Seed yield, dormancy and seedling survival of some perennial tropical grasses in northern New South Wales

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Abstract: *These data are the first to be reported for the North-West Slopes of NSW that indicate the potential of the tropical perennial grasses Bambatsi panic, Premier digit, Katambora Rhodes grass and Swann forest bluegrass to recruit and establish seedlings from natural seed fall and a lack of primary dormancy associated with the structures surrounding mature caryopses of Premier, Katambora and Swann.*

Key words: Natural seed fall, regeneration, recruitment, establishment, florets, caryopses

Introduction

Increasingly, tropical perennial grass-based pastures are being more widely sown in the predominantly summer rainfall environment of the North-West Slopes of New South Wales (NSW) (McCormick *et al.* 1998; Boschma and McCormick 2008). However, the results of a recent focus group study (McCormick *et al.* 2009) indicated that much more information than is currently available is required to enable producers to successfully and reliably establish, grow and manage these grasses.

Several local producers have successfully grown tropical perennial grass pastures (e.g. Anderson 1992; Cull 1992; Coupland 1995; Murray 2004) and there is increasing interest in their wider adoption and use, particularly if they are both productive and persistent. For persistence, pasture species need to be either long-lived, or have an ability to regenerate vegetatively from stolons or rhizomes, or set seed and recruit seedlings into the population. A question that often arises is whether or not 'locking-up' a paddock of tropical perennial grasses is a useful strategy for improving plant density; the answer depends on the ability of different cultivars to flower and set seed and for new plants to establish from seedlings. Harper (1977) described this as a process of 'seed rain' to replenish the soil 'seed bank', but indicated that the success of such a tactic depended on several factors such as seed dormancy, seed predation and favourable conditions for seedlings to emerge and grow. Data were collected to assess; 1) the relative weight of seed dispersal units (seed and florets) of each cultivar, 2) the dormancy status of the seed collected and 3) the time of emergence and the rate of survival of naturally regenerating seedlings.

Methods

These studies were conducted at the Tamworth Agricultural Institute (TAI), NSW (31°09' S; 150°59' E; elevation 434 m, 5 km south-east of Tamworth). In spring 2006, five plants of the tropical perennial grasses *Panicum coloratum* var. *makarikariense* cv. Bambatsi (panic), *Dichanthium aristatum* cv. Floren (bluegrass), *Chloris gayana* cv. Katambora (Rhodes grass), *Digitaria eriantha* var. *eriantha* cv. Premier (digit), and *Bothriochloa bladhii* var. *glabra* cv. Swann (forest bluegrass) were transplanted into three replicated plots each 1 x 1 m. Plants were sown on the plot diagonals with one plant located in the centre of each plot and the others at a distance of 0.5 m. Plants were watered during establishment and throughout summer 2006-07 with a complete fertiliser solution applied in November 2006 and 2007 and again in March 2008. However, all plots of Floren failed to flower and set seed in summer 2006-07 so no data were collected for this species.

Flowering and seed set commenced in Bambatsi, Katambora and Premier in early February 2007 and in Swann in mid March 2007. Natural seed fall was measured on 9 occasions (12 February to 25 May 2007) in 5 containers located in each plot. By the end of May 2007 all seed had fallen from the inflorescences of all of the cultivars. Containers (150 mm long cylinders of 90 mm PVC pipe) were sealed at the base using 0.2 mm mesh (to allow drainage) and placed at a height of 200 mm above ground level to avoid seed predation by ants and mice. At each sampling time containers were emptied and the seed dispersal units weighed. In June 2007, floret weights, seed numbers per floret and seed weights were determined on 6 lots of 100 florets and germination percentage was assessed on 4 lots of 25 seeds of each cultivar. After processing, any unused florets were returned to the plot from which they were harvested.

At the end of May 2007 florets were sampled from each plot by vacuum harvesting. Subsamples of each cultivar were mixed and used to assess the effect of the floret structures (glumes, awns, lemmas and paleas) on germination. Sufficient florets were retained for further study and the remaining material returned to the plot from which it was harvested. Each month from July 2007 to June 2008, 4 lots of 50 seeds (caryopses) or caryopses contained in florets were placed in Petri dishes lined with moistened filter papers in a germination cabinet (continuous light; alternating day temperatures 12 h at 25^{0}C, 12 h at 20^{0}C) and germination counted after 14 days. Caryopses were removed from the florets by hand-picking. Data are presented (Fig. 2) for 3 of the twelve sampling times to indicate the general pattern observed.

Seedling emergence and seedling survival was measured in the field plots in the first week of each month from September 2007 to November 2008. No seedlings emerged in September 2007 and from April to November in 2008. In each plot, all new seedlings that emerged in a fixed quadrat (200 x 300 mm) were marked with a coloured pin, with different colours representing different emergence times. Seedling survival was determined at each sampling time by removing and counting pins that no longer marked a seedling. Data are presented (Fig. 3) for each cultivar and emergence time, together with the actual monthly rainfall for Tamworth from October 2007 to November 2008. Six soil cores (50 mm diameter by 50 mm depth) were also taken from each plot in November 2008, but the only cultivar with any residual seeds in the soil was Bambatsi with a mean of 1867 seeds/m^2.

Results and discussion

Natural seed fall commenced in Premier, Katambora and Bambatsi in early February 2007 and continued until late May (Fig. 1). In comparison, seed fall in Swann did not commence until mid April. Total seed yields ranged from around 625 kg/ha for Swann to 700 kg/ha for Katambora and 950-990 kg/ha for Premier and Bambatsi. Swann had the highest floret weights and the highest number of seeds per floret (Table 1), but Bambatsi had the highest seed weight and germination percentage.

Germination percentages over time were generally lower for naked seed than for seed in the floret (Fig. 2) and so reductions in germination related to the presence of the florets were not evident. This indicated an apparent lack of primary dormancy in the mature florets of Swann, Premier and Katambora, but secondary dormancy may occur as a result of the harvesting of physiologically immature florets or inappropriate storage conditions.

More than 250 seedlings/m^2 of Bambatsi, Premier and Swann emerged (Fig. 3) and despite low rainfall in March-May 2008 survival rates were >85% for seedlings of Bambatsi, Premier and

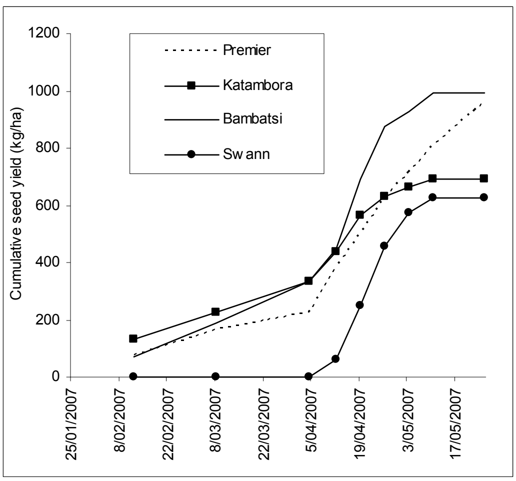

Figure 1. Cumulative seed yield (kg/ha) from natural seed fall of four cultivars of tropical perennial grasses in 2007.

Table 1. Floret and seed characteristics of four tropical perennial grasses harvested in 2007.

Cultivar	Floret weight (g/100 florets)	No. of seeds per 100 florets	Seed weight (mg)	Germination (%)
Bambatsi	-	-	1.13	85
Premier	0.0277	20	0.44	69
Katambora	0.0297	22	0.24	77
Swann	0.0395	60	0.25	65

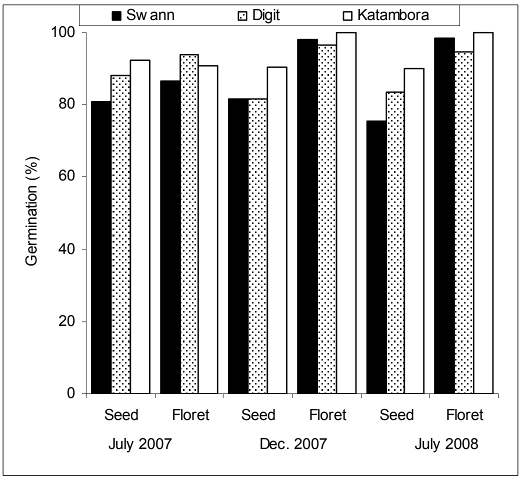

Figure 2. Germination (%) of seeds and mature florets of Swann, Digit and Katambora in July 2007, December 2007 and July 2008, 2, 7 and 14 months after collection.

Swann that emerged in December 2007, January 2008 and March 2008, respectively. Seedling survival rates were 50-60% for seedlings that emerged in October–November 2007 (Bambatsi) and January 2008 (Swann) and 25-45% for Katambora and Premier seedlings that emerged in October–November 2007 and those of Swann that emerged in November 2007. Hence, for the cultivars tested the data indicate that 'locking-up' a paddock of tropical perennial grasses would be a useful strategy for improving plant density.

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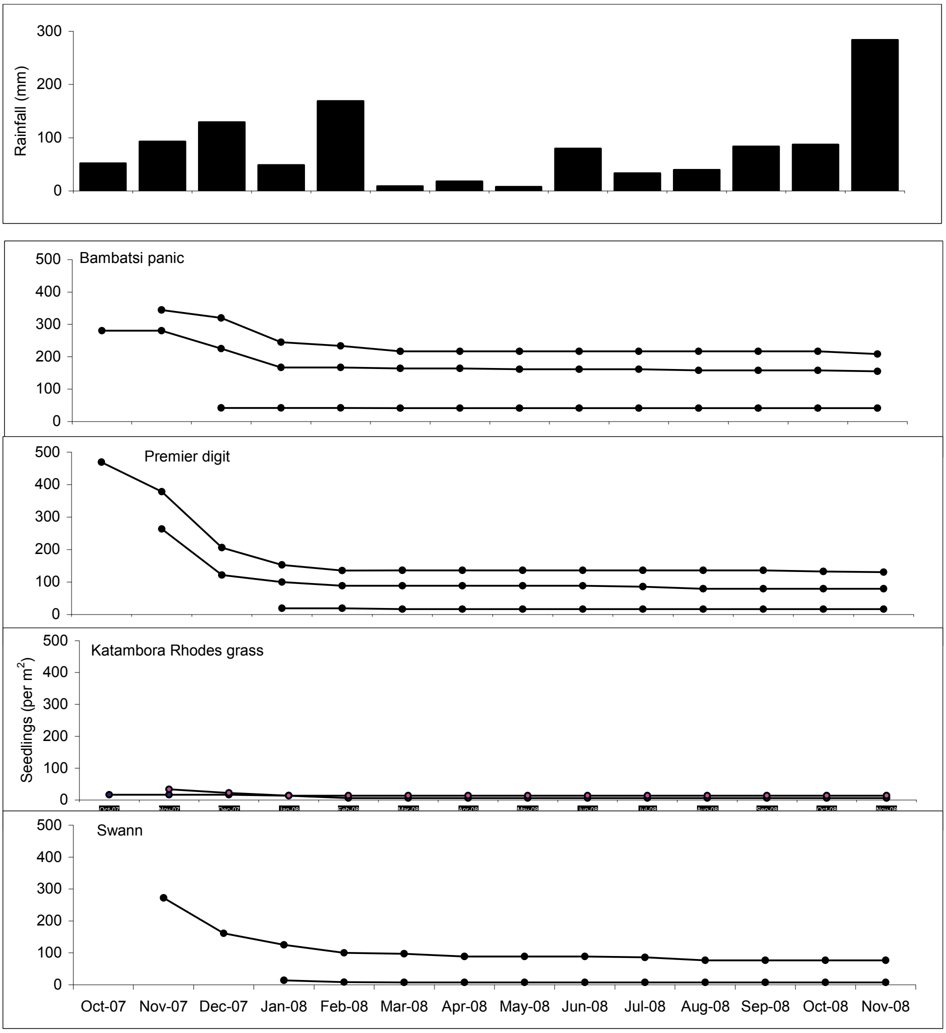

Figure 3. Actual monthly rainfall (mm) for Tamworth and natural seedling emergence and survival (seedlings/m²) from October 2007 to November 2008 of four cultivars of tropical perennial grasses.