

Eucalyptus polybractea and *E. horistes* Provenance by
Family Trials: Establishment of Experiment at
Junortoun, near Bendigo, Victoria.

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Trial was established with the assistance of the Joint Venture Agroforestry Program, and the Private Forestry Unit of the Victorian Department of Natural Resources and Environment. This project is a component of the Australian Low Rainfall Tree Improvement Group (ALRTIG) co-operative.

For details of Measurements
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1 Introduction

Eucalyptus polybractea occurs naturally in the Whipstick Scrub near Bendigo, Inglewood, and the Wychetilla areas of north central Victoria (Willis 1978), with another occurrence near West Wyalong NSW. Native stands in Australia have long been harvested for distillation of oil. The yield from native material is around 2.5% of fresh leaf weight. The oil, a mix of naturally produced compounds, is dominated (90%+) by 1,8-Cineole (Boland *et al.* 1991). The species forms a mallee habit, and prefers red-brown or sandy loams. It grows well with 400-mm annual rainfall. *E. horistes* is a Western Australian mallee of restricted range that produces Cineole-dominated oil yields of up to 3%.

These species are proposed to be planted on a very large scale in low rainfall parts of the Western Australian wheat-belt. Such stands are thought likely to have similar soil-water dynamics to those of the woodland that existed prior to the land's conversion to wheat farming. By devoting a substantial proportion of the wheat-belt land area to mallees, land degradation may be reversed. The WA plan envisages oil mallee plantations as a productive crop, which would facilitate planting on the scale required. Improvement of the economic viability is expected to come through increasing oil yield per unit weight of leaf, and improving harvesting efficiency. Such crops may also be appropriate for similar land protection and economic objectives in eastern Australian states

Analysis of leaf oil content from natural provenances has identified mean and elite cineole content (as percentage oil of leaf fresh weight). For instance, mean cineole content of *E. horistes* was 2.3%, while elite content was 3.5%. For *E. polybractea* the mean was 2% and elite 3.1% (Bartle *et al.* 1999). Elite stands have been revisited and seed collected to establish around 40 breeding trials. These trials have been measured and analysed to provide breeding values for desired traits, which have been used as a basis of initial culling of the stands to seed production areas.

Increase of oil yield from the typical 2%, to 5%, is a main ambition of the present breeding program. Genetic material supplied for the trials described in this paper have originated from the above program.

E. horistes is intolerant of water logging. Both species require good deep soils. *E. polybractea* suffers drought death on shallow soils in the WA wheatbelt.

A cooperative research project was thus established to test the extent of genotype/environment (G/E) interaction in two oil mallee species. These trials have been established across southern Australian states, under the Australian Low Rainfall Tree Improvement Group project. There will be five sites in total, one in each of SA, Vic and NSW, and two in WA.

2 Material in the plantings

Species used are *E. horistes* and *E. polybractea*, with 24 families of each. These are:

E. polybractea:

- 6 families from native Victorian stands
- 6 families native New South Wales stands

Eucalyptus polybractea
Eucalyptus horistes
 24 families of each

- 12 families from CALM SSO (all of NSW origin)

E. horistes:

- 12 families native provenance (there is only one)
- 12 families CALM SSO

3 Purposes of the plantings

Trials are to test the extent of genotype/environment (G/E) interaction in two oil mallee species. Trials will be established at five locations across southern Australian states, under the Australian Low Rainfall Tree Improvement Group project.

4 Raising of planting stock

The seedlings were produced from family seed lots in the CALM Narrogin Nursery in WA, situated some 140-km from the coast at an elevation of 300 m at a latitude of 33 degrees S.

At planting the seedlings varied in size, from 10 cm to 25 cm in height. Roots were well formed. The best 40 seedlings of the 60 supplied per seedlot were used in the trials.

5 Planting site location and characteristics

5.1 Location and access

The trial is located in an ex-native pasture paddock on the property of Mr. Jim Nielsen, at Junortoun, near Bendigo in Victoria. Latitude and longitude of the planting site are 36°46'12" and 144°21'15". Altitude is 210 metres above sea level. Aspect is northerly, with a maximum slope of 6 degrees. Judging from the incidence and distribution of remnant native trees, the site would have originally carried *E. macrorhyncha* (red stringybark) and *E. goniocalyx* (long-leaved box) woodland, with a grass and native legume under storey.

Mr Nielsen's property is located on the McIvor Highway, approximately 10 km east of Bendigo (Figure 1). Access to the property is via Alexander Road, which runs north from the McIvor Highway.

5.2 Soils

The soils comprise a brown loam varying in depth from 20 to 40 cm over rock fragments. Parent material is sedimentary, yellowish mudstone.

6 Site preparation

The site was ripped by the landholder in July 2001 to a depth of approximately 30 cm. On 13 August 2001, riplines were pulverised by rotary hoe and bedded to form elevated mounds of light consistent texture. On August 14 2001 the planting rows were sprayed with 3 l/ha Simazine to destroy germinating seeds. On the same day the plot layout was established and individual plot pegs placed.

7 Trial design

The two species were planted in adjacent trials (Figure 2). This was done to maintain some separation between the species in the event that seed production areas became appropriate in the future. Each trial was designed with 5 replicates of 24 seedlots, in a row-column alpha-design with 4 rows x 5 columns per replicate. Plot size was 8 trees in a row planted at 3.0 m between rows and 1.0 m within rows.

8 Plot survey, marking and labelling, and sorting of planting stock

The corners of each block were marked with steel pegs, with wire pins used to mark the position of individual plots along the edges of the trial. Survey and marking were done by Forest Science Centre. The planting process comprised planting each block (Figure 2) at a time, prior to moving to the next block. Planting position was established by string lines, marked along their length by the appropriate spacing within a plot.

9 Sorting of seedlings

Seedlings were delivered to the farm a week prior to planting, and stored in Mr Nielsen's nursery until planting. They were transferred to the field on the planting day.

Each seedlot was presented in a tray of 60 plants, identified by species and seedlot number (1 to 24). A key to the numbers is presented in Appendix 1.

10 Layout of family trial

Planting of the trials was carried out on 15 and 16 August 2001. Allocating seedlings correctly to plots and delivering them to the site involved a number of operations:

1. The planting design (Figure 2) was established on the site. Each plot pin was labelled with an adhesive label with the seedlot number prominently marked. Each seedling tray was marked with the corresponding number.
2. Planting spots were marked out at accurate spacing (1.0 m apart) by use of string lines described previously.
3. Each seedlot tray was positioned within the replicate at its corresponding plot. Planting of that replicate was completed. After planting the seedling trays were moved to the second replicate, repositioned according to the seedlot codes, and planting resumed.
4. After each replicate was planted each seedling was watered with 3-4 litres of water.
5. The following day each seedling was fitted with a 1 l milk carton tree guard, which was held in place by two bamboo stakes.

Buffer rows

A single row of spare seedlings was planted around the trial. The seedlot identity was recorded as in Figure 2.

11 Planting crew

A team comprising the landholder, DNRE staff from Bendigo and the Forest Science Centre, one paid contractor and several of the landholder's neighbours carried out planting. All trial trees (about 2000) were planted in one day. Weather conditions were cool and partly cloudy. Ground moisture conditions were slightly dry, hence the need for follow-up watering. Planters used pottiputkis and planting spades, placing seedlings in a depression at the crown of the mound.

Trees were not fertilised at planting. It is intended to supply each seedling with 100 g of Pivot 900 in August 2002.

12 Plot checking

Upon completion of planting in each block, plots were checked immediately. No discrepancies occurred.

13 Fencing of trial area

The site was fenced to stock proof standard. Protection against hares was achieved by use of individual guards.

14 Early establishment

The site received ample rain in the spring following planting, commencing immediately on the completion of planting, and have established well. No damage by hares has been observed.

15 Actions required over 2001 and 2002.

A number of matters need to be addressed. These are discussed briefly below.

- *Replacement of temporary plot labels* – Tree spacing and plot corner marking is consistent, and recorded in Figure 2, and Forest Science Centre files. Thus, replacement of temporary plot labels is unnecessary.
- *Weed control* – will be applied as necessary, in the first succeeding spring under ALRTIG funding and then by the site manager.
- *Regular inspection* – DNRE staff have regularly inspected the trial in the spring of 2001. Monitoring of weed growth, insect pests or other developments will continue with assistance from Bendigo DNRE staff.

- *Insect assessment* – If significant outbreaks of insects occur, damage should be assessed by entomologists from the Forest Science Centre, and control undertaken as recommended.

16 Acknowledgments

Thanks are due to the landowner Mr Jim Neilsen and Ms Carmen Zerafa of DNRE Bendigo.

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17 References

Bartle, J., Edgecombe, W., and Brennan, G. (1999) Western Australia program for the selection and development of new tree crops. In: Rural Industries Research and Development Corporation (1999) National low rainfall tree improvement project- workshop proceedings. RIRDC publication number 99/66, October 1999

Boland, D., Brophy, J., and House, A. (1991) Eucalyptus leaf oils- use, distillation and marketing. Inkata, Melbourne and Sydney.

Willis, J. (1978) Plants of Victoria, Volume II. Melbourne University Press, Melbourne, 832 pp.

Figure 1. Location and access to the Junortoun Oil Mallee family trial.

VicMap sheet: Mandurang 7724-2-4.

Trial location Lat. 36°46'12", Long. 144°21'15"

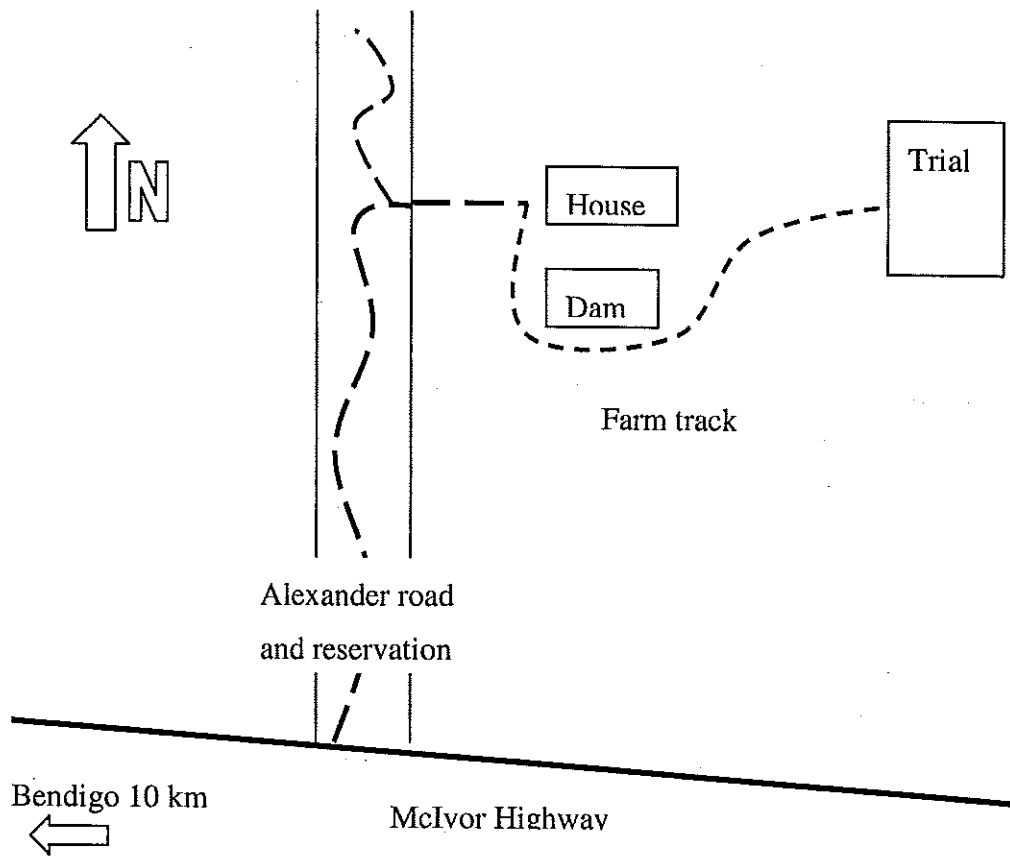


Figure 2. Plantation trial layout for *E. polybractea* and *E. horistes* trial established on the property of Mr Jim Nielsen, near Junortown, Bendigo.

		<i>E. polybractea</i>								<i>E. horistes</i>								Block																														
		16	20	8	6	1	21	16	2	20	11	8	10	17	14	24	11		4	20	1	9	5	10	20	2	16	8	18	15	23	17	21	22	12	19	6	16										
14	4	13	5	20	18	15	8	12	1	23	3	5	24	7	4	1	8	24	14	21	15	21	5	22	24	4	21	15	13	1	9	5	10	20	2	16	8	18	15	23	17	21	22	12	19	6	16	
24	16	11	4	20	2	18	9	22	12	1	23	3	5	24	7	4	1	8	24	14	21	15	21	5	22	24	4	21	15	13	1	9	5	10	20	2	16	8	18	15	23	17	21	22	12	19	6	16
11	16	11	4	20	2	18	9	22	12	1	23	3	5	24	7	4	1	8	24	14	21	15	21	5	22	24	4	21	15	13	1	9	5	10	20	2	16	8	18	15	23	17	21	22	12	19	6	16
4	11	20	2	18	15	8	12	1	23	3	5	24	7	4	1	8	24	14	21	15	21	5	22	24	4	21	15	13	1	9	5	10	20	2	16	8	18	15	23	17	21	22	12	19	6	16		
20	2	18	15	8	12	1	23	3	5	24	7	4	1	8	24	14	21	15	21	5	22	24	4	21	15	13	1	9	5	10	20	2	16	8	18	15	23	17	21	22	12	19	6	16				
13	8	9	18	3	11	21	14	15	20	18	20	17	13	10	2	19	21	16	7	23	11	19	5	22	24	4	21	15	13	1	9	5	10	20	2	16	8	18	15	23	17	21	22	12	19	6	16	
9	18	3	11	21	14	15	20	18	20	17	13	10	2	19	21	16	7	23	11	19	5	22	24	4	21	15	13	1	9	5	10	20	2	16	8	18	15	23	17	21	22	12	19	6	16			
2	6	11	21	14	15	20	18	20	17	13	10	2	19	21	16	7	23	11	19	5	22	24	4	21	15	13	1	9	5	10	20	2	16	8	18	15	23	17	21	22	12	19	6	16				
23	19	21	14	15	20	18	20	17	13	10	2	19	21	16	7	23	11	19	5	22	24	4	21	15	13	1	9	5	10	20	2	16	8	18	15	23	17	21	22	12	19	6	16					
3	14	17	12	13	10	2	19	21	16	7	23	11	19	5	22	24	4	21	15	13	1	9	5	22	24	4	21	15	13	1	9	5	10	20	2	16	8	18	15	23	17	21	22	12	19	6	16	
10	3	15	4	21	16	7	23	11	19	5	22	24	4	21	15	13	1	9	5	10	20	2	16	8	18	15	23	17	21	22	12	19	6	16	8	18	15	23	17	21	22	12	19	6	16			
21	1	4	21	16	7	23	11	19	5	22	24	4	21	15	13	1	9	5	10	20	2	16	8	18	15	23	17	21	22	12	19	6	16	8	18	15	23	17	21	22	12	19	6	16				
1	24	19	16	7	23	11	19	5	22	24	4	21	15	13	1	9	5	10	20	2	16	8	18	15	23	17	21	22	12	19	6	16	8	18	15	23	17	21	22	12	19	6	16					
7	7	23	11	19	5	22	24	4	21	15	13	1	9	5	10	20	2	16	8	18	15	23	17	21	22	12	19	6	16	8	18	15	23	17	21	22	12	19	6	16								
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13	19	18	22	12	17	15	11	2	16	8	18	15	23	17	21	22	12	19	6	16	8	18	15	23	17	21	22	12	19	6	16	8	18	15	23	17	21	22	12	19	6	16						



North

Each cell represents eight seedlings at 1 x 3-m spacing

Numbers in bold are seedlot numbers for *E. horistes*, numbers in normal weight for *E. polybractea*.

Appendix 1. Key to seedlot numbers for Junortoun Oil Mallee trial

Treat. Nr.	<i>E. horistes</i>		<i>E. polybractea</i>	
	Seedlot Nr.	Source	Seedlot Nr.	Source
1	B9546	Canna	T277	West Wyalong
2	B9547	Canna	T320	West Wyalong
3	B9548	Canna	T232	West Wyalong
4	B9549	Canna	T237	West Wyalong
5	B5950	Canna	T328	West Wyalong
6	B9551	Canna	T363	West Wyalong
7	B9552	Canna	V93	Bendigo
8	B9554	Canna	V122	Bendigo
9	B9564	Canna	V75	Bendigo
10	B9566	Gutha	V39	Bendigo
11	B9568	Canna	V40	Bendigo
12	B9569	Canna	V70	Bendigo
13	14 – 2A	Collie Orchard	12-1A	Collie Orchard
14	14 – 3C	Collie Orchard	9-5C	Collie Orchard
15	8- 7A	Collie Orchard	9-6A	Collie Orchard
16	HS8 - 9B	Collie Orchard	9-8B	Collie Orchard
17	HS58 -13A	Collie Orchard	10-15B	Collie Orchard
18	13-14B	Collie Orchard	8-22A	Collie Orchard
19	5-17A	Collie Orchard	5-20C	Collie Orchard
20	9-18C	Collie Orchard	8-18C	Collie Orchard
21	HS41- 19B	Collie Orchard	8-3B	Collie Orchard
22	HS85-20B	Collie Orchard	9-11C	Collie Orchard
23	6-6A	Collie Orchard	10-9C	Collie Orchard
24	13- 4B	Collie Orchard	13-16A	Collie Orchard

Note: Full seedlot data are held by FPC Science and are available for data analysis as required.