Effect of grazing system on the yield and quality of summer-active tall fescue in the Western District of Victoria

Margaret Raeside[1,2], Michael Friend[2,3], Alister Lawson[2,4]
[1]Department of Primary Industries, Hamilton, Vic
[2]CRC Future Farm Industries
[3]Charles Sturt University, Wagga Wagga, NSW
[4]Department of Primary Industries, Kyabram, Vic

Introduction

Effective grazing management may improve pasture production and quality. In the Western District of Victoria, the need for additional high quality feed from pasture is especially apparent over summer, when pastures dry off in response to low rainfall, prior to regenerating after the opening rains, usually in autumn.

Large areas of the Western District of Victoria are characterised by heavy clay soils which are prone to waterlogging for 2 – 3 months of the year, usually in winter (Newell, 1962). Livestock producerscould potentially improve pasture production over summer, filling the feed gap, while also reducing groundwater recharge by sowing in these areas a pasture species that can utilise out of season rainfall and stored soil moisture to continue growth over summer. One such pasture species is summer-active tall fescue (*Lolium arundinaceum* syn. *Festuca arundinacea*).

There is no information on how summer-active tall fescue should be grazed to optimise yield and quality in the Western District of Victoria. Therefore, a PhD project located at Hamilton aims to develop grazing strategies specific for summer-active tall fescue. This article summarises the yield and herbage nutritive value results to date from this project.

Materials and method

The experiment was located at the Department of Primary Industries EverGraze research site at Hamilton, Victoria, Australia (37°49'S, 142°04'E; altitude 200 m). The region has a temperate climate with a mean annual rainfall of 684 mm (1962 – 2007). The long term (1965 – 2007) average maximum and minimum daily temperatures in the warmest month (February) are 26°C and 11°C and in the coolest month (July) are 12°C and 4°C. Total monthly rainfall and mean maximum and minimum daily temperatures (for the duration of the project and long-term) are shown in Figure 1.

The soil was a very fine sandy clay loam (Northcote, 1979). Analysis of the top 10 cm of soil indicated the soil had a $pH_{(CaCl2)}$ of 5.0, phosphorus (Olsen) of 18 mg/kg, potassium (skene) of 420 mg/kg and sulphur (CPC) of 18 mg/kg.

A summer-active tall fescue (cv. Quantum)/subterranean clover (*Trifolium subterraneum* cv. Leura and Gosse) pasture was established in November 2004. Four grazing system treatments were imposed in a completely randomised design in September 2006. They were; set stocked (SS) where the sward is maintained at an average feed on offer of ~1000 kg DM/ha; or rotational grazing at either the 2- (RG2), 3- (RG3), or 4- (RG4) leaf stage. When the respective leaf stage is reached the plots are grazed to an average feed on offer of ~1000 kg DM/ha over a 5 – 14 day period. Merino ewes or lambs grazed the sward.

Herbage mass was generally measured every month using a calibrated falling plate meter (Bransby *et al.* 1977) and used to calculate herbage accumulation. The plate meter was calibrated monthly by cutting between 15 and 40 circular 0.1 m^2 quadrants to ground level and relating the actual herbage mass to the plate meter value by regression analysis. The herbage mass of each plot was then measured using 8 fixed points per plot (24 per treatment). Pasture cages were used on SS areas to exclude grazing. The method of restricted maximum likelihood in GenStat (GenStat Committee, 2003) was used with a variance-covariance structure as selected via a sequence of likelihood ratio tests on a number of nested models, with a power model selected, in order to model the repeated measurements over time.

Herbage nutritive value of green dry matter collected as toecuts along plot transects were measured using near infrared spectroscopy (NIR) by FEEDTEST (Department of Primary Industries, Hamilton). Herbage nutritive value was analysed using a split plot analysis with the treatments as the main plots and time periods as the sub-plots. After checking the residuals for normality, a repeated measures analysis of variance was done.

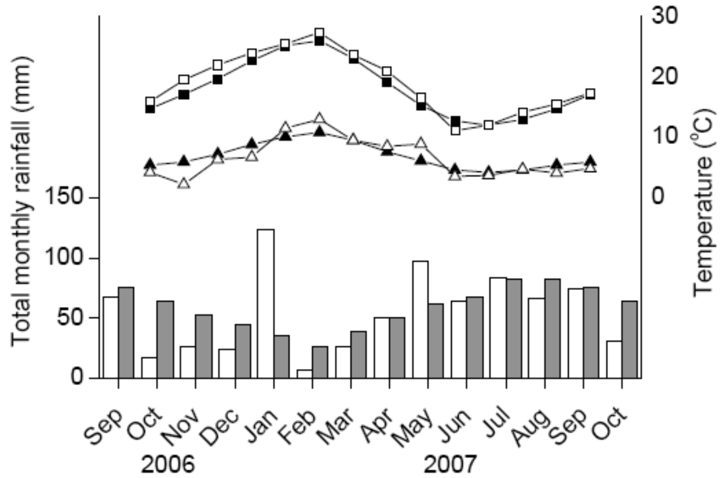

Figure 1 Total monthly rainfall (white) (mm) and average daily minimum (Δ) and maximum (□) temperatures (°C) over experimental period (September 2006 to October 2007). Long term total monthly rainfall (grey) and average daily minimum (▲) and maximum (■) temperatures. Measured at Department of Primary Industries, Hamilton, Victoria.

Results and discussion

Herbage Accumulation

Between October 2006 and November 2007, RG3 accumulated a total of 13.9 t DM/ha, compared to 12.2, 10.9 and 13.7 t DM/ha under SS, RG2 and RG4, respectively. Total herbage accumulation is dependent on herbage accumulation rates, which were affected by season and grazing treatments.

Herbage accumulation rates followed a seasonal pattern dependent on growing conditions (Figure 2). Between October and December 2006, only 69 mm of rain fell and herbage accumulation rates declined in response to the season drying off. Herbage accumulation rates increased over January and February 2007 in response to January rainfall (112 mm). However, with little follow-up rain over February (7 mm) and March (27 mm) 2007, herbage accumulation rates declined. The autumn break occurred on 27 April 2007, prompting pasture growth over May, but pasture growth was inhibited over June by waterlogging and low temperatures (average daily minimum 5°C). Since July 2007, herbage accumulation rates have generally increased in response to improved growing conditions.

At times during the experiment, grazing system had an effect on herbage accumulation rates ($P < 0.05$). Grazing system, based on length of regrowth, affected herbage mass and hence the leaf area and photosynthetic capacity of the treatments, this influenced the ability of treatments to sustain growth under variable environmental conditions. For example, over winter and spring 2007, RG4 was more tolerant of frosts and waterlogging and was able to sustain higher herbage accumulation rates than RG2 over August, September and October 2007. SS was very sensitive to frost and waterlogging damage. This is evidenced over September 2007 when this treatment recorded a decline in herbage accumulation rate following a week of frost days where other treatments continued to grow. In mid-September 2007, RG3 and RG4 had higher herbage accumulation rates than SS or RG2. This effect continued over October 2007, where RG3 and RG4 continued to accumulate herbage faster than RG2. This effect is likely due to higher herbage masses under RG3 and RG4 providing a greater leaf area to facilitate photosynthesis.

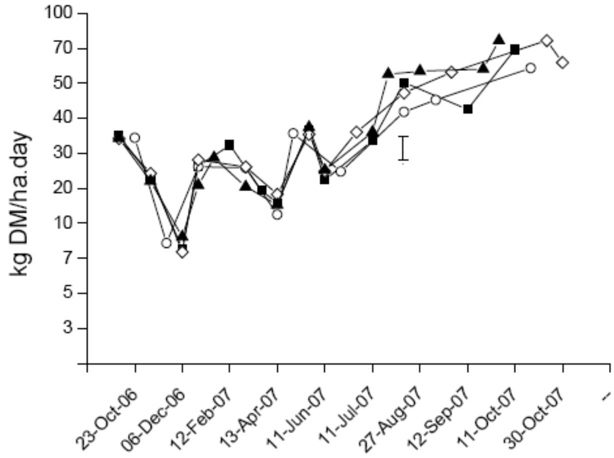

Figure 2 Changes in herbage accumulation rate in response to SS (■), RG2 (○), RG3 (◊) or RG4 (▲). Data were logged transformed and the L.s.d (*P=0.05*) fitted. Y axis shows back transformed values.

Herbage Nutritive Value

The production of high quality pasture for livestock is dependent on season and grazing treatment. Herbage nutritive values for the green portion of the sward between October 2006 and October 2007 are shown in Figure 3. In general, crude protein (CP) and dry matter digestibility (DMD) followed a similar trend, which was inverse to neutral detergent fibre (NDF).

As the season dried off between October and December 2006, DMD and CP declined while NDF increased. This is likely due to a reduction in the proportion of leaf relative to stem material over this dry period because leaf material in grasses is more digestible than stem material (De Santis and Chiaravalle, 2001). Following rainfall in late April 2007, pasture resumed growth and the proportion of leaf material increased and was associated with an increase in CP and DMD and a reduction in NDF. Herbage production was rapid over spring and the swards under rotational grazing entered the reproductive phase and developed seed heads. Consequently, there were reductions in CP and DMD and an increase in NDF.

At times during the experiment, the grazing treatments affected the herbage nutritive value. These treatment effects occurred primarily over winter and spring 2007. In July 2007, RG3 had higher DMD and CP than SS. This is likely due to the displacement of tall fescue from SS plots by low quality weed species under the high grazing pressure. Large treatment differences in October 2007 are probably due to the timing of sampling relative to grazing.

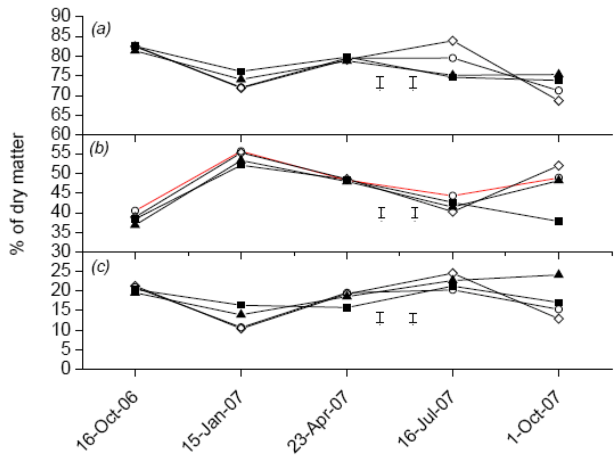

Figure 3 Changes in DMD (a), NDF (b) and CP (c) (% of dry matter) of the green portion of summer-active tall fescue herbage in response to SS (■) RG2 (○), RG3 (◊) or RG4 (▲). The left bar indicates the grazing system °— time interaction L.s.d (P=0.05). The right bar indicates the L.s.d when comparing means with the same level of grazing treatment (P=0.05).

Conclusions

The results of this study indicate that the accumulation rate and nutritive value of summer-active tall fescue sward are closely correlated with growing conditions. Grazing system, using leaf stage as an indicator of when the swards are ready to be grazed, interacted with the prevailing environmental conditions and had an effect on the relative herbage accumulation rates and nutritive value during times when stresses due to waterlogging or frosts were present. This research has found that during times of environmental stress, long grazing rotations (RG3 and RG4) produced a more rapidly growing sward with acceptable nutritive value.

References

Bransby, DI, Matches, AG and Krause, GF 1977, 'Disk meter for rapid estimation of herbage yield in grazing trials', *Agronomy Journal*, **69**, 393 – 396.

De Santis, G and Chiaravalle, E 2001, 'Heritabilities of nutritive quality factors and interrelationships with yield in selected progenies of tall fescue', *Plant Breeding*, **120**, 337 – 343.

GenStat Committee 2003, 'GenStat® Release 7.1', VSN International Ltd, Oxford.

Newell, JW 1962, *Soils of the Hamilton Pastoral Research Station, Victoria*, Technical Bulletin No. 15, Department of Agriculture, Victoria, Melbourne.

Northcote, KH 1979, *A Factual Key for the Recognition of Australian Soils*, 4th edn, Rellim Technical Publications, Adelaide.