residue of lindane had after 4 weeks not fallen below 0.2 ppm. Introduction of a new group of cows to treated pasture following a very hard grazing by dry stock and a 3 week recovery period for the pasture resulted in lindane residues again rising to relatively high levels; 0.94 ± 0.14 ppm for broadcast and 0.19 ± 0.04 ppm for drilled treatments which clearly indicates that irrespective of application method or grazing management over winter, unacceptable lindane residues in milkfat cannot be avoided.

One factor apparent in the data presented on pasture and milkfat lindane levels is that there was about a fivefold difference in lindane level in the pasture between the broadcast and the drilled treatments which was reflected in a very similar difference in the residue levels in milkfat. Although only half as much lindane was applied to pastures in the drilled treatment only one fifth was measured in the milkfat residues. Thus the hypothesis that drilling lindane to prevent residues in dairy products was partly successful.

Insecticide trial

Very poor control of grass grub was obtained after the application of lindane and fensulfothion in May and there was no carry-over insecticide effect into the next year as reported would occur with lindane by East *et al* (1981) and Henzell *et al* (1981). This time of application was not recommended by these authors because lindane is more effective on beetles than larvae, and applications made closer to beetle emergence gave better control. However, considering these limitations a greater level of control was expected judging from the published work.

Henzell *et al* (1981) reported a failure of lindane and also isazophos to control grass grub in one of the soils investigated and attributed this to the adverse influence of high soil organic matter on insecticidal activity. The level of soil organic matter was not determined in this trial but poor control of grass grub following the use of insecticides

on Taranaki soils have been reported previously by Carpenter *et al* (1981) and Thomson (unpublished) and the influence of organic matter or other aspects of soil which may make insecticides less effective warrants further investigation.

CONCLUSION

The grazing of dairy cows on pasture treated with lindane applied either broadcast or through a drill at 2 and 1 kg/ha respectively gave unacceptable lindane residues in milkfat at the subsequent lactation at least 4 months later. However, by grazing cows on pastures drilled at 1 kg/ha for only one third of their time over winter (simulating partial treatment of the farm) lindane residues in milkfat were reduced to 0.2 ppm the acceptable minimum level set by Codex (1978).

Drilling lindane into the soil at half the broadcast application rate reduced the residue level of lindane in milkfat to one fifth. However, this was not sufficient to reduce residues to an acceptable level.

Lindane, either broadcast at 2 kg/ha or drilled at 1 kg/ha in late May had a low level of control on grass grub sampled in July and had no effect on the subsequent population as determined by a March sampling ten months after application.

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