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LUCERNE CULTIVARS: INTERACTION WITH SITE, MANAGEMENT AND GRASS

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Abstract

Lucerne cultivars were compared at different Manawatu sites and under different management regimes in twelve trials. Cool season plot yields were increased by introducing grass, only for cool season dormant cultivars. Cool season active cultivars appeared to be more tolerant of frequent cutting. Rere and Oranga, the aphid resistant cultivars bred in New Zealand, performed well. Cool season active cultivars are a better means of increasing available feed in early spring than sowing grass into lucerne stands.

Keywords: Lucerne, lucerne-grass mixtures, management, genotypeenvironment interactions, cool season growth.

INTRODUCTION

When lucerne *(Medicago sativa)* is used as a grazing plant, rather than as a hay crop occasionally grazed, its management requirements impose constraints on farm practice. In particular its winter growth and availability in early spring are inadequate for stock needs and farmers may be unable to wait until the plant is at an optimum stage for grazing (Douglas and Wilkinson, 1976). McQueen and Baars (1980) showed that lucerne (cv Wairau') growth in the Central North Island over winter differed little from that of pasture and that spring availability was the major lack. Management of lucerne to be more available in spring has been researched and discussed (Smallfield, 1982).

Overdrilling with annual or perennial grasses to improve winter and early spring yields of lucerne stands has also been researched (e.g. Vartha, 1967, 1971; Marsh and Brunswick, 1978; McQueen and Baars, 1980). This is common farm practice in some districts (Mace, 1982). Generally, trials have shown that the grass contribution is often in part offset by a depression of lucerne production, that early autumn sowing is necessary to improve success and that as with pure lucerne stands, maximum yield is achieved with only one or two cuts or grazings in the cooler months.

'AS13-R' and 'Rere' are cultivars with significantly greater cool season growth than 'Wairau', which has been used for most research to date, and particularly more than such cultivars as 'Saranac'. The value of cool season active cultivars in New Zealand has not yet been extensively researched, and certainly it is not known if current management recommendations hold for them.

As well as cultivars with greater cool season growth, it may be possible to develop cultivars with improved management flexibility derived from an adaptation to frequent cutting or to the presence of grass.

This paper discusses trials in which lucerne cultivars were compared in contrasting environments and management conditions. From the results conclusions are drawn concerning the value of cool season active cultivars at different sites and the use of overdrilled grass. Lines of agronomic and plant breeding research which should be pursued are suggested.

MATERIALS AND METHODS

Twelve trials were conducted in Manawatu. Experimental details are described elsewhere (Easton and Stiefel, in preparation).

Cultivar trials I-III were sown into an intensively drained silt loam at the DSIR property 'Aorangi', near Kopane, and IV-VI were grown on free draining sand at Flock House. Cultivars tested were marketed in New Zealand or thought likely to be so.

In trial VIII at Flock House on sand, a 3-year-old stand of 'Wairau' lucerne was overdrilled in March with Tama ryegrass, Matua prairie grass and Amuri oats at 16, 20 and 114 kg/ha respectively. A pure lucerne control was included and all compared at two harvesting frequencies. A third no-cut winter treatment was applied to pure lucerne plots.

In trials IX and X at Palmerston North and at Aorangi respectively, 33 and 18 lucerne cultivars of a range of cool season growth were grown under two harvesting frequencies. Trial IX was sown with and without cocksfoot (cv Kara) or prairie grass (cv Matua). Trial IX could not be harvested over the summer and autumn because of marked heterogeneity of moisture availability.

Trials XI and XII were sown at Flock House on sand and alluvial soil in October 1979 and November 1980 respectively. Six lucerne cultivars with a range of cool season growth were grown and Amuri oats at 70 kg/ha and Tama ryegrass at 10 kg/ha were drilled into plots in March 1981. Control plots of pure lucerne were also retained.

All trials were fertilised with phosphorus and potassium but not nitrogen.

Table 1: CULTIVAR PERFORMANCE IN VARIOUS TRIALS

	Cool season* % total	Relative yields (Saranac = 100) AS13R	WL311	WL318	P524	Rere	Oranga
I Aorangi	18-20	90-110	90-99	86-90			
II Aorangi	16		112		104	99	111
III Aorangi	16	96	97		99	87	88
IV Flock House	18-26	149	134	122			
V Flock House	20	155	152	117	73	129	164
VI Flock House	29	195	154		120	133	200
XI Flock House	26	119-145				123-134	
XII Flock House (alluvium)	25	110				117	

* Cool season = 1 April-30 September; mean of all cultivars.

RESULTS

Cultivar Comparisons

Table 1 gives a summary of results. The figures given for trials XI and XII concern only the lucerne alone plots.

All cultivars currently marketed in New Zealand performed adequately at Aorangi but they differed at Flock House.

The proportion of mean cultivar annual yield harvested between 1 April and 30 September was higher at Flock House, particularly on the sand. These proportions are approximate only as their calculation involved interpolating between harvest dates. Also the yield of AS13-R relative to Saranac was higher at Flock House than at Aorangi, again less so on the alluvium than on sand.

The recently bred New Zealand cultivars 'Rere'and 'Oranga' both performed well wherever they were present.

Table 2: WINTER AND SUMMER YIELDS AFTER AUTUMN OVERDRILLING INTO WAIRAU LUCERNE – TRIAL VIII – INFREQUENT CUT. Kg DM/ha

	Lucerne alone	Lucerne plus Tama	Lucerne plus Matua	Lucerne plus Oats	lsd 5%
29.03.77 – 13.10.77					
Lucerne	1198	1371	1386	1485	480
Sown grass	–	3545	1848	3280	570
Weeds	955	185	502	420	460
13.10.77 – 27.04.78					
Lucerne	4918	2059	2564	2874	1290
Sown Grass	–	3500	4705	2554	660
Weeds	952	271	428	411	770

Overdrilling and Winter Management of an Established Stand

Total winter and summer yields for the less frequently cut treatment in trial VIII are shown in Table 2. Pure lucerne winter yield was highest if not cut. Overdrilling increased total yield, particularly at the less frequent cutting rate. The yield of lucerne was not adversely affected by the grass, and the weed component was reduced by overdrilling. In the succeeding summer there was a carryover depressing effect on lucerne of Tama and oats. Prairie grass was still contributing to plot yield, and depressing the lucerne. The winter cutting regime had an important carryover effect on pure lucerne plots so that the no-cut treatment yielded better and also had less weeds.

Cultivar Treatment Interactions.

Selected results for trials IX and X are shown in Table 3. Cutting frequency means are not comparable. Interaction between cultivar and cutting frequency or the presence of grass could be largely accounted for by dividing the cultivars into groups according to cool season activity. During winter grasses increased total plot yield of the non-active cultivars. They also contributed most of the plot yield when with the active cultivars but their depressing effect on these more than offset their contribution. The cool season active cultivars tended to yield less well than others in late spring and in summer.

There were many cuts for which yield or plant height interacted with cutting frequency. Cool season active cultivars tended to better tolerate frequent cutting, particularly in mid and late summer. Such an effect was apparent in the first differential harvest of each trial.

Table 3: MEAN CULTIVAR PERFORMANCE IN COOL SEASON ACTIVITY GROUPS

		Frequent cut groups*			Infrequent cut groups		
		1	2	3	1	2	3
Trial IX							
August 1980" *	no grass	.04	.10	.24	.08	.18	.49
	grass	.19	.23	.32	.15	.22	.36
Nov. 1980**	no grass	1.46	1.40	1.46	1.87	1.85	1.62
	grass	1.37	1.20	1.24	1.85	1.82	1.78
Trial X							
Jan 1980†		41.6	44.4	48.0	69.6	69.2	67.8
Sept. 1980" *		0.4	0.6	0.7	0.6	0.9	1.0
March 1981**		1.2	1.4	1.5	1.9	1.8	2.0

* Groups 1 -cool season inactive. 2 – medium, 3 – cool season active.
** Fresh weight -kg per plot
t Height in cm – mean of 3 measurements per plot

Table 4: MEAN YIELDS (kg/ha) FOR TRIALS XI (SAND) AND XII (ALLUVIUM)

	Date	Cultivar	Sand WL514	Sand WL216	Alluvium WL514	Alluvium WL216
Sand	09.07.81	Lucerne alone	1015	199	1344	115
Alluvium	22.07.81	Drilled – lucerne	1064	257	1244	228
		Drilled – Tama	98	120	87	122
Sand	17.09.81	Lucerne alone	1915	645	2030	1519
Alluvium	30.09.81	Drilled – lucerne	1877	773	1663	1382
		Drilled – Tama	398	496	463	779
Sand	11.11.81	Lucerne alone	3181	3250	3729	3738
Alluvium	19.11.81	Drilled – lucerne	2326	1495	1736	2933
		Drilled – Tama	1696	3166	3157	3530

A winter score for lucerne ground cover after four years showed significantly less cover on the more frequently harvested plots. The cool season active group of cuitivars was less subject to this effect.

Table 4 presents some results for trials XI and XII. Interactions between cultivar and the presence of grass occurred on sand but were never significant on the alluvium. With the cool season dormant cultivars there was better grass growth, less effect on the lucerne and a more significant grass contribution to total spring yield than for the cool season active cultivars. There was a carry-over depressing effect of Tama ryegrass on sand, in March of the following year, which was more severe for the cool season active cultivars. Even where overdrilling had a measurable effect, the yield of grass was usually much less than that of the more active lucernes. Oats gave the highest early yield (May), but the yield of Tama was much greater in the spring.

DISCUSSION

The performance of such cultivars as 'AS13-R' and 'Rere' relative to 'Saranac' is clearly site dependent. They grew more vigorously at Aorangi in the winter than 'Saranac' but this extra growth in annual terms was less significant than at Flock House. On the sand, cool season growth potential is more clearly expressed while summer growth, greater for the cool season inactive than active cultivars at Aorangi and at Palmerston North (Tables 1 and 3), is restricted by moisture stress.

Of particular interest are the high yields at Flock House of 'WL311' and the related new cultivar 'Oranga'. Though much more cool season active than 'Saranac', they are less so than 'AS13-R'. However, they grow well in the April/May period and again in September/early October. The plants are therefore strong going into the winter, and into the main growing season, and can be expected to be less sensitive to suboptimal management.

It has been conclusively shown that lucerne outproduces pasture on certain classes of the sands (Rumball, 1978; Smith and Stiefel, 1978). S.M.Nesbit (pers. comm.) surveyed the Bulls district to determine why farmers do not use it more and concluded that the major concern limiting lucerne use was the effects of pests and diseases. Cultivars now available surmount these and the management constraints cited as secondary may assume greater importance. Of these, bloat will remain a concern.

The data presented show that on sand country, cultivars differ significantly in annual yield and in seasonal distribution of it. The best yield more and also come out of the winter stronger, so offering more management flexibility. They should enable farmers to more confidently use lucerne as a grazing species.

Most previous research on overdrilling winter grasses into lucerne has involved 'Wairau', and results have varied. Our results from trial VIII show a yield advantage, with other effects, so that the benefit from the operation was far from clear cut.

Cultivars in trial IX could be listed in order of cool season growth. Those at the top of the list, active, showed a reduced plot yield with the presence of grass. Those at the bottom showed an increase. Wairau' was placed in the middle of the list and showed little change. The variation in results reported by other authors is thus not surprising.

Annual grass establishment and growth (trials XI and XII) was better with the non-active lucernes, and had less adverse carryover effects on them. We do not know if this last result would hold under intensive spring use of the grass growth, involving early and perhaps repeated grazing. Certainly, however, it was only for winter dormant lucernes that introducing grasses, perennial or annual, had a consistently positive effect.

Interactions between cultivar and cutting frequency were not always accounted for by grouping cultivars, but in some cuts of both trials IX and X the adverse effects of frequent cutting were less severe for the winter active material. Such an interaction was observed for the first differential cuts, before there could be any effect of the treatment. Cool season active cultivars achieved a relatively high standing yield early in the growth cycle and the more dormant types accumulated a higher proportion of their mature yield at the later stages. The difference explains the immediate effect and also may account for a carryover effect of treatment – interactions late in the season, and in ground cover score after four years. Early cutting occurred at different maturity stages for different cultivars, although all at the same date.

Generally, however, the interactions remaining after the group effects were removed represent minor shifts in position, or differences in scale of variation, not major changes in rank.

Chamblee (1972) reviewed the international literature on lucerne grass associations. Generally, the highest yielding cultivars gave the highest yielding mixtures. Lucernes adapted to more frequent cutting were more aggressive competitors. Those adapted to less frequent cutting but cut at the faster rhythm quickly declined as a component of the mixture. Although this research was conducted in harsher climates and compared lucernes adapted to 2,3 and 4 cuts in a year, the pattern of response is similar to that reported here.

Yield increases from using grass with 'Wairau' lucerne in the cold Central Plateau winter did not improve animal performance (Marsh and Brunswick, 1978). The data in this paper, from 3 areas of Manawatu show that feed available for harvest in early spring is better provided, with less management complications, with cool season active lucernes than by introducing grass. Even with grass, these specialist lucernes will perform better than others in the spring if early harvest is necessary.

Trials IX and X addressed plant breeding questions and so included many cultivars, studied cursorily. The interactions revealed suggest that the dynamics of grass lucerne associations under different managements should be intensively studied. It is not known how winter lucerne yield is'suppressed by grass, or the patterns of regrowth of lucernes of different cool season activity after winter and early spring cuts.

Interaction between cultivar and treatment, and the association of much but not all of it with maturity groups, is of significance for plant breeding. In providing lucernes which will afford management flexibility to farmers, plant breeders should first concentrate on developing a range of cool season activity. 'Rere' and 'Oranga' contrast sufficiently to provide a useful start in this respect. Within winter growth groups, it may be possible to breed lines specifically for sowing with grass, or early cutting and grazing.

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