NO-TILLAGE ESTABLISHMENT OF LUCERNE

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Summary

Field experiments comparing no-tillage establishment of lucerne (*Medicago sativa*) with two cultivation depths showed that the no-tillage establishment treatment yielded better than deep cultivation on one trial, the same on a second, and not as good on a third. Minimum tillage establishment of lucerne was as good as the best seed bed preparation treatment in all trials. 'Herbicide fallow' and 'desiccation' techniques for pre-drilling turf control gave variable results. Comparisons of herbicides for turf destruction showed no differences in lucerne yield on one site but large differences on a different site and soil type. Similarly, yield responses were variable from post-emergence applications of herbicides for weed control in lucerne established without tillage.

INTRODUCTION

No-tillage establishment of crops has several advantages over conventional cultivation for seed bed preparation. One advantage is the effect on soil conservation as tillage increases erosion and damages soil structure (Elliott and Pollard 1974). Another is the possibility of growing crops such as lucerne (*Medicago sativa*) on hill soils which are either too steep for cultivation or, once cultivated, subject to serious erosion. Also as cultivation costs increase due to the increasing cost of fuel, no-tillage cropping systems become more attractive, however these cost-saving advantages are offset to some extent by the need for sophisticated drilling equipment and the cost of herbicides required for turf destruction.

In New Zealand, the development of no-tillage systems is not new, but has, as elsewhere, been fraught with instances of unexplained poor crop performance. As early as 1957, trial results were published (Blackmore 1957) on pasture oversowing using chemical ploughing and the first work with lucerne was reported a year later (Dawes 1958). However, initial enthusiasm waned as a result of poor crops, and it was not until 1969 (Clare and Matthews 1969) that promising results at Wairakei Research Station prompted further investigations into no-tillage establishment of lucerne.

This paper reports on trials conducted on a range of North Island soils, under different climatic conditions, to see if lucerne could be established satisfactorily without cultivation.

METHOD

Herbicide treatments

The herbicide treatments (shown in Tables 1-4) were applied with a modified Oxford Precision Sprayer (propane powered). 'Herbicide fallow' was achieved by 2,2-DPA 5.0 kg/ha plus amitrole 2.0 kg/ha applied 4-6 weeks prior to cultivation or drilling and 'herbicide desiccation' was given by paraquat 1.0 kg/ha applied immediately prior to cultivation or drilling. Propyzamide 1.5 kg/ha plus 2,4-DB 1.5 kg/ha was applied as a post-emergence treatment when the crop was at the 3-5 true leaf stage.

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Cultivation and drilling methods

Normal cultivation	— mould board ploughing, discing, harrowing and rolling.
Surface cultivation	— discing, harrowing and rolling.
Rotary hoeing	— followed by harrowing and rolling (to the same extent regardless of treatment depth differences).
No-tillage	— no cultivation (seed drilled directly into chemically killed sward).
Drilling	— drill used was either a Duncan with Blackmore coulters and disc openers, or a Duncan triple disc or a Connor Shea three point linkage mounted disc drill (only one drill was used on any one trial).
Fertiliser	— standard district application made in all instances; basal fertiliser and lime applied before cultivation, and soil incorporated except in no-tillage plots, lime reverted superphosphate was drilled with the seed.
Seed	— Coated 'Wairau' lucerne seed was sown at a bare seed rate of 10 kg/ha.

Lucerne yield cuts were made, where possible, when plants were at the crown bud stage and were dissected to give yield of lucerne only. The yield data do not, in all cases, give the total production from the stands during the periods measured.

All treatments were replicated four times in a randomised block design, except for trial 2 where the main cultivation treatments were unreplicated but chemical treatments replicated five times.

TRIALS AND RESULTS

Effect of seed bed preparation on yield

This trial, established in spring 1972 on a sloping clay soil (Whatawhata clay) at Whatawhata Hill Country Research Station, compared no-tillage establishment with two depths of rotary hoeing (4.5 and 9.0 cm). The lucerne yield for the no-tillage treatment was significantly higher than that from the deeper cultivation, but not significantly different from the shallow cultivation, during the first two seasons (Table 1).

TABLE 1: EFFECT OF SEED-BED PREPARATION ON LUCERNE YIELD — WHATAWHATA

Cultivation treatment	Herbicide treatment	Rate kg/ha	Timing*	Lucerne yield kg DM/ha	
				Last cut 1st season	Total 8 cuts
Rotary hoeing (9.0 cm)	2,2-DPA + amitrole	5.0 2.0	28	1560 bB	8060 bA
Rotary hoeing (4.5 cm)	2,2-DPA + amitrole	5.0 2.0	28	1340 bB	8300 abA
No-tillage	2,2-DPA + amitrole	5.0 2.0	42	2050 aA	9150 aA
	propyzamide	1.5	0		
CV %				14.7	8.2

* Number of days herbicide treatment applied prior to cultivation or drilling in the case of no-tillage.

Comparison of chemical and mechanical turf destruction

This consisted of two experiments, commencing in spring 1973, comparing methods of seed bed preparation and comparisons of chemical treatments to achieve a 'herbicide fallow' or 'desiccation' for turf destruction.

In the first trial at Wairakei Research Station (Atiamuri sand) on a flat site on pasture mainly comprising brown top (*Agrostis tenuis*), the two cultivation treatments gave 10% greater lucerne yield than no-tillage establishment. The 'desiccation' resulted in a significant yield advantage over the 'herbicide fallow' treatment (Table 2). However, the second experiment, conducted on a hilly site at Whatawhata Hill Country Station on a paspalum (*Paspalum dilatatum*) sward, gave different results. Surface cultivation resulted in significantly higher lucerne yields than the other two seed bed preparation treatments, neither of which differed markedly in total production after 2 years (Table 2). Normal cultivation was distinctly superior in the early establishment phase but the effects did not persist. 'Herbicide fallow' resulted in significantly higher lucerne yields than 'desiccation' on the no-tilled plots.

TABLE 2: LUCERNE YIELD FROM THREE SEED-BED PREPARATIONS AND TWO TURF DESTRUCTION COMPARISONS

		Lucerne yield kg DM/ha		
		Normal cultivation	Surface cultivation	No-tillage
Wairakei		Total 5 cuts		
Herbicide fallow	19920 a	20290 b		16590 b
Herbicide desiccation	19210 a	22550 a		18980 a
Whatawhata		Total 8 cuts		
Herbicide fallow	13900 a	16520 a		15170 a
Herbicide desiccation	13440 a	16400 a		12840 b
CV % 8.9				

Soil compaction measurements were not made but there was no apparent effect from the different seed bed preparations on lucerne root development at the end of the first full production season.

There was no difference in soil 'quick test' figures between the three cultivation treatments in each of three depths sampled (0 - 80 mm; 80 - 150 mm; 150 - 300 mm).

Herbicide interactions: turf destruction and weed control

Two experiments were conducted comparing herbicides and herbicide combinations for pre-drilling turf destruction. All comparisons were made with and without a post-emergence herbicide treatment.

The first experiment was established in spring 1973 at Wairakei Research Station on a run out brown top pasture (Atiamuri sand). Responses were recorded for the post-emergence treatment at the first and second cuts but this did not persist. Some of the pre-drilling treatments achieved small significant responses from individual cuts but the overall effect from six cuts in two seasons showed no differences (Table 3).

The second of these trials was conducted at Otakanini Research Area (north of Helensville) and was established in autumn 1975 on a Tangatiki sandy loam. The treatments were applied to a reasonably vigorous ryegrass (*Lolium* sp) and white clover (*Trifolium repens*) sward with some paspalum present. Although good initial control of the existing turf was achieved, the effects were not long-lasting and those treatments without paraquat applied immediately prior to drilling allowed ingress of grasses (mainly ryegrass) which competed with the establish-

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ing crop. This resulted in significant differences between treatments (Table 4). Post-emergence herbicides resulted in considerable increases in yield.

TABLE 3: EFFECTS OF HERBICIDES FOR PRE-DRILLING TURF DESTRUCTION AND WEED CONTROL ON LUCERNE YIELD — WAIRAKEI (MAIN EFFECTS)

<i>Treatments</i>	<i>Rate kg/ha</i>	<i>Timing*</i>	<i>Lucerne yield kg DM/ha Total of 6 cuts</i>
glyphosate	1.5	2	15040 a
glyphosate	2.0	42	15380 a
glyphosate & paraquat	1.5 & 0.25	42 & 2	14930 a
paraquat	1.0	2	15180 a
2,2-DPA + amitrole	5.0 + 2.0	42	14680 a
2,2-DPA + amitrole & paraquat	5.0 + 2.0	42	14560 a
LSD (5%)	0.25	2	1900
without propyzamide + 2,4-DB			14600 a
with propyzamide + 2,4-DB	1.5 + 1.5	(post-em)	15330 a
LSD (5%)			980
CV %			10.7
Interaction			NS

* Number of days herbicide treatment applied prior to drilling.

TABLE 4: EFFECT OF HERBICIDES FOR PRE-DRILLING TURF DESTRUCTION AND WEED CONTROL ON LUCERNE YIELD — OTAKANINI (MAIN EFFECTS)

<i>Treatments</i>	<i>Rate kg/ha</i>	<i>Timing*</i>	<i>Lucerne yield kg DM/ha Total of 3 cuts</i>
glyphosate	2.0	34	2400 bc
dicamba & paraquat	0.4 & 1.0	34 & 1	3200 abc
paraquat + dicamba & paraquat	0.5 + 0.4	34	4310 a
paraquat	0.5	1	3900 a
2,2-DPA + amitrole	5.0 + 2.0	34	1930 c
2,2-DPA + amitrole & paraquat	5.0 + 2.0	34	3540 ab
without propyzamide + 2,4-DB	0.25	1	1630 bB
with propyzamide + 2,4-DB	1.5 + 1.5	(post-em)	4800 aA
CV %			40

* Number of days herbicide treatment applied prior to drilling.

DISCUSSION

Results from trials 1 and 2 showed that overall, the minimum tillage plots were either as good or better than the deeper cultivation or no-tillage plots.

'Herbicide desiccation' was superior on surface cultivation and no-tillage plots with no difference on normal cultivation at Wairakei. This was not the case at Whatawhata where there were no differences except on the no-tillage plots where 'herbicide fallow' was superior in terms of eventual lucerne production. This suggests, in the absence of weed differences between treatments at Wairakei, that the 'herbicide fallow' had a soil residue effect inhibiting lucerne establishment. This effect was

confounded on the Whatawhata trial where a higher weed population occurred in 'desiccation' treatments on the no-tillage plots and the effect of weed competition may have been greater than that of soil residue.

Post-emergence herbicide treatments in lucerne have been demonstrated in the past to have beneficial effects on lucerne yield during the first season's production (Atkinson and Douch 1973). The two trials with post-emergent treatments have further demonstrated this, although the weed levels at Wairakei were low and yield increases as a result were not significant. With the greater weed levels on the autumn sown Otakanini trial dramatic yield responses were measured from post-emergence weed control.

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