Evaluating seedling emergence, establishment and survival of tropical perennial grasses in Central West NSW

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Abstract: *Seedling emergence, establishment and survival of five tropical grass species were investigated in Central West NSW. Seedling emergence was evaluated at six sowing times and was highest in spring and lowest in late autumn/early winter. Establishment and survival were assessed over three sowing dates and under irrigated and non-irrigated conditions. Like emergence, establishment was highest in spring. Irrigated plots showed higher establishment density than non-irrigated plots. The observed established plant density for all species over the three sowing times was in most cases greater than the desirable benchmark of 4–9 plants/m^2.*

Key words: *Panicum coloratum, Cenchrus ciliaris, Chloris gayana, Digitaria eriantha, Megathyrsus maximus*

Introduction

Central West NSW has a low annual rainfall (400–600 mm) with a near even distribution across all seasons. During summer, temperatures are high and during winter, frosts are common. Increasing climate variability and changing weather patterns are projected to have a negative impact on feed availability and livestock production (Cullen *et al*. 2009). Utilising a range of pasture species including tropical perennial grasses is an option to fill the feed gap in this region. Tropical perennial grasses are able to produce large amounts of high quality feed in response to variable rainfall. However, the risk of establishment failure of tropical perennial grasses was identified as a major limitation to their widespread uptake in south-eastern Australia (Boschma *et al*. 2018). While some producers have successfully established tropical grass pastures in Central West NSW, the moisture and temperature requirements of the major tropical perennial grass species requires further investigation to improve the reliability of establishment and persistence. This information will be used to provide guidelines around optimum sowing times for tropical perennial grass species in Central West NSW.

Methods

Seedling emergence, establishment and survival of five tropical grasses were studied in two experiments. The studies were conducted at the Trangie Agricultural Research Centre (31°59’45” S, 147°56’18” E, elevation 214 m above sea level) on a red Chromosol soil with pH_{Ca} 5.1 (0–10 cm) and about 20 frost days per annum.

Experiment 1

Seedling emergence was determined at six sowing times. The sowing times were 17 October 2016, 5 December 2016, 17 February 2017, 31 March 2017, 15 May 2017 and 26 June 2017. Each sowing time was a randomised complete block design with three replicates. The grasses were *Panicum coloratum* (Bambatsi panic) cv. Bambatsi; *Cenchrus ciliaris* (buffel grass) cv. Gayndah; *Chloris gayana* (Rhodes grass) cv. Katambora; *Digitaria eriantha* (digit grass) cv. Premier; and *Megathyrsus maximus* (panic grass) cv. Gatton. Emergence was recorded every three days for two weeks during which seed beds were kept moist at all times.

Experiment 2

An experiment to study establishment and survival was conducted in spring (October 2016), early-summer (January 2017) and late-summer (February 2017) under irrigated and non-irrigated conditions. Irrigated plots were watered fortnightly to simulate average monthly rainfall (23–39 mm). Seeds were sown by hand broadcast onto a prepared seedbed in plots (4 × 4 m) arranged in a randomised complete block design with three replicates. Grass seedlings were counted using two 0.5 × 0.5 m quadrats 8-weeks after sowing. Five plants from each plot were marked at the end of May 2017 and their winter survival was assessed when growth recommenced in spring.

Total number of seedling emergence and number of plants established data were analysed using linear mixed models of the form Count ~ Species + random(Rep) where: Count = number of seedlings emerged and number of plants established; species = grass species.

Results and Discussion

Across all species emergence was highest in October (34%) and lowest in June (0%). Bambatsi panic, Rhodes grass and buffel grass had significantly higher emergence than panic grass and digit grass in October and December while Rhodes grass had significantly higher emergence than all other species in March and May (Table 1). Since soil was kept moist throughout the 2-week period, any differences were likely to be due to soil temperature. The average weekly temperature during October, November and February were within the range described as suitable for tropical grass germination (Lodge and Harden 2009). However, there were three consecutive days with maximum temperatures over 44°C just after sowing in February that may have affected germination. In this experiment emergence of Rhodes grass seedlings was higher in the cooler autumn period than for all the other species suggesting that there may be a wider sowing 'window' for this species.

In Experiment 2, irrigated plots seemed to have higher establishment density than the non-irrigated plots for all species except panic grass. There were no significant differences between grasses sown without irrigation in early-summer with plant densities ranging 6–25 plants/m^2 (Table 2). The observed differences in establishment between irrigated and non-irrigated plots were probably a result of a failure to germinate and/or seedling death post germination due to moisture stress. The observed number of established plants across all species and sowing times is considered greater than the desirable plant population (Moore *et al.* 2013; Boschma *et al.* 2019).

All of the established seedlings from the spring sown treatment survived the extended hot dry weather experienced in January and February, but growth was slow. However, the plants responded well to over 80 mm rainfall in mid-March. Over 90% of established seedlings from the early-summer sown grasses also survived, however, seedlings remained small and had a lower response to rainfall than those sown in spring.

Table 1. Field emergence percentage (%) of the five the tropical grasses. Values within a column followed by different letters are significantly different (P = 0.05).

Species	Emergence (%)					
	October	December	February	March	May	June
Bambatsi panic	50 b	44 c	12 a	12 b	2 a	0
Buffel grass	42 b	12 ab	18 a	6 ab	6 a	0
Rhodes grass	48 b	30 bc	6 a	26 c	26 b	0
Panic grass	16 a	4 a	8 a	0 a	2 a	0
Digit grass	14 a	2 a	0 a	2 a	2 a	0

Table 2. Established plant densities (plants/m^2) of tropical grasses with and without irrigation. Values within a column followed by different letters are significantly different (P = 0.05).

Species	Sowing rate (kg/ha)	Spring sowing		Early-summer sowing		Late-summer sowing	
		Non-irrigated	Irrigated	Non-irrigated	Irrigated	Non-irrigated	Irrigated
Bambatsi panic	8	29 b	40 c	19 a	30 c	12 b	29 c
Buffel grass	12	5 a	14 a	6 a	14 ba	2 a	5 a
Rhodes grass	8	14 a	25 a	15 a	20 ba	7 b	13 b
Panic grass	12	28 b	29 a	25 a	22 b	14 b	18 b
Digit grass	12	11 a	22 a	11 a	11 a	11 b	15 b
Mean		17.4	26.0	15.2	19.4	9.2	16.0

Conclusions

Experiments in Central West NSW sought to study germination and emergence of a range of tropical perennial grasses. Once established the seedling growth and survival of the grass species were monitored. All species performed well both with and without irrigation, especially when sown in spring. These tropical perennial grass species could prove to be a viable resource for the region. However, more evaluation of their performance is required before firm recommendations can be made. Irrigation is unlikely to be a practical option for commercial enterprises in the region, however, including irrigation treatment in this study showed the potential of tropical grasses in seasons with rainfall that is near the long term average.

Acknowledgments

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