



Genetic Gain Trials of Eucalypts for Low Rainfall Sites

AUSTRALIAN LOW RAINFALL TREE IMPROVEMENT GROUP

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Background

ALRTIG implemented genetic improvement programs for a small number of hardwood 'key species' in 1999. The species were selected for sawn timber production on sites typical of southern Australia's sheep-wheat belt, with low rainfall and other stressors such as frost, alkalinity and saline soils. In the interim, while ALRTIG's seed orchards mature, we have recommended seed sources for growers to deploy. These include 'best-bet' wild provenances identified by the Partner's pre-existing trials, selectively thinned planted stands and trials, and for spotted gum, seedling seed orchard seedlots. Our State and Commonwealth Government partners were joined by forestry companies Integrated Tree Cropping Ltd and Woollybutt Pty Ltd in a genetic gain trial program to test recommendations for several of the key hardwood species. This poster focuses on two of the most prospective species, sugar gum and spotted gums.



PHOTO: PIRSA sugar gum gain trial at Bundaleer, South Australia

Table 1. Details of sites for the sugar gum and spotted gum gain trials

Species	Site	Latitude	Longitude	Soil description	MAR (mm)	Collaborator
<i>E. cladocalyx</i>	Craigieburn, VIC	37° 35'	144° 56'	Duplex, basalt	600	Woollybutt Pty Ltd
<i>E. cladocalyx</i>	Rocky Gully, WA	35° 30'	117° 56'	Shallow granitic	835	ITC Ltd.
<i>E. cladocalyx</i>	Lismore, VIC	37° 45'	143° 30'	Buckshot gravel, clay-loam	600	DPI Victoria
<i>E. cladocalyx</i>	Bundaleer, SA	33° 19'	138° 33'	Medium clay/loam	580	PIRSA
<i>Corymbia</i> spp.	Melville Forest, VIC	37° 30'	141° 55'	Duplex lateritic sediments	670	DPI Victoria
<i>Corymbia</i> spp.	Craigieburn, VIC	37° 35'	144° 56'	Duplex, basalt	600	Woollybutt Pty Ltd
<i>Corymbia</i> spp.	Rocky Gully, WA	35° 30'	117° 56'	Shallow granitic	835	ITC Ltd.
<i>Corymbia</i> spp.	Bordertown, SA	36° 15'	140° 34'	Loamy sand over ironstone clay	500	PIRSA

Materials and Methods

Genetic gain trials test whether or not genetically improved materials perform significantly better than unimproved controls. The trials were established for sugar gum and spotted gum (*Corymbia maculata* (CM) and *C. citriodora* ssp. *variegata* (CCV) in winter 2003 at the sites detailed in Table 1. Establishment and follow-up silviculture was according to local best-practice. The seed sources used are listed in Table 2.

The trials were established in 5-8 replicates of 40-64 tree plots in winter or spring 2003. The design was randomized complete block with incomplete block structures superimposed in some cases.

Trials were measured in late 2006, except Lismore, which was measured in January 2006. Traits assessed included height, diameter, axis persistence, stem form and ease of pruning (not all traits were assessed at all sites). Axis persistence is a measure of forking, ranging from 1-6 (worst-best). Stem form was assessed on the basis of defects that would lead to commercial log downgrade, scored from 1 for highly defective tree, to 6 for a defect-free stem. Ease of pruning was assessed on a 1-4 scale (worst-best) based on the estimated effort needed to form prune the tree. Trials with incomplete block structures were analysed using a mixed-model reml procedure, with replicate and seedlot effects treated as fixed, and incomplete blocks as random. Trials without incomplete blocks were analysed using fixed-effects ANOVA.

Table 2. Seed sources for the genetic gain trials

Species	Seed source	
Spotted gum	Hamilton CM plus trees	Bulk of 7 candidate plus trees from Hamilton 1995 provenance trial
	Deniliquin SSO	Bulk of 18 CM trees from Deniliquin selectively thinned progeny trial
	Bodalla CM	Bulk of 10 wild trees from Bodalla, NSW
	Hamilton CCV	Bulk of 9 candidate plus trees from Hamilton 1995 provenance trial
	Paddys Land CCV	Bulk of 10 wild trees from Paddys Land NSW
Sugar gum	Kersbrook SPA	Bulk seed from selectively thinned seed production area
	Lismore	Seed from phenotypically selected trees in Lismore area of W. Victoria
	Keyneton SS (seed stand)	Bulk seed from a thinned plantation in SA
	Wirrabara (wild)	Bulk of 10 wild trees from Wirrabara, SA
	Leighton SS (seed stand)	Bulk seed from a thinned plantation (planted 1911) in SA
Flinders Chase (wild)	Bulk of 9 wild trees from Kangaroo Island (KI), SA	
Bundaleer PT	Seed from trees in a provenance trial including Eyre Pa. S. Flinders and KI material	



PHOTO: Woollybutt Pty Ltd spotted gum gain trial at Craigieburn, Victoria

Results and Discussion

Sugar gum

The trials demonstrate that Kersbrook SPA is the best all-round seed source in terms of growth and form (see Table 3). The Lismore seed source was next-best, though the seed used here was from phenotypically selected trees: there is no guarantee that all seed from this general location will perform as well. Seed from Bundaleer provenance trial was the worst performer, being in the lowest ranking group for height, diameter and stem form at all sites. This seed source may have been negatively affected by pollen contributions from the poorly-performing Eyre Peninsula origin. Seedlot differences were not marked at the Lismore site, where survival was 78%. Survival at Rocky Gully, Bundaleer and Craigieburn was 98, 89 and 86% respectively, with no significant difference between seedlots at any site.

Table 3a. Results from sugar gum analysis at four sites

Site	Rocky Gully (WA)				Craigieburn (VIC)			Lismore (VIC)		Bundaleer (SA)	
	DBH (cm)	Ht (m)	Form (1-6)	Axis persist. (1-6)	DBH (cm)	Ht (m)	Axis persist. (1-6)	Ht (m)	DBH (cm)	Ht (m)	
Kersbrook SPA	8.9	5.6	3.9	5.2	6.1	4.2	5.6	3.3	6.4	5.5	
Lismore	8.5	5.6	3.5	5.3	5.6	4.1	5.8	3.2	5.2	4.8	
Keyneton SS	8.4	5.3	3.4	5.3	5.5	3.9	5.7	3.4	4.9	4.6	
Wirrabara (wild)	8.1	5.2	3.5	4.7	5.4	3.8	5.6	3.3	4.6	4.2	
Leighton SS	7.8	5.2	3.4	5.2				3.1	4.6	4.1	
Flinders Chase (wild)	7.3	5.2	3.2	4.4	5.3	4.0	4.6	3.4	3.7	4.0	
Bundaleer PT	6.1	4.3	2.9	4.7	4.7	3.5	4.6	3.0	3.7	3.7	
s.e.d.	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.1	
significance level (p<x)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	

Spotted gums

Overall, the Deniliquin SSO and CM from Hamilton have the best height and diameter growth. The Hamilton seed source is not generally available to growers, but this source is integrated into ALRTIG's long term spotted gum program. The best bet is therefore SSO seed such as Deniliquin SSO. The trials confirm earlier provenance trial results that show CCV is a slenderer species than CM. CM may also be hardier than CCV, with the two CCV seedlots tending towards poorer survival across sites. Paddys Land is often chosen for its cold resilience. It has not performed well in terms of growth or survival in these trials, and is therefore not recommended. The trial at Rocky Gully has grown very poorly from the time of establishment onward, with no significant difference between seedlot heights.

The trials have demonstrated that there are significant differences between seed sources for both species. Tree improvement theory would suggest that selected seed sources should out-perform wild ones, and this is the case for both growth and form traits in these species.

Table 3b. Results from spotted gum analysis at four sites

Site	Melville Forest (VIC)				Craigieburn (VIC)		Bordertown (SA)				Rocky Gully (WA)			
	DBH (cm)	Ht (m)	Axis persist. (1-6)	Survival (%)	DBH (cm)	Survival (%)	DBH (cm)	Ht (m)	Axis persist. (1-6)	Pruning ease (1-4)	Survival (%)	Ht (m)	Survival (%)	
Hamilton CM plus trees	6.0	4.9	3.8	97	4.7	3.8	79	4.6	4.1	4.5	2.3	80	1.7	88
Deniliquin SSO	6.0	4.9	3.8	93	4.6	3.7	89	4.4	4.1	4.1	2.2	86	1.9	88
Bodalla CM	5.2	4.4	3.1	95	4.5	3.7	84	4.1	3.8	3.8	2.0	81	1.6	88
Hamilton CCV	5.3	4.7	4.2	80	4.4	3.9	83	3.9	3.8	4.7	2.3	51	1.9	72
Paddys Land CCV	5.2	4.5	4.3	78	4.2	3.4	76	3.6	3.2	4.6	2.2	54	1.9	83
s.e.d.	0.1	0.1	0.2	8	0.2	0.1	4	0.2	0.1	0.2	0.1	8	0.2	5
significance level (p<x)	0.001	0.001	0.001	0.083	0.039	0.002	0.056	0.001	0.001	0.001	0.001	0.001	n.s.	0.025

ALRTIG's mission is to produce genetically improved planting material for farm forestry in the low rainfall areas of southern Australia, and inform tree growers of its availability

