Tropical grass pastures have potential to enhance summer-autumn feed supply and improve profitability in a low rainfall mixed farming system

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Abstract

Southern Australian grazing systems are based on temperate species and a range of strategies are used to manage the summer-autumn feed gap. Tropical pasture species are highly responsive to summer rainfall and may provide a productive forage alternative over this period. The AusFarm model was used to explore the potential role of these species in a Merino enterprise within a mixed farming system at Condobolin in central-western New South Wales. This interim study examined how different pasture compositions (based on lucerne (*Medicago sativa*), annual ryegrass (*Lolium rigidum)*, subterranean clover (*Trifolium subterraneum* L.) and tropical perennial grasses (*Panicum maximum*)) can alter the performance of the system across a range of biophysical and economic indicators. The simulations showed clear differences in the quantity and timing of pasture availability, which influenced both the supplementary feed requirements of the animals and system gross margins. The results demonstrated there is a potential role for tropical grasses grown with cool-season annual legumes to provide summer-autumn feed and can enhance profitability when replacing an annual ryegrass/subterraneam clover or lucerne pasture in an environment currently considered marginal for tropical species.

Keywords

AusFarm, mixed farming systems, feed gap.

Introduction

Southern Australian grazing systems with a uniform or winter dominant rainfall pattern have traditionally been based on temperate pasture species. These systems use a range of different strategies to manage the summer-autumn feed gap to maintain livestock production, such as: utilising residual dry feed, stubbles, summer active species/cultivars and supplementary feed (Moore et al. 2009). There are risks associated with these practices including assuring that the feed has sufficient quality and quantity to meet livestock requirements, and the cost of feeding livestock supplementary feed. Tropical pasture species are responsive to summer rainfall and may provide a productive forage alternative to help manage the feed gap as part of a whole-farm forage resource.

The aim of this interim study was to model the potential effect of incorporating tropical pasture in temperate regions on key performance indicators within a mixed farming system in central-western New South Wales (NSW). It was hypothesised that replacing winter active temperate pastures (annual ryegrass (*Lolium rigidum*) and subterranean clover *(Trifolium subterraneum* L.)) with tropical pastures would increase feed availability through the summer-autumn period and reduce supplementary feed and improve whole-farm gross margins.

Methods

Farming System Description

CSIRO's AusFarm™ model (version No 1.4.13) (Moore et al. 2007) was used to simulate a Merino enterprise within a mixed farming enterprise at Condobolin in central-western NSW (33.08°S, 147.14°E). Weather data for the model was generated from the Silo Patched Point Data base datadrill (Jeffery et al. 2001). AusFarm was run for the period 1955 to 1992 (with the first 5 years excluded from analysis) to capture a range of seasonal conditions. The model was set to represent a 1000 ha, 8- paddock mixed farming system. Soil characteristics were obtained from the ApSoil database (Dalgliesh et al. 2012) using ApSoil No. 690 Condobolin (Sandy loam over sandy to light clay).

Four paddocks were configured as permanent pastures while the remaining 4 paddocks mimicked a 4-year rotation of canola, wheat and 2 years of annual ryegrass and subterranean clover. Pasture composition for the permanent pastures consisted of a combination of lucerne (*Medicago sativa*), annual ryegrass, subterranean

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clover, and/or a generic tropical pasture, panic grass (*Panicum maximum*). The animal system modelled Merino ewes joined to Border Leister rams with lambing on 17 July and weaning on 28 October. Lambs were sold when they reached the target weight of 45 kg or by 3 March. Animals were moved between paddocks based on feed availability and provided supplement (barley) when performance criteria were triggered. The cropping system modelled was a canola, wheat and two-year pasture rotation (annual ryegrass and subterranean clover).

Comparative analysis
Three comparisons were undertaken to explore which pasture composition can provide the highest benefit from the introduction of a tropical pasture (Table 1). For each comparison five levels of tropical based pasture inclusion were analysed (0%, 25%, 50%, 75% and 100%).

Table 1. Pasture compositions used for the comparative analysis to assess farming system performance.

Comparison	Existing temperate based pasture	Tropical species replacement pasture
1	Lucerne/Annual Ryegrass/Subterranean clover (LRC)	Panic grass/Annual Ryegrass/Subterranean clover (TRC)
2	Lucerne (L)	Panic grass/Subterranean clover (TC)
3	Annual Ryegrass/Subterranean clover (RC)	Panic grass/Subterranean clover (TC)

Performance Indicators
Key indicators were used to assess the performance of each pasture composition in terms of its cost-effectiveness and pasture performance. Pasture performance was evaluated by farm (pasture availability and supplementary intake of the animals) and economic (simple gross margin) indicators. Income and costs were determined using NSW DPI budgets (NSW Department of Primary Industries 2012; 2018) and adjusted where necessary to industry accepted values.

Results

Pasture performance
Average green dry matter for the permanent pasture paddocks (kg DM/ha) varied depending on pasture composition (Figure 1). Changing the proportion of tropical pasture resulted in clear differences in the quantity and timing of green dry matter throughout the year. As the proportion of tropical pasture increased, two clear growth periods emerge; autumn and spring.

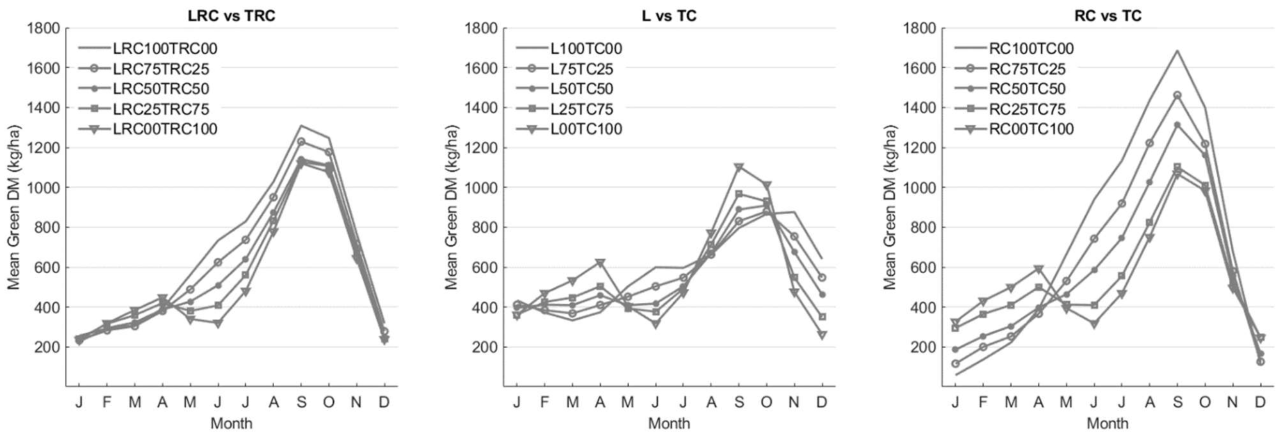

Figure 1. Monthly mean green dry matter (kg/ha) for the three permanent pasture combinations: LRC = Lucerne/Annual ryegrass/Subterranean clover, TRC = Tropical/Annual ryegrass/Subterranean clover, L = Lucerne, TC = Tropical/Subterranean clover, RC = Annual ryegrass/Subterranean clover. The proportions of pasture are 100 = 100%, 75 = 75%, 50 = 50%, 25 = 25%, 00 = 0%.

Supplementary feed intake throughout the year, as a description of feed deficits, varied depending on pasture composition (Figure 2). Generally, as the percentage of tropical pasture increased, the amount of grain as a proportion of the total intake decreased during autumn. This trend was not present over winter, where supplementary intake was more dependent on the presence or absence of temperate annuals in the pasture mix rather than the percentage of tropical pasture present.

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The temperate pasture mixes which contained an annual winter growing species component (i.e. LRC and RC) had the highest supplementary intake during summer and autumn (January–June), decreasing as the proportion of tropical pasture increased. In June, the amount of supplementary feed intake was near equal in all pastures. The relationship was opposite during the July–September period, with a greater proportion of supplement consumed as the proportion of tropical pastures increased. This was corresponded with the growth patterns of the temperate and tropical species in the pastures.

The pure lucerne (L) pastures responded differently to those containing subterranean clover. From mid-June until mid-November, both the lucerne and tropical pastures had similar supplementary feed intake irrespective of their relative proportions. From spring to early summer, supplementary feed intake between the three pasture combinations was similar.

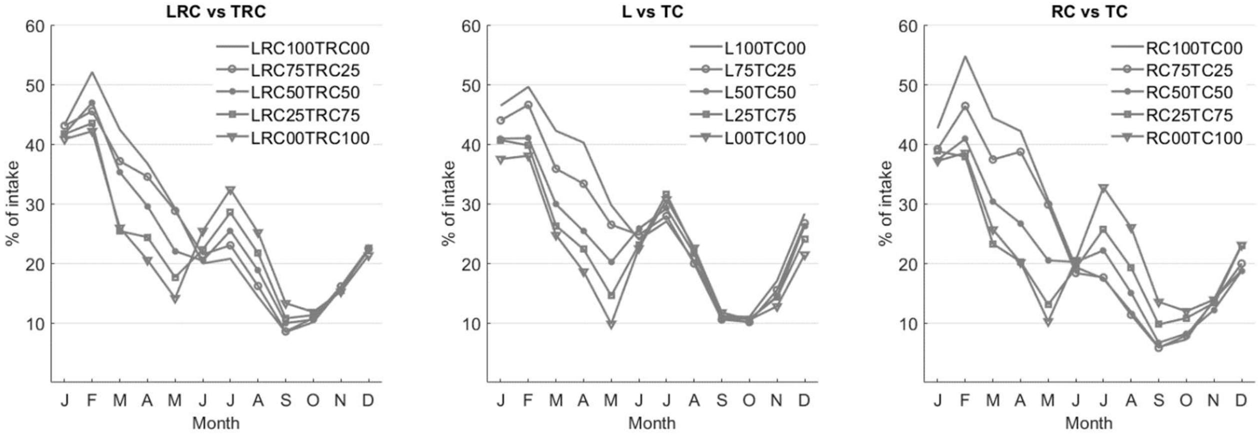

Figure 2. The proportion (%) of monthly mean grain supplement (as a percentage of total animal intake) for the three permanent pasture combinations: LRC = Lucerne/Annual ryegrass/Subterranean clover, TRC = Tropical/Annual ryegrass/Subterranean clover, L = Lucerne, TC = Tropical/Subterranean clover, RC = Annual ryegrass/Subterranean clover. The proportion of temperate and tropical pasture are 100 = 100%, 75 = 75%, 50 = 50%, 25 = 25%, 00 = 0%.

Cost-effectiveness

The gross margin analysis showed clear differences between the three 100% temperate pasture combinations. The RC had the highest median gross margin ($413/ha) followed by LRC ($396/ha) and then L ($382/ha). Overall, farms in the RC vs TC comparison had the highest median gross margins of the three pasture comparisons ($404–429/ha); while LRC had the lowest ($380–$398/ha; Figure 3). The median gross margin of both the RC and L pasture comparisons increased as the proportion of TC increased. Interestingly, the opposite occurred with the profitability decreasing with the proportion of tropical pasture when annual ryegrass was included in both the temperate and tropical pastures.

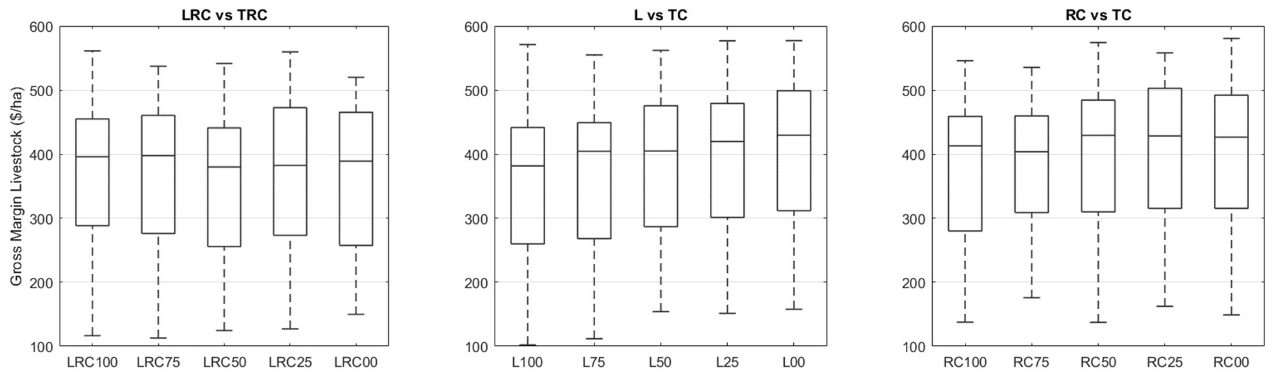

Figure 3. Gross margin ($ha) comparison of the three pasture mix comparisons: LRC = Lucerne/Annual ryegrass/ Subterranean clover, TRC = Tropical/Annual ryegrass/Subterranean clover, L = Lucerne, TC = Tropical/ Subterranean clover, RC = Annual ryegrass /Subterranean clover. 100 = 100% of the pasture mix, 75 = 75%, 50 = 50%, 25 = 25%, 00 = 0%.

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Conclusion

This interim study identified opportunities for tropical grasses to fill the summer-autumn feed gap within a mixed farming system at Condobolin in central-western NSW. The simulation modelling shows that the TC pasture can provide green biomass during summer/autumn, reducing supplementary feed requirements. However, this is at the expense of winter feed when the TC replaces the RC pasture. Although, there was little benefit in changing the LRC pasture to the TRC pasture to fill the summer-autumn feed gap in terms of green biomass, this approach did reduce supplementary feed requirements of the animals during this period. Changing from the LRC pasture to the TRC pasture also increased the demand for supplementary feed over winter. Replacing L pasture with TC pasture improved green biomass in late summer to mid-autumn and this practice also reduced the need for supplementary feed during this period. There were no differences in supplementary feeding for any system from October through to December/January, when generally there was ample feed available.

The addition of TC increased whole-farm gross margin when up to 100% of the permanent pasture replaced L, and increased profit when up to 50% of RC was replaced with TC. This was not expected and is likely due to the presence of subterranean clover in the TC pasture as opposed to just only lucerne. There were no differences in whole-farm gross margin for both LRC and TRC comparison, and overall was lower. Subterranean clover component of TC was important for suppling feed both in winter and spring and contributed to increased profitability.

While this study has shown that replacing productive pastures with tropical pasture has potential advantages, recent consultations with producers indicate that many producers in central West NSW are sowing tropical pastures where they have not been able to successfully establish temperate pastures (K. Sinclair, pers comm.). In these circumstances it is expected that the value of the tropical pasture should be significantly higher. Further investigation is required to explore the advantage of tropical pastures under different management practices, such as alternative lambing times or different stocking rates.

The simulation modelling is the initial analysis of a wider field trial research program, that examines how livestock production may be increased by integrating tropical pastures into farming system. Further model refinement is expected, with expected changes to the climatic periods used in the simulation model, along with minor changes in the farm system set up and soil characterisation.

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