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Native Pasture Restoration in the Kimberley Rangelands, Western Australia – Seed Production Areas

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Abstract

The pastoral industry in the Kimberley region is an important economic contributor to Western Australia. However, as a result of past land management practices, there has been a decline of the more desirable native pasture grasses resulting in a loss of feed-base productivity. To reverse this decline, research is being conducted to help restore important native pasture grasses in this region.

In the Kimberley region, access to native grass seed for restoration is limited as wild-harvest is opportunistic, typically un-mechanised and ripe seed collection sites can be difficult to access during the wet season. Establishing a Seed Production Area (SPA) close to existing all weather roads will allow access to seed at the optimum harvesting time, and planting of single species on flat terrain will allow rapid and efficient collection of seed especially if using mechanical harvesters. Also, the use of fertiliser and irrigation could improve seed quality and increase seed production. This should improve the availability and reduce the cost of native grass seed for use in restoration of native grasses to degraded rangelands and mine-sites.

Six native grass species have been planted out on a small scale to trial a SPA located in Perth, Western Australia. Plants were fertilised and irrigated during summer. Plant growth and phenology were monitored and seed quality compared to wild-harvested seed. Irrigation extended the flowering period and hence seed production. Seed fill (a measure of seed viability) from the SPA was equal to or significantly greater than for wild-harvested seed. There was a trend towards increased seed yield and seed fill in the SPA when grasses were cut before summer re-growth, and with increased irrigation.

Introduction

The pastoral beef industry in the Kimberley region is an important economic contributor to Western Australia. The climate is tropical savanna, with hot wet summers (wet season) and dry winters (BOM 2024). Native grasses are the main forage resource for cattle (Chilcott *et al.* 2020), but the extremes of rainfall create seasonal patterns in forage quality. Extended periods of average and above average rainfall can encourage managers to increase livestock numbers. When seasons return to average or below average, these higher livestock numbers are often retained, which can result in overgrazing of preferred pasture plants,

resulting in a loss of soil cover and therefore increased potential for degradation and a decline in productivity.

Seeding is one of the most used methods of restoring vegetation to degraded sites. Sourcing of seed for restoration largely relies on harvesting from wild plant populations (Neville *et al.* 2016). However, sourcing of seeds can be problematic, especially in remote areas like the Kimberley region of Western Australia. Access to seed is limited by a lack of suppliers and difficulty to access ripe seed after wet season rains due to road closures. The authors have noted after three years of seed collecting in the Kimberley, that seed ripening can be spatially and temporally heterogenous, requiring extensive resources and time to search large areas to find plants where seed has not dispersed or is ripe for collection. In addition, much of the rangelands are grazed or have experienced late wet season/early dry season burns reducing the available area for seed collection and requiring further travel. Also, seed collecting by foot can be hazardous especially on cracking-clay plains, where deep "crab holes" are concealed by long grass.

Establishing a Seed Production Area (SPA) close to existing all weather roads will allow access to seed at the optimum time, and planting of a single species on flat terrain will allow rapid and efficient collection of seed especially if using mechanical harvesters. Also, implementing horticultural practices like irrigation, the use of fertilizer and annual cutting of grasses could increase seed production and seed quality.

Methods

Wild seed was collected from a range of grass species growing on Napier Downs and Mt House Stations located in the Shire of Derby-West Kimberley in Western Australia during May, after the end of the wet season when road access was available. All six species chosen for this study (Table 1.) can be found growing in clay and/or loam soils with three species also found growing in sandy soils (Ryan et al. 2013).

Due to logistical and accessibility issues in setting up a SPA in the Kimberley, it was decided to trial a site at the University of Western Australia (UWA) research facility in Shenton Park, Perth. The soils are yellow-brown sands of the Spearwood dune system of the Swan Coastal Plain (McArthur and Bettenay 1960). The climate is subtropical, with a warm dry summer and cold wet winter (BOM 2024).

Tubestock was propagated from wild collected seed germinated in petri dishes and transplanted into tubes about 2-3 weeks after germination. Grasses were grown in a proprietary potting mix (supplied by Richgro, Jandakot, Western Australia) and in nursery conditions for 10 months before planting.

The SPA trial site at Shenton Park was established in late November 2022. The original planting comprised 206 plants consisting of five perennial and one annual grass (*Iseilema vaginiflorum*) species. In 2023, the trial was reduced to five perennial species of 176 plants (40 *Dichanthium fecundum*, 52 *Dichanthium sericeum*, 40 *Heteropogon contortus*, 18 *Panicum decompositum*, and 26 *Sehima nervosum*).

Each species was planted in separate plots. Within each plot, tubestock was planted in 3 rows 35 cm apart, with plants planted 40 cm apart in each row and offset with the adjacent row by 20 cm (6 plants/m^2). Fertiliser (Seamungus® by Neutrog) was added (1 handful) to the planting hole and mixed with soil before planting tubestock. All plants were hand watered for the first two weeks. Once established all plants were fertilised with NPK Blue (Cresco), one handful/m^2 on the 5 November 2023 and 26 February 2024. Overhead irrigation (approximately 30 minutes, 2-3 times/week) commenced 27th November 2023 with the volume applied doubling on the 20th of March 2024. To measure the effect of defoliation on future growth and seed production, approximately half of each perennial grass plot was cut (to a height of 10-15

cm) on the 11 September 2023. Seed was collected separately from cut and uncut sections of the plot every 1-2 weeks depending on the quantity of seed produced.

All seed harvesting, from the wild and SPA, was done by hand by lightly pulling at inflorescences to remove ripe florets and dropping into a bucket. Weights harvested are inclusive of florets for all grasses except for *P. decompositum* as seed readily fell out of florets during harvesting. Grass florets/seed were x-rayed to determine seed fill using a Faxitron Specimen Radiography System (MX-20 Cabinet X-ray Unit) (Faxitron, Wheeling, Illinois, USA).

Results

Wild seed was collected in May 2021, 2022, and 2023. While seed was found at Napier Downs every year, no or very little seed was found at Mount House in two of the three years. Seed collecting in the SPA commenced in February 2023 and seed was still being collected in June for *D. sericeum* and *S. nervosum*. While there was an extended period of seed production there was a peak of seed production in May for all species. Seed fill of grasses harvested in SPA was equal to or greater than wild-harvested seed (Table 1). In the SPA, seed yield and seed fill was greater when grasses were cut before summer growth. Also, following an increase in irrigation volume, seed yield increased by 3 to 50-fold and seed fill more than doubled for most species (Figures 1 and 2). There was an interaction between grass cutting and irrigation with the effect of cutting grass on seed yield and fill greater with low irrigation than high irrigation. For *H. contortus* there was no seed produced from uncut grass until after the irrigation volume was increased.

Table 1. Seed fill (%) of seed harvested from the wild (Wild) and the Seed Production Area (SPA) in Perth, (n = number of collections).

			Seed fill (%)			
Species	Common name	Soil type	SPA	n	Wild	n
Dichanthium fecundum	Bundle-Bundle	sand, loam, clay	12-51	5	12-39	3
Dichanthium sericeum	Blue grass	clay	48-87	5	43-63	3
Heteropogon contortus	Black Speargrass	sand, loam, clay	36-74	4	17-32	2
Iseilema vaginiflorum	Red Flinders grass	clay	32	1	21	1
Panicum decompositum	Native Millet	loam, clay	88-99	5	56-94	2
Sehima nervosum	White grass	sand, loam, clay	29-60	5	23-37	2

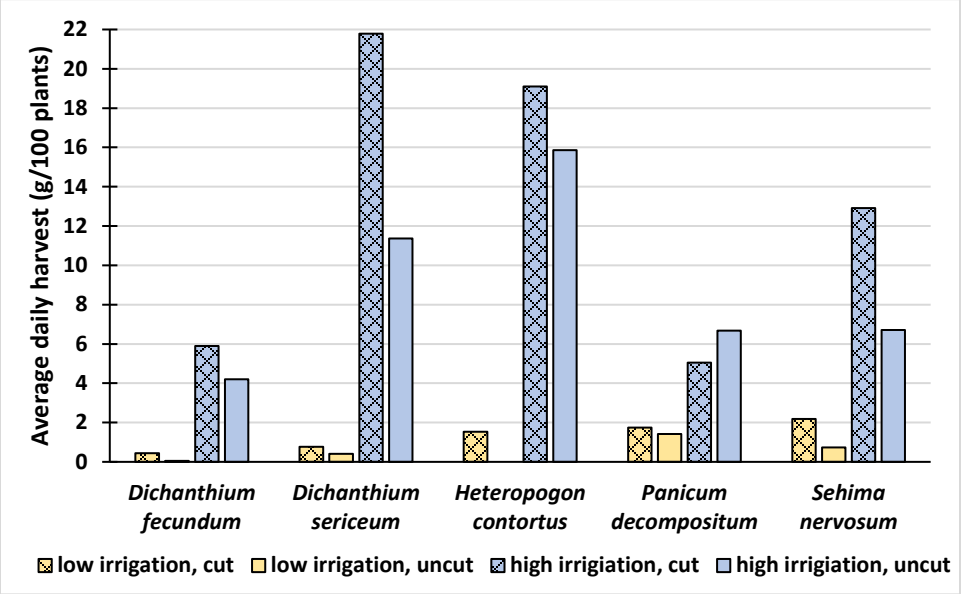

Figure 1. Average daily quantity of seed (g) collected from cut and uncut grasses grown in the SPA at Shenton Park, Perth before and after the increase in irrigation.

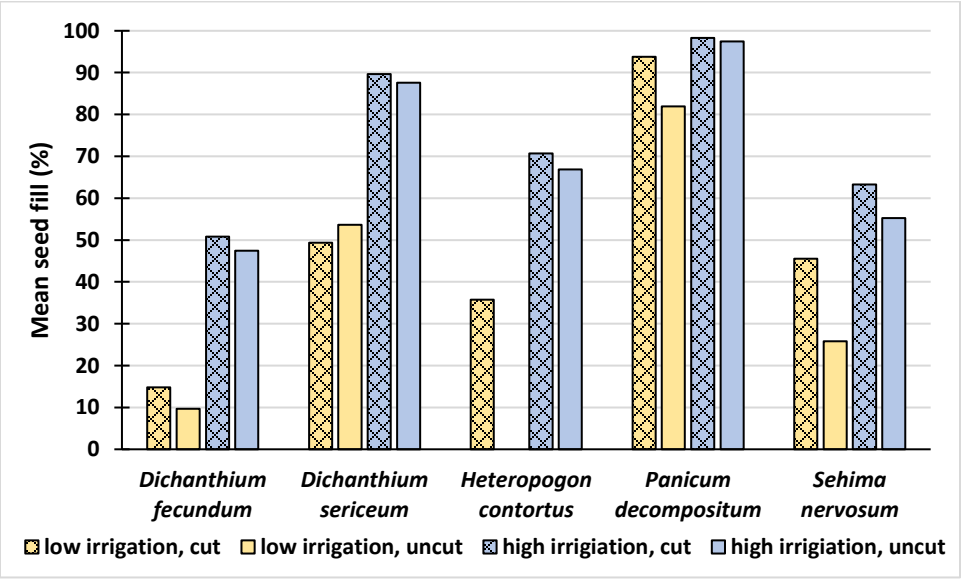

Figure 2. Mean seed fill (%) of seed collected from cut and uncut grasses grown in the SPA at Shenton Park, Perth before and after the increase in irrigation volume.

Discussion

This small-scale seed production area (SPA) in Perth demonstrated that the grass species trialled in this experiment can be successfully grown in climatic and soil conditions that differ to that of wild populations. Also, with irrigation and fertiliser, the SPA can produce larger quantities of viable seed by extending the

period of flowering and hence seed production, and of higher quality (% seed fill) than seed collected from wild populations. Although the grasses were planted in soil and climate conditions quite different to wild populations, seed quality and productivity were not negatively impacted. The broad adaptability of these grasses to a range of site conditions, will enable the establishment of SPA close to population centres and infrastructure that will allow access to all weather roads, improve monitoring of plant growth and seed development, and allow the use of mechanized seed harvesting technology which will all lead to faster and more efficient harvesting of seed. We suggest the establishment of SPA is a feasible approach to improve the reliability of supply, quality of seed and potentially reduce the cost of supplying seed for use in restoring native pasture grasses in rangeland landscapes.

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