WEED FREE LUCERNE IN PUMICE COUNTRY

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Summary

Yield increases were achieved with early post-emergence chemical treatments on the first production cut after establishment on small plot trials at Wairakei Research Station. Lucerne tolerance trials indicated small but significant yield decreases to some herbicides. In weed control trials significant weed control results were achieved, but these did not show any significant crop response. In a "weed free" trial initial crop responses had disappeared by the second year. Crop suppression was recorded to herbicide treatments and grazing gave higher yields than haying.

INTRODUCTION

LUCERNE (*Medicago sativa*) has achieved relative importance in the pumice sand areas of the central region of the North Island of New Zealand. As a result of the studies made of the crop at the Wairakei Research Station, weed control in lucerne has come under scrutiny. Clare and Matthews (1969) concluded that soil incorporation of trifluralin and benfluralin before seeding resulted in better weed control and establishment of the crop. It was also concluded that no significant increases in yield of lucerne resulted from eliminating the weed competition. A further series of small plot experiments in lucerne establishment, weed control both during establishment and in a mature stand, and lucerne tolerance to herbicides were initiated by the authors which culminated in a field trial, maintaining lucerne weed free under haying and grazing management.

EXPERIMENTAL METHOD

Plot trials were on a randomised block design with 4 to 6 replications. Pre-plant treatments were sprayed with a tractor mounted boom sprayer applying 670 litres/ha and incorporated with a rotary hoe to 75 mm. All other small plot treatments were applied with an Oxford Precision Sprayer delivering 380 litres/ha. The paddock scale trial was sprayed with a Land Rover mounted sprayer applying 140 litres/ha.

In all trials the lucerne variety was Wairau and new sowings were drilled at 11 kg/ha inoculated seed with normal district fertiliser applications. Production measurements were made by cutting with a sickle bar-mower when the lucerne was at a late vegetative stage.

TRIALS AND RESULTS

Weed control during the establishment of lucerne: Wairakei Research Station

The treatments are shown in Table 1. Pre-plant treatments EPTC and benfluralin were applied two days before drilling (3/12/69) and the post emergent treatments pronamide and carbetamide were applied 18 days later when the weeds were in the cotyledon stage. 2,4-DB and a repeat carbetamide treatment were applied, 6 weeks after drilling, with lucerne at the six node stage.

No weeds were present at drilling but the major weeds present at subsequent treatment were sheep's sorrel (*Rumex acetosella*), fathen (*Chenopodium album*), shepherd's purse (*Capsella bursa-pastoris*) and to a lesser extent yarrow (*Achillea millefolium*). At the first cut made three months after sowing there were lucerne yield differences and weeds presence. These had disappeared by the second cut some two months later (Table 1). The first cut of the next season showed no significant differences in yield, but the spectrum and extent of the weed populations had increased.

TABLE 1: LUCERNE ESTABLISHMENT TRIAL

Wairakei Treatment	Rate kg/ha	Yield of lucerne in kg/ha dry weight			
		1st Cut	% weeds*	2nd Cut	Total
EPTC	3.36	1660	20	1170	2830
benfluralin	3.36	1300	32	1080	2380
pronamide	0.84	2070	4	1180	3250
carbetamide	1.68+1.68	1650	17	1030	2680
2,4-DB	1.68	1960	0.4	1020	2980
control		1550	27	1080	2630

* weeds were present at the first cut only

Lucerne Tolerance Trials: Wairakei Research Station

Two lucerne tolerance to herbicide trials were conducted, the first on a 9-year-old stand relatively free of weeds. This trial was retreated a year after the initial treatments. The second trial was conducted on a 3-year-old stand. Treatments are shown in tables 2 and 3 respectively.

The first trial showed small but significant effect in yields (Table 2). The weeds present at spraying were poa annua (*Poa annua*), parsley piert (*Aphanes arvensis*), white clover (*Trifolium repens*), dandelion (*Taraxacum officinale*), shepherd's purse and chickweed (*Stellaria media*). However these weeds were not present in any great quantity. These weeds were still present in approximately the same quantity at the second treatment a year later except for poa annua which was not so evident in any plot that had been sprayed with pronamide the year before.

The second trial was laid down on a weed-free site and all the treatments except for a coded herbicide resulted in similar yields to the control plots (Table 3).

Lucerne

TABLE 2: WAIRAKEI LUCERNE TOLERANCE TRIAL

Treatment 3/10/69	Rate kg/ha	1st cut 8/12/69	Yield of lucerne in kg/ha dry weight		
			Total 4 cuts	5th Cut 15/12/70	Total 7 cuts
paraquat	0.28	3660 aA	10470 abA	2710 bA	19020 abA
carbetamide	3.36	3220 abAB	9890 abcAB	2790 bA	18310 abcAB
terbuthylazine	2.24	3010 bB	8730 cB	2630 bA	16630 cB
isobumeton	2.24	3230 abAB	9820 abcAB	2700 bA	18360 abcAB
terbacil	1.12	3020 bB	9380 bcAB	2690 bA	17660 bcAB
terbacil+	0.56				
bromacil	0.56	3330 abAB	10280 abAB	2890 abA	19150 abA
pronamide	0.84	3460 abAB	10220 abAB	3060 abA	19150 abA
pronamide	1.68	3250 abAB	10320 abAB	3360 aA	19820 aA
pronamide+	0.84				
simazine	1.12	3590 aAB	10590 abA	2750 bA	19280 abA
asulam	1.68	3420 abAB	10880 aA	3020 abA	20100 aA
control		3540 aAB	10270 abAB	3080 abA	19130 abA
CV %		9.6	8.4	13.4	6.7

TABLE 3: WAIRAKEI LUCERNE TOLERANCE TRIAL

Treatment 14/9/71	Rate kg/ha	Cut 1 8/11/71	* Yield of Lucerne in kg/ha dry weight		
			Cut 2 16/12/71	Cut 3 19/1/72	Total 4 cuts
NC303	1.0	860 abAB	2500 bAB	2160 aA	7870 bAB
NC303	2.0	770 bB	2200 cB	1790 bB	6870 cB
metribuzin	0.7	880 aAB	2620 abA	2210 aA	8140 abA
metribuzin	1.4	870 aAB	2600 abA	2290 aA	7180 abA
terbacil	0.5	930 aA	2510 abAB	2290 aA	8280 abA
terbacil	1.0	910 aA	2660 abA	2360 aA	8430 abA
isobumeton	1.0	920 aA	2620 abA	2270 aA	8330 abA
isobumeton	2.0	970 aAB	2510 abAB	2150 aA	7900 abAB
pronamide+	1.5				
simazine	1.0	890 aAB	2720 abA	2320 aA	8360 aA
control		930 aA	2760 aA	2390 aA	8630 abA
CV %		7.5	6.9	8.1	6.2

* Site completely weed free.

Lucerne Renovation Trials: Galatea and Reporoa

Chemical weed control was tested on two "weedy" established lucerne sites. One was in a "grassy" stand on a dairy farm at Galatea and the other on a badly "run out" stand on a sheep farm at Reporoa. Treatments are shown in Table 4, and were the same at each site except for the inclusion of asulam at Galatea because of the presence of docks (*Rumex* spp).

At Galatea weed control resulted in non significant yield differences from all chemical treatments at the first cut. Weed yields were significantly reduced by all treatments.

TABLE 4: WEED CONTROL TRIAL GALATEA

Treatments	Rate kg/ha	Yields in kg/ha		dry weight	
		Lucerne 1st Cut	Weeds 1st Cut	Lucerne Total Cuts 2	Weeds Total Cuts 2
paraquat	0.28	2330 abA	1000 bcBC	4560 abA	1320 cBC
paraquat+	0.28	2350 abA	480 dCD	4690 abA	710 dCD
simazine	1.12				
pronamide	1.68	2610 abA	400 dCD	4920 abA	480 dD
pronamide+	1.68	2300 abA	580 cdCD	4390 bA	800 dCD
simazine	1.12				
terbacil	0.9	2450 abA	260 dD	4560 bA	530 deD
terbacil	1.8	2230 bA	30	4370 bA	80 cD
asulam	1.68	2790 aA	1630 bD	4950 abA	1980 bB
carbetamide	3.36	2810 aA	520 dcD	5220 aA	620 deCD
control		2300 abA	2510 aA	4440 bA	2910 aA
CV %		16.5	57.5	11.7	42.1

At the second cut there were no differences in lucerne yield but there were still differences in weed control plots. Weeds present at the time of spraying included Yorkshire fog (*Holcus lanatus*), poa annua, poa pratensis (*Poa pratensis*), couch (*Agropyron repens*), juncus tenuis (*Juncus tenuis*), ryegrass (*Lolium* spp.), white clover, shepherd's purse, paspalum (*Paspalum dilatatum*) cut-leaved geranium (*Geranium dissectum*) mallow (*Malva* sp), chickweed and field speedwell (*Veronica arvensis*). No further cuts were taken as the area was being subjected to a serious drought, but from a further measurement of yields made in the first cut of the following season, no crop yield differences were detected though there were differences in weed control (Table 5).

TABLE 5: WEED CONTROL TRIAL GALATEA

Treatment	Ryegrass	Yield in kg/ha dry weight 12/11/70			Lucerne
		Poa spp	Phalaris	White clover	
paraquat	380 abAB	70 abA	60 abA	10 bB	850 a
paraquat+	340 abAB	120 abA	20 bA	60 abAB	930 a
simazine					
pronamide	160 bB	30 bA	150 aA	90 aA	870 a
pronamide+	390 abAB	90 abA	40 abA	90 aA	720 a
simazine					
terbacil	590 aA	90 abA	40 abA	20 bAB	800 a
terbacil X2	350 abAB	280 aA	20 bA	20 bB	760 a
asulam	190 bAB	260 aA	70 abA	10 bB	900 a
carbetamide	330 abAB	90 abA	0 bA	190 aA	870 a
control	260 bAB	120 abA	40 abA	30 bAB	940 a
MN SG DIFF					270
CV %	58.1	108.6	140.1	63.2	19.0

Lucerne

Similar trends were measured in the Reporoa trial although the crop yields were low owing to the "run out" condition of the stand. Sheep's sorrel was a major weed in this trial. A production cut in the year following was not possible as the stand was ploughed up.

Weed Free Maintenance of Lucerne: Wairakei Research Station.

A weed free stand at Wairakei was established on a 1.6 ha site using a split plot design. The major treatments being haying or grazing in 0.2 ha plots with 4 replicates. The sub treatments are 1000 kg/ha and 500 kg/ha of 50% potassic super phosphate, herbicide and no herbicides. The fertiliser applications were made in split dressings after each cut or grazing during the production season. The herbicide treatments were selected to control all the weeds and were generally chosen on the basis of previous small plot results. The lucerne was sown on 30 October, 1970. A pre-emergence treatment of pronamide (0.84 kg/ha) was boom sprayed on to the herbicide treated areas on November 6. The whole area had been treated with 2,2-DPA and amitrole 5 to 6 weeks prior to cultivation. During the first season the entire trial area was grazed. The haying and differential fertiliser treatments being applied in the second season. Herbicides used have been pronamide+simazine 1971 and terbacil 1972, applied in August. Crop yields were made from two large cages in each grazing sub plot and from randomly selected strips in the hayed plots. The crop was grazed at a late vegetative stage by heavy mob stocking with 700 to 800 sheep/ha. Plant numbers have been monitored in permanent quadrats after each cut and soil tests were made at the end of each production season.

This trial has given unexpected results. The initial cut after establishment indicated there was no significant difference in lucerne yield to herbicide treatment. However, there was an increase to treatment in the second cut (significant at the 1% level). This increase was large enough to give an increase in yield at the 5% level over the 2 cuts (Table 6). In the second production year the herbicide treatment resulted in significant decreases in yield for the first 2 cuts, resulting in a crop depression for the whole production season of a thousand kg/DM/ha of lucerne. Of the other treatments, grazing gave increases in yield after the first 2 cuts whereas there was no difference measured to the fertiliser treatments (Table 7) nor was there any indication of change in the soil quick test figures. Plant counts indicate little difference to any treatment; they have stabilised at a level of 280 000/ha.

TABLE 6

Treatments	Yields in kg/ha dry weight					
	18/2/71		31/3/71		Total	
	Lucerne	Total	Lucerne	Total	Lucerne	Total
herbicide	2070 a	2100 a	1500 aA	1500 aA	3570 aA	3600 a
no herbicide	1790 a	2150 a	1190 bB	1240 bB	2980 bB	3380 a
MN SIG DIFF	320	250				390

TABLE 7

Wairakei Main effects	8/11/71	Yield in kg/ha dry weight				Total 5 Cuts
		*16/12/71	*18/1/72	*21/3/72		
		†7/1/72	†25/2/72	†12/4/72		
hayed	4010 a	3990 a	1550 bA	2270 aA	‡11830 a	
grazed	3840 a	3550 a	3100 aA	1750 bB	14050 a	
MN SIG DIFF	1220	860			2890	
herbicide	3560 bB	3650 bA	2400 a	2000 a	12490 bB	
no herbicide	4300 aA	3890 aA	2230 aA	2020 a	13390 aA	
MN SIG DIFF			250	210	580	
low fert.	3860 a	3830 a	2400 a	2070 a	13070 a	
high fert.	4000 a	3710 a	2250 a	1950 a	12820 a	
MN SIG DIFF	410	230	250	210	580	

* Grazing cut dates

† Haying cut dates

‡ Haying received only 4 cuts for the season

DISCUSSION

Although small plot experiments gave significant increases in yield to weed control, and tolerance data indicated that there was no reduction in crop yields. This has not proven to be the case in the second year after establishment in the weed-free trial currently being conducted at Wairakei. Nor has the removal of weeds resulted in an increase of plant numbers. Although this is the result of one year's post establishment phase only, the next year's data, which as yet is unanalysed, would tend to indicate that the situation presently reported will be similar. In the establishment phase there was a considerable sheep's sorrel weed population and the use of pronamide applied crop pre-emergence, although controlling the weed, did not result in a very great increase in yield. Subsequent herbicide treatments have actually resulted in crop suppression. Admittedly the weed spectrum being encountered is not very great, nor is the degree of weed infestations, being only 10% in the "no herbicide" areas at the first cut in 1971 and 1972. The major weed so far is shepherd's purse with a little poa annua and some composites.

ACKNOWLEDGEMENTS

The authors would like to thank L. Brunswick and staff of the Wairakei Research Station for their assistance and encouragement; Mr T. Heymann and the N.Z. Dairy Co., Reporoa for the provision of trial sites and Biometrics Division for the analyses.

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