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Liveweight gain of young sheep grazing tall fescue or perennial ryegrass swards of different white clover content.

M.G. HYSLOP, T.J. FRASER [1], D.R. SMITH, T.L. KNIGHT [1], M.W.A. SLAY AND C.A. MOFFAT

AgResearch Poukawa, PO Box 8144, Havelock North.

ABSTRACT

It is not clear whether the inherent qualities of tall fescue or the legumes grown with it are responsible for the wide range of liveweight gains in young sheep grazing these swards. The objective of this experiment was to determine the value of the white clover content in tall fescue swards relative to perennial ryegrass/white clover swards in respect to liveweight gain in young sheep. Nine trials (ranging from 41 to 190 days) were conducted at AgResearch Poukawa and AgResearch Lincoln from spring 1995 to autumn 1997 using 15 animals as replicates in 19 treatments. Overall, liveweight gains ranged from –87 to 366 g/head/day. Even small increases in clover content had large positive effects on liveweight gain of young sheep grazing both perennial ryegrass and tall fescue. At the same pasture mass and composition, all spring grazing liveweight gains were significantly greater than those in autumn (P<0.001). Tall fescue swards appear to sometimes produce higher liveweight gains than perennial ryegrass-based swards, but this is by virtue of growing more white clover, particularly in spring.

Keywords: liveweight gain; perennial ryegrass; tall fescue; white clover content; young sheep.

INTRODUCTION

Over recent years tall fescue (*Festuca arundinacea* Schreb.) has increased in popularity as a pasture species option in a broad range of New Zealand farming systems (Martin and Moloney, 1988; Milne *et al.*, 1997). Its benefits include, tolerance to drought (McCallum *et al.*, 1992; Milne *et al.*, 1993; Reed, 1996), resistance to grass grub (*Costelytra zealandica*) and Argentine stem weevil (*Listronotus bonariensis*) tolerance (Prestidge *et al.*, 1986; McCallum *et al.*, 1990), and being endophyte free (Easton *et al.*, 1994).

Legumes (*Trifolium repens*, *T. pratense*) are recommended (Milne *et al.*, 1998), and commonly sown with tall fescue to provided symbiotic nitrogen. Exton *et al.*, (1996) found that tall fescue pastures had higher legume contents after one year from sowing in comparison to high endophyte perennial ryegrass swards that were sown with the same amount of legume seed. Tall fescue swards also have excellent compatibility with white clover (Hay, 1987; Milne *et al.*, 1997) due to less competition in the inter-plant spaces and the upright and “clump” forming growth habit of individual plants, particularly in cattle grazed swards. Lucerne (*Medicago sativa*) and chicory (*Cichorium intybus* L.) have successfully been grown in combination with tall fescue (Milne *et al.*, 1998), which demonstrates its low level of inter-plant competition and the attractive environment it provides for companion species.

However, a wide range of liveweight gains have been experienced in young sheep grazing tall fescue/white clover swards which range from excellent apparent gains (Davies and Morgan, 1982) to steady declines or very small gains in live weight (Reid *et al*., 1978). It is not clear whether the inherent qualities of tall fescue or the legumes grown with it are responsible for these wide ranges in liveweight gain of young sheep. The objective of this experiment was to determine the value of the clover content in fescue swards relative to perennial ryegrass/white clover swards in respect to liveweight gain in young sheep.

MATERIAL AND METHODS

Experimental sites

The experiment was conducted at AgResearch Poukawa Research Station, Hastings, New Zealand (39° 45 min S), which is flat to gently rolling hill country with a sandy loam soil type and an average 10-year rainfall of 771 mm, and at AgResearch Lincoln Research Station, Christchurch, New Zealand (43° 40 min S) with a similar 10-year rainfall of 684 mm and flat topography with a clay loam soil type. Both sites have predominantly dry summers with drought conditions every three to four years.

Trial design and animals

Nineteen pastures (six at Poukawa, thirteen at Lincoln) were selected for the trial, with plot size varying between 0.5 ha and 1.5 ha. Nine treatments (three at Poukawa, six at Lincoln) of tall fescue (cultivar; cv. Triumph sown at 25 kg/ha), and nine treatments (three at Poukawa, six at Lincoln) of perennial ryegrass (six of cv. Nui, high endophyte and three of breeders seed lines, nil endophyte sown at 20 kg/ha) were sown with varying levels of white clover (0 – 20% by sown population of cv. Tahora). One treatment of pure white clover (cv. Tahora, 5 kg/ha) was also sown. All treatments were established by conventional cultivation (plough, roll, power harrow) during autumn 1994 except for the three perennial ryegrass swards which were established in 1989 at Poukawa. Due to the age of the Poukawa swards, one was sprayed with 1.16 l/ha of Gramoxone® (200 g/l paraquat as a soluble concentrate in 250 l water) to suppress grass and increase the clover percentage 8 weeks before the first spring grazing period in 1996. Another two treatments were sprayed with 0.9 L/ha of Versatill™ (300 g/l clopyralid as a water-soluble concentrate in 900 l/ha) to remove clover from these treatments.

Eight grazing periods were conducted over three years, and two seasons (spring and autumn), each averaging 52 days in duration to complete a data set of 84 lamb and hogget liveweight gain measurements paired with pasture quality

[1] AgResearch, PO Box 60, Lincoln.

and quantity characters. Not all treatment plots were grazed at each grazing period.

Treatments were set stocked with 15 spring-born (24-31kg) Coopworth ewe lambs in the autumn grazing periods, and 15 (39-57kg) Coopworth ewe hoggets for the spring grazing periods. After autumn grazing periods, animals (lambs) were massed from all treatments at each site and randomly reallocated to treatments for the spring grazing period (as hoggets), each year. All animals were treated with an oral anthelmintic for the control of internal parasites 30 days prior to the start of each grazing period, and at the commencement of each grazing period. Historically, trace elements had been found not to limit growth of young sheep at either site, except for selenium, which was administered via the oral anthelmintic. Animals were not shorn within any of the grazing periods.

Management

Herbage allowance on offer was maintained by a give-and-take system through altering the pasture area available. A moveable electric fence was used so that sward covers were kept between 1200-2500 kg DM/ha during grazing periods, with the movement of the electric fence based on pasture probe measurements and sward height, which was maintained between 3 - 8cm (see Table 1). Extra non-treatment animals from the same population were also used to control spring growth when required. Fifty units of nitrogen per hectare, as sulphate of ammonia or urea, were applied one month before the start of each grazing period additional to an annual autumn/winter topdressing of 300 kg/ha superphosphate. All treatments at Lincoln were spray irrigated to maintain 25% available soil moisture.

MEASUREMENTS

Unfasted live weights of young sheep were taken immediately prior to, at weekly intervals during, and at the completion of each grazing period, except for all animals at the Poukawa site which were weighed (animals fasted overnight) immediately prior to, and at the completion of each grazing period, but weighed unfasted within each grazing period.

Pasture height was measured weekly at 50 sites across each treatment using a perspex disc pasture height meter, 0.1 m^2 in area (Mueller *et al.,* 1990). Pasture capacitance probe dry matter (DM) measurements were also taken at 50 sites across each treatment. Probe measurements were used as an immediate measure of pasture cover so that grazing area or non-treatment animal numbers could be adjusted accordingly. Pasture cuts (kg DM/ha) were taken fortnightly by cutting to ground level four randomly selected, 0.18 m^2 quadrats per treatment and oven drying samples for 12 hours at 80° C. Dissection samples were also cut to ground level from 20 sites across each treatment at fortnightly intervals with sub-samples dissected into grass leaf, grass stem, clover, weed and dead matter.

Pasture height, pasture probe, pasture dry matter cuts, and pasture dissection measurements were taken on a proportional basis within each treatment from the area being grazed and from the area adjustment if the electric fence was moved.

Statistical methods

Liveweight gain data from all nineteen treatments were analysed by multiple regression using Genstat 5 (Payne, 1993). The data were classified by season (spring or autumn) as well as by grass species (either tall fescue or perennial ryegrass) and combined over sites.

A model incorporating pasture mass, green:dead ratio, and grass:clover ratio was used to explore the effect of clover, after adjusting for other effects. This model was specified as:

Equation 1 LWG = Location + Grass species + $\log_e$(Green Mass) + $\log_e$(Green:Dead ratio) + $\log_e$(Grass:Clover ratio) + Grass species x $\log_e$(Grass:Clover ratio)

Each term in this model represents a single degree of freedom contrast. Logarithms of ratios were used to reduce scale effects and the interdependencies between the predictor variables. Separate regressions were calculated for spring and autumn seasons, after a combined analysis across seasons indicated strong season by composition interactions.

No statistical analysis was undertaken on the botanical data for this experiment due to measurements being taken on the same treatments over time with the intention of multiple regression analysis for each sward component being correlated to liveweight gain, which will be reported in a separate paper.

RESULTS

Spring

Liveweight gain of young sheep was significantly less ($P<0.001$) (on average 37.5g/day less), in tall fescue swards when compared to perennial ryegrass swards of the same white clover content, over a range of 0 – 60% clover contents (see Figure 1). However there was no significant difference ($P<0.170$) in the slope of each line for each grass species as clover content increased (adjusted R^2 = 66.7%).

Autumn

FIGURE 1: Spring liveweight gains (g/head/day) in young sheep grazing tall fescue (—•—) or ryegrass swards (---•---) of different white clover contents.

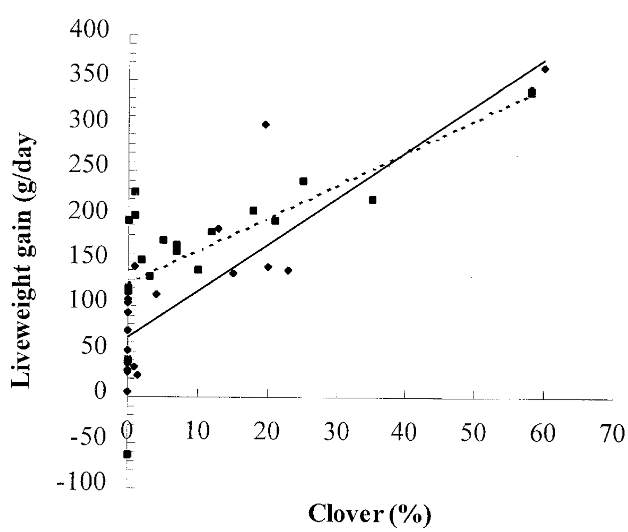
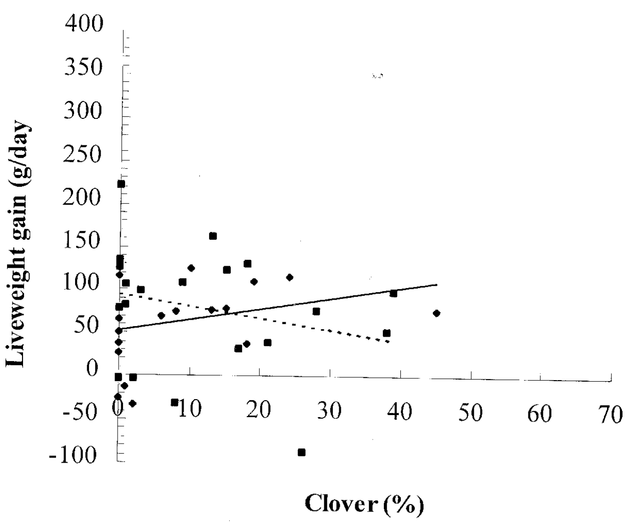


TABLE 1: Average spring (1995 & 1996) botanical compositions, sward height and mass of tall fescue/clover and perennial ryegrass/clover treatment combinations.

Treatment number	Grass species	Sward height (cm)	Mass (kgDM/ha	Clover (%)	Grass leaf (%)	Grass stem (%)	Weed (%)	Dead (%)
1	ryegrass	9	1711	0	19	60	2	19
2	tall fescue	12	2454	0	36	24	23	17
3	tall fescue	6	1021	0	46	20	0	34
4	ryegrass	5	870	0	47	24	0	29
5	tall fescue	6	1129	1	47	22	0	30
6	tall fescue	8	1961	4	46	38	2	10
7	ryegrass	5	1068	5	46	26	0	23
8	ryegrass	8	2371	5	20	69	0	6
9	ryegrass	5	960	8	41	31	0	20
10	ryegrass	7	1971	9	27	55	0	9
11	tall fescue	5	1893	13	28	51	0	8
12	ryegrass	3	1088	18	43	31	0	7
13	tall fescue	5	1996	20	63	10	3	4
14	tall fescue	5	1506	20	47	19	9	5
15	ryegrass	4	1385	21	46	26	0	7
16	ryegrass	5	1366	25	26	42	5	2
17	tall fescue	4	1367	37	34	11	9	9
18	tall fescue	4	1490	42	26	17	9	6
19	ryegrass	3	1086	47	23	16	7	7

Young sheep grazing either grass species showed no significant association in liveweight gain to increasing levels of clover. This is shown by no difference in the slope or elevation of each regression line for each grass species (see Figure 2). Average liveweight gain was 76g/day across all treatments in autumn compared to 98 – 257g/day for treatments in the spring grazing period at similar clover levels (40% mass, respectively).

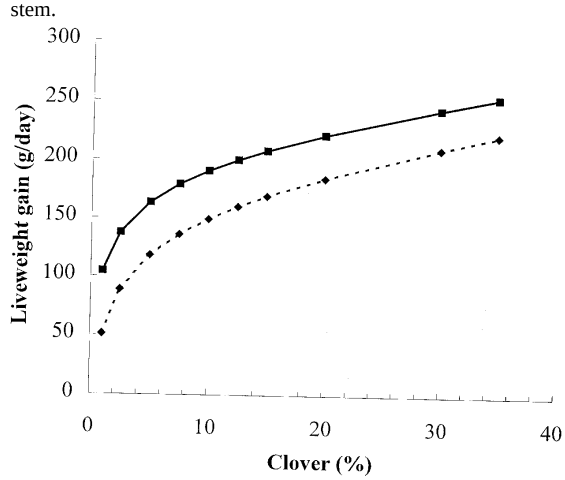
FIGURE 2: Autumn liveweight gains (g/head/day) in young sheep grazing tall fescue (—•—) or ryegrass swards (---•---) of different white clover contents.



Average spring (1995 & 1996) botanical compositions, sward heights and mass give a sample of the range of components in the 19 treatments (see Table 1). Treatment 2 had a high weed content due to a poor initial establishment, but all other treatments had over 90% purity. Sward height was maintained between 3 – 8 cm for all treatments except for treatment 2. The variability in mass between treatments was often reflected in the amount of grass reproductive stem present.

The predicted relationship for percent clover and liveweight gain of young sheep (see Figure 3) from an empirical model incorporating five parameters – total green pasture mass (clover + grass leaf), the ratio of green to dead, the ratio of clover to grass, a seasonal effect, and the interaction of season with the clover:grass ratio (see Equation 1) showed that the main effect appeared when clover content was increased form 0 to 10% and to a lesser degree, from 10% to 20%. The model also predicted perennial ryegrass based swards of different clover contents having a liveweight gain advantage over tall fescue based swards. Seventy eight percent of the total variation of young sheep liveweight gain was accounted for by the model when the perennial ryegrass/tall fescue parameter was added.

FIGURE 3: Predicted relationship between percentage clover in the diet on offer and liveweight gain in young sheep fed either tall fescue (—•—) or ryegrass swards (---•---) at 1200 kg/DM/ha and 30% dead & stem.



DISCUSSION

When tall fescue or perennial ryegrass swards were at pasture covers between 1200-2500 kg DM/ha and 3 – 8cm in height with a range of comparable clover contents (by mass), the difference in the value of each grass species was clearly reflected. Perennial ryegrass swards reliably produced greater liveweight gains in young sheep, but only in spring (see Figure 1). However, both grass species showed a similar response to liveweight gain in these spring grazing periods (no significant difference in the slope of the line for each grass species), so, under the imposed grazing management, tall fescue swards would only produce higher or similar liveweight gains if the tall fescue swards had higher clover content.

The predictive model (see Figure 3 and Equation 1) suggests that small changes in clover content (by mass) between the levels of 0 – 20% in the sward make a large difference to liveweight gain for either grass species. Tall fescue has been shown to grow high amounts of clover in its inter-plant spaces (Hay, 1987; Milne *et al.,* 1997), which may be why excellent liveweight gains of young sheep have been reported in spring (Davies *et al.*, 1982). The results from this experiment would suggest that clover content would have to be 40% of sward mass or greater before liveweight gains of over 250 g/day were achieved.

However, liveweight gains are difficult to attribute to any one sward component as the ratio of species on offer constantly changes due to selective grazing and plant growth rate (Hodgson, 1982). In this experiment, grazing management was governed by sward height (mainly grass height) and pasture cover so that, at the start of each grazing period, clover contents were at their largest and declined thereafter. The regression analysis presented used an average of the clover contents from the fortnightly botanical analyses as an estimate of clover content over each of the grazing periods. This method may overestimate or underestimate the amount of clover thought to be responsible for the different liveweight gains because of selective grazing over time and clover growth rates within each grazing period.

The reasons for no clear relationship being found to clover content (by mass) in either grass species for the autumn grazing periods is unclear. A similar range of swards with different clover contents existed to those grazed in the spring periods so another factor, or a combination of factors such as fungal toxins, forage quality, facial eczema may have been responsible. Evidence suggests fungal endophyte in the perennial ryegrass swards could have been partly responsible for the lower liveweight gains (Fletcher *et al.*, 1999), but this does not explain why tall fescue swards also produced similar gains in live weight that were not significantly different to those in perennial ryegrass swards at comparable clover contents (since tall fescue does not contain fungal endophyte).

This work suggests that clover content is one of the reasons for the higher liveweight gains experienced in young sheep grazing tall fescue swards in spring, in comparison to liveweight gains of young sheep in perennial ryegrass based swards. The less competitive nature of tall fescue at the individual plant level (particularly in spring) is thought to provide a more suitable environment for clover growth, and the reason for the higher levels of clover content in tall fescue swards.

Small increases in clover content made large differences in liveweight gain of young sheep but, in autumn, no relationship was found between clover content and animal liveweight gain in either grass species. Existing technologies should be advocated and promoted to increase legume contents in less-competitive grass-based swards for better spring liveweight gain in young sheep.

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