The domestication of native grasses for pastoral use

G.M. Lodge

NSW Agriculture, Agricultural Research Centre, RMB 944, Tamworth NSW 2340

Summary. Domestication is not a new idea and cultivars of pasture plants, selected from naturally occurring ecotypes are commonly sown overseas. *Danthonia richardsonii* cv. Taranna and *D. linkii* cv. Bunderra will be the first Australian native grasses to be registered for pastoral use. Comparative data are presented to show the yield, quality and seed production of these two species. Although the native grasses are not intended as replacements for introduced grasses, preliminary comparisons of their performance in the establishment year indicates that they are productive and have a high regeneration potential. The commercial availability of seed in 1995 will coincide with the release of information packages on the establishment and management of these new cultivars.

Introduction

It was almost 70 years ago that the wallaby grasses, *Danthonia* spp., were described *as* the most economically important grasses in New South Wales (NSW) and it was predicted that they would be commercially available within a few years (3). Similarly, in the 1930s, Cashmore (5) wrote, 'that improved types of *Danthonia* may be obtained by selection and breeding from the great mass of material available and that highly productive pastures may be established provided that suitable species and strains are employed'. Unfortunately, there are still no cultivars of native grasses registered for pastoral use in Australia, but several research programs (9) are addressing this problem. At Tamworth on the Northern Slopes of NSW, the collection and assessment of naturally occurring ecotypes of *Danthonia* since 1985 has led to the selection of two cultivars, *D. richardsonii cv.* Taranna and *D. linkii cv.* Bunderra, which will be registered in 1992.

Native grasses are adapted to the Australian environment, having evolved under harsh conditions of periodic drought and on soils of inherently low fertility. Clearly, the best native grasses to domesticate for pastoral use will have these features as well as attributes such as high nutritive value and seasonal production of green leaf, particularly in winter. Native grasses have also been subjected to 200 years of grazing by domestic livestock and some have adapted to increased fertility, grazing pressure and competition. Early anecdotal and experimental evidence (3,5) indicated that the *Danthonia* spp. were among the more palatable and nutritious of the native grasses. Further studies of *D. linkii* growing in native pastures in northern NSW (8) have shown that this yearlong green perennial produces quantities of green leaf forage high in crude protein and digestibility. Similar data have also been reported for monospecific plots (2,10). Previous studies on the breeding systems of the self-pollinating *Danthonia* spp. (1,4) have also contributed greatly to the progress made in the domestication of these species.

This paper describes a program to domesticate *Danthonia* spp. for pastoral use. The major factors limiting domestication were assessed to be seed shattering and low seed production. Data are presented to show the comparative yield, quality and seed production of D. richardsonii and *D. linkii.* Preliminary yield data for these two species and introduced grasses are compared.

Methods

Two thousand plants of *D. richardsonii* and *D. linkii* were collected in 1985-86 (6) and grown in spaced nursery rows on a red brown earth at Tamworth NSW. Selection for seed retention and high yield over four generations resulted in the identification of seven *D. richardsonii* and three *D. linkii* elite accessions. These accessions together with *D. richardsonii* cv. Hume (a turf grass type selected by CSIRO) and unselected ecotypes were sown in a Plant Variety Rights testing block in June 1990 (7). Seed production was assessed on five inflorescences per plant in each generation. Caryopses were obtained by thrashing and cleaning.

Although the selection program concentrated on seed production as its main criterion, some dry matter production and plant quality data were also collected. From the initial parent plant nursery, 20 randomly selected plants of *D. richardsonii* and *D. linkii* were harvested every six weeks from January 1986 to February 1988. Individual plants were harvested to a height of 8 cm above ground level and hand sorted into green leaf, green stem, dead leaf and dead stem. These portions were dried for 48 h at 80?C, ground to pass through a 1 mm sieve and analysed for nitrogen content. In May 1990 4x2 m plots of seven perennial grasses cultivars and third generation selections of *D. richardsonii* and *D. linkii* (Table 1) were established to assess their dry matter production. Plots were sown at 3 kg/ha and superphosphate (125 kg/ha) was applied. Plants were harvested in 0.16 m^2 quadrats and dried as described above. Plots were mown after sampling and allowed to flower in 1990.

Results and discussion

The *Danthonia* spp. are probably best suited to lower input (fertiliser and herbicide) manage- ment systems in environments where introduced grasses have either been difficult to establish or have not persisted. While the *Danthonia* spp. have not been developed as replacements for introduced species, comparisons of their performance are inevitable. At Tamworth, their initial performance has been comparable to that of introduced grasses (Table 1). While most of the introduced grasses had higher early dry matter production than the *Danthonia* spp., yields of cv. Sirosa were lower. However, with dry conditions in summer and early autumn, yields were generally highest for the *Danthonia* spp. Rust was prevalent in the ryegrass plots and cv. Cajun in winter 1991. New seedlings counted in July 1991 had a mean of 26, 86 and 348 per m^2 for fescue, phalaris and perennial ryegrass compared with 1490 and 2170 per m^2 for D. *richardsonii* and *D. linkii,* respectively. Seedlings of the *Danthonia* spp. were also observed to be invading adjacent plots. These plots will be monitored in the longer-term to assess the performance of these grasses in the absence of nitrogen inputs.

Although there is some published information on the production and quality of *D. linkii (2,8,10),* little information is available for *D. richardsonii.* Data collected under comparative growing conditions (Fig. 1) for these two species indicated that they have similar dry matter yield potential and crude proteins. Growth rates varied seasonally being highest in spring and lowest in winter. Green leaf crude protein percentages ranged from 11-19.5% and were always higher in *D. richardsonii* compared with *D. linkii.*

Table 1. Dry matter production of perennial grasses at Tamworth.

	Dry matter production (kg/ha)				
Species	16.10.90	5.12.90	4.3.91	14.5.91	19.7.91
Phalaris aquatica					
cv. Holdfast	1763	1188	3050	338	3556
cv. Sirosa	0	994	432	606	3483
D. richardsonii	343	1528	3478	872	1512
D. linkii	150	1205	5168	613	1537
Festuca arundinacea					
cv. Cajun	1106	2002	3251	828	2225
Lolium perenne					
cv. K. Valley	3887	1638	1880	469	1026
cv. K.V. Early	8300	1130	2271	663	976
cv. Brumby	4269	1386	975	394	1341
cv. Roper	3750	3056	2445	778	1421
Mean ± s.e.	2619±1215	1570±284	2550±631	618±85	1897±441

Seed of cvv. Taranna and Bunderra will not be available commercially until 1995. Meanwhile, research is being conducted in the key areas of establishment and management, to provide information to advisers and farmers. The release of information packages on management will coincide with the commercial availability of seed, reducing establishment failures and maxim- ising the persistence and production of grasses adapted to the Australian environment. Current studies on sowing time and depth, sowing method, sowing rate, compatibility with other species, herbicide sensitivity, tolerance to acid and saline soils and phosphate requirements,

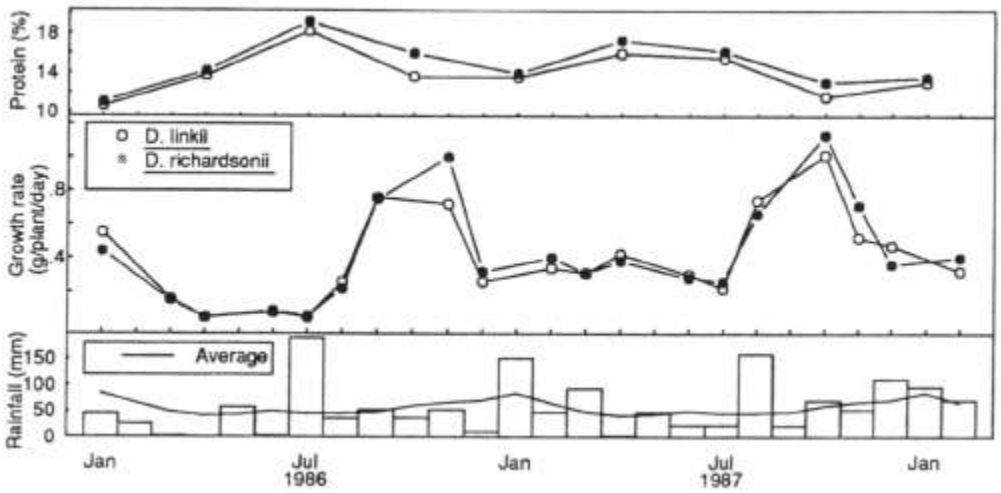

Figure 1. The pattern of dry matter production and protein content of two *Danthonia* spp. at Tamworth *in* 1986-88, together with rainfall and the long term average rainfall for the site.

The mean seed yields of the selected cultivars were higher than those of the unselected ecotypes (Table 2). The mean seed production of cvv. Taranna and Bunderra were similar, and twice that of cv. Hume.

Table 2. Seed yield (mean ? s.e.) of *Danthonia* cultivars and unselected ecotypes.

	Seed yield (g/plant)
D. richardsonii	
cv. Taranna	0.97 ± 0.39
cv. Hume	0.40 ± 0.31
Unselected ecotypes	0.26 ± 0.20
D. linkii	
cv. Bunderra	0.93 ± 0.49
Unselected ecotypes	0.51 ± 0.27

together with planned studies on grazing management will be used to devise these guidelines. Other selection programs in progress will eventually lead to an increase in the diversity and number of native grasses available to farmers.

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