Alternative perennial grass species for North facing slopes in Tasmania

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ABSTRACT

The drought tolerance and persistence of 110 accessions and cultivars from 25 species of the grass genera *Agropyron, Arrhenatherum, Bromus, Dactylis, Elymus, Elytrigia, Festuca, Lolium, Phalaris and Poa* were assessed in a spaced plant trial located at Hamilton in Tasmania, between June 1995 and June 2000. The trial was situated on a north-facing slope on a clay loam soil type. The site received a mean annual rainfall of 382mm over the five year duration of the trial, 35% below the long term average for the region. Survival of accessions ranged from 0% to 95%. *Dactylis glomerata* ssp *hispanica, Poa ligularis, Festuca ovina* and *Bromus auleticus* accessions had the highest percentage survival.

KEY WORDS

Perennial grasses, drought tolerance, persistence, north facing slope, *Dactylis glomerata* ssp *hispanica*.

INTRODUCTION

Considerable potential exists on the dry steep hill country of Tasmania for the use of drought tolerant perennial grass species, outside the range of traditionally sown pasture species. The need for alternative species is highlighted by the result of a pasture survey in the Midlands and Derwent Valley regions of Tasmania which showed ground cover contributed by commonly sown improved species (*Dactylis glomerata* and *Lolium perenne*) to be frequently as low as 5% (1).

Dry summers and longer term droughts have been a regular feature throughout these regions resulting in poor productivity, lack of persistence and in some cases complete failure of current species and cultivars. Future developments must acknowledge that the environment from which a species originates will set some limits on how much further progress can be made in selecting and breeding more drought tolerant plants from within that species (2).

Environmental conditions prevailing in Tasmania are sufficiently different to other regions of temperate Australia to warrant the evaluation of germplasm collected from homoclimes similar to Tasmania (3). This paper reports on the persistence under drought conditions of germplasm collected from such homoclimes.

MATERIALS AND METHODS

A field trial was established on a North facing slope at Hamilton (42?33'S, 146?47'E) in the Derwent Valley of Tasmania, which has a mean annual rainfall of 581mm. The soil type is a clay loam with pH 6.2 (1:5 water), Colwell P 37 $mgkg^{-1}$ and Colwell K 463 $mgkg^{-1}$.

A range of 110 accessions and cultivars representing 25 species of perennial grasses were raised in cellular trays in a glasshouse. In June 1995 after a period of hardening, seedlings were transplanted into a cultivated seedbed as a single replication of 5m rows at 0.25m plant spacing and 1m row spacing. Plants were watered in after transplanting. The trial site was topdressed with 300kg/ha of

0-6-17 NPK prior to planting. In Autumn 1997 8-4-10 NPK fertiliser was applied at 200kg/ha. Plant survival was assessed in 1999 and 2000 by counting the original plants surviving in each row.

The 84 *D. glomerata* accessions were divided into three groups on the basis of leaf morphology (4) as follows: there were 13 large broad-leaved vigorous accessions representing the subspecies *glomerata*,

19 smaller narrow-leaved summer dormant accessions representing the subspecies *hispanica* and 52 intermediate forms.

RESULTS AND DISCUSSION

The climate data recorded on site (table 1), shows that rainfall for the five year duration was 35% below the long term average resulting in one of the worst droughts the region had ever experienced.

Table 1. Climate data for the five year period June 1995 – June 2000. Mean monthly rainfall (mm) and mean maximum and minimum monthly temperatures (?C) compared to long term averages.

Month	Rainfall (mm)		Temperature (?C)			
	5 year mean	Long term mean	5 year mean		Long term mean	
			maximum	Minimum	maximum	minimum
Jan	37	42	24.6	11.0	23.6	10.0
Feb	49	35	24.0	11.8	23.7	10.0
Mar	27	40	20.9	9.3	21.7	8.6
Apr	32	48	16.5	6.0	17.9	6.4
May	13	47	14.3	5.2	14.1	4.2
June	16	49	11.7	1.8	11.0	2.3
Jul	33	50	10.6	2.9	10.9	1.6
Aug	42	53	12.8	2.7	12.9	2.4
Sep	31	53	14.8	4.3	15.3	3.9
Oct	37	58	17.1	6.0	17.6	5.9
Nov	39	54	19.1	6.7	19.7	7.7
Dec	26	52	21.2	8.6	21.8	9.2

Total	382	581

Table 2. Plant survival after the fourth and fifth years expressed as a percentage of the original plants.

Species	Fourth year survival (%)	Fifth year survival (%)
Agropyron intermedium	0	0
Agropyron trichophorum	60	0
Arrhenatherum elatius	5	0
Bromus araucanus	0	0
Bromus auleticus	75	30
Bromus biebersteinii	10	0
Bromus macranthos	0	0
Bromus mango	0	0
Bromus stamineus (cv Grasslands Gala)	0	0
Bromus uniloides (cv Matua)	0	0
Brimus valdivianus	0	0
Dactylis glomerata ssp *hispanica* (a)	82	67
Dactylis glomerata “intermediate” (b)	34	11
Dactylis glomerata ssp *glomerata* (c)	13	2
Dactylis glomerata (cv Porto)	32	0
Dactylis marina	10	10

Dactylis smithii	42	5
Elymus trachycaulus	0	0
Elytrigia intermedia	11	0
Festuca arundinacea (cv Demeter)	0	0
Festuca idahoensis	0	0
Festuca ovina	85	85
Festuca rubra	0	0
Lolium perenne (cv Jackaroo)	0	0
Phalaris aqautica (cv Australian)	100	20
Poa ligularis	80	80
Poa pratensis	0	0

(a) mean of 19 accessions (b) mean of 52 accessions (c) mean of 13 accessions

Results shows that plant survival within accessions after four years ranged from 0% to 100% and in the fifth year from 0% to 85%. Year 5 was extremely dry with only 277 mm of rainfall resulting in high plant losses. *Festuca ovina, Poa ligularis, D. glomerata* ssp *hispanica* and *Bromus auleticus* had the highest percentage of surviving plants after five years with 85%, 80%, 67% and 30% survival respectively.

Survival for the three groups of *D. glomerata* ranged from 1.5% for the broad leaved ssp *glomerata* group (range 0-10%) to 67% for the fine leaved ssp hispanica (range 45-95%). The intermediate group averaged 10.6% survival (range 0-85%).

The most drought tolerant and persistent of the *D. glomerata* and *F. ovi*na accessions originated from the temperate dry and semi-arid region (300-500mm annual rainfall) centred in the administrative districts of Leon, Salamanca, Valladolid and Zamora in Northern Spain on low fertility acid soils. These soils are very similar to those found in Tasmania (3). *P. ligularis* and *B. auleticus* originated from low rainfall regions of Patagonia in South America.

Phalaris aquatica cv Australian was the only commercial cultivar to survive, with 20% survival after 5 years. Those accessions that Lane et al. (5) reported as having the highest seasonal herbage accumulation to year 3 at this site failed to survive the extreme conditions experienced in years 4 and 5.

CONCLUSION

The superior drought tolerance and persistence of a number of alternative grass species against the commonly sown cultivars and species tested, highlights the need to develop new cultivars from this

material. It also highlights the need to acknowledge the environment a species has come from when developing new cultivars. With the failure of currently used cultivars and the increasing problem of land degradation in low rainfall areas of Tasmania, the development of drought tolerant, persistent alternatives must now be considered a high priority with long term persistence becoming the principal selection criteria.

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