# EVALUATION OF TEMPERATE PERENNIAL GRASSES FOR LOW TO MEDIUM RAINFALL AREAS OF TASMANIA

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Abstract

In response to the need to develop better adapted and more persistent species/cultivars of perennial grasses for cool temperate, low to medium rainfall (500-750 mm) regions, a wide range of Dactylis and other perennial grass germplasm is being evaluated at three sites in Tasmania. Preliminary results, based on seasonal herbage production over two years, indicate that three accessions of D. glomerata have superior production and good potential for commercial release as alternatives or replacements for the current standard cultivar, Porto. Australian phalaris and Demeter tall fescue, two species not widely used in Tasmania also have shown good levels of herbage production. Other new species assessed as worthy of further investigation include Arrhenatherum elatius, Bromus macranthos, B. biebersteinii, B. auleticus, Elymus trachycaulus, Agropyron trichophorum and Festuca ovina. The relatively poor performance of Lolium perenne cv 'Jackaroo' highlights the inability of this species to adapt to low input, marginal conditions.

***Keywords:*** *Perennial grasses, temperate Australia, plant introductions, evaluation, cultivars, low-input grasses, seasonal production, annual production.*

The widespread decline in the productivity and persistence of sown perennial pastures in the low to medium (500-750 mm) rainfall zones of temperate Australia has been well documented (10). The cause of this decline has been linked to a number of possibilities including soil acidification, dryland salinity, pests and diseases, limited renovation of degraded pasture, reduction in fertiliser use, overgrazing especially during periods of drought and inappropriate grazing management.

Friend et al. (1) have recently surveyed the botanical composition of perennial grass-based pastures in the Midlands and Derwent Valley regions of Tasmanian in relation to environmental and management factors. The findings of this survey confirm the degraded status of these pastures with the most commonly sown grass, perennial ryegrass, frequently having 5% cover in the pastures sampled. Cocksfoot which is regarded as being better adapted to the relatively low rainfall of the region occurred in fewer pastures and where present also frequently had 5% cover.

A number of strategies have been promoted to address the problem of pasture decline including high input management systems (4), improved grazing manage-ment (2), the development of improved cultivars for specific environments (6) and identification of alternat-ive species (7). For many situations some combination of the above strategies may be required to redress the degradation of the pasture resource base.

Considerable work is continuing on breeding and selection within the four main perennial pasture grasses in common use in southern Australia, ie. perennial rye-grass (Lolium perenne L.), cocksfoot (Dactylis glom-rata L.), phalaris (Phalaris aquatica L.) and tall fescue (Festuca arundinacea L.) (6, 7). Given the diverse genetic resource that exists within these species it would be expected that most new cultivars will emerge from this group. However, for more 'difficult' environments potential exists to include new or alternative species for evaluation. Pasture species evaluation research in Tas-mania, since the early 1990's, has concentrated on the assessment of species and accessions belonging to the genera Dactylis, Festuca and Bromus.

The plant evaluation process adopted in this study is consistent with that described by Laidlaw and Reed (3) where the yield, seasonal distribution, nutritive value, sensitivity to stress, pests and disease and animal production capability are determined across a range of environments. The target environments selected for this study are considered 'difficult' because of the combined effects that drought, cold and low to moderate soil fertility have on pasture productivity and persistence. ?The results reported in this paper are a summary of two years of measurement of herbage production for the most promising species and accessions.

Materials and methods

The accessions under evaluation were introduced from a large number of sources, the principal centres being :

• USDA, Pullman, Washington, USA.

• Vavilov Institute, St Petersburg, Russia.

• INTA, Rio Gallegos, Argentina.

• CSIRO, Canberra, Australia.

• Margot Forde Germplasm Centre, New Zealand.

• Department of Primary Industry and Fisheries, Launceston, Tasmanian.

Following plant characterisation and seed production in the glasshouse 100 accessions of perennial grasses were selected for evaluation at three field sites in the wool producing, low to medium rainfall regions of Tasmania. The selected accessions and the commercial standard cultivars, Jackaroo perennial ryegrass, Demeter tall fescue, Australian phalaris, Porto cocksfoot, Grasslands Gala, grazing brome and Matua prairie grass were raised in cellular trays in a glasshouse during autumn 1995. Following a short period of hardening established seedlings were planted into a prepared seedbed at each site in early June 1995 as a single replication of 5 m rows, at 0.25 m plant spacing and 1 m row spacing. Plants were watered in after transplanting.

The key climate and soil characteristics of the three experimental sites are as follows:

• Site 1. Jericho: situated in the Midlands region at an altitude of approximately 400 m, mean annual rainfall 571 mm. Soil is a sandy clay loam with pH(water) 5.6, Colwell P 16 mg/kg, and Colwell K 212 mg/kg.

• Site 2. Swansea: situated on the East Coast at an altitude of approximately 20 m, mean annual rainfall 601 mm. Soil is a heavy clay loam, pH(water) 6.4, Colwell P 23 mg/kg, and Colwell K 372 mg/kg.

• Site 3. Hamilton: situated in the Derwent Valley at an altitude of approximately 200 m on a North facing slope, mean annual rainfall 581 mm. Soil is a clay loam with pH(water) 6.2, Colwell P 37 mg/kg, and Colwell K 463 mg/kg.

The trial sites were topdressed with 0-6-17 NPK fertiliser at a rate of 300 kg/ha prior to planting and in autumn 1997 received an application of 8-4-10 NPK fertiliser at a rate of 200 kg/ha. Plant establishment at Swansea and Hamilton was excellent, however, severe frosts at Jericho in the weeks after planting resulted in the loss of some plants. Porto cocksfoot suffered 100% losses and as a result replacement seedlings were planted.

In the first year of growth, general observations were recorded for herbage production, palatability, rust susceptibility and frost damage. These observations have been continued but are not reported in this

paper. Harvests for herbage production commenced in late Autumn 1996 and are to be continued on a seasonal basis for at least three years. The final harvest included in the data presented in this paper is for Summer 1998 which gives results for two full years.

Five representative plants of every species or access-ion were selected from each row and the herbage harvested with hand shears, aiming to remove between 80 to 90% of the herbage. Where possible the same plants have been harvested on each occasion and in cases where the death of 'harvest' plants occurred a representative replacement was sampled. Immediately after sampling the sites were 'crash grazed' with sheep at a stocking rate of about 100 sheep/ha. Results are presented and discussed on a seasonal basis as the mean of the three sites over two years. The results for spring are the mean of sites 1 and 2 only, as site 3 was inadvertently grazed during the spring growth period.

## Results and discussion

Initial results based on the evaluation of herbage production from spaced-plants have provided good evidence of the relative performance of a range of perennial grass species and accessions in 'difficult' environments. Although there are similarities in the climate of the three sites (Table 1) the combining of pasture evaluation data across sites has produced some confounding effects due to differences in factors such as soil type, soil fertility and seasonal variation in climate. However despite some differences between sites and years in the relative performance of the selected species and accessions the overall trends provide a reliable guide to the likely long-term outcome for the plants under investigation.

| | Swansea | | | Jericho | | | Hamilton | | |
|---|---|---|---|---|---|---|---|---|---|
| | Min | Max | Rainfall | Min | Max | Rainfall | Min | Max | Rainfall |
| Month | (° C) | (° C) | (mm) | (° C) | (° C) | (mm) | (° C) | (° C) | (mm) |
| Jan | 11.4 | 22.2 | 47 | 8.2 | 20.5 | 41 | 10.0 | 23.6 | 42 |
| Feb | 11.5 | 22.1 | 42 | 8.5 | 21.0 | 38 | 10.0 | 23.7 | 35 |
| Mar | 10.3 | 20.8 | 51 | 6.0 | 18.3 | 41 | 8.6 | 21.7 | 40 |
| Apr | 8.2 | 18.6 | 51 | 4.2 | 15.2 | 51 | 6.4 | 17.9 | 48 |
| May | 6.1 | 15.8 | 49 | 1.8 | 12.4 | 46 | 4.2 | 14.1 | 47 |
| Jun | 4.3 | 13.8 | 59 | 0.2 | 9.3 | 45 | 2.3 | 11.0 | 49 |
| Jul | 3.1 | 14.6 | 50 | 0.7 | 9.0 | 48 | 1.6 | 10.9 | 50 |
| Aug | 4.2 | 14.0 | 44 | 1.3 | 10.1 | 48 | 2.4 | 12.9 | 53 |
| Sep | 5.7 | 15.7 | 41 | 1.5 | 10.9 | 43 | 3.9 | 15.3 | 53 |
| Oct | 7.1 | 17.6 | 53 | 3.6 | 14.7 | 56 | 5.9 | 17.6 | 58 |
| Nov | 8.9 | 18.9 | 51 | 4.6 | 15.7 | 53 | 7.7 | 19.7 | 54 |
| Dec | 10.4 | 20.2 | 63 | 6.1 | 19.2 | 61 | 9.2 | 21.8 | 52 |

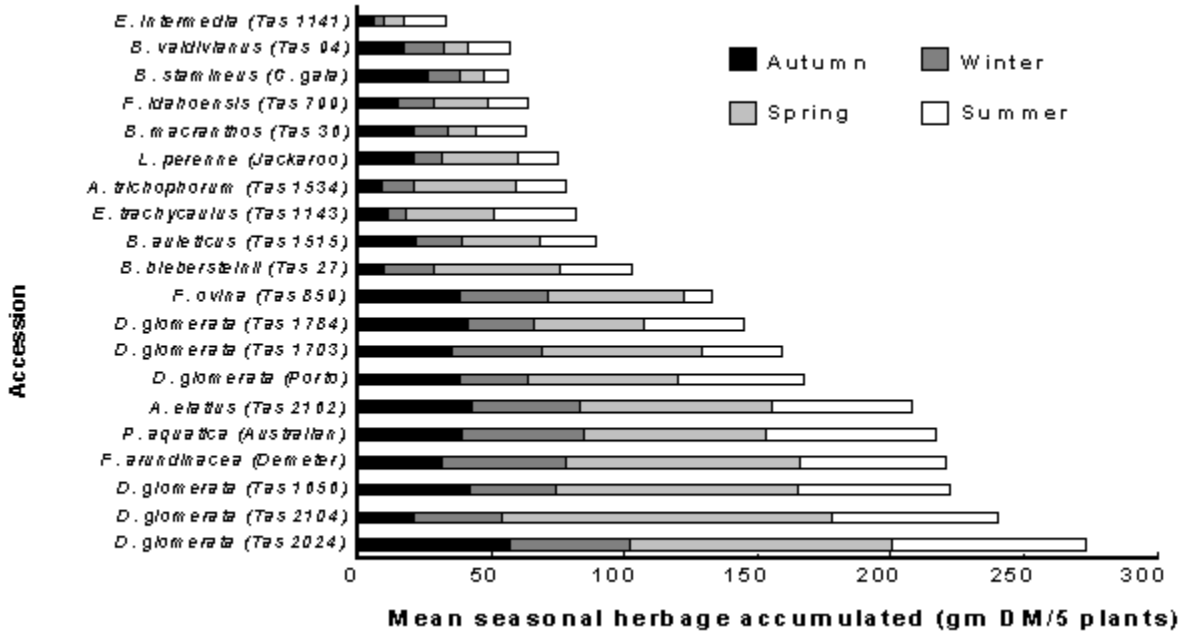


Figure 1

The results presented in Fig. 1, indicate that cocksfoot offers the greatest potential for improved seasonal and total annual production under conditions where moisture stress is common, winters are cold and soil fertility is marginal, conditions to which this species is well adapted (5). The three accessions, Tas 2024, 2104 and 1656, have consistently ranked higher in terms of total herbage production compared to the industry standard cultivar, Porto, over the three experimental sites. Seasonal herbage accumulation shows the expected spring dominated production pattern experienced in a cool temperate climate.

Australian phalaris and Demeter tall fescue, two relatively minor commercial species used in Tasmania, have produced considerably more herbage dry matter than Jackaroo perennial ryegrass, suggesting that they are underutilised as well adapted species in more 'difficult' environments. The poor productivity of

perennial ryegrass emphasises the problem faced by farmers that still rely heavily on this species as the major component in sown pastures across many local environ-ments in Tasmania.

Tall oatgrass (A. elatius) has performed best of the alternative species and has produced equally well at all three sites. This finding is supported by work conducted in New Zealand which demonstrated the suitability and persistence of this species in low to moderate rainfall areas and under drier soil conditions (9). Despite con-cerns about the weed potential and variability in palat-ability of this species (8), further study of this particular accession is warranted with careful consideration to be given to nutritive value, palatability and response to grazing. Festuca ovina and two species of brome, B. auleticus and B. biebersteinii, have also shown good adaptation and justify further evaluation.

Several of the alternative perennial grasses that have attracted some interest in recent years such as Elytrigia intermedia, Festuca idahoensis and other Bromus spp. have performed relatively poorly in terms of initial herbage production. However, these species may have a potential role in situations where persistence and/or particular seasonal growth characteristics are more important than total herbage production.

## Conclusion

The development of new grass cultivars from the four main existing pasture species, perennial ryegrass, cocksfoot, phalaris and tall fescue, or the introduction of new commercial species remains a high priority in the management and improvement of degraded pastures. ?The selection of the best performed species for a given environment would result in higher and more predict-able levels of herbage and animal production. In some situations the maintenance of ground cover and long-term persistence are more important selection criteria than total annual herbage production. The results of work in progress suggest adequate scope exists for selection of individual accessions that meet one or both of these criteria. The most encouraging outcome of this work to date is the performance of several cocksfoot accessions which have shown an ability to perform well in terms of establishment and survival, seasonal and total herbage production and persistence across a range of marginal environments. Further detailed evaluation of a wider range of plant characteristics of these cocksfoot accessions is considered a high priority in the next stage of the evaluation process.

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