

Novel Cocksfoots for SE Australia – Establishment and production

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Abstract

Four new Cocksfoot (*Dactylis glomerata*) cultivars have been bred for areas of temperate Australia that have annual rainfall normally considered insufficient for the species. The new cultivars were bred from plants selected for persistence and production in areas with acidic, high aluminium content soils in an earlier project. Two are fine-leaved lines bred from selections from Morocco, one is a replacement for cv. Currie and was bred from persistent plants of three cultivars – Currie, Jana and Medly. The last is a selection from a Portuguese accession – AVH48. Five field experiments were established in 2009 and 2010 in Victoria and NSW to evaluate these new cocksfoot cultivars.

Establishment density was satisfactory for all treatments at all sites (range 46-263 plants/m²). There were differences within sites and between sites. These experiments are ongoing but total herbage production to date indicates strong genotype x environment interactions. Unusually high summer rainfall in 2010/11 (up to 375% of the mean summer total at one of the Victorian sites) has not put selection pressure on the treatments to persist but the two fine leafed lines, bred from Moroccan genotypes, have been the most productive at the two southern NSW sites, Beckom and Trungley Hall. The Currie Replacement line and AVH48 have out-produced Currie at three of the four southern sites.

If the new cultivars are successful in these experiments their commercial use will allow persistent perennial grass-based pastures to be established where currently the only option is unproductive annual grass pastures.

Key Words

Summer dormancy

Introduction

The higher rainfall areas of temperate Australia are well served with a suite of introduced perennial grass species. As rainfall declines with distance from the coast, and particularly on the inland slopes of the Great Dividing Range, the persistence of temperate species is unreliable and they become commercially risky. In southern NSW and Victoria the annual rainfall limit is around 600 mm for perennial ryegrass (*Lolium perenne*) and tall fescue (*Festuca arundinacea*) and about 500 mm for phalaris (*Phalaris aquatica*) and cocksfoot (Culvenor 2009). In northern NSW with predominately summer rainfall, the limit for temperate perennial grass species is around 700 mm/year (Kemp and Dowling 1991).

Perennial grasses would be of great benefit to these marginal regions (Dear and Ewing 2008). Productivity would improve as persistent perennial pastures are more able to cope with climatic variability relative to annual pastures. Cocksfoot has been recognised as a species with untapped genetic potential for lower rainfall regions (Lolicato and Rumball 1994). The subspecies *hispanica* which grows in dry regions of the Mediterranean basin has shown promise in plant improvement programs in Australia, France and Italy (Lelièvre and Volaire 2009). The cultivar Kasbah was bred at the Waite Institute in South Australia in the 1960s from plants collected in Morocco. It exhibits extreme summer dormancy and good persistence in regions with as little as 350 mm of annual rainfall. More recently, two cultivars – Sendace and Uplands – have been bred from Spanish material by the Tasmanian Institute of Agricultural Research and have also been shown to be persistent in low rainfall environments.

In 1994, Cunningham collected 51 accessions of Cocksfoot from low rainfall sites in Morocco (Cunningham et al. 1997). A subset of these from the lowest rainfall sites and other potentially useful material was evaluated as spaced plants at two sites in central western Victoria from 2004 to 2006. The best performing plants were removed and crossed at the Department of Primary Industries Hamilton to produce four synthetic cultivars. Two of these are fine leafed lines based on Moroccan and Spanish accessions. A third is a selection from Currie and two other commercially available cultivars; Medly from France and Jana from Italy. The final candidate cultivar is based on an accession from Portugal. A full description of the breeding methodology was given by Harris et al. (2008). The new experimental cultivars are being evaluated in a series of genotype x environment experiments (along with phalaris and tall fescue candidate cultivars) in Victoria and NSW. Preliminary results covering establishment and herbage production of the cocksfoots are reported in this paper. Results for the phalaris and tall fescues are reported in Culvenor et al. (2012) and Harris et al. (2012) respectively.

Methods

Five genotype x environment experiments were established in 2009-2010. Two (Eversley and Bealiba) were in central western Victoria, two (Trungley Hall and Beckom) in the Riverina of New South Wales and one (Inverell) in northern NSW. The Victorian sites have a predominately winter-spring rainfall distribution. The southern NSW sites have a uniform pattern of rainfall through the year and the northern NSW site has a summer dominant rainfall pattern. Soil types vary from sandy loams over medium clays (the two Victorian sites) to sandy loams (Beckom), grey clay (Trungley Hall) and a red clay loam (Inverell). The Victorian sites were highly acidic with 0-10 cm pH (CaCl₂) of 4.0 for Eversley and 4.6 for Bealiba. Aluminium levels at depth were also high with 60-80 cm Al of 110 mg/kg for Eversley and 120 mg/kg for Bealiba.

The four Cocksfoot candidates are being compared with three cultivars common to each site and up to seven cultivars in all. Each site consisted of a randomised complete block experiment with four replicates of small plots ranging from 7.5 to 15 m². The sowing rate was 3.0 kg/ha (adjusted for seed quality) and subterranean clover (*Trifolium subterraneum*) cv. Urana was sown at 3.0 kg/ha as a companion legume in all treatments.

Measurements included seedling establishment counts using 3 randomly placed quadrats per plot, basal frequency in autumn or winter using 2 fixed quadrats per plot and seasonal herbage production of sown species using Botanal and either mower cuts or calibrated visual estimates. After each herbage mass assessment the plots are grazed or mown. Analysis of variance was conducted for all measurements and the establishment density and total herbage production results are presented here. A more detailed analysis of the herbage production and persistence data will be published separately in a future paper.

Results

The annual rainfall totals for recent years at each site are compared to the long term averages in Table 1. All sites except Eversley had below average rainfall in 2009. At Inverell the 2009 rainfall was insufficient for the success of the original sowing and the experiment was resown in 2010. Both 2010 and 2011 totals were well above average at all sites. These totals were mostly influenced, however, by extremely high rainfall totals during the 2010/2011 summer. The November 2010 to March 2011 rainfall at Bealiba, for example, was 561 mm compared to the long term average of 159 mm. Such a wet summer makes it difficult to evaluate a cultivar's persistence in low rainfall environments.

Table 1. Long-term average (LTA) and annual rainfall (mm).

Year	Bealiba	Eversley	Beckom	Trungley Hall	Inverell
2009	428	599	330	447	539
2010	740	852	594	749	889
2011	700	661	632	702	1088
LTA	479	599	460	520	700

Sowing dates and establishment count data are presented in Table 2. The mean establishment density varied from 73 plants/m² at Trungley Hall to 179 plants/m² at Eversley. All cultivars at all sites had sufficient plants to form swards despite the variation in establishment. There were differences between sites with AVH48 establishing best in the Victorian sites but low in establishment counts in the NSW sites. Currie and Sendace established well in the southern NSW sites but less well elsewhere. The two fine leafed Moroccan

entries established well at all sites.

Table 2. Sowing dates and establishment counts (plants/m²) of Cocksfoot entries at 5 sites in Victoria and NSW (-, not sown).

Cultivar	Sowing date	Bealiba 25.06.09	Eversley 17.06.09	Beckom 10.05.09	Trungley Hall 19.05.09	Inverell 16.06.10
Currie		89	170	177	92	99
Jana		73	124	-	-	115
Kasbah		82	147	198	46	118
Medly		92	214	-	-	91
Porto		-	-	-	-	180
Sendace		73	133	179	57	114
Uplands		92	179	-	-	146
Currie Replacement		90	195	169	65	154
AVH48		150	263	130	56	89
Fine leaf		110	233	184	114	150
Very Fine leaf		98	133	195	82	190
LSD (P=0.05)		49.5	53.7	43.0	30.8	51.4

Total herbage production and number of harvests are presented for each site in Table 3. Mean herbage masses were highest at Eversley although Inverell, sown a year later, also had high DM yields. Trungley Hall had low herbage masses. Currie is the most commonly sown cultivar in the region covered by these experiments. At all five sites it ranked in the middle for herbage mass, indicating that more productive cultivars are available if they are found to persist. AVH48 was the most productive at the Victorian sites but was not particularly productive at the NSW sites. Currie Replacement was more productive than Currie at all sites except Inverell. Jana and Medly were at least as productive as Currie at the Victorian sites and at Inverell. The fine leafed cultivars, Sendace and Uplands, were ranked in the middle to least productive range at each site. The extremely summer dormant cultivar, Kasbah, was unproductive. The two Moroccan fine leafed cultivars had poor productivity at Bealiba, Eversley and Inverell compared to AVH48 and Currie Replacement but were the most productive at Beckom and Trungley Hall.

Table 3. Total sown grass herbage production (DM t/ha) of Cocksfoot entries at 5 sites in Victoria and NSW (-, not sown).

	Bealiba	Eversley	Beckom	Trungley Hall	Inverell
No. of harvests	7	8	11	11	6
Currie	7.7	12.9	6.7	3.2	10.6
Jana	8.8	13.7	-	-	11.6
Kasbah	4.0	7.6	3.5	2.3	2.3
Medly	8.3	14.3	-	-	14.4
Porto	-	-	-	-	17.9
Sendace	5.5	9.7	3.9	0.8	3.5
Uplands	7.4	13.1	-	-	10.0
Currie Replacement	10.1	15.3	12.0	5.9	11.3
AVH48	12.2	18.3	9.8	1.6	8.7
Fine leaf	7.0	11.7	13.3	6.9	6.1
Very Fine leaf	5.8	9.7	12.9	6.1	5.5
LSD (P=0.05)	1.99	2.35	2.12	2.41	2.00

Conclusion

The lack of typical hot, dry conditions during the summers of 2009/10 and 2010/11 has meant that all cultivars have substantially survived. It was expected that cultivars such as Porto, Currie and possibly others would have lost plants in each summer while the Fine Leafed Moroccan cultivars in particular would not have lost plants. The experiments will continue with on-going persistence measurements. Trungley Hall, with its heavy clay soil, is not a site where Cocksfoot would normally be considered although the Fine Leafed Moroccan cultivars have been reasonably productive there. Currie Replacement has been more productive than Currie at Bealiba, Eversley, Beckom and Trungley Hall. It was equal to Currie at Inverell. AVH48 was outstanding at the two Victorian sites but not so at the NSW sites.

Acknowledgments

We are most grateful for the high quality work of the project technical officers: Caroline McDonald, Alan

Byron, Micaela Murray, Justin Tidd, Richard Lowrie and Karen Lowien. We work with supportive farmers: Paul Harrington (Eversley), Alan Weir (Bealiba), Mike O'Hare (Beckom), Phillip Davies (Trungley Hall) and the Department of Environment, Climate Change and Water (Inverell). Funding for the project was sourced from the Future Farm Industries CRC, Department of Primary Industries, Victoria, NSW Department of Primary Industries and CSIRO Plant Industry.

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