COMPARISON OF A GROOVED AND SMOOTH ROLLER FOR CONTROL OF GRASS GRUB

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SUMMARY

Control of grass grub (*Costelytra zealandica*) with two 9.1 tonne tandem rollers, one with a grooved front wheel and a smooth surfaced rear wheel, the other with both wheels smooth-surfaced was investigated. Sixteen days after rolling pasture in May, the grooved and smooth rollers had reduced grub densities by 77% and 59% respectively compared with untreated plots. Only in November was grass grub control with the grooved roller (68%) significantly greater than with the smooth roller (44%). These results do not justify the extra cost of building a grooved roller unless it is to be used extensively.

INTRODUCTION

Previous studies have demonstrated that rolling grass grub (*Costelytra zealandica*) infested pasture with a heavily-weighted tandem roller caused grass grub mortalities of up to 61% (van Toor and Stewart 1986) with subsequent increases in pasture yields (Stewart and van Toor 1983, 1986). The roller consisted of a smooth surfaced rear wheel which flattened out ridges made by a grooved front wheel. Stewart *et al* (in prep.) demonstrated that the grooved tandem roller gave better control of immature third instar grass grub at 0-50 mm soil depth than a smooth-surfaced tandem roller. However, because numbers of grubs at this stage of development were low in that trial it was not clear whether the difference in mortality was great enough to justify the extra cost of construction of a grooved front roller. This paper reports on a further trial which compared grass grub control using grooved and smooth tandem rollers on pasture containing grub densities high enough to cause pasture damage.

METHODS

A 9.1 tonne tandem roller consisting of a grooved front wheel and a smooth surfaced rear wheel was compared with a tandem roller of the same weight but with both wheels smooth-surfaced. Front and rear wheels were 600 mm diameter and 1.2 m wide. Ridges on the grooved wheel were 100 mm wide x 50 mm deep and spaced 100 mm apart. The grooved roller developed a ground pressure (calculated from the formula: weight of roller (kg) x gravity (9.8 Newtons (kg) ÷ area (m²) of roller contact) of 190 kPa and the smooth roller 160 kPa. The rollers were towed at 6 km/h by a 118 kw 4-wheel drive tractor. The trial site was at Ardlussa, Central Southland, on a Hororata stony silt loam (yellow grey earth). The gravimetric soil moisture at time of rolling estimated from twenty, 25 mm diameter cores, was 50% at the 0-50 mm depth, 36% at 50-100 mm and 35% at 100-200 mm depth.

On 8 May 1984, the day before rolling was carried out, density of larvae was estimated in 30 sets of paired 1.2 m x 1.5 m plots on grass grub damaged pasture by taking six, 100 mm diameter cores from each of the intended untreated plots and three from each plot intended to be rolled. This was to minimise the influence of core holes on the effect of rolling. As a result of this pre-treatment sampling, 18 pairs of plots were chosen for the trial in which the grub densities in the paired plots differed by no more than 45%.

On 24 May, 2 weeks after rolling, six, 100 mm diameter cores were taken per plot. On 1 November, four 150 x 150 mm spade squares were taken per plot and the pupae

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counted and weighed. The position of larvae in the soil profile was assessed from 300 grubs taken from core samples adjacent to the trial, at the time of rolling and at the time of the first post-treatment sampling, by dividing cores into 0-50, 50-100 and 100-200 mm depths.

Shear strength as a measure of compaction of the soil in rolled plots was estimated on 9 May before and after rolling using a "Vicon" 4-vane shear tester with vanes 20 mm wide x 32 mm deep. The torque required to shear the soil was measured three times in each plot at each of three depths, 50-80 mm, 100-130 mm and 150-180 mm.

Analysis of variance was performed on natural logarithms of grass grub numbers in each plot.

RESULTS AND DISCUSSION

At the time of rolling, 99% of the grass grub population of 358 larvae/m² were mature third instars of the two-year life cycle. Within the soil profile 61% were located at a depth of 0-50 mm, 17% at 50-100 mm and 22% at 100-200 mm.

In comparison with the untreated plots, the grooved roller killed 77% of grass grubs and the smooth roller 59% (Table 1). Mortality was highest at the 0-50 mm level (Table 1) but the difference, at this depth, between the two rollers was not significant. Mortality at the lower soil depths was 65% with no significant difference between roller types. In November, when most of the grass grub population had pupated, there were 68% fewer grubs in the plots rolled with the grooved roller than in the untreated plots and 44% fewer in the smooth-rolled plots. The advantage of the grooved roller relative to the smooth roller in grass grub control was significant only in November (Table 1). The natural decline in relative grub densities from May to November within untreated plots and that which occurred in the treated plots was not significantly different ($P > 0.05$). There was also no difference between the mean weights of pupae in untreated and treated plots suggesting that the rollers had no long-term effect on development of surviving grass grub.

TABLE 1: Effect of roller type on log counts* (total larvae/plot) of grass grub 16 days after rolling and 5 months later with percent mortality of arithmetic means in brackets.

Soil Depth (mm) Treatment	24 May 1984				1 November 1984	
	0-50		0-200		0-200	
	Untreated	Roll	Untreated	Roll	Untreated	Roll
Grooved roller	2.22	0.58 (87)	2.88	1.46 (77)	2.47	1.32 (68)
Smooth roller	1.87	0.87 (70)	2.82	1.83 (59)	2.47	1.91 (44)
LSD _(.05) Comparison						
Vertical	0.54		0.50		0.48	
Horizontal	0.54		0.53		0.50	

* To convert data to larvae/m², subtract 1 from back transformed means and multiply by 21.2 for May data and 11.1 for November data.

Over a range of 177-619 grubs/m² there was no relationship between initial grub density and the proportion killed by rolling suggesting that mortality from rolling is not density dependent.

Both rollers increased the shear strength of the soil by 14.5 kPa (25%) at 50-80 mm depth, 9.1 kPa (13%) at 100-130 mm and 13.9 kPa (18%) at 150-180 mm. There was no relationship found between shear strength and proportion of grubs killed at any depth indicating that measuring compaction in this way cannot accurately determine the efficacy of rolling.

CONCLUSIONS

The results presented here in addition to those presented by Stewart *et al* (in prep.) suggest that the grooved roller is marginally better than the smooth roller at controlling third instar larvae. Therefore it is recommended that a grooved roller be built for grass

grub control only if it is to be used on a large scale, such as by a contractor. For a farmer who uses a roller for a multitude of purposes, the extra cost of building the grooved roller assembly (about \$4,000) and tandem arrangement to attach in front of a smooth roller, may not be justified if there is little use made of the roller for grass grub control. Previous studies (Stewart 1979, Stewart and van Toor 1986) have shown that a single smooth-surfaced roller of small diameter can give acceptable results and this can be improved by increasing the load of the roller.

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