Proceedings of the New Zealand Grassland Association 44: 91-97 (1983)

AN EVALUATION OF **PAWERA** RED CLOVER WITH PERENNIAL GRASSES IN A SUMMER-DRY ENVIRONMENT

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Abstract

Five grasses (Nui ryegrass, Roa tall fescue, Matua prairie grass, Maru phalaris and experimental cocksfoot selection K1858) were sown in mixtures with Pawera tetraploid red clover and compared with a pure sward of Pawera and with a Ruanui ryegrass/Huia white clover control. Yields were taken when mean herbage height was 18 cm by cutting quadrats to 4 cm. Sufficient sheep were used to graze herbage in 48 hours on a 'Cafeteria' basis.

Matua, the most rapidly establishing grass, yielded 900 kg DM/ha of sown grass at the first grazing, 4 to 6 times more than cocksfoot. Roa and Ruanui, and 30% more than Nui and Maru. During the next two years, the Matua/Pawera mixture outyielded other mixtures, with most of its superiority evident in the summer and winter. All mixtures outyielded Ruanui/Huia over the same period. The grasses evaluated varied in their compatability with Pawera, the more aggressive the grass the greater the suppression of DM yield of Pawera in the mixture. However, even the most aggressive grass mixture yielded more legume at each grazing than did the Ruanui/Huia pasture.

The place of Matua, Nui and Pawera as useful *varieties* in this summer-dry environment are discussed.

Keywords: Pawera red clover, Nui ryegrass, Matua prairie grass, Roa tall fescue, Maru phalaris, K1858 cocksfoot, Ruanui ryegrass, Huia white clover, grazing, summer-dry environment, Northern Southland.

INTRODUCTION

Because the performance of 'Grasslands Ruanui' perennial ryegrass *(Lolium perenne* L.)/'Grasslands Huia' white clover *(Trifolium repens* L.) pastures is often mediocre in Northern Southland, an area usually affected by summer drought, a cutting trial was laid down near Wendonside in the late 1960's to look at alternative pasture legumes to white clover. Of the legumes evaluated 'Grasslands Pawera' tetraploid red *clover (Trifolium pratense* L.) was the highest producer. Pure swards of Pawera outyielded Huia by 50%, producing 7800 kg DM/ha (Harris and Turner unpub.) The bulk of this difference was due to Pawera's superior productivity over summer. Daily growth rates for white clover declined from a peak of 40 kg DM/ha day during December to 20 in January and 13 in February. Three major factors are responsible for this; moisture stress because of white clover's shallow rooted habit (Evans 1978); the early onset and heightened development of reproductive growth in summer-dry environments (Trivedi and Tripathi 1982); damage by disease and insects - nematodes *Heterodera trifolii* in particular (Yeates and Risk 1976).

Pawera is deep rooted, late flowering, has a good measure of resistance to diseases and nematodes, and has an erect growth habit which enables it to utilise efficiently sunlight for growth (Anderson 1973 a,b). for these reasons, it seemed logical to use it as the pasture legume in a grazing trial to evaluate

a number of grasses likely to be more productive than Ruanui in this environment.

'Grasslands Nui' perennial ryegrass is more productive and persistent than Ruanui in dryland conditions (Rumball 1969, Sheath et *al.* 1976, Harris et *al* 1977, Rys *et al.* 1977, Hayman 1980). 'Grassland Matua' prairie grass *(Bromus catharticus* Vahl) has yielded exceptionally well at Lincoln (Vartha 1977). 'Grasslands Roa' tall fescue *(Festuca arundinacea* Schreb.) (Vartha 1978). an experimental cocksfoot *(Dactylis glomerata* L.) selection K1858 (Harris unpub.) and 'Grasslands Maru' phalaris *(Phalaris aquatica* L.) (Rumball 1980) have all shown promising productivity and persistence in dry environments. These varieties were therefore chosen for comparison as Pawera/grass mixtures with Ruanui/Huia.

METHODS AND MATERIALS

Species and Seeding Rates

Species and the sowing rates of the five grasses used are given in Table 1. All grasses were sown at a rate adjusted for viability and seed weight that gave the same number of seeds per unit area as 18 kg/ha of Nui ryegrass (approx. 1000 seed/sq.m). The controls were Pawera alone and a Ruanui/Huia mixture.

Table 1: SPECIES AND SOWING RATES OF MIXTURES bass: clover kg/ha)

'Grasslands Nui' Perennial ryegrass, 'Grasslands Pawera' tetraploid red clover (18.5)
'Grasslands Matua' Prairie grass, Pawera (100:5)
K1858 (1/8 Spanish X 1/8 Moroccan x 3/4 NZ) cocksfoot, Pawera (6.6:5)
'Grasslands Roa' tall fescue, Pawera (26:5)
'Grasslands Maru' phalaris, Pawera (16.55)
Pawera (10)
'Grasslands Ruanui' perennial ryegrass, 'Grasslands Huia' white clover (18:3)

Site

The trial was at Kaweku, 4 km south of Riversdale on a Kaweku stony silt loam. Average annual rainfall is 760 mm, summer rainfall is variable and high evaporation rates (Garnier 1958) often produce droughts. Winters are drier and colder than in other Southland regions (N.Z. Met. Service data), but soils become very wet because of an impervious subsoil (J.G.Bruce pers. comm.).

Trial Layout, Measurements and Management

The trial was hand sown in November 1975 into a cultivated seedbed. Each plot measured 6 x 4 m and was randomised within each of 4 blocks. Dry matter

production measurements were taken immediately before grazing by cutting four 0.25 m^2 quadrats per plot with hand shears to 3-4 cm when the average plot height reached 17-19 cm. Plots were not individually fenced so the whole trial area was grazed with sufficient sheep to defoliate to the cutting height in 48 hours. If necessary, plots were topped after grazing. Representative samples were taken to determine botanical composition at each grazing. Pawera plant numbers were assessed by counting living plants in 10 randomly placed 0.25 m^2 quadrats per plot. Yield measurements began at the first grazing after establishment.

Soil pH was 5.8 at the start of the trial, and 350 kg of 25% potassic superphosphate was applied at sowing and subsequently each November for the duration of the Trial. Fensulfathion was surface applied at 2 kg ai/ha after drilling to control grass grub *(Costelytra zealandica)* and Porina *(Wiseana spp).*

RESULTS

New Zealand Meterological Service rainfall data for the station at Kaweku (<2km from the trial site) and rainfall and evaporation data from Gore, (13km from the trial site) showed that over the summer months there was a considerable moisture deficit at both sites and in fact the only summer month that rainfall exceeded evaporation for the duration of the trial was in December 1975, the month after sowing. It is highly probable that evaporation would be higher at Kaweku than at Gore.

Although there were no differences between species in numbers of grass plants established, there was a considerable difference in their early growth. Yields of the sown grass fraction for the establishment period (sowing until 28 February 1976) showed that Matua had the highest DM yield (890 kg/ha) followed by Nui (675) and Maru (630). The slower establishing varieties, Roa, K1858 cocksfoot and Ruanui yielded only 15% to 25% of Matua. There was no signficant difference between treatments in DM yield of Pawera, but yields of weeds were greater in the plots containing the slower establishing varieties.

Table 2: SEASONAL AND ANNUAL DM YIELD OF TOTAL HERBAGE (kg/ha) (Mean of 1976/77, 77/78)

Treatment	Aut/Winter*	Spring	Summer	Annual	
Nui	2860	3645	3960	10465	(125)""
K1858	2160	3445	4230	9835	(118)
Roa	2370	3685	3550	9605	(115)
Matua	3195	3540	4830	11565	(139)
Maru	1735	3245	3755	8735	(105)
Ruanui-Huia	1895	3240	3245	8380	(100)
Pawera	1245	3240	3900	8385	(100)
LSD 5%	300	N.S.	430	700	
cv %	12.8	12.2	10.5	6.9	

* Autumn/Winter = 1 March to 30 August, spring = 1 September to 30 November, summer = 1 December to 28 February

** Annual DM figures expressed as a percentage of Ruanui/Huia control

As there were no year x treatment interactions in annual and seasonal yields of total herbage, means for the 2 years are presented in table 2. The Matua/ Pawera mixture outyielded all others annually. Its superiority was evident in the autumn/winter period and in summer. This mixture outyielded the Ruanui/Huia control by 39%. Nui ryegrass performed well in this environment, particularly in spring where (with Roa) it showed a trend to out-produce Matua. All treatments apart from pure Pawera and Maru yielded more than the Ruanui/Huia control which showed its poorest production in summer. Seasonal production of Pawera is not shown as there were no season x treatment interactions of the Pawera component of the mixtures in either year.

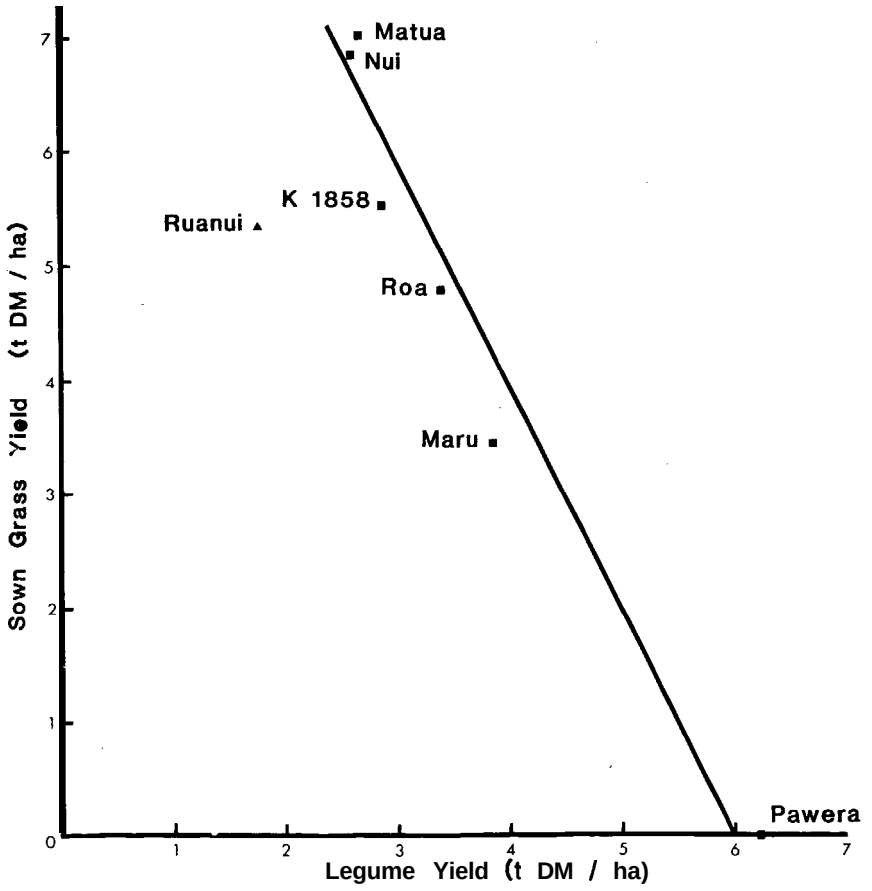

Fig. 1. *Harvested yield of sown grass (y) and legume (X) in variousseedmixtures. (Data mean of two years). Equation of regression line Y = 11.34 - 1.87X; R = 0.97*** (excludes Ruanui/Huia mixture).*

To investigate the competitive effects between Pawera and its grass companions, the production of sown legume was plotted against that of sown grass (Fig. 1). The two highest yielding mixtures, Matua and Nui, contained the smallest amount of Pawera and the greatest amounts of sown grass. However, the steepness of the slope of the regression line ($b=1.87 +/- 0.21^{***}$) meant that there was only a small difference in Pawera yield between the highest and lowest yielding grass. Gaining an extra unit of legume meant losing nearly 2 units of grass.

In the initial harvests there was a strong correlation between Pawera plant numbers/unit area and DM yield of Pawera, the faster establishing grasses having a lower population of pawera in the sward. This difference disappeared in the second year, Pawera plant numbers stabilising at 16-20/m^2 in the mixtures and 20/m^2 in the pure sward. The difference in Pawera productivity in the mixtures from then on was a function of the size and vigour of individual Pawera plants, which depends on the degree of competition from the companion grass, as shown in Fig. 1. All Pawera mixtures yielded more legume DM than did the Ruanui/Huia control.

DISCUSSION

Results from this trial confirm those from other dryland sites (Vartha 1977; Scott and Maunsell 1981; Sheath and Greenwood 1982) showing that Matua prairie grass and Nui ryegrass have important roles to play in pastoral agriculture in these sub-humid regions. Perennial ryegrass is a basic component of all improved grasslands of Northern Southland, and therefore a notable feature of the results was the superior performance of Nui compared with Ruanui, which was, until recently, the only perennial ryegrass cultivar available. The clear yield superiority of Matua/Pawera over the other mixtures in summer and autumn/winter makes this combination particularly effective in this environment. Although much of the summer production is in the form of seed-head, farmlet systems at Lincoln (T.J.Fraser pers. comm.) have shown this feed to be highly palatable to stock.

A major disadvantage of the trial reported here and of those reported by Sheath et *al.* (1976) and Sheath and Greenwood (1982) are that they are not long enough to give any accurate data on persistence. For instance Allo and Southon (1967). Rumball (1969) and Scott and Maunsell (1981) have shown that Maru phalaris and Roa tall fescue need 2 years to establish; only later do they demonstrate their superior productivity in these dryland climates over more traditionally used species. However it could be argued that on the intensive sheep and mixed cropping farms of Northern Southland a 2 year establishment is a luxury which cannot be afforded, particularly as Matua and Nui established so rapidly that they did not allow the weed ingress observed in Roa, K1858, and Maru plots.

There was no evidence of frost damage in winter with Maru as observed with Sirocco Phalaris by Sheath and Greenwood (1982) in North Otago, and by O'Connor and Clifford (1977) in the MacKenzie Basin. Winter damage was apparent on K1858 cocksfoot and underlines the common problem in cold winter environments with material of Mediterranean origin that is winter active. The newly released 'Grasslands Wana' Cocksfoot (Rumball 1982) is superior to other cocksfoots at Gore (Turner in press), and is certainly more suitable for sheep grazing than other cocksfoot cultivars (A.J.Harris and G.S.Baxter pers. comm.). This cultivar may prove to be more productive than K1858 in Northern Southland.

The importance of legumes in pastures for their high nutritive value is stressed by Ulyatt et *al.* (1976) and Thomson (1978). Figure 1 demonstrates that even plots with the highest grass yields (Nui and Matua) produced more clover (+800 kg/ha) than Ruanui/Huia plots. The less aggressive grasses, K1858, Roa and Maru produced much more. Most of the superiority of Pawera over Huia in the mixtures occurred during summer and autumn, and is due principally to its ability to exploit water and nutrients through its tap root from greater soil depths.

Pure swards of Pawera yielded the same in this trial as the Ruanui/Huia control and would obviously be of considerable benefit to farmers in this region as special purpose pasture for hay conservation and high quality feed for lamb fattening. As pointed out by Hay et ***al.(1978)*** and Kelly *et al.*(1979) care would have to be taken not to flush and mate ewes on these phyto-oestrogenic pure red clover pastures.

At least three useful varieties seem to have emerged frorn this trial: Matua, Nui and Pawera. Recent work by Bell (1982) at Flock House has shown Matua to be very sensitive to defoliation frequency under cutting in terms of DM production and persistence. Work in dryland conditions in Lincoln (Lancashire et ***al,*** 1978) showed that Nui was no better than Ruanui under frequent and intensive grazing. Unpublished work by the authors have shown DM production and persistence of Pawera to decline with increasing frequency of grazing. It is thus very important in these summer-dry regions for Pawera, Nui, and Matua pastures to be rotationally grazed at infrequent intervals to enable their growth potential to be expressed.

Although more research needs to be done in these environments to define the optimum seed mixtures, seeding rates and frequency and intensity of grazing, Matua prairie grass and Nui ryegrass in combination with Pawera red clover have demonstrated a good balance of cool-season-activity, drought tolerance and high potential summer growth in this region of variable summer rainfall, and must be considered when seeking more productive pasture plants for these environments.

ACKNOWLEDGEMENTS

Mrs N.Heaps (nee Grace), M.J.Hickey and J.D.Turner, Grasslands Division, Gore, for technical assistance. Our thanks for the co-operation from Mr N.L. Shallard on whose property at Kaweku the trial was situated. Our thanks also to Mr H.Gibbs who bought the property in 1977.

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