EverGraze: the productive management of perennial grazing systems in extreme drought

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Abstract

EverGraze is a national research and delivery project developing profitable perennial-based livestock systems which aims to increase profit by 50% while improving environmental outcomes. Four sheep grazing systems were tested near Tarcutta NSW during the drought of 2006/07. The apparent plant density of lucerne (*Medicago sativa*) pasture was maintained between years, phalaris (*Phalaris aquatica*) retained 70-90% of plants while tall fescue (*Festuca arundinacea*) density declined by 50%. The persistence of both lucerne and fescue did not decline with higher stocking intensities. Groundcover in December 2006 and May 2007 at the autumn rains was similar between grazing systems. Minimum lucerne groundcover was between 40 and 60%, while phalaris and fescue was maintained above 60%. Ewes in the higher stocking rate systems were removed from plots to a containment area earlier to protect pastures, and returned later after the seasonal break. It is concluded that productive pastures can be maintained through extreme droughts with suitable grazing management. The flexibility of different grazing systems in terms of generating cash flow and potential for stock sale to counter seasonal conditions in adverse years should be considered.

Key Words

reproduction, growth rates, lambs

Introduction

Dryland salinity threatens the long-term viability of grazing enterprises in southern Australia. The spread of salinity can be reduced through the replacement of annual with perennial pasture systems, which reduce groundwater recharge. However, the adoption of perennials is reliant upon these grazing systems being profitable. EverGraze is a national project aiming to design farming systems which increase profit by up to 50% while reducing groundwater recharge through the use of perennial pastures. The cost of establishing perennial pastures means that grazing systems which utilise them need to produce higher returns in order to be cost-effective. Modelling has shown that profits from perennial-based grazing systems can be up to 800% that of annual systems, depending on choice of sheep enterprise (Friend *et al.* 2007).

Performance in drought is a key determinant of adoption of specific grazing systems. The consequences of different grazing systems on the production of perennial pasture could also limit profit. The current study examined the effect of drought on the resilience of perennial pastures, and the consequent production in four grazing systems.

Methods

Design

The experiment was located near Ladysmith, (35?13? S, 147?37? E) east of Wagga Wagga New South Wales. There were three replicates of four grazing systems. Each grazing system comprised 5.2 ha of pasture, containing one paddock each of lucerne (*Medicago sativa*), phalaris (*Phalaris aquatica*) and tall fescue (*Festuca arundinacea*), all sown in June 2006 with sub clover (*Trifolium subterraneum*). All systems used CentrePlus bloodline (Tullamore, NSW) Merino ewes joined to either CentrePlus or terminal sires (Elsted, Heywood, Vic). All systems were stocked at a similar mid-winter stocking rate (8 dry sheep equivalents (dse/ha) in 2006, increased to 10 dse/ha in 2007).

The four systems were: Self Replacing Merino (SRM), High Lucerne (HL), Later Lambing (LL) and Split Joined (SJ). Lucerne area, breed of sire, lambing times and target sale weights and times are outlined in Table 1. Ewes in all but the self-replacing Merino system were ranked on condition score and liveweight measured prior to each joining, with the highest ranked ewes joined to the terminal sires. Joining length was 4 weeks in all treatments, except the SJ system where ewes joined to the terminal were only joined for 14 days.

Table 1. Description of the four grazing systems in 2006.

	Self Replacing Merino	Late Lambing	High Lucerne	Split Joined
Lucerne, tall fescue, phalaris (%)[A]	20-20-60	20-20-60	40-15-45	20-20-60
No. breeding ewes/ha	3.9	7.7	7.7	5.2
Ram breed (terminal/Merino)	0/100	50/50	50/50	60/40[B]
Month lambing	Aug	Sep	Sep	Aug and Sep
Target lamb sale weight (terminal/merino) (kg)	50	35/30	35/30	50/30
Removed from plots 2006	7 Dec	20 Oct	13 Oct	25 Oct
Returned to plots 2007	23 May	31 May	31 May	27 May

[A] Species as a percentage of total pasture area.
[B] Plus any non-pregnant ewes from the terminal joining, expected to be 10% of all ewes in this system.

Soils and management

The major soil types were lithosolic rudosols on the hills grading to mesotrophic chromosols on the lower slopes (Isbell 1996). Phosphorus levels (Colwell) were adequate (40 ppm) and the pH ($CaCl_2$) was 7.

All replicates within each system were treated identically, such that sheep within a system were moved between pasture types at the same time and fed identically when required. Strategic grazing was used with the intent of joining ewes on lucerne, optimising lamb growth rates, and joining and lambing ewes in condition score 3. Ewes were supplementary fed when required to achieve a group average minimum condition score (measured monthly) of 3 for joining and lambing. Phalaris toxicity caused some ewe deaths which required all ewes to be removed from phalaris pastures between 20 May and 5 July 2006. During this time all phalaris pastures were grazed at the stocking rate appropriate for the system by non-experimental sheep accustomed to phalaris. Prolonged drought conditions meant sheep in the various systems had to be progressively removed from pastures and fed in a containment area from October

2006 until the end of May 2007 (Table 1). Sheep were removed from paddocks when total herbage biomass fell below 1000 kg DM/ha in phalaris and fescue, and 500 kg in lucerne. Lambs were sold at weaning in October or December.

Measurements

Apparent plant density was counted in four fixed 1 m x 1 m quadrats per paddock in early May each year. Pasture biomass (Campbell and Arnold 1973) and groundcover were visually estimated every month in 30 quadrats per paddock. Pasture composition was estimated seasonally by Botanal (Mannetje and Haydock 1963) using the same quadrats.

Results and discussion

Annual rainfall in 2006 was well below average (252 compared with 575 mm) with a dry winter/spring. Only January, June, July and November received more than 20 mm/month. The dry conditions continued until April 2007.

Pastures

Grazing system did not deleteriously reduce overall groundcover in each system at either December 2006 (73%) by which time all sheep were removed from paddocks, or by May 2007 (44%) after which sheep were permanently returned to paddocks (Figure 1). Groundcover differed ($P<0.001$) between pasture types in May of both years and in December 2006, with lucerne usually having the least cover, particularly after grazing. All pastures recovered quickly after rain with over 90% groundcover present at the start of June 2007 in phalaris and fescue, and by September for lucerne.

Grazing system did not affect the persistence of lucerne or fescue ($P>0.05$) (Table 2) but phalaris density declined (51%; $P=0.002$) in the Later Lambing (LL) system. The lower persistence of fescue could have been due to a lower tolerance of low rainfall conditions or heavy grazing in winter because ewes were unable to graze the phalaris paddocks due to phalaris toxicity. On average, sheep spent similar DSE grazing days/ha on each pasture type in 2006.

It is unclear why the density of phalaris in the LL system declined more than in the other systems. Differences between the LL and HL systems in live biomass, botanical composition and time grazed were small. Live pasture biomass was often lowest in the LL system, but similar to the HL system (Figure 2a). Phalaris comprised a similar ($P>0.05$) proportion of total pasture composition as the other grazing systems at all sampling times (Figure 2b). In July 2007 the proportion of phalaris had declined and been replaced by sub-clover, but not by broadleaf weeds or other grasses. This decline in proportion of phalaris only became apparent with increasing sub-clover biomass after the autumn rains. However, the phalaris plants may have died at any stage over summer.

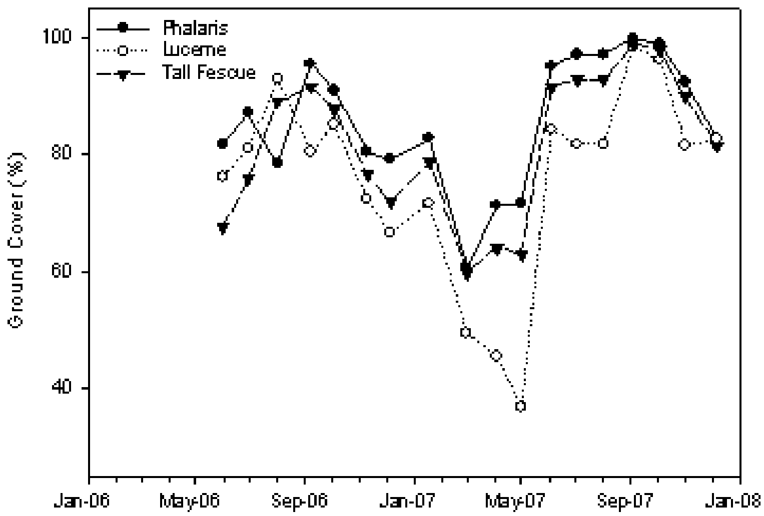

Figure 1. Mean groundcover (%) of phalaris, lucerne and tall fescue pastures during 2006 and 2007.

Table 2. Apparent plant density of pastures in 2007 as a percentage of density in 2006 (plants/m^2) and mean dry sheep equivalent (DSE) grazing days/ha in 2006.

	Mean density in autumn 2006	Self-replacing Merino	Late Lambing	High Lucerne	Split Joined	Mean DSE grazing days/ha 2006
Phalaris	26	91 c	49 a	67 b	78 bc	2238
Lucerne	38	95	117	99	92	2571
Tall Fescue	51	51	53	49	52	2274

a, b, c – different letters within rows indicate means differ at P<0.05.

Kemp and Culvenor (1994) state the critical period for phalaris vulnerability to grazing is during reproductive development, in particular, between stem elongation and ear emergence. Heavy or regular grazing during this phase can reduce regeneration from buds in the following autumn (Cullen *et al.* 2005), and Lodge and Orchard (2000) observed that a spring rest favoured maintenance of phalaris density in a summer-dominant rainfall environment. However, in contrast, Virgona *et al*. (2000) and Li *et al*. (2004), both working in winter-dominant rainfall areas, observed that grazing management influenced phalaris persistence in summer and autumn but not in spring. The periods of time the phalaris was grazed during spring before removal of sheep from paddocks was similar between the two highest stocking rate systems. While grazing commenced one week earlier on the LL phalaris, sheep were removed from both the LL and HL phalaris paddocks at the same time at the end of September 2006. However, the stocking pressure on the HL phalaris was 24% higher during this time, suggesting spring grazing management did not affect phalaris persistence. Similarly, as all treatments were de-stocked over summer-autumn, management over this time did not affect persistence. We can conclude only that subtle differences in autumn-early spring management during drought years may have a significant effect on persistence; this is an area that warrants further investigation. All pasture types were productive following autumn rains in 2007, producing feed on offer of over 1300 kg live DM/ha by June and over 4 T live DM/ha by September.

Conclusion

Pastures can be maintained even through extreme droughts with high stocking rate systems providing management ensures pastures are not overgrazed. The presence of productive pastures at the end of the drought avoided the cost of re-sowing pastures and meant sheep production post-drought was not reduced by low pasture production. The high stocking rate, spring lambing systems have the potential for higher gross margins in average rainfall years but entail more production risk and risk to pasture persistence and production.

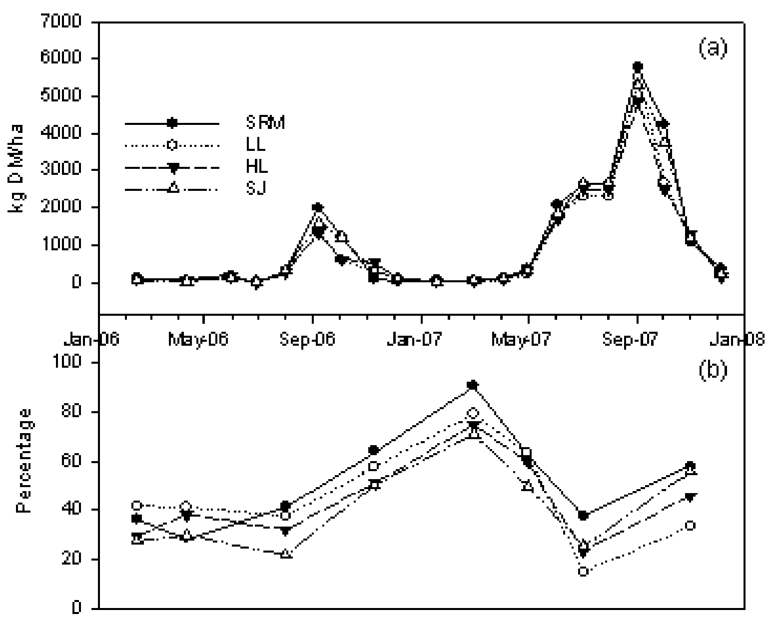

Figure 2. Changes in a) live phalaris biomass (kg DM/ha) and b) percentage of phalaris in four grazing systems during 2006-2007.

Acknowledgment

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References

Campbell NA, Arnold GW (1973). The visual assessment of pasture yield. *Australian Journal of Experimental Agriculture and Animal Husbandry* **13**, 263-267.

Cullen BR, Chapman DF, Quigley PE (2005). Persistence of Phalaris aquatica in grazed pastures 2. Regenerative bud and tiller development. *Australian Journal of Experimental Agriculture* **45**, 49-58.

Friend MA, Robertson S, Masters D, Avery A (2007). EverGraze - a project to achieve profit and environmental outcomes in the Australian grazing industries. *Journal of Animal and Feed Sciences* **16**, 70-75.

Isbell RF (1996). 'The Australian Soil Classification.' (CSIRO Publishing: Melbourne).

Kemp DR, Culvenor RA (1994) Improving the grazing and drought tolerance of temperate perennial grasses. *New Zealand Journal of Agricultural Research* **37**, 365-378.

Li GD, Helyar KR, Conyers MK, Cullis BR, Poile GJ, Knight PG (2004). Phalaris persistence under rotational grazing on a highly acidic soil on the south-west slopes of New South Wales. *Australian Journal of Experimental Agriculture* **44**, 771-778.

Lodge GM, Orchard BA (2000). Effects of grazing management on Sirosa phalaris herbage mass and persistence in a predominantly summer rainfall environment. *Australian Journal of Experimental Agriculture* **40**, 155-169.

Mannetje L, Haydock KP (1963) The dry-weight-rank method for the botanical analysis of pasture. *Journal of the British Grassland Society* **18**, 268-275.

Virgona JM, Avery AL, Graham JF, Orchard BA (2000) Effects of grazing management on phalaris herbage mass and persistence in summer-dry environments. *40*, 171-184.