WHITE CLOVER VERSUS NITROGEN FERTILISER 1. PASTURE PRODUCTION

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ABSTRACT
White clover (*Trifolium repens* L.) is extensively used in New Zealand pastoral systems due to its nitrogen fixing ability and its quality as an animal feed. Increasing use of nitrogen fertilisers reduces biological nitrogen fixation and proportion of clover in pastures. Pasture production of ryegrass/white clover pastures, depending on biological nitrogen fixation, was compared with ryegrass (*Lolium perenne* L.) pastures receiving 270 kg N/ha/year. Average pasture production (over four years) was 17,400 kg/ha/year from the mixed and 14,200 kg/ha/year from the ryegrass pastures. Tiller densities were 60% higher in ryegrass pastures in the first two years and similar for years 3 and 4 in both pastures. The ryegrass component of both treatments had similar nitrogen concentration (3.1%). It is concluded that at similar input rates the inefficiencies associated with fertiliser give rise to lower yield potential.

KEYWORDS
Lolium perenne, nitrogen, pasture production, perennial ryegrass, tiller density, *Trifolium repens*,white clover

INTRODUCTION

Biological nitrogen fixation by white clover has been a dominant feature of pastoral farming in New Zealand. White clover provides a cheap source of nitrogen and has a high feeding value (Ulyatt, 1981). There is both geographic variation in the rate at which nitrogen is fixed (range 85 to 342 kg N/ha), and seasonal and annual variation (Hoglund et al., 1979).

The increasing use of nitrogen fertilisers (Kidd and Howse, 1994) has negative effects on the proportion of white clover in pastures and biological nitrogen fixation rate (Harris *et al.* 1994).

A grazing experiment was conducted to compare the impact of biologically fixed and fertiliser nitrogen on pasture production over a period of five years.

MATERIAL AND METHODS

The experiment carried out at AgResearch Gore (46°07' S; 168°54'E; altitude 123 m), on Waimumu silt loam (Dystric Ochrept) had an Olsen P of 22 at the start of the five year experiment and pH 5.8. The site had been in ryecorn (*Secale cereale* L.) for two years preceding sowing and was in permanent pasture prior to that. Gore has a cool-moist climate, mean annual air temperature of 10.3 C and annual precipitation of 920 mm evenly distributed throughout the year.

The trial area was cultivated, fertilised with superphosphate and the seed was broadcast and harrowed. Treatment paddocks were individually fenced. Perennial ryegrass ('Grasslands Huia') and white clover ('Grasslands Huia') were sown at 18 and 3 kg/ha respectively in either mixed ryegrass/white clover or ryegrass pastures in October 1989. The ryegrass paddocks received 270 kg nitrogen/ha/year in nine equal sized split applications, over spring, summer and autumn. The eight 0.5 ha paddocks were subdivided so they could be rotationally grazed all year round by sheep, regrowth periods varied from $2^1/_2$ weeks in spring to 7 weeks in summer and 14 weeks in winter. Grazing duration varied from one day in winter to two weeks (one week lambs with one week ewes following) in summer. Volunteer clover was sprayed out of the ryegrass pastures using dicamba at 4 l/ha in 1990 followed by spot spraying with dicamba in 1993.

Ryegrass and clover seedling density was determined five weeks after sowing and ryegrass tiller density was determined quarterly from June, 1990. Pasture growth rates were measured using exclusion cages. Herbage in cages was trimmed to a 30 mm stubble and regrowth above 30 mm was collected one (two in winter) month later. Pre and post grazing herbage levels were assessed using a capacitance probe (Mosaic industries, NZ), calibrated regularly for different pasture types.

The chemical composition of the ryegrass herbage fraction was determined on five weeks regrowth, once in the summer and once in the autumn of the final year.

RESULTS AND DISCUSSION

Annual herbage production was significantly ($P<0.05$) higher in mixed than ryegrass pastures. There were no significant differences in the production of the ryegrass and weed components. Clover yield of mixed pastures was additive to grass and weed yields and contributed on average 27% (range 23 - 35%) to the total annual production (Fig. 1).

The total herbage production of mixed pastures was significantly higher than that of ryegrass pastures from November to January and in April, generally the time of year when clover production was highest (Fig. 1). Ryegrass production reached its highest level in October in the ryegrass and in December in the mixed pastures, but monthly ryegrass production of the mixture was similar from September to April (Fig. 1). Only in October was ryegrass production significantly ($P<0.01$) higher in ryegrass than in mixed pastures. This can be attributed to the start (late September) of fertiliser nitrogen application, which raised the level of available mineral nitrogen in ryegrass pastures to levels in excess of those in mixed pastures.

There were more ($P>0.05$) ryegrass seedlings 42 days after sowing in ryegrass (537 seedlings/m^2) than in mixed pastures (463 seedlings/m^2). The number of clover seedlings was on average 220/m^2 in mixed and 50/m^2 in ryegrass pastures. Ryegrass tiller densities were higher in ryegrass than mixed pastures with the difference only significant ($P<0.01$) for the first 18 months of the experiment (Fig. 2).

The nitrogen concentration of the ryegrass components were 3.0 % and 3.1%, digestibility was 83.5% and 80.5% and energy levels 12.6 and 12.0 MJME/kg DM respectively for mixed and ryegrass pastures.

The nitrogen rate applied appeared to be comparable to the amount of nitrogen fixed by white clover at Gore (Hoglund *et al*., 1979). This was indicated by the similar ryegrass tiller densities (Van Loo *et al*., 1992) and nitrogen concentration of the ryegrass components of the pastures (Van Loo *et al*., 1992).

CONCLUSION

Mixed ryegrass/white clover pastures outyielded ryegrass pastures supplied with 270 kg N/ha, by 22%. It is concluded that at similar input rates the inefficiencies associated with fertiliser give rise to lower yield potential. It can however be argued that strategic management of rate and time of application could produce different outcomes.

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Figure 1
Annual growth patterns (mean of 4 years) of mixed ryegrass/white clover and ryegrass pastures and their components (ryegrass, clover and weeds).

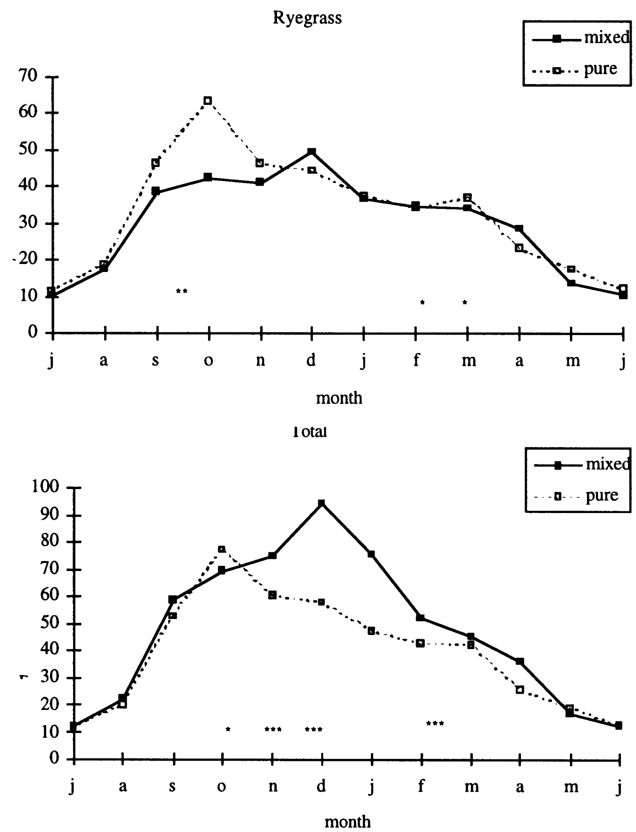

Figure 2
Ryegrass tiller densities in mixed ryegrass/white clover and ryegrass pastures at Gore over time. Bars indicate s.e.d. values, *, ** significant at P<0.05 and <0.01 respectively