Growth Rates of Species Trials and Demonstration Sites at Appin, Yarrawalla, Gunbower, and Huntly

D. Stackpole

Forest Science Centre

May 2002

Report no 2002/035

1. INTRODUCTION

Agroforestry species trials were established at Appin and Yarrawalla in the lower Loddon River catchment in 1996, and a species demonstration was established at Gunbower in 1997. The purpose was to determine the general suitability of eight *Eucalyptus*, two *Acacia*, two *Casuarina* and one *Corymbia* species for timber production under irrigation. This report presents results from measurements conducted in July 2001 at these three sites.

A dry-land demonstration forest was planted at Huntly, north of Bendigo in 1999. In 2001 a series of permanent sample plots were established in five species, four of which were common to the above trials. This report presents growth data at Huntly at age 2 years.

2. METHODS

2.1. Trial Design and Establishment

The irrigated trial sites are located on the northern plains of the Loddon River. The climate of Yarrawalla, Appin and Gunbower is very similar. Daily maximum and minimum temperatures average 30.2 and 14.0 °C in January and 13.3 and 2.9°C in July (Figure 1). Annual rainfall is 490 mm with a slight winter maximum. Pan evaporation (Figure 2) greatly exceeds rainfall in January (250 and 26 mm/month respectively), while almost equal in July (39.5 and 38.5 mm/month). Observation wells were installed and soil profiles described at plantation establishment. Groundwater behaviour was monitored for the year after establishment (Hocking and Heislers 1997). This showed shallow water tables of around 1-1.5m metres, which rose in reaction to irrigation, with a corresponding fall between each irrigation event. Groundwater salinity was between 6700 (surface) and 25,000 μs cm^{-1} (deep) at Yarrawalla, and between 13,000 (surface) and 40,000 μs cm^{-1} (deep) at Appin.

The sites were laser graded to set the slope to approximately 1:500. Planting lines were ripped and bedded to elevate planted seedlings above possible soil saturation. Pre-planting weed control comprised a mixture of Roundup and Simazine. Each seedling was individually guarded to protect it from browsing by European hares.

The Appin and Yarrawalla trials consist of 14 seedlots of 12 species (Table 1). These were planted in 9 x 11 tree plots, with 4 replicates, in October 1996. The planting density was 1300 stems per hectare (sph). Appin has one extra eucalypt species (*E. badgensis*). Trial layout is presented in Figures 4 and 5. The Gunbower site consists of seven seedlots planted as demonstration blocks. For each species, two plots 15m in length and either 3, 4 or 5 rows wide were established and measured in August 2001 (Figure 6).

2.2. Tree Measurement

At Appin and Yarrawalla (age 5 years) and Gunbower (age 4 years) all trees were measured for status, diameter over bark at 1.3 m above ground level, and fork score. The heights of the eight largest diameter trees per plot, and one tree in each 1 cm diameter class below, were also measured. Data were recorded on field sheets and entered into excel spreadsheet files prior to summarisation.

2.3. Data Analysis

For each plot, survival, dominant height, basal area and over bark stem volume was calculated from the individual tree measurements. All volumes were calculated from a generalised individual-tree volume function developed for fast growing eucalypts. The plot means within Appin and Yarrawalla were analysed with Genstat to identify significant differences where present, and to enable comparison between treatment means using the Least Significant Difference statistic.

Because height and basal area are used to compute volume, volume is used as the main discussion variable when considering growth rates.

3. RESULTS AND DISCUSSION

3.1. Growth Data

Mean values for species at each site are presented in Table 2. Previous seedlot means from Appin and Yarrawalla (age 2 years) are tabled with the present data in Table 3, and include significance of differences and the Least Significant Difference value.

3.1.1. Survival

There were significant differences in survival at both ages 2 and 5 years at Appin and Yarrawalla. At Yarrawalla (age 2 years), all seedlots had survival between 90 and 100% (Table 2), with the exception of *E. tricarpa*, which was significantly poorer at 81.5 %. By age 5 years, survival of *E. grandis*, *E. maculata* and *E. saligna* was significantly lower than the highest bracket.

At Appin, survival of seven seedlots was significantly lower than the top bracket at age 2 years, and remained so at age 5 years. These were *Casuarina cunninghamiana*, *E. badgensis*, *E. globulus*, *E. grandis*, *C. maculata*, *E. saligna*, and *E. tricarpa*. The lower survival of these lots may be due to sensitivity to the saline soils. For *C. cunninghamiana*, browsing by stock (observed at age 2 years) contributed to seedling losses. Survival of *E. tricarpa* was low at both sites.

3.1.2. *Growth: Appin and Yarrawalla*

There were significant differences in growth at both ages at both sites. At Yarrawalla, most eucalypts were in the top bracket at age 2 years, reaching a total volume of between 5.5 and 9.3 m^3/ha (Figure 3). *E. tricarpa*, and *Corymbia maculata* were significantly poorer, as were the *Casuarina* and *Acacia* species. By age 5 years, only *E. grandis* and the *E. camaldulensis* seedlots Tarranyurk and Yando remained in the top bracket (39.7 to 44.2 m^3/ha), while most other eucalypts measured between 30.2 and 36.1 m^3/ha. The exceptions were *E. tricarpa* and *C. maculata* (13.1 and 28.4 m^3/ha respectively). The acacias still had the smallest volumes, with very similar volume averaging 8.7 m^3/ha. The volume of Casuarinas was also low, with 15.1 and 17.6 m^3/ha for *C. glauca* and *C. cunninghamiana* respectively.

At Appin (Figure 4), a smaller number of species had outstanding total volume at age 2 years, with only *E. occidentalis* significantly better than the others, at 3.4 m^3/ha. The only other seedlots to excel were *E. camaldulensis* (Gunbower and Tarranyurk), and *E. cladocalyx*, with 1.0, 2.2 and 0.9 m^3/ha respectively. By age 5 years, these distinctions were clearer. *E. occidentalis* remained the outstanding seedlot, with 44.6 m^3/ha, with *E. cladocalyx* now ranked second, with 28.4 m^3/ha. The *E. camaldulensis* seedlots were satisfactory with a range from 17.2-10.8 m^3/ha. Most other eucalypt species had low volumes, especially *E. globulus*, *E. saligna*, *E. badgensis* and *E. grandis*, ranging from 5.5 to 10.4 m^3/ha. *E. tricarpa*, *C. cunninghamiana* and the acacia seedlots were still relatively slow growing, however *A. stenophylla* had reached 11.3 m^3/ha, exceeding eight poorer seedlots.

Comparisons of growth in terms of volume should be made in consideration of the form of trees. The good growth rate of *E. camaldulensis* at Yarrawalla, and of *E. occidentalis* at Appin is tempered by the fact that both had relatively poor stem form. Considering form and growth rate, *E. cladocalyx* is probably the superior species at Appin. *E. occidentalis* would be satisfactory if presently available genotypes were used and trees are rigorously pruned to promote development of a straight bole; or if genetically improved, straighter planting material was used.

E. grandis, a high rainfall species of naturally good form continues to be the fastest growing at Yarrawalla. If irrigation is maintained, and soil salinisation can be avoided, this growth rate of *E. grandis* should be maintained.

3.1.3. *Gunbower*

The plots measured at Gunbower give useful corroboration for the results at Appin and Yarrawalla. At Gunbower, survival was very high for all species (Table 2).

E. occidentalis had the largest volume, followed by *E. camaldulensis* (Tarranyurk), then *E. camaldulensis* (Yando), and then *E. cladocalyx*. Volume of these at age 4 years ranged

from 18.8 to 12.5 m^3/ha. *A. stenophylla* grew well at Gunbower ($8m^3$/ha) and *E. saligna* reached 10.4 m^3/ha. General observations for the stand were that most species had heavy foliage and healthy growth, with the exception of *E. saligna* that had premature death of lower limbs and relatively sparse foliage in the crown. Note that this site does not have overt symptoms of salinity, nor is the irrigation water saline. However volumes of water applied are probably not large, and if irrigation periods are greater than 14 days over the summer it is likely that some potential growth will be lost.

4. HUNTLY PERMANENT SAMPLE PLOTS

In 1999, thirty hectares of ex-grazing land north of Bendigo was planted to a demonstration of low rainfall tree species in an unirrigated context. The plantation included mono-specific blocks of each species, including *E. occidentalis*, *E. cladocalyx*, *E. tricarpa*, *C. cunninghamiana* and *A. mearnsii*. Mean annual rainfall at the site is around 450 mm. Other species were present, however the above species had established best and were clearly superior in performance. Therefore, these species were nominated for the establishment of permanent sample plots.

4.1. Method

From the 2.5-year-old stands, compartments were selected for location permanent plots. Areas that showed obvious difficulties in establishment or poor soil were excluded. Three permanent sample plots were established on a systematic random basis in each species block. Positions of plots are as marked in Figure 8. Plots were seven rows wide, and 20m in length along a row. Precise plot areas were recorded and added to the data files. For each tree, diameter, fork, height and status were recorded. Plots were summarised to provide survival, mean and dominant height, basal area and volume.

4.2. Results

The main purpose of this inventory was to establish an initial set of permanent sample plots, measure variates if possible, and to facilitate future re-measurement. This objective was achieved. Overall, the basal area and volume data presented in Table 4 are very small, which is to be expected of any plantation at age 2.5 years. Survival of all seedlots was between 91 and 100% at age 2 years. Overall *A. mearnsii* had the greatest height, basal area and volume (4.3 m^3/ha), although the density of foliage in the crown appeared to be thinning. This may be due to water stress. Volume of the eucalypts ranged between 2.8 and 3.9 m^3/ha. *C. cunninghamiana* diameters were too small (<2cm) to warrant measurements, hence basal area or volume could not be calculated. Its mean height was 2.6 m, and the stand appeared to be in good health.

5. DISCUSSION

Species comparison trials are the preferred way of comparing seedlots for specific sites. When repeated on two or more sites further inference can be gained of the effect of soils, and whether the sites interact with species performance. While this report only evaluates differences within sites, this interaction can be formally tested by statistical procedures (Williams and Matheson 1994). Appin and Yarrawalla vary in that soils at Appin are saline, and irrigated only twice per year. Yarrawalla has lighter, well-drained soils and requires regularly scheduled irrigation to maintain soil moisture. Each site/irrigation combination suits a different group of species. At Appin, those species tolerant of the saline, alkaline clay soils are superior to those intolerant of these conditions, and here, based on volume growth and survival, *E. occidentalis* and *E. cladocalyx* would be the most suited species.

At Yarrawalla, species considered more sensitive to saline conditions were included among those with large volumes. Yarrawalla also appears better suited to *E. camaldulensis* species than Appin. At Yarrawalla, many of the species tested could be considered as commercial plantation species, depending on the objectives of the land manager. Ongoing irrigation would be required to continue the performance observed to date in those species from higher rainfall environments..

The Acacia species achieved very high establishment percentages at all sites, and by age 5 years had reached the stage that substantial volume growth had commenced. At this point their volume growth remains below that of eucalypts for total volume accumulation, however if growth rate continues to increase they may still be worth planting. Future measurement of the sites will enable further evaluation of the growth of these species. Note that *A. stenophylla* appears to have better potential to develop a single bole than *A. salicina*. However, even for *A. stenophylla* form and limb pruning would still be required. The *A. salicina* seedlot tested here was fastigate, and would require intensive pruning if it were to have any prospect of producing a usable length of timber.

6. CONCLUSIONS

To age 5 years, the best performing species on irrigated saline soils of the lower Loddon valley were *E. occidentalis*, followed by *E. cladocalyx*. Their ability to tolerate the soil conditions, and produce wood growth rates up to 9.5 m^3/ha/year makes these species the obvious choice for afforestation for timber production purposes. Note however that irrigation of 3 Ml/ha/year is required, and if unavailable these growth rates will not be achieved.

On the better quality soil at Yarrawalla, with regular irrigation of 6-8 Ml/ha/year, other species grew better than they did at Appin. These included *E. camaldulensis* varieties, as well

as *E. grandis* and *E. globulus*. It is likely that fast growth of these species can only be maintained if soil salinity can be maintained at a low level, and high application rates of fresh water (6-8 Ml/ha/year) can be maintained during the rotation.

The Gunbower site had relatively low volumes of irrigation water applied. The growth rates of *E. occidentalis*, *E. cladocalyx* and *E. camaldulensis* were acceptable, while the high rainfall species used here (*E. saligna*) appears to require more irrigation water than is being applied. Thus, under the existing irrigation regime, this species should not be considered.

At all the irrigation sites, *A. stenophylla* grew a relatively straight bole, whereas *A. salicina* was invariably forked and crooked. On this basis alone *A. stenophylla* appears to be the more promising 'craftwood' species, although its productivity at age 5 years was only 2 – 3 m^3/ha/year.

To age 2.5 years, the Huntly site demonstrated that *E. occidentalis* and *E. cladocalyx* and *E. tricarpa* are capable of rapid expansion and occupation of the site. The growth of *C. cunninghamiana* to age 2.5 years is somewhat slower than that of the above species. However this is typical of its early performance in species comparison trials elsewhere (ie Shepparton). *A. mearnsii* grew fastest of all the species, to 2.5 years. Unfortunately, its present appearance suggests that it is under increasing water stress, judging from the appearance of the foliage.

7. RECOMMENDATIONS

The plots established at Gunbower and Huntly will be of maximum utility if they are measured annually for the next few years. This is so that Current Annual Increment curve for each species can be calculated from measurements. Measurement date should be in the same month of each year, preferably when stands are seasonally dormant (May to August).

The Tragowel sites should be measured in September of 2002, 2004, and 2006, in order to obtain a full set of biennial inventories to age 10 years. The Gunbower plots should be measured annually, in 2002, 2003, and 2004. The Huntly plots should be measured in 2002, 2003, 2004, and 2005. The future measurement regime should be determined as data is accumulated and reviewed. The measurement plots should not be thinned during this period, although light lower stem pruning is acceptable.

8. REFERENCES

Hocking, M., and Heislers, D. (1997) Groundwater Monitoring Installation for the Tragowel Plains Farm Forestry Trial. Centre for Land Protection Research, Technical Report 49, Department of Natural Resources and Environment, Victoria.

Williams, E. R., and Matheson, A.C. (1994) Experimental design and analysis for use in tree improvement. CSIRO Melbourne.

9. ACKNOWLEDGEMENTS

These plantation trials are the result of the foresight, commitment, labour and goodwill of many people to ensure progress toward the vision of a forest-products industry in the lower Loddon catchment. Contributors towards the works detailed in this report include: Bendigo City Council, Sue Bennett, Ben Boxshall, Department of Natural Resources and Environment, Paul Haw, Andrew Pearson, Shaun Quayle, Brian Smith, Jenny Spence, Barry Steggall, Richard Stokes, Malcolm Thompson, John Toll, Greg Whinfield, Ron Whinfield, Nimal Wijesinghe, and Greg Wood.

Table 1. Species, seedlots and measurement schedule of the Tragowel Species Trials.

Species	Seedlot	Age (years) Measured	Appin 2 July 1998	Appin 5 July 2001	Yarrawalla 2 July 1998	Yarrawalla 5 July 2001	Gunbower 4 July 2001
A. salicina	Bael Bael	Vic	Y	Y	Y	Y	Y
A. stenophylla	Bael Bael	Vic	Y	Y	Y	Y	Y
C. glauca	(P) Mincha	Vic	Y	Y	Y	Y	
C. maculata	(P) Bendigo	Vic	Y	Y	Y	Y	
Casuarina cunninghamiana	(P) Canary Island	Vic	Y	Y	Y	Y	
E. badgensis	Camden	NSW	Y	Y			
E. camaldulensis	Tarranyurk	Vic	Y	Y	Y	Y	Y
E. camaldulensis	Gunbower	Vic	Y	Y	Y	Y	
E. camaldulensis	Yando	Vic	Y	Y	Y	Y	Y
E. cladocalyx	(P) Tragowel	Vic	Y	Y	Y	Y	Y
E. globulus spp. *globulus*	Jeeralang	Vic	Y	Y	Y	Y	
E. grandis	Coffs Harbour Seed Orchard	NSW	Y	Y	Y	Y	
E. occidentalis	(P) Mincha	Vic	Y	Y	Y	Y	Y
E. saligna	Yadboro State forest	NSW	Y	Y	Y	Y	Y
E. sideroxylon	Dunolly	Vic	Y	Y	Y	Y	

(P) Seed was collected from outstanding specimens planted outside their natural range. Pedigree is not known.

Table 2. Mean plot data from 2001 measurement at Appin, Yarrawalla, and Gunbower plantation trial sites.

Seedlot		Yarrawalla 6 years					Appin 6 years					Gunbower 5 years					mean rank [1]
		Survival	MDH	BA	VOL	rank	Survival	MDH	BA	VOL	rank	Survival	MDH	BA	VOL	rank	
E. occidentalis	Mincha	98	9.5	12.1	36.1	4	99	9.5	14.6	44.6	1	100	7.1	6.4	18.8	1	1
E. camaldulensis	Tarranyurk	100	9.7	12.6	39.7	3	98	8.1	6.9	17.2	3	100	7.4	5.6	16.5	3	=2
E. camaldulensis	Yando	96	10.3	12.0	45.1	1	94	7.8	4.6	10.8	6	100	7.1	5.8	16.7	2	=2
E. cladocalyx	Mincha	100	9.4	11.9	35.7	5	93	8.5	10.3	28.4	2	99	6.4	4.6	12.5	4	4
E. grandis	CHSO	94	12.0	11.7	44.3	2	76	7.8	4.2	10.4	8						5
E. camaldulensis	Gunbower	96	9.1	11.1	32.5	7	97	7.7	5.4	12.8	4						6
E. globulus	Yeodene	97	10.6	10.0	33.3	6	70	7.6	3.7	8.3	10						=7
A. stenophylla	Bael Bael	99	6.0	4.9	8.5	14	100	6.5	5.7	11.3	5	97	5.3	3.3	8.0	6	=7
E. saligna	Yadboro	92	9.3	10.4	30.2	8	63	6.7	2.7	5.5	14	100	6.2	3.8	10.4	5	=9
C. glauca	Mincha	100	8.5	5.5	15.1	11	98	7.6	4.3	10.5	7						=9
C. cunninghamiana	Canary Island	98	8.7	5.7	17.6	10	77	7.4	3.6	7.9	11						=11
A. salicina	Bael Bael	98	5.5	4.7	8.9	13	95	5.5	4.8	8.7	9						=11
C. maculata	Bendigo	87	10.2	9.2	28.4	9	25	6.0	0.8	1.8	15						=13
E. tricarpa	Dunolly	79	7.8	6.1	13.1	12	52	6.9	3.6	7.8	12						=13
E. badgensis	Camden	na	na	na	na	na	56	9.2	3.2	7.4	13						15

[1] Mean of ranks at all three irrigated sites

Table 3. Site mean data for Appin and Yarrawalla trial measurements at age 2 and 5 years.

Species	Collected	Appin								Yarrawalla							
		Survival %		Height (m)		Basal area (m^2/ha)		Volume (m^3/ha)		Survival %		Height (m)		Basal area (m^2/ha)		Volume (m^3/ha)	
		1998	2001	1998	2001	1998	2001	1998	2001	1998	2001	1998	2001	1998	2001	1998	2001
A. salicina	Bael Bael	99a[1]	95a	2.3	4.6	0.2	4.8	0.1	8.7	99a	97a	2.5	4.6	0.2	5.1	0.2	8.9
A. stenophylla	Bael Bael	100a	100a	2.6	6.5	0.3	5.7	0.2	11.3	99a	99a	2.4	5.2	0.2	4.5	0.2	8.5
E. badgensis		59	56	2.3	9.2a	0	3.2	0.1	7.4								
E. camaldulensis	Gunbower	98a	98a	3.6a	8.1a	0.9	6.9	1.0	17.2	99a	100a	5.7a	9.9a	4.1a	12.7a	7.2a	39.7a
E. camaldulensis	Tarranyurk	99a	97a	4.2a	7.7a	1.6	5.4	2.2	12.8	100a	96a	5.7a	9.0	4.3a	11.2a	7.7a	32.5
E. camaldulensis	Yando	99a	94a	3.4	7.8a	0.7	4.6	0.8	10.8	98a	95a	5.4a	9.8	3.6a	14.1a	6.0a	45.0a
Casuarina cunninghamiana	Canary Island	87	77	3.0	7.4a	0.2	3.6	0.2	7.9	99a	98a	4.3a	6.2	1.5	6.8	2.0	17.6
Casuarina glauca	Mincha	99a	98a	3.0	7.6a	0.3	4.3	0.3	10.5	100a	100a	4.1a	7.2	1.2	5.7	1.5	15.1
E. cladocalyx	Tragowel	94a	93a	3.2	8.5a	0.9	10.3	0.9	28.4	100a	99a	5.0a	9.2	3.8a	11.8a	6.0a	35.7
E. globulus	Yeodene SO	77	69	3.0	7.6a	0.5	3.7	0.5	8.3	99a	96a	6.6a	9.6	4.1a	10.0	8.1a	33.3
E. grandis	Coff's H SO	83	76	2.8	7.8a	0.3	4.2	0.3	10.4	99a	94	6.6a	11.3a	4.5a	8.0	9.3a	44.2a
C. maculata	Bendigo	47	25	2.0	6.0	0	0.8	0	1.8	90a	88	5.0a	9.2	1.8	6.3	2.7	28.4
E. occidentalis	Mincha	100a	99a	4.1a	9.7a	2.7a	14.6a	3.4a	44.6a	99a	98a	4.9a	8.7	3.5a	12.1a	5.5a	36.1
E. saligna	Yadboro SF	79	63	2.4	6.7	0.2	2.7	0.2	5.5	97a	92	5.8a	8.6	3.7a	10.4a	6.5a	30.2
E. tricarpa	Dunolly	69	52	2.3	6.9a	0.1	3.6	0.1	7.8	81.5	78	3.6	6.9	0.6	5.3	0.6	13.1
Mean		86.1	79.5	2.9	7.2	0.6	5.2	0.7	12.9	97.2	95.2	4.8	8.3	2.7	8.9	4.6	27.7
Significance level		<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Least Significant difference		10.65	14.64	0.5	2.92	0.39	1.66	0.61	5.51	14.6	5.3	2.9	1.4	1.7	3.8	5.5	9

[1] Values followed by 'a' are within one Least Significance Value of the highest mean value.

Table 4. Stocking, Height, Basal area and Volume at age 2.5 Years, of low rainfall species permanent sampling plots at Huntly.

Species	Replicate	Stocking	Survival	Height (m)		Basal Area (m^2/ha)	Volume (m^3/ha)	Fork
		(sph)	(%)	Mean	Dominant[1]	Total	Total	Mean
A. mearnsii	1	812	100	4.8	5.8	1.6	4.3	1.04
A. mearnsii	2	800	100	4.3	5.1	1.3	3.3	1.00
A. mearnsii	3	769	96	3.6	3.9	0.9	2.1	1.06
C. cunninghamiana	1	929	97	2.6	na [2]	na	na	na
C. cunninghamiana	2	1030	100	2.9	na	na	na	na
C. cunninghamiana	3	956	94	2.3	na	na	na	na
E. cladocalyx	1	800	98	3.6	4.3	1.3	2.8	1.00
E. cladocalyx	2	739	100	3.7	4.3	1.3	2.8	1.02
E. cladocalyx	3	738	96	3.7	4.3	1.2	2.7	1.02
E. occidentalis	1	851	91	3.8	4.3	1.3	3	1.17
E. occidentalis	2	800	92	3.9	4.6	1.3	3.1	1.22
E. occidentalis	3	869	95	4.4	4.9	2.4	5.3	1.43
E. tricarpa	1	944	96	2.9	3.1	0.6	2.1	2.30
E. tricarpa	2	1017	99	2.8	3.0	0.5	1.9	2.09
E. tricarpa	3	1052	99	2.5	2.8	0.4	1.4	1.86
A. mearnsii	average	794	99	4.2	4.9	1.3	3.2	1.0
C. cunninghamiana		972	97	2.6	na	na	na	na
E. cladocalyx		759	98	3.7	4.3	1.3	2.8	1.0
E. occidentalis		840	93	4.0	4.6	1.7	3.8	1.3
E. tricarpa		1004	98	2.7	3.0	0.5	1.8	2.1

[1] Dominant trees selected as the largest diameter 200 sph trees in any plot

[2] Diameters of *C. cunninghamiana* were too small to warrant measurement, hence dominant height, basal area and volumes were not calculated

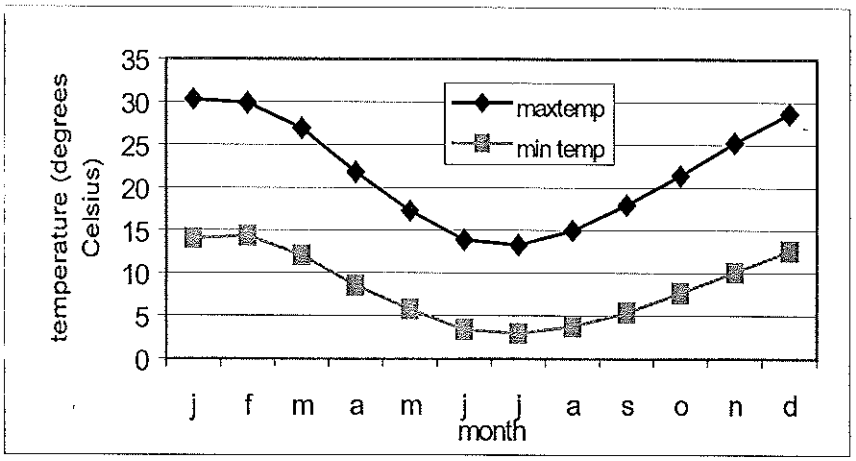


Figure 1. Mean monthly maximum and minimum temperatures for the Tragowel plains

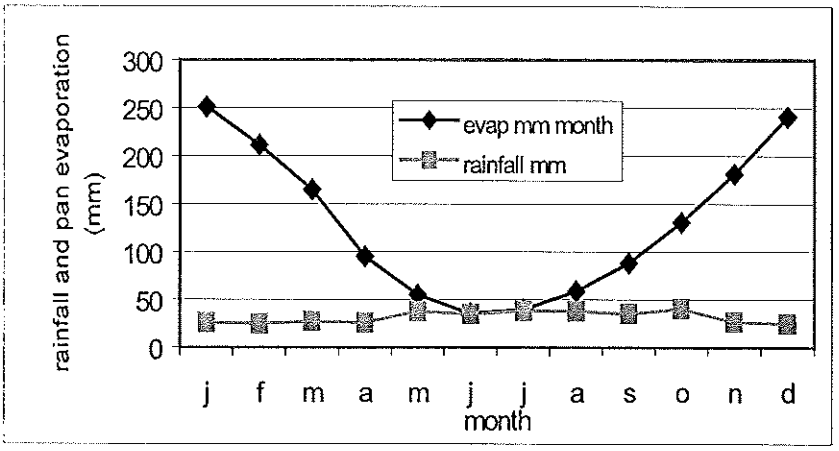


Figure 2. Monthly rainfall and pan evaporation for the Tragowel plains

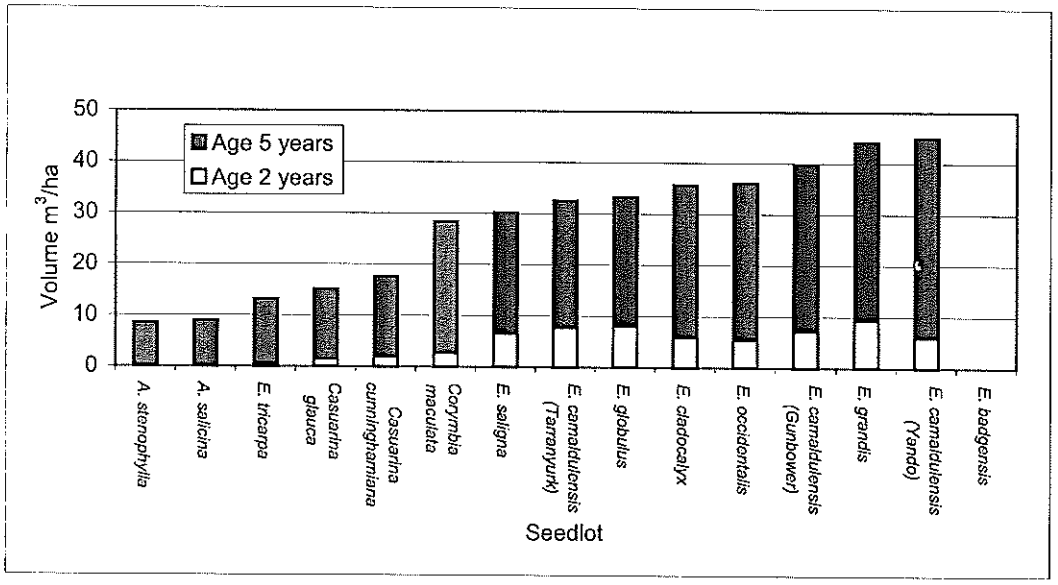


Figure 3. Total Stem wood volume at Yarrawalla, at ages 2 and 5 years

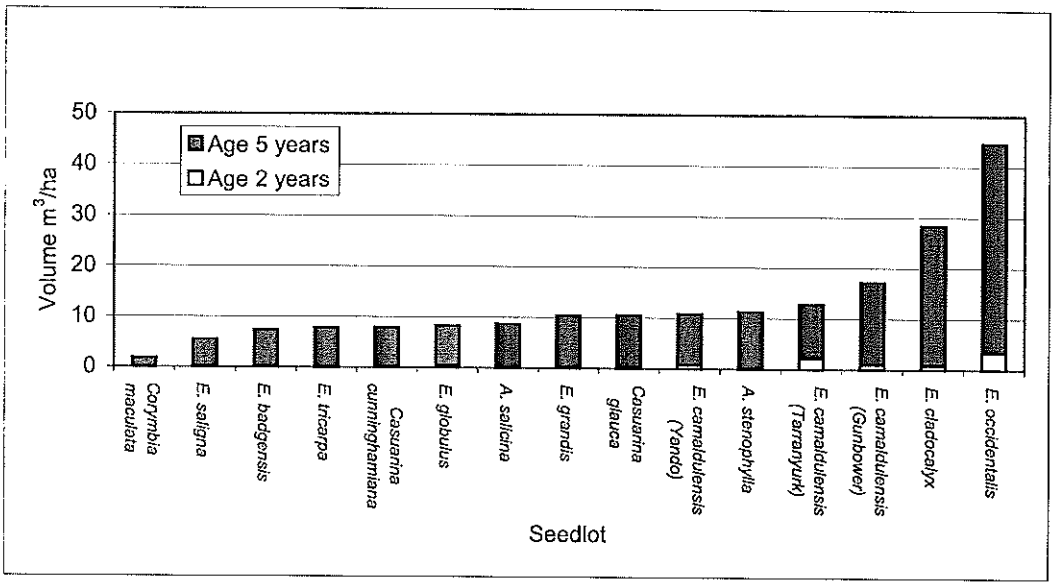
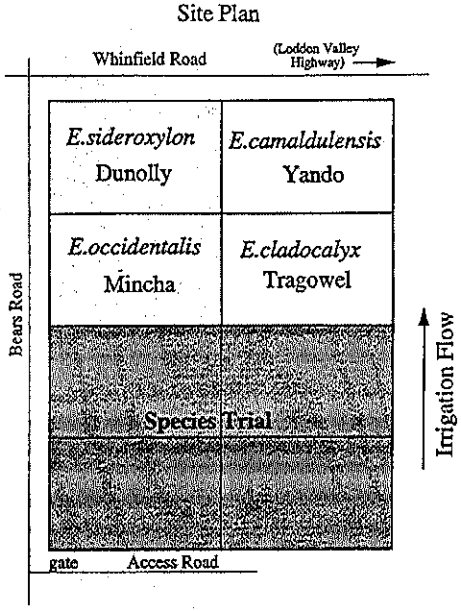


Figure 4. Total stem wood volume at Appin at ages 2 and 5 years

Appin South Species Trial (ASs)

4.15 *E.occidentalis* Mincha	4.14 *A.salicina* Beal Beal	4.13 *C.glauca* Mincha	4.12 *C.cunninghamiana* Canary Island	4.11 *E.camaldulensis* Gunbower	3.15 *E.occidentalis* Mincha	3.14 *C.cunninghamiana* Canary Island	3.13 *E.camaldulensis* Yando	3.12 *E.sideroxylon* Dunolly	3.11 *C.glauca* Mincha
4.10 *E.globulus* Jeeralang	4.9 *E.badjensis*	4.8 *E.cladocalyx* Tragowel	4.7 *E.sideroxylon* Dunolly	4.6 *E.grandis* Coffs Harbour Seed Orchard	3.10 *A.salicina* Beal Beal	3.9 *E.globulus* Jeeralang	3.8 *E.camaldulensis* Gunbower	3.7 *E.grandis* Coffs Harbour Seed Orchard	3.6 *E.badjensis*
4.5 *E.camaldulensis* Terranyerk	4.4 *E.camaldulensis* Yando	4.3 *E.maculata* Bendigo	4.2 *A.stenophylla* Beal Beal	4.1 *E.saligna* Yadboro State Forest	3.5 *A.stenophylla* Beal Beal	3.4 *E.maculata* Bendigo	3.3 *E.camaldulensis* Terranyerk	3.2 *E.cladocalyx* Tragowel	3.1 *E.saligna* Yadboro State Forest
2.15 *E.saligna* Yadboro State Forest	2.14 *C.cunninghamiana* Canary Island	2.13 *E.camaldulensis* Gunbower	2.12 *A.salicina* Beal Beal	2.11 *E.cladocalyx* Tragowel	1.15 *E.cladocalyx* Tragowel	1.14 *E.globulus* Jeeralang	1.13 *E.badjensis*	1.12 *E.maculata* Bendigo	1.11 *C.cunninghamiana* Canary Island
2.10 *A.stenophylla* Beal Beal	2.9 *E.maculata* Bendigo	2.8 *E.badjensis*	2.7 *E.grandis* Coffs Harbour Seed Orchard	2.6 *E.sideroxylon* Dunolly	1.10 *C.glauca* Mincha	1.9 *A.stenophylla* Beal Beal	1.8 *E.grandis* Coffs Harbour Seed Orchard	1.7 *E.camaldulensis* Yando	1.6 *A.salicina* Beal Beal
2.5 *E.camaldulensis* Yando	2.4 *E.globulus* Jeeralang	2.3 *E.occidentalis* Mincha	2.2 *E.camaldulensis* Terranyerk	2.1 *C.glauca* Mincha	1.5 *E.camaldulensis* Gunbower	1.4 *E.occidentalis* Mincha	1.3 *E.camaldulensis* Terranyerk	1.2 *E.sideroxylon* Dunolly	1.1 *E.saligna* Yadboro State Forest

Site Plan



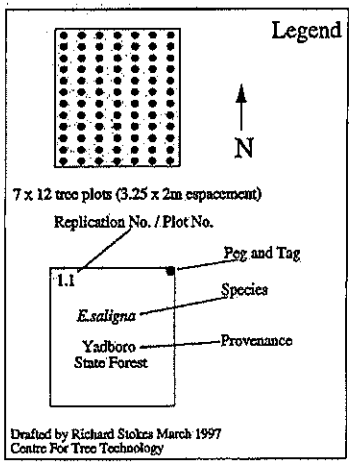


Figure 5. Species comparison trial layout at the Appin site.

Yarrawalla Species Trial (YAs)

4.14 *E.occidentalis* Mincha	4.13 *A.salicina* Beal Beal	4.12 *C.glauca* Mincha	4.11 *C.cunninghamiana* Canary Island	3.14 *E.occidentalis* Mincha	3.13 *C.cunninghamiana* Canary Island	3.12 *E.camaldulensis* Yando	3.11 *E.saligna* Yadboro State Forest
4.10 *E.camaldulensis* Gunbower	4.9 *E.globulus* Jeeralang	4.8 *E.cladocalyx* Tragowel	4.7 *E.sideroxylon* Dunolly	3.10 *E.sideroxylon* Dunolly	3.9 *C.glauca* Mincha	3.8 *A.salicina* Beal Beal	3.7 *E.globulus* Jeeralang
4.6 *E.grandis* Coffs Harbour Seed Orchard	4.5 *E.camaldulensis* Terranyerk	4.4 *E.camaldulensis* Yando	4.3 *E.maculata* Bendigo	3.61 *E.camaldulensis* Gunbower	3.5 *E.grandis* Coffs Harbour Seed Orchard	3.4 *A.stenophylla* Beal Beal	3.3 *E.cladocalyx* Tragowel
4.2 *A.stenophylla* Beal Beal	4.1 *E.saligna* Yadboro State Forest	2.14 *E.occidentalis* Mincha	2.13 *A.salicina* Beal Beal	3.2 *E.camaldulensis* Terranyerk	3.1 *E.cladocalyx* Tragowel	1.14 *E.saligna* Yadboro State Forest	1.13 *C.cunninghamiana* Canary Island
2.12 *C.glauca* Mincha	2.11 *C.cunninghamiana* Canary Island	2.10 *E.camaldulensis* Gunbower	2.9 *E.globulus* Jeeralang	1.12 *E.camaldulensis* Gunbower	1.11 *A.salicina* Beal Beal	1.10 *E.cladocalyx* Tragowel	1.9 *A.stenophylla* Beal Beal
2.8 *E.cladocalyx* Tragowel	2.7 *E.sideroxylon* Dunolly	2.6 *E.grandis* Coffs Harbour Seed Orchard	2.5 *E.camaldulensis* Terranyerk	1.8 *E.maculata* Bendigo	1.7 *E.grandis* Coffs Harbour Seed Orchard	1.6 *E.sideroxylon* Dunolly	1.5 *E.camaldulensis* Yando
2.4 *E.camaldulensis* Yando	2.3 *E.maculata* Bendigo	2.2 *A.stenophylla* Beal Beal	2.1 *E.saligna* Yadboro State Forest	1.4 *E.globulus* Jeeralang	1.3 *E.occidentalis* Mincha	1.2 *E.camaldulensis* Terranyerk	1.1 *C.glauca* Mincha

Site Plan

(Loddon Valley Highway) ← Yarrawalla West Road

gate

E.cladocalyx Tragowel	*E.camaldulensis* Yando
E.occidentalis Mincha	*E.occidentalis* Mincha

Species Trial

Irrigation Flow

Legend

N

7 x 12 tree plots (3.25 x 2m espacement)

Replication No. / Plot No.

1.6

Peg and Tag

Species

E.saligna

Provenance

Yadboro State Forest

Drafted by Richard Stokes March 1997
Centre For Tree Technology

Figure 6. Species comparison trial location at the Yarrawalla site

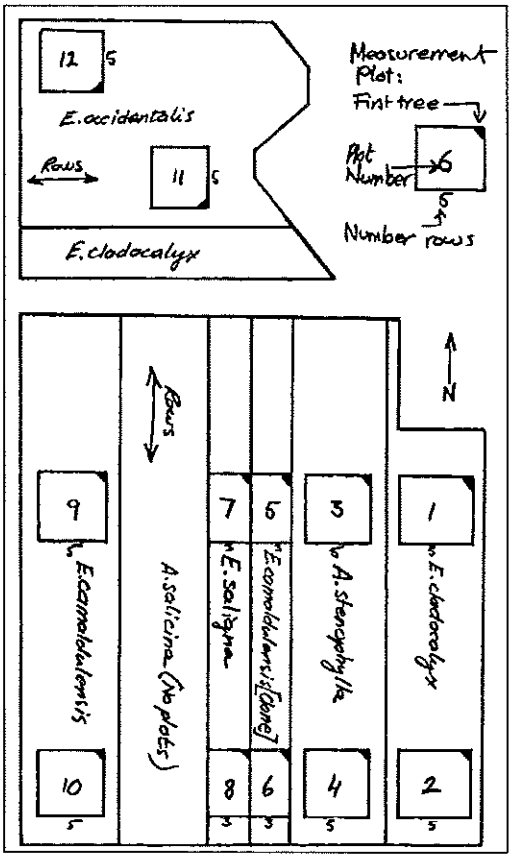


Figure 7. Approximate position of the permanent sampling plots installed at the Toll farm forestry plantation near Gunbower.

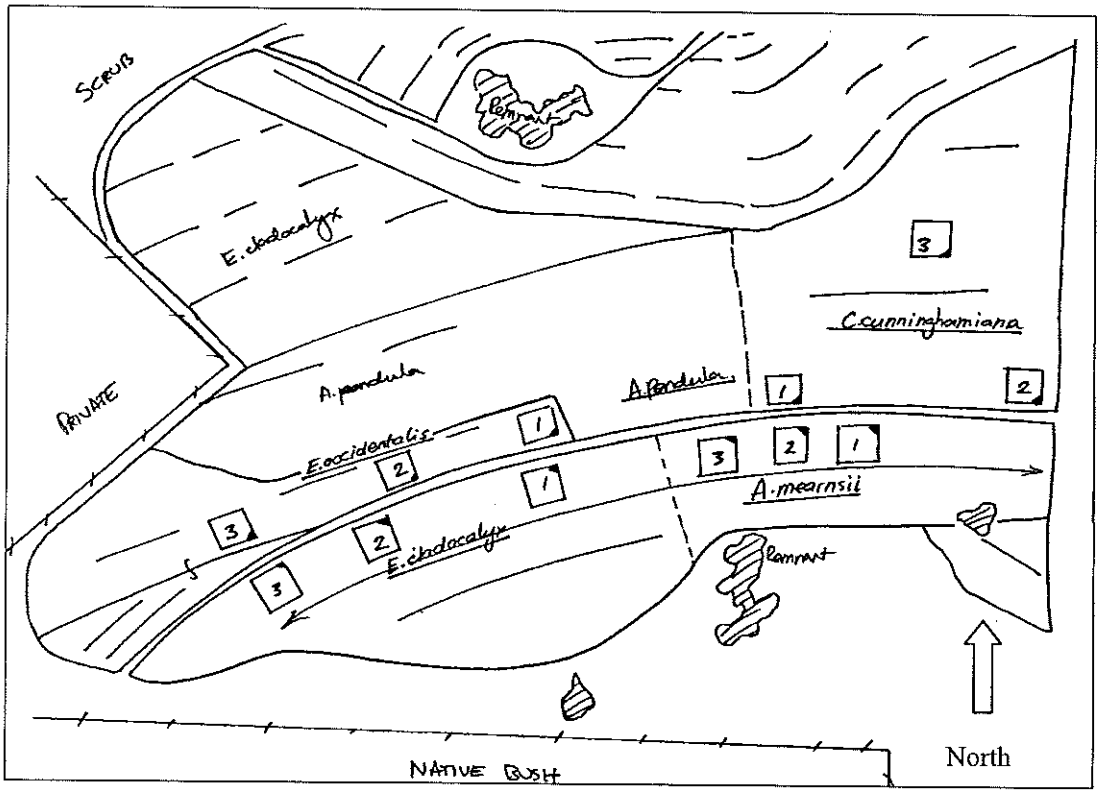


Figure 8. Schematic position of *E. cladocalyx*, *E. occidentalis*, *C. cunninghamiana* and *A. mearnsii* permanent measurement plots in the 1999-planted portion of the Huntly demonstration site. Not to scale.