Using growth and dry matter estimates to devise year-round forage systems for the North-West Slopes of New South Wales

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Abstract

Estimation of growth and dry matter production of 3 species of tropical perennial grass, a native perennial grass mixture, lucerne, forage oat and forage sorghum for 3 years after establishment were used to identify pasture/forage types with potentially high growth (>50 kg DM/ha/d) and identify combinations that could be used to provide year-round pasture growth for livestock production on the North-West Slopes of New South Wales (NSW). Premier digit grass had peak growth of 73 kg DM/ha/d in November and high growth for 5 months of the year. Forage oat had consistently high growth from May to September. Venus lucerne attained a peak of 77 kg DM/ha/d in December, and provided high growth in November and December. While forage sorghum produced a maximum growth rate of 139 kg DM/ha/d in December, its period of peak production was concentrated into a 4-month period in the summer growing season. Between December and February, native perennial grass growth was 20−25 kg DM/ha/d, but outside this period their growth was low. These data demonstrated that a forage system that combined Premier digit grass (November to March) with Eurabbie oat (May to September) could provide growth >50 kg DM/ha/d for 10 months of the year.

Key Words

tropical perennial grass, estimated growth.

Introduction

Livestock production systems on the North-West Slope of New South Wales (NSW) encounter seasonal feed gaps in late autumn and winter as a result of the C_4 dominant native perennial grass pastures being frosted. The North-West Slopes has a summer dominant rainfall pattern, receiving up to 60% of total annual rainfall between November and March. Tropical perennial grasses appear to be well suited to this environment because their seasonal growth matches these rainfall patterns (Murphy 2004).

Lucerne is the most commonly sown perennial legume on the North-West Slopes of NSW, but if stored soil water is depleted or it is winter-dormant it can fail to provide substantial green forage in the cooler winter period. Therefore, producers tend to use cereal forage crops (e.g. oat or dual purpose cereal, Hennessy and Clements 2009), sown in late summer, to meet the nutritional requirements of breeding livestock in winter and spring or to grow-out or fatten young animals. With a variable climate in recent years (Lodge and McCormick 2010), tropical perennial grasses have shown an ability to respond to limited summer rainfall and produce large quantities of herbage (Boschma et al. 2010), providing a range of feed management options.

While no growth estimates are available for a range of pasture and forage types growing at the same site on the North-West Slopes of NSW in different seasons and years, McDonald (1999) provided some estimates derived from the Growest model. Dry matter (kg DM/ha) data collection as part of a soil water dynamics study provided an opportunity to estimate comparative growth for a range of forages over 3 growing seasons. These data were used to identify pasture/forage types with potentially high growth (>50 kg DM/ha/d) and identify combinations that could be used to provide year-round forage for livestock production on the North-West Slopes of NSW.

Methods

Species, establishment and fertiliser application

An experimental site was established on a red chromosol to study the effects of tropical grasses on soil water dynamics at ‘Dunreath’ (31^{o}16’S, 150^{o}52’E, 490 m a.s.l.) in the Goonoo Goonoo Creek catchment on the North-West Slopes of NSW. Three tropical perennial grasses (digit grass, *Digitaria eriantha* cv. Premier; Rhodes grass, *Chloris gayana* cv. Katambora; forest bluegrass, *Bothriochloa bladii* cv. Swann), a mix of native perennial grasses (redgrass, *B. macra*; bluegrass, *Dicanthium sericeum*; windmill grass, *C. truncata*; and wallaby grass, *Austrodanthonia bipartita* cv. Bunderra), lucerne (*Medicago sativa* cv. Venus), forage oat (*Avena sativa* cv. Eurabbie) and forage sorghum (*Sorghum bicolor* x *S. sudanese* cv. Jumbo) were randomly allocated to plots (6 x 9 m) across 3 replicates. Sown plots were fallowed for at least 6 months prior to sowing to increase stored soil water. Tropical grasses were sown on 5 December 2005 at 2 kg/ha of viable seed at a depth of ~10 mm into a prepared seed bed using a cone seeder with press wheels at a 0.17 m row spacing. Lucerne was sown on 2 March 2006 at 2 kg/ha by broadcasting seed onto a prepared soil surface and using a roller to improve seed-soil contact. Native grasses were established by both transplanting tussocks (redgrass and bluegrass) and broadcasting seed (windmill grass and wallaby grass). Forage sorghum was sown on 5 December 2005, 31 October 2006 and 24 October 2007 at 7 kg/ha of viable seed into a 0.20 m row spacing in a prepared seed bed. Forage oat was sown on 2 March 2006, 6 March 2007 and 27 February 2008 at 80 kg/ha of viable seed into a 0.18 m row spacing in a prepare seed bed. Tropical grass treatments were fertilised annually in spring with a mix of nitrogen (N), potassium (K) and sulfur (S) at 40.6, 13.8 and 3.8 kg/ha, respectively. Lucerne was fertilised each spring with phosphorus (P) and S at 11.4 and 14.4 kg/ha, respectively. Forage sorghum received at sowing N, P and S at 56.3, 9.1 and 11.5 kg/ha, respectively. Forage oat received at sowing N, P and S at 72.5, 18, and 1 kg/ha, respectively. Native grasses were not fertilised.

Dry matter and growth

Dry matter (kg DM/ha) for the perennial pasture treatments was estimated in 3 strata per treatment plot at 6-week intervals during the growing season (September−April) using a comparative yield method (Haydock and Shaw 1975). At each sampling time, dry matter was estimated for 20 calibration quadrats (0.4 x 0.4 m). Quadrats were harvested to a height of ~20 mm and harvested material was oven-dried at 80^{o}C for 48 h. Regression was used to determine the relationship between actual and estimated values of dry matter for the calibration quadrats and these relationships were used to predict dry matter in the strata of each treatment plot. Where the growing season of the forage crops overlapped with those of the perennial pastures, their dry matter was assessed using the comparative yield method, but otherwise it was estimated by harvesting a quadrat (0.4 x 0.4 m) in each of 3 strata per plot and oven-drying the material. Plots were mown to a height of ~80 mm after each assessment and cut material was removed from the plots. The experimental area was not grazed over the period of the study and was enclosed with rabbit-proof netting.

Comparative growth was estimated by dividing the dry matter (kg DM/ha) of sown species for each plot and treatment by the number of days since the last sampling. Over the duration of the experiment, 5 to 7 values of growth were available in each month for each species to calculate mean daily values and construct growth curves. Mean values of daily growth were integrated for each species to calculate total dry matter production for each month and year.

Results and Discussion

Between December and February, native perennial grasses had growth of 20−25 kg DM/ha/d, but outside this period their growth was low (Fig. 1). The low values recorded from March to November emphasised the feed gap that often occurs in this period for livestock enterprises on this pasture type on the North-West Slopes of NSW.

Although Premier digit grass is a frost susceptible tropical species, it commenced growth from early September and continued to provide some growth until as late as May (Fig. 1). It attained a peak growth in December of 73 kg DM/ha/d and provided high rates (i.e. >60 kg DM/ha/d) for 5 months of the year. Swann forest bluegrass had some growth from October onwards and between December and March it provided rates of 34−44 kg DM/ha/d (Fig. 1). Growth of Katambora Rhodes grass tended to be lower in the early part of the growing season compared with Premier digit grass (Fig. 1), but between January and March it had rates of 42−54 kg DM/ha/d. These data suggested that Premier digit grass was the preferred tropical grass at this site because of its extended growth season and consistently higher growth.

Eurabbie oat consistently had high growth (50−67 kg DM/ha/d) from May to August, but it also provided useful growth of 36, 48 and 34 kg DM/ha/d in April, September, and October, respectively (Fig. 1). Eurabbie oat was sown in early autumn and being late maturing (McRae et al. 2006), provided higher growth from April to September than the perennial pasture species. While McDonald (1999) showed oat having a second growth rate peak in spring, it is likely that those data represented a composite range of varieties, including those sown in late autumn, whose growth rate would be likely to peak in spring. Further, in our study measurements of stored soil water suggested that reserves under Eurabbie oat were often limiting by mid-spring, particularly in the absence of spring rainfall.

Venus lucerne provided growth >50 kg DM/ha/d in November and December with a peak in December of 77 kg DM/ha/d (Fig. 1). Venus, being a semi winter-active type with a dormancy rating of 5, also provided some growth in autumn and late winter-early spring depending on soil water availability and temperatures.

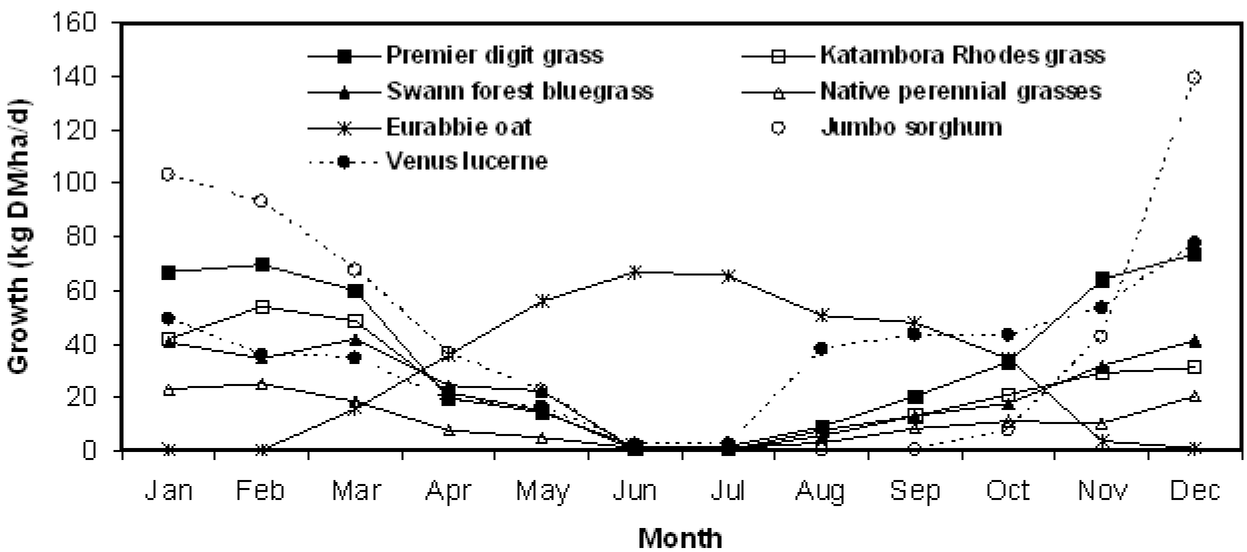

Figure 1. Mean values of comparative growth (kg DM/ha/d) observed over 3 growing seasons on the North-West Slopes of NSW for 3 tropical grasses, a native perennial grass pasture, lucerne, forage oat and forage sorghum.

Jumbo sorghum produced the maximum value of growth of 139 kg DM/ha/d in December (Fig. 1), but its production was high only for the 4-month period from December to March. This was consistent with its classification as a very long season, leafy variety, providing at least 12 weeks of grazing under ideal conditions (Collett 2004).

Mean daily growth each month (Fig. 1) and monthly and annual dry matter production (Table 1) for each species were used to identify combinations of pasture types that when sown in different paddocks may provide high growth year-round. A forage system that combined Premier digit grass (November to March) with Eurabbie oat (May to September) could provide growth >50 kg DM/ha/d for 10 months of the year. These data also clearly identified those times that growth was likely to be low. One such time was April when tropical grasses, lucerne and native perennial grasses were likely to have depleted available reserves of soil water (Murphy et al. 2010), and forage oat had not yet reached peak production.

Table 1. Monthly and total dry matter production (kg DM/ha) calculated from mean growth estimates for 3 tropical grasses, a native perennial grass pasture, lucerne, forage oat and forage sorghum.

Species	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Premier digit grass	2054	1945	1851	582	441	39	41	265	606	1031	1911	2278	13044
Eurabbie oat	0	5	470	1071	1736	2006	2022	1553	1436	1062	94	19	11475
Katambora Rhodes grass	1290	1514	1495	637	457	6	6	237	389	650	859	967	8506
Swann forest bluegrass	1249	961	1294	727	695	0	0	164	374	539	949	1263	8213
Native perennial grass	714	687	569	229	141	16	16	87	238	326	304	620	3946
Jumbo sorghum	3192	2600	2092	1088	695	0	0	0	0	239	1276	4310	15492
Venus lucerne	1518	995	1062	567	509	63	65	1166	1300	1338	1588	2393	12563

For high liveweight gain, sheep and cattle require feed with a digestibility of >70% (McDonald 1999). Our growth values suggested that in October, Premier digit grass and Eurabbie oat have only moderate growth and at this time Venus lucerne could provide high quality forage, benefiting the animal production system. Recent studies of forage quality of green leaf of Premier digit grass and Katambora Rhodes grass suggested that while they may have metabolisable energy and crude protein contents sufficient to meet animal requirements for maintenance and growth, pastures need to be kept in the young vegetative state and supplied with adequate available N (Boschma et al. 2010).

While we report mean values of daily growth for each pasture/forage type and month, it is important to recognise the variation in values obtained for assessments made in each month. For example, values for Premier digit grass ranged from 28 to 116 kg DM/ha/d for January 2009 and 2008, respectively. These results and commercial experience indicate that in favourable seasons there may be excessive growth of tropical perennial grasses, which could be utilised by cutting for hay or silage or with appropriate supplementation in winter to help fill feed gaps. Our results also highlighted the importance of graziers having an understanding of the growth and dry matter production potential of different species throughout the year, so that animal requirements may be met.

Conclusions

Measurement of comparative growth and dry matter production for a range of pasture types and forage crops on the North-West Slopes of NSW indicated that a forage system including Premier digit grass and forage oat would provide high growth (>50 kg DM/ha/d) for up to 10 months of the year, collectively.

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