Tedera out-yields lucerne and perennial ryegrass five months after sowing

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Abstract

Over summering is often a significant challenge for newly sown perennial forage species. Poorly adapted species often fail or underperform as a result of this stress. It was hypothesised that production measured at the end of summer would be best in species which are adapted to the summer-dry environment of southern Australia. To test this hypothesis, perennial ryegrass (*Lolium perenne* L. cv. Banquet II), lucerne (*Medicago sativa* L. cv. Stamina GT6), plantain (*Plantago lanceolata* L. cv. Tonic) and tedera (*Bituminaria bituminosa* L. var. *albomarginata*) were sown on 5 November 2009 as monocultures or in mixtures in a randomised complete block design with four replications at Hamilton in south west Victoria. Tedera was the highest yielding species five months after sowing (March 2010) and also had a higher metabolisable energy (ME) and water soluble carbohydrate (WSC) content than lucerne. The lucerne and the plantain monocultures had higher herbage production ($P<0.05$) than the perennial ryegrass monoculture, perennial ryegrass/plantain mixture and perennial ryegrass/lucerne/plantain mixture. These results suggest tedera has significant potential for use in the temperate regions of Victoria.

Key Words

Pasture, production, density, nutritive characteristics, climate variability.

Introduction

Variable climatic conditions have created challenges for livestock production in southern Australia, with shorter drier springs and longer hot and dry summers that often result in low pasture availability. Livestock production can be further limited in some monocultures of perennial ryegrass (*Lolium perenne* L.) and lucerne (*Medicago sativa* L.) by ryegrass staggers (Reed et al*.* 2004) and redgut (Jois 2009), respectively.

Livestock production in southern Australia could be improved by using pasture species which are better adapted to the summer-dry environment and sowing these species in mixtures which allow livestock the opportunity to self-select a diet that improves digestive health and reduces the risk of toxicities.

This paper reports on an experiment in southern Australia comparing the establishment, early growth and nutritive value of perennial ryegrass (cv. Banquet II), lucerne (cv. Stamina GT6), plantain (*Plantago lanceolata* L. cv. Tonic) and tedera (*Bituminaria bituminosa* L. var. *albomarginata*), which were sown in November 2009 and harvested in March 2010.

Methods

The experiment was located at the Department of Primary Industries research farm at Hamilton, Victoria, Australia (37?49’S, 142?04’E). The site has a temperate climate with mean annual rainfall of 685 mm. Mean maximum and minimum daily temperatures in the hottest month (February) are 26?C and 11?C and in the coldest month (July) are 12?C and 4?C. There was only 37 mm of rain in October 2009 (Figure 1), compared to the long term average of 62 mm for the site. Experimental plots were sown on 5 November 2009 following 6 mm of rain on 2 November 2009. There was no further rain in that month until 22 November 2009 (13 mm) and 27 – 28 November 2009 (19 mm).

Experimental plots, 7.5 m by 1.5 m in size, were direct drilled at a depth of 15 mm in a randomised complete block design with four replications. At sowing, 5 kg N/ha, 11 kg P/ha, 0.75 kg S/ha and 0.025 kg Mo/ha were drilled with the seed, as monoammonium phosphate (MAP). Treatments and sowing rates are shown in Table 1.

The top soil (0 – 20 cm) was a very dark grayish brown fine sandy clay loam (Northcote 1979). Analysis (0 – 10 cm) on 7 October 2009 indicated a $pH_{(H20)}$ of 5.6, phosphorus (Olsen) of 13 mg/kg, potassium (Skene) of 120 mg/kg and sulfur (KC140) of 8.9 mg/kg. The site received 5 t /ha of surface applied lime on 20 October 2009. The site was sprayed with the knockdown herbicide RoundupPowerMAX? at 2 L/ha (540 g/L glyphosate, ~10 % w/v surfactant with water comprising the balance), plus 250 ml/ha Dicamba? (500 g/L dicamba present as dimethylamine salt) and 100 ml/ha Lemat? (290 g/L omethoate) on 10 October 2009. A second application of RoundupPowerMAX? (2 L/ha) was applied on 22 October 2009.

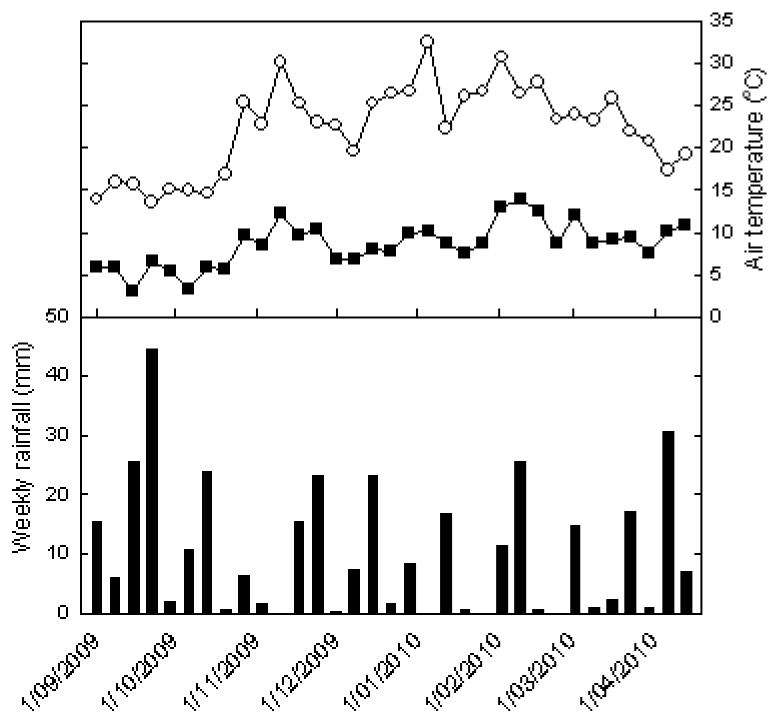

Figure 1. Weekly rainfall (mm) and average maximum (○) and minimum (■) air temperatures at the experimental site prior to and during the experimental period.

Table 1. Treatment names, species sown and sowing rates.

Treatment name	Pasture species sown	Sowing rate (kg/ha)
PR	Perennial ryegrass (*Lolium perenne* L. cv. Banquet II)	25
LU	Lucerne (*Medicago sativa* L. cv. Stamina GT6)	10

PL	Plantain (*Plantago lanceolata* L. cv. Tonic)	6
TE	Tedera (*Bituminaria bituminosa* L. var. *albomarginata*)	33
PR/LU	Perennial ryegrass (*Lolium perenne* L. cv. Banquet II)/	20
	Lucerne (*Medicago sativa* L. cv. Stamina GT6)	5
PR/PL	Perennial ryegrass (*Lolium perenne* L. cv. Banquet II)/	20
	Plantain (*Plantago Lanceolata* L. cv. Tonic)	4
LU/PL	Lucerne (*Medicago sativa* L. cv. Stamina GT6)/	5
	Plantain (*Plantago lanceolata* L. cv. Tonic)	4
PR/LU/PL	Perennial ryegrass (*Lolium perenne* L. cv. Banquet II)/	18
	Lucerne (*Medicago sativa* L. cv. Stamina GT6)/	3
	Plantain (*Plantago lanceolata* L. cv. Tonic)	2

Seedling densities (seedlings/m^2) were measured on 20 January 2010 from three random 1 m by 10 cm quadrats per plot. Herbage production (kg DM/ha) was measured on 23 March 2010 by mowing and capturing a 7.5 m by 0.5 m strip to a height of 1 cm. Herbage nutritive characteristics were estimated on 22 March 2010 from 30 random herbage samples per plot cut to ground level. For each plot, the samples were bulked and the green portion of a subsample dried at 60^{o}C for 48 hours. The crude protein (CP), metabolisable energy (ME), neutral detergent fibre (NDF) and water soluble carbohydrate (WSC) content was estimated by near infrared spectroscopy (NIR). Near infrared spectra were collected using a FOSS-NIRSystems 6500 scanning monochromator in conjunction with Infrasoft International Software. Near infrared spectra calibrations had previously been derived from large sample populations using the procedures of Shenk and Westerhaus (1991). Referencing methods used for NIR calibrations were as follows; CP using the Kjedahl method, NDF by the method of van Soest and Wine (1967), *IVV*DMD using a pepsin-cellulase technique (Clarke et al*.* 1982) and WSC by the method of Yemm and Willis (1954), with analytical values adjusted using a linear regression based on similar samples of known value. Any spectral outliers from the calibrations were analysed by wet chemistry techniques as described above. Data was analysed by one-way ANOVA using Genstat Version 11 (Payne et al. 2008).

Results

Perennial ryegrass sown as a monoculture or in a mixture with lucerne had the highest ($P<0.05$) seedling density eight weeks after sowing (Figure 2). The lucerne, plantain and tedera monocultures and the lucerne/plantain mixture had similar seedling densities.

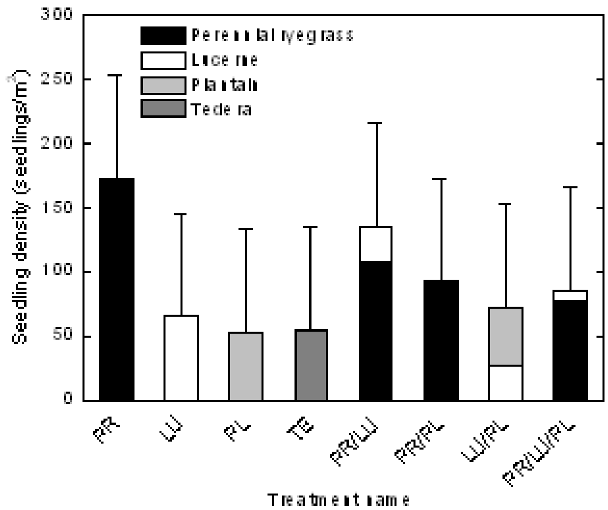

Figure 2. Seedling density (seedlings/m^2) eight weeks after sowing (error bars indicate the l.s.d (*P=0.05*)).

Tedera had the highest (*P<0.05*) herbage production measured on 23 March 2010 and comprised 87 % of sward DM (Figure 3). The lucerne and the plantain monocultures also had higher herbage production (*P<0.05*) than the perennial ryegrass monoculture, perennial ryegrass/plantain mixture and perennial ryegrass/lucerne/plantain mixture (Figure 3). None of the pasture mixtures produced more herbage than the sown monocultures.

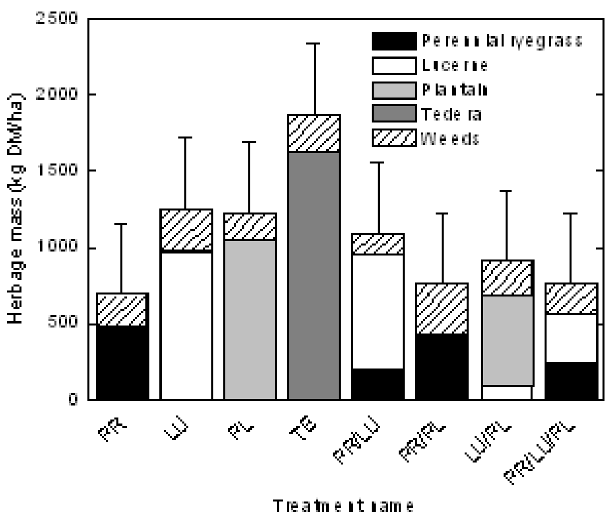

Figure 3. Herbage production measured on 23 March 2010 (error bars indicate the l.s.d (*P=0.05*)).

Perennial ryegrass had the highest (*P<0.05*) and lucerne the lowest (*P<0.05*) ME and WSC, with tedera being intermediate (Table 2). Crude protein and NDF were highest (*P<0.05*) in the perennial ryegrass and lowest (*P<0.05*) in the tedera, with the lucerne being intermediate (Table 2).

Table 2. Nutritive value of the green portion of perennial ryegrass (PR), lucerne (LU) and tedera (TE) monocultures, as well as l.s.d (*P=0.05*) for comparing means between pasture treatments.

Treatment	ME (%DM)	CP (%DM)	NDF (%DM)	WSC (%DM)
PR	12.7	19.8	41.7	21.9
LU	10.3	17.1	36.0	11.4
TE	11.7	15.2	28.8	15.4
L.s.d (*P=0.05*)	0.47	0.82	2.39	2.41

Discussion

Tedera had the highest herbage production five months after sowing, yielding nearly 1900 kg DM/ha despite having lower seedling establishment than the perennial ryegrass and plantain treatments. Tedera swards were also relatively weed free, comprising approximately 10 % of herbage production. The competitive and productive nature of tedera over summer suggest it is adapted to areas of Victoria and its higher ME and lower NDF than lucerne suggest that it could be of great benefit to livestock industries. Tedera has also shown tolerance to rotational grazing for short (Sternberg et al. 2006) and long periods in Mediterranean environments (Gutman et al. 2000) but little is known of how the species performs under more temperate conditions. The results from this trial indicate that this is a species which warrants further research.

The lucerne and plantain monocultures produced more forage than the perennial ryegrass monoculture and mixtures of perennial ryegrass/plantain and perennial ryegrass/lucerne/plantain. The perennial ryegrass swards in this trial only had a seedling density of approximately 170 seedlings/m^2 which may have been inadequate for maximum production. Previous research has shown that tall fescue (*Lolium arundinaceum* syn. *Festuca arundinacea* Shreb.) swards at Hamilton, which is a pasture species closely related to perennial ryegrass (Darbyshire 1993), are able to support a seedling density of 400 – 600 seedlings/m^2 when sown at a rate of 16 – 24 kg seed/ha under dry conditions in late October (Raeside et al*.* 2009). The 25 kg/ha of perennial ryegrass should have produced high perennial ryegrass numbers, although in this experiment establishment may have been hindered by the lack of soil surface moisture at establishment.

Conclusion

These experimental results suggest tedera has significant promise for use in livestock industries through the temperate regions of Victoria. Consequently more research is warranted in this new species and in particular information on its performance in mixtures will be important along with the determination of an optimum density range for maximum production. Further research is also needed into how the species copes with the cold and wet winters experienced in southern Victoria. Finally, animal health studies will be needed to determine if there are any animal health considerations for tedera.

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