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LEGUME OVERSOWING ON HILL COUNTRY IN MARLBOROUGH

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Abstract

Legumes oversown onto hill country in Marlborough *were* compared in six trials. At low altitude sites with northerly aspects, legume establishment was negligible unless resident vegetation was treated with herbicide prior to oversowing. On a southerly aspect, legumes established without herbicide although yields were higher if it was applied. 'Grasslands Pawera' red clover outyielded other legumes at 350m, producing 4.6 and 10.1 t DM/ha on a sunny and shady face respectively. Pawera also produced more than lucerne, 'Grasslands Maku' lotus, 'Grasslands Huia' white clover, alsike clover and subterranean *clover* at altitudes of 780 and 1000m, but yields were highest from lucerne at 600m and lotus at 1300m. Factors which may have influenced legume establishment and yields are discussed.

Keywords: clovers, lotus, lucerne, herbicide, hill country, aspect, altitude.

INTRODUCTION

White clover *(Trifolium repens)* is the most commonly oversown legume on hill country in Marlborough, but may not be the most suitable species for all situations. In Otago and Canterbury, 'Grasslands Maku' lotus *(Lotus pedunculatus)* has been shown to outyield white clover on low fertility acid soils (Lowther, 1977,1980; Nordmeyer & Davis, 1977). while red clover *(T. pratense)* may be more productive on less acid soils at high altitudes (Musgrave, 1977) and in dry environments (Scott ***et al.,*** 1974; Clifford, 1975; Allen -et ***al.,*** 1976). Lucerne *(Medicago sativa)* and subterranean clover *(T. subterraneum)* gave higher yields than white clover on a dry, sunny aspect in North Canterbury, (White & Meijer, 1979) typical of much hill country in Marlborough. This paper presents the results of experiments which compared the production of legumes oversown at various altitudes in the Wairau and Awatere Valleys, Marlborough. Herbicide treatments were included at sites where resident vegetation may have affected legume establishment, since Beggs (1962, 1964) had reported improved clover growth with herbicides where danthonia *(Notodanthonia sp.)* was present.

MATERIALS AND METHODS

Wairau Valley

Experiments were situated on a Haldon steepland yellow-grey earth at an altitude of 350m. Sites were danthonia dominant sunny (northern) and shady (southern) aspects with soil quick test values of; pH 5.7 and 5.9, Ca 8 and 8; K 16 and 12 and Olsen P 25 and 22 respectively.

A split plot randomised block design with four replicates was used. Main plot treatments were no herbicide or dalapon (4 kg/ha) and amitrole (1 kg/ha) applied in June, 1975, with paraquat (0.5 kg/ha) applied two months later. Legume sub plots were 'Grasslands Pawera' red clover, 'Grasslands Huia' white

clover (unpelleted seed), 'Grasslands Huia' white clover (pelleted seed), *T. hybridum* alsike clover, *Lotus corniculatus* cv. Maitland, *M. sativa* cv. Wairau lucerne, *Onobrychis viciifolia* cv. Melrose sainfoin and *Melilotus alba* cv. Polaris sweet clover. Inoculated seed was broadcast onto plots 4 x 1.5m in September, 1975, at rates to give seed numbers equivalent to 8 kg/ha of white clover. Potassic superphosphate (30% K) at 1250 kg/ha and a trace element mixture of Cu (4 kg/ha), B (2 kg/ha), Zn (4 kg/ha) and Mo (0.06 kg/ha) were applied prior to sowing.

In the establishment season, plots were cut in late autumn and legume yields estimated by herbage dissection. In the following season, the experiment on the shady aspect was cut in November, 1976, and both experiments were cut in January, 1977, when all sown species were flowering. Legume content of the cut herbage was estimated visually.

Table 1: SITE DETAILS, AWATERE VALLEY

Site	Altitude (m asl)	Soil type	pH	Soil quick test Ca	K	Olsen P
1	600	Hurunui	6.0	8	16	48
2	780	Hurunui/ Tekoa	6.1	8	14	16
3	1000	Tekoa	5.8	7	14	23
4	1300	Kaikoura	5.2	4	6	27

Awatere Valley

Four experiments were situated on sites with a northerly aspect. Site details are given in Table 1. Resident vegetation at site 1 was predominantly browntop *(Agrostis tenuis)* with some sweet vernal *(Anthoxanthum odoratum)* and hair-grass *(Vulpia* sp.). At site 2, browntop, danthonia, and sweet vernal were dominant, while at sites 3 and 4, there was much bare ground with scattered fescue tussock and *Celmisia* sp.

Legumes compared at each site were: 'Grasslands Pawera' red clover, 'Grasslands Huia' white clover, alsike clover, *L. pedunculatus* cv. Grasslands Maku, *M. sativa* Wairau lucerne and *T. subterraneum* cv. Mt. Barker. At sites 1 and 2 a split plot randomised block design with 3 replicates was used, Main plot treatments were no herbicide and glyphosate at 2.2 kg/ha, applied in September, 1977, and legume species were sown as subplots. Herbicide treatments were not included at sites 3 and 4, where legume treatments were arranged in a randomised block design, replicated four times.

'Prillcote' pelleted seed, inoculated at ten times the normal rate, was broadcast on October 11, 1977. Seeding rates were adjusted to give seed numbers equivalent to 6 kg/ha of white clover. Superphosphate (500 kg/ha), Mo (0.06 kg/ha) and B (3 kg/ha) were applied to all plots in September, 1977, and lime at 1.25 t/ha to lucerne plots only.

No yield measurements were made in the establishment season or in 1978-79. In January, 1980, rank herbage which had accumulated since sowing at sites 1 and 2 was cut and discarded. The first yield cut was taken in April, 1980, except at site 2 where there was a breakdown with mowing equipment. All sites

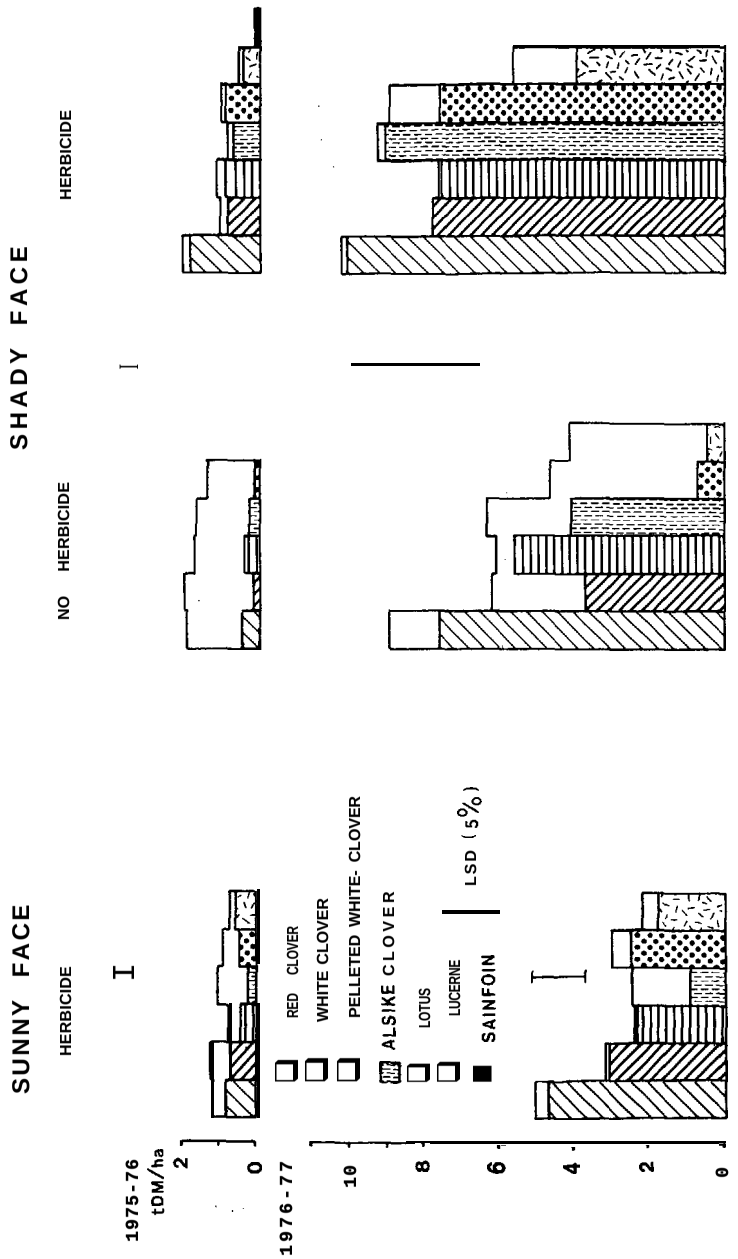

Fig. 1: *Total herbage and legume (hatched) yields on sunny and shady aspects, Wairau Valley.*

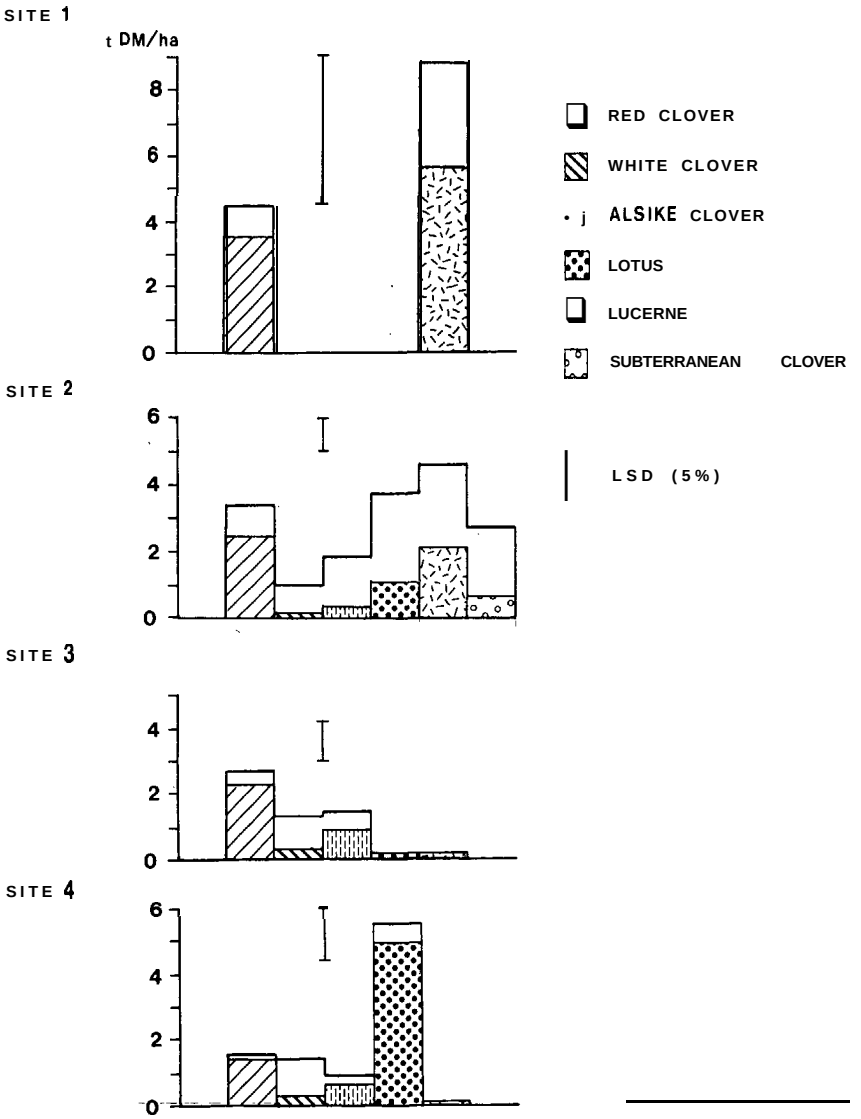

Fig. 2: ***Total herbage and legume (hatched) yields at four sites in A watere Valley, December 1981.***

were cut in December, 1981, when the legume content of cut herbage was determined by herbage dissection.

RESULTS

Wairau Valley

Legume establishment on the sunny aspect was negligible without herbicide and yields for the herbicide treatment only are given in Figure 1. Yield differences among legumes (except for sainfoin and sweet clover which did not establish successfully) were small in the first season, but red clover produced about twice as much as white clover, lotus and lucerne in the second season.

Production was similar from all species on the shady aspect in the establishment season where herbicide was not applied, but in the second year red clover outyielded other legumes. Lotus and lucerne yields were low compared to the clovers, but lotus yield in particular was increased by herbicide, which resulted in similar production to white and alsike clover. Red clover was highest yielding in both seasons where herbicide was applied, although differences from other legumes in the second season were generally not significant. There was no significant or consistent response from using pelleted white clover seed.

Awatere Valley

The effect of herbicide was significant only at site 1, where legume yields in the absence of herbicide were insufficient to warrant measurement. Lucerne and red clover outyielded alsike clover at the first cut in April, 1980 (Table 2) and were the only productive sown species at the second cut in December, 1981 (Fig. 2).

All legumes established at site 2, although white and alsike clover yields were very low (Fig. 2). Lotus and subterranean clover were higher producing than white clover, but were outyielded by red clover and lucerne.

At site 3, red, white and alsike clover yields were not significantly different at the autumn cut, (Table 2) but in December, red clover yielded more than other species, particularly white clover, lotus and lucerne, which produced very little.

Lotus and red clover yields were similar at site 4 in autumn, but lotus yield was markedly higher at the spring cut. Alsike produced more than white clover at both times, but was inferior to red clover.

Table 2: HERBAGE YIELDS (kg DM/ha) AT THREE AWATERE VALLEY SITES, APRIL, 1980.

Legume	Site 1	Site 3	Site 4
Red clover	2220	5140	4790
White clover	-	3650	1940
Alsike clover	1050	3580	3300
Lotus	-	-	4140
Lucerne	2660	-	-
Sub clover	-	-	-
LSD (5%)	830	2350	1970

DISCUSSION

Herbicide application to resident vegetation appears to enhance the establishment of legumes oversown onto dry, sunny aspects in Marlborough, since yields were negligible at Wairau Valley and the low altitude site in the Awatere Valley in the absence of herbicide. Establishment may have been assisted through the beneficial effects of dead plant cover (Evans & Young, 1970; Campbell & Swain, 1973). reduced competition (Dowling et *a/.,* 1971; Cambell, 1974). or the elimination of danthonia, which can inhibit nodulation (Parle, 1965; Janson & White, 1971 b). Reduced competition from resident vegetation may have been the most important factor responsible for the herbicide response on the shady aspect at Wairau Valley, particularly for lotus and lucerne. These species tend to have low seedling growth rates (de Ruiter, 1981; Palmer, 1982; Palmer & Wynn-Williams, 1982) and therefore would have been less competitive with resident vegetation than other legumes.

It has been suggested that lucerne may be more suited to dry hill country than clovers (Janson &White, 1971a; Nixon, 1971), but high levels of inoculum, seed pelleting and liming where soil pH is below 5.8 are required for successful establishment (Musgrave, 1982). This may explain the low yields of lucerne in comparison with red clover at Wairau Valley (Fig. 1) and the better performance of lucerne relative to red clover at low altitudes in the Awatere Valley, where a higher soil pH, combined with the use of lime and heavily inoculated pelleted seed appears to have favoured lucerne. These results confirm that lucerne can have a greater potential than clovers under dry hill conditions, provided attention is given to those factors mentioned above.

'Grasslands Pawera' red clover was found by Musgrave (1977) to outyield other legumes at an altitude of 1070m in North Otago, which supportsthe results from site 3 at Awatere Valley. Production was also highest from Pawera on the shady aspect at Wairau Valley, which indicates that greater use of this legume could be made under moist, cool situations which occur on shady aspects at low altitudes and on sunny aspects at high (1000m) altitudes.

Several workers have shown that 'Grasslands Maku' lotus outyields white clover on acid (pH < 5.0) soils (Scott & Mills, 1981), where aluminium toxicity can reduce P absorbtion by clover (Nordmeyer & Davis, 1977; Scott & Lowther, 1980). This could explain the higher yield of Maku compared with white clover at site 4 in the Awatere Valley, where soil pH was 5.2. Red clover may be more tolerant of low pH conditions than white clover, since production was higher from Pawera, particularly at the autumn cut (Table 2).

The management of the Awatere Valley experiments may have favoured some legume species relative to others, since grazing animals were excluded and accumulated herbage was removed only occasionally. However, the results have given an indication of which legumes may be the most productive over the range of altitudes where experiments were situated. A more realistic assessment of the potential of these legumes will not be possible until they are oversown on a farm scale and subjected to the stock effects of grazing, treading and excreta return.

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