

Australian Low Rainfall Tree Improvement Group

Mallee Genotype /
Environment Interaction

**A report for the RIRDC/
Land & Water Australia/FWPRDC
Joint Venture Agroforestry Program
Supported by the Natural Heritage Trust**

by John Bartle and Gary Brennan

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Foreword

Growing interest in farm forestry on crop and grazing land in the 400–600 mm rainfall region of southern Australia has prompted a cooperative national effort to select and breed better trees. Tree planting can help control dryland salinity — a result of rising water tables — and reduce soil erosion. Rates of planting are likely to increase if farmers can choose trees that will also provide a worthwhile economic return. Selection and breeding will boost the benefits of tree planting by increasing yields of high quality timber or leaf oils.

This report gives an overview of the Australian Low Rainfall Tree Improvement Group (ALRTIG) genotype by environment study for oil mallee eucalypts. ALRTIG aims at speeding the improvement process of tree improvement by coordinating efforts across Australia.

The group is supported by the Joint Venture Agroforestry Program (RIRC, L& W Australia, FWPRDC and the MDBC) and the Natural Heritage Trust. Significant financial and in-kind contributions were also made by the project partners: CSIRO Forestry and Forest Products; Department of Conservation and Land Management, WA; Department of Natural Resources and Environment, Victoria; ForestrySA; Primary Industries and Resources SA and; State Forests of NSW.

This report, a new addition to RIRDC's diverse range of over 800 research publications, forms part of our Agroforestry and Farm Forestry R&D program, which aims to integrate sustainable and productive agroforestry within Australian farming systems.

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Simon Hearn

Managing Director

Rural Industries Research and Development Corporation

Abbreviations

ALRTIG	Australian Low Rainfall Tree Improvement Group
a.s.l.	Above sea level
G/E	Genotype by environment
JVAP	Joint Venture Agroforestry Program
OMC	Oil Mallee Company
OP	Open pollinated
R&D	Research and development
RCB	Randomised complete block

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Executive Summary

The Australian Low Rainfall Tree Improvement Group (ALRTIG) is a cooperative of State and Commonwealth Government research organisation partners, whose aim is to produce and provide high quality genetic resources for selected hardwoods, softwoods and oil yielding mallee eucalypts suited to the 400-600 mm rainfall zone of southern Australia.

The focus is on species that can produce valuable forest products. Commercial viability is seen to be the key to widespread adoption of farm forestry, and achievement of the environmental benefits that it can provide. ALRTIG has selected nine 'key species' from many that are adapted to low rainfall environments in southern Australia, on the basis of their good performance across a wide range of sites, and their ability to produce a commercial product (timber or leaf oil). ALRTIG's three working modules cover hardwoods, softwoods and short-rotation woody crops.

ALRTIG have recently completed a series of tree improvement strategies for the key species. This strategy is for mallee eucalypts, which are the focus of the short-rotation woody crops module.

This strategy outlines a process that will test two mallee species (*Eucalyptus horistes* and *E. polybractea*) which produce commercially proven products, across a wide range of sites in the target planting area of southern Australia. This type of study is termed a genotype by environment study. The study is being conducted across five sites and involves a number of genetically improved and unimproved families of each species. The study will show the relative suitability of the genetic material to sites in southern Australia's low rainfall zone. The paper gives detail of the overall strategy, trial procedure, materials, methods and execution.

1. Abstract

The Australian Low Rainfall Tree Improvement Group (ALRTIG) established five eucalypt oil mallee trial sites in winter 2001. The objective of the trial was to assess the performance of different genotypes of two oil producing mallee eucalypt species across a range of sites in the target plantation areas in southern Australia. These species have both been planted and studied quite extensively in Western Australia, where they are grown as a short rotation tree crop.

2. Project Background

During 1998, a Joint Venture Agroforestry Program (JVAP) National workshop on Low Rainfall Tree Improvement was held to address specific problems of productivity in low rainfall tree species. The workshop participants identified a need for a coordinated, cooperative approach to tree improvement for Australia's low rainfall agricultural areas. The Australian Low Rainfall Tree Improvement Group, (ALRTIG), was formed, and the project formally commenced in mid 1999.

ALRTIG's aim is to produce and provide high quality genetic resources for selected hardwoods, softwoods and oil yielding mallee eucalypts suited to the 400-600 mm rainfall zone of southern Australia. The program will concentrate on species that can produce saleable products. Commercial viability is seen to be the key to widespread adoption of farm forestry, and achievement of the environmental benefits that it can provide. ALRTIG will focus on nine of the many species adapted to low rainfall environments in southern Australia. These key species were selected on the basis of their good performance across a wide range of sites in southern Australia, obtained from existing information from trials and plantings within the target planting environments, and their ability to produce a commercial product (Bush et al. 2001). ALRTIG's three working modules cover hardwoods, softwoods and short-rotation woody crops.

3. Short Rotation Crops Background

Australia was the pioneer in developing production systems and markets for *Eucalyptus* oil but dominance of the traditional world market has now passed decisively to China (Boland et al. 1991). Many eucalypt species have been used as a source of oil. The Chinese industry is based on oil as a by-product from *E. globulus*. The two remaining major producers in Australia are G.R. Davis Pty Ltd at West Wyalong in New South Wales, and the Felton Grimwade and Bickford operation near Bendigo in Victoria. Both harvest blue mallee (*E. polybractea*), which yields oil high in the desirable cineole fraction.

CALM-WA commenced developing mallee as a large-scale, short-rotation crop in 1992. This was stimulated by the dire position with dryland salinity in Western Australia and the success of tree sharefarming schemes in the high rainfall areas. The selection of mallee as a prospect for commercial development was based on the extensive work of Barton (2000).

The development of mallee in WA is now well advanced. There are more than 900 growers and 8000 ha has been planted. Growers initially formed the Oil Mallee Association to guide industry development but with the quickening commercial interest they decided to vest the mallee prospect in the Oil Mallee Company (OMC). The OMC recently issued an Offer Information Statement to invite investors to subscribe funds for R&D (OMC 2001) but this failed to attract the desired support. The Association retains a substantial shareholding in the Company.

Four species (or groups of closely related species) are currently used in commercial mallee planting in Western Australia (Table 1). They have been selected for their leaf oil content, biomass

productivity and suitability for production on the major soil and climates of the wheatbelt. Another 20 species have been identified to have potential for commercial development.

All taxa in Table 1 have been subject to extensive selection from native populations (Bartle et al. 1999). Some 15 000 individuals in native populations have been screened for oil content. Superior individuals from native populations have been selected as the source of seed for current planting and to form breeding populations. Some 90 000 individuals from 500 elite families have been planted in 50 progeny trials since 1993. These trials have been designed to be converted to seed orchards on completion of progeny testing. Orchard seed is now flowing into operational planting.

Table 1: Oil Mallee taxa used in Western Australia

Species or species group	Geographic range and site preference
<i>E. kochii</i> (Maiden & Blakely) ssp <i>kochii</i> , <i>E. kochii</i> (Maiden & Blakely) ssp <i>plenissima</i> ((Gardner) Brooker) and <i>E. horistes</i> (Johnson & Hill)	All from the oleosa group of eucalypts that occur in the northern wheatbelt and prefer well-drained light to medium soils
<i>E. loxophleba</i> (Benth) ssp <i>lissophloia</i> <i>E. loxophleba</i> (Benth) ssp <i>gratiae</i> (Brooker)	The smoothed bark York gums, occurs in the central wheatbelt as far east as Kalgoorlie. Prefers heavy soils and can tolerate some waterlogging and salinity
<i>E. angustissima</i> (F. Muell)	From the inland south coast area from Ravensthorpe to Esperance. Is waterlogging and salinity tolerant
<i>E. polybractea</i> (R. Baker)	The blue mallee from New South Wales and Victoria. Is well adapted to the wetter western and southern Western Australian wheatbelt soils

This WA mallee project initially focused on the opportunity to reduce the cost of eucalyptus oil production by developing economies of scale. However, this appeared economically marginal and it was decided that utilization of mallee residue would be necessary (Bartle et al. 1996). With the recent emergence of the Renewable Energy Act obligation on electricity utilities to produce an extra 2% of power from renewable sources, the prospects for commercial development in WA now look promising. In association with Western Power Corporation and Enecon, the Oil Mallee Company recently completed a feasibility investigation of 'integrated processing' of mallee feedstocks (Enecon 2001). This showed that concurrent production of eucalyptus oil, activated carbon and electricity should be commercially viable. Western Power has commenced construction of a demonstration scale integrated plant (20 000 tonnes/year of mallee feedstock) projected to cost \$6 million.

There is now a large body of experience in growing oil mallee on farmland in WA. Operational plantings show strong site preference, suggesting a large genotype/environment interaction. This presents a fundamental question concerning mallee genetic improvement – will regionally specific taxa be required to achieve best productivity? If so, the genetic improvement strategy will be necessarily different to that used if mallee exhibited less genotype/environment interaction. A sound strategy for mallee genetic improvement cannot be developed until the significance of the genotype/environment interaction is assessed.

To address this question ALRTIG proposed testing the productivity of two contrasting taxa, *E. polybractea* and *E. horistes*, at five widely differing sites across southern Australia. Both taxa have indicated strong segregation of performance across sites in WA. The trials were originally proposed to determine the relative performance of a set of clones of the two species.

Clonal propagation proved to be more difficult than anticipated. Despite the use of techniques proven for *E. globulus* and *E. camaldulensis*, and various treatments being tried, rooting percentages for both species were unsatisfactory (Barbour, 1999). The ALRTIG Short Rotation Woody Crops Technical Committee therefore decided to proceed with the experiments using seedling stock.

This report provides the detail of the planning and implementation of seedling genotype/environment interaction trials for these two taxa at five locations in Western Australia, South Australia, Victoria and New South Wales.

4. Mallee Genotype/Environment Trial

4.1. Objective

The objective of the trials is to assess genotype by environment interaction in oil mallee species by measuring the productivity of two contrasting taxa, *E. polybractea* and *E. horistes*, at differing sites across southern Australia. In Western Australia, it has already been determined that the species have differing site requirements, and they will therefore be deployed to appropriate sites. Both species will be deployed to individual sites in New South Wales, Victoria and South Australia, to determine which genotypes perform best on particular site types.

4.2. Sites

There are five separate trial sites: two in Western Australia and one each in Victoria, New South Wales and South Australia. Brief location and sites details are given in Table 2, and full detail is provided in Appendix 3.

Table 2: Location and site details

Site	Species	Coordinates (Approximate)	Regional town	Soil type	Mean rainfall (mm)	Elevation (m a.s.l.)
WA (1)	<i>E. horistes</i>	31°11'S 117°02'E	Dowerin	Gravely sand over clay	325	239
WA (2)	<i>E. polybractea</i>	32°43'S 117°31'E	Wickepin	Dark loamy clay	325	505
SA	Both	35°07'S 139°16'E	Murray Bridge	Sandy clay loam	342	55
Victoria	Both	36°46'12"S 144°21'15"E	Bendigo	Brown loam	551	210
NSW	Both	33°55'S 147°12'E	West Wyalong	Loamy sand over gravel	486	300

The sites selected are representative of the southern Australian winter rainfall dryland/cereal cropping zone where large areas of land that could feasibly be targeted for oil mallee plantations exist. Further information about selection of sites for ALRTIG plantings is provided in Bush et al. (2001).

4.3. Trial Treatment Structure and Design

4.3.1. Treatments

The treatment of primary interest in this series of trials is comprised of open pollinated families of *E. polybractea* and/or *E. horistes*. The suitability of the two species to various site types has already been determined in Western Australia, so each species was deployed on an appropriate site, whereas the material was applied to single sites representative of the perceived target planting zone in the eastern states (Table 3). An identical set of material has been used in each State, with the exception of New South Wales, which deployed one additional *E. polybractea* treatment.

Table 3. Distribution of treatments between sites and design summary

Site	Nr. <i>E. polybractea</i> treatments	Nr. <i>E. horistes</i> treatments	Design
Dowerin	0	24	RCB
Wickepin	24	0	RCB
Murray Bridge	24	24	Two discrete RCBs
Bendigo	24	24	Two discrete RCBs
West Wyalong	25	24	Split-plot

The treatments within each species are comprised of a mix of open pollinated (OP) families collected from seedling seed orchards and the wild (Table 4). The orchard seed will provide a broader genetic base and may display a different degree of genotype/environment interaction than the narrower genetic base of the wild seed. The NSW trial also includes one treatment consisting of the open pollinated progeny of a West Wyalong seed tree selected by G.R. Davis. A further treatment in NSW was raised from a seedlot of the G.R. Davis seed orchard at West Wyalong.

Table 4. Treatment number and identity of for *E. horistes* and *E. polybractea*.

Treat. nr.	<i>E. horistes</i>		<i>E. polybractea</i>	
	Seedlot nr ^[1]	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
25	None	-	-	G.R. Davis plus tree
26	None	-	-	Same as above

1. Seedlot numbers identify collections of open pollinated seed from individual trees. Seedlot data are held by CALM Science and are available for data analysis as required.

4.3.2 Trial Design

The trial design and layout vary by site (Table 3). The detailed plans provided by each State of site layout (trial orientation, treatment randomisation, treatments configuration within block and block sequence) are given in Appendix 3. These include local maps that have sufficient resolution and instruction so that the non-familiar observer can readily locate the site and interpret layout.

A randomized complete block layout was used. For each species at each site there were 5 blocks with 24 treatments in each block. Each treatment was represented once in each block by a single line plot of 8 trees. Generally the two species were planted separately but at West Wyalong both species were together in a split-plot design. The West Wyalong trial also included a double entry (treatments 25 and 26) of an additional *E polybractea* treatment supplied by G.R. Davis.

Plant spacing of 3 m between rows and 1 m within rows was prescribed. Layout of treatments within each block (2 * 12 or 3 * 8 etc) varied to suit the available site. Plot randomisation was done using the computer program 'Cycdesign' (Whitaker et al. 1998). Twin row buffer trees at trial spacing were established on the boundary of the trial area. No internal buffers were prescribed.

All seedlings for all treatments were sown and raised as a single batch at the CALM Narrogin Nursery (170 km south east of Perth WA) in December 2000, with the exception of the extra treatment planted in New South Wales which was raised at the G.R. Davis nursery at West Wyalong. The seedlings were trucked from Western Australia to their planting locations in July 2001 as hardened planting stock approximately 25 cm tall.

4.4. Trial Management and Maintenance

Planting was done in winter/spring using the establishment techniques appropriate to the district and the prescribed guidelines (Appendix 2). A more detailed account of establishment operations is given in Appendix 3.

The trials will be given high quality management and protection from pests and grazing. A long-term management protocol prepared by each State is included in Appendix 4.

4.5. Trial Measurement and Assessment

Each State agency will assist with data collection as follows:

Biomass production: In December 2002, 2003 and 2004 the height and 2 cross sectional dimensions of 4 middle trees in each 8 tree plot will be measured to derive a crown volume index. Then existing correlations of crown volume index with biomass will be used to estimate biomass production. These correlations will be validated by destructive sampling of some trees (probably buffers) at each trial site.

Cineole content: In December 2003 and 2004 the leaf cineole content will be measure by the standard method used by CALM in WA (3 g extraction by 50 ml ethanol measured GC analysis).

Flowering period: Trials sites will be monitored for flowering commencing in 2004.

Funding for data collection will be subject to negotiation with ALRTIG partners and RIRDC. RIRDC will fund one person to participate in data collection at all locations so that collection standards are uniform.

4.6. Data Analysis and Information Control

Each Sate agency will collate the data and pass it to CALM for analysis. Information will be available to ALRTIG partners and RIRDC.

4.7. Intellectual Property

All ALRTIG partners involved in the trials will sign a non-propagation agreement (copy attached as Appendix 5) and acknowledge that CALM-WA is the sole owner of all pedigree information for the WA

material included in the trials. No pedigree data for this material will be released until these agreements are endorsed. Similarly, Davis Pty Ltd own their genetic material included in the trial at West Wyalong.

4.8. Project Management

CALM will have management control of the trials and will liaise closely with the ALRTIG National Coordinator in the execution of this responsibility. CALM-WA will coordinate data collection and carry out Australia wide analysis and report.

4.9. Project Outcomes

The project will indicate whether national breeding programs are appropriate for oil mallee species.

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APPENDIX 1: Planting Instructions

ALRTIG MALLEE GENOTYPE/ENVIRONMENT TRIALS 2001

Trials to test the extent of genotype/environment (G/E) interaction in two oil mallee species will be established at five locations across the southern States. Treatments consist of 24 open pollinated family seed lots produced at the CALM Narrogin Nursery in WA¹ Nursery stock was despatched to the field in May 2001. This note sets out trial design and seedling description details as agreed by discussion amongst the project partners.

A1.1. Locations: five sites in total, one in each in SA, Vic. and NSW and two in WA.

A1.2. Species: two species, namely *E. horistes* and *E. polybractea*

A1.3. Families: 24 families

E. polybractea: 6 families from native Victorian stands
 6 families native New South Wales stands
 12 families from CALM SSO (all of New South Wales origin)

E. horistes: 12 families native provenance (there is only one)
 12 families CALM SSO

A1.4. Plot size and replication: 8 tree plots with 5 replications

A1.5. Numbers of seedlings to be delivered to each location:

- Each location will have two trials, i.e. one for each species *E. horistes* and *E. polybractea*.
- Each trial will have 24 families. Hence each trial will require $24 * 5 * 8 = 960$ seedlings or 40 trial seedlings for each family.
- CALM have produced 376 buffer seedlings to each trial or 24 seedlings/family. This has been calculated to be sufficient for 2 buffer rows around any family layout from 2 x 12 to 6 x 4.

A1.6. Planting density and trial dimensions

A planting density of 3m x 1m (3 m between rows and 1 within rows) is proposed. Hence each 8 tree plot will be 8 m long. Each replication of 24 families for the likely range of configurations will be:

- 2 x 12 configuration will 16m x 36m. For 5 replications in continuous linear configuration, actual trial dimensions will be 16m x 180m or 0.288ha. Buffers will add 2 rows on all sides to give dimensions of 20m x 192m or 0.384ha and a need for 320 buffer trees.
- 3 x 8 will be 24m x 24m. For 5 replications in a block actual trial dimensions 24m x 120m or 0.288ha. Buffers will add 2 rows on all sides to give dimensions of 28m x 132m or 0.3696ha and a need for 272 buffer trees.
- 4 x 6 will be 32m x 18m. For 5 replications in a block actual trial dimensions 32m x 90m or 0.288ha. Buffers will add 2 rows on all sides to give dimensions of 36m x 102m or 0.3264ha and a need for 264 buffer trees.

A1.7. Site selection

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.

¹ Note that an extra treatment was concurrently produced by G.R. Davis and planted at the West Wyalong site

APPENDIX 2: Trial site details

A2.1. Western Australia – Dowerin, *E. horistes*

A2.1.1. Site description

The Dowerin site at Botherling East Road (31°06'26"S 116°57'36", 240 m asl) is on a mid-slope position with gravelly/loam soil with some clay (Figure A2.2.) Associated native vegetation consists of York gum (*Eucalyptus loxophleba*), jam (*Acacia acuminata*) and other mallee vegetation. MAR is 367.8 mm.

A2.1.2. Site preparation

Planting lines were ripped on the contour 350-400 mm with a tractor mounted ripper.

A2.1.3. Weed control

The trial was sprayed with 0.5 L/ha Round-up, 2 L/ha Simazine and 0.5 L/ha Atrazine at the break of the season. This occurred on the 13th June 2001, about 3 weeks before planting.

A2.1.4. Planting method and date

This trial was hand planted on 4 July 2001.

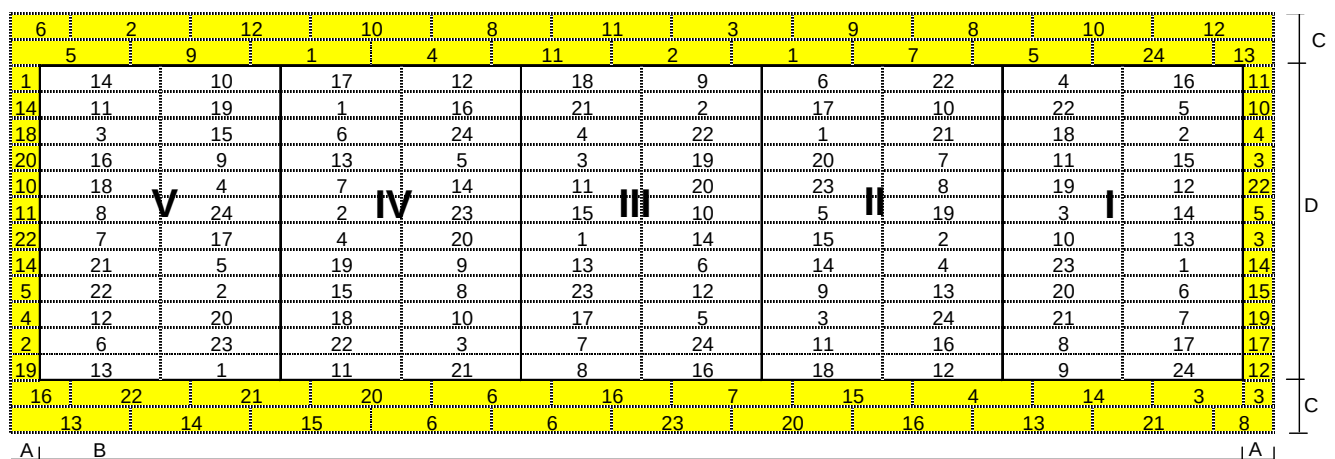
A2.1.5. Spring weed control, pest control and protection from grazing

The site has been fenced. The trial design was a randomised complete block (Figure A2.1.).

A2.1.6. On-going monitoring and management

Management and monitoring is the responsibility of CALM-WA.

Figure A2.1. Trial layout, Dowerin

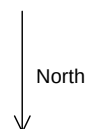


Trial dimensions

A: 4 m, (2 trees)
B: 160 m (10x8 tree line-plots=80 trees)
C: 6m (2 rows)
D: 36 m (12 rows)

Notes:

Dashed lines delineate plot boundaries
Block-replicate numbers in large roman numerals
Shaded line plots at perimeter are buffers



486 000mE

487 000mE

6 533 000mN

6 533 188mN

LOC. 26224

LOC. 20467

Shire of Goomalling

BOTHERLING

EAST

ROAD

ROAD

LIBERIN

ALRT10 PLOT (Botherling)

OWNER: John and Jenny Thomas
L.G.A.: Goomalling

0 500m

Goomalling

Botherling

A2.2. Western Australia – Wickepin, (*E. polybractea*)

A2.2.1. Site description

This trial site is located at Rose Road, Wickepin (32°47'41"S 117°24'10"E, 340 m asl) (Figure A2.4.). It is a mid-slope landscape position with dark loamy/clay soil. Previous land use was sheep grazing. Associated native vegetation consists of York gum (*Eucalyptus loxophleba*), jam (*Acacia acuminata*) and rock sheoak (*Allocasuarina huegeliana*). MAR is 502.7 mm.

A2.2.2. Site preparation

Planting lines were ripped to 350-450 mm and mounded to 150-200 mm with a tractor-mounted ripper-moulder. Protection from rabbits is achieved by a rabbit-proof fence.

A2.2.3. Weed control

The trial area was burnt prior to mounding and sprayed with a herbicide mix of 2 L/ha Round-up and 4 L/ha Simazine at the break of the season. This occurred on the 25th June 2001, about 5 weeks before planting. The site would have been planted earlier, but very little rain occurred in July, which delayed planting until early August.

A2.2.4. Planting method and date

This trial was hand planted on the 6th August 2001. The trial design was a randomised complete block (Figure A2.3.).

A2.2.5. Spring weed control, pest control and protection from grazing

The fencing should provide on-going protection from vermin.

A2.2.6. On-going monitoring and management

CALM-WA are responsible for the on-going management of this trial.

Figure A2.3. Trial layout, Wickepin

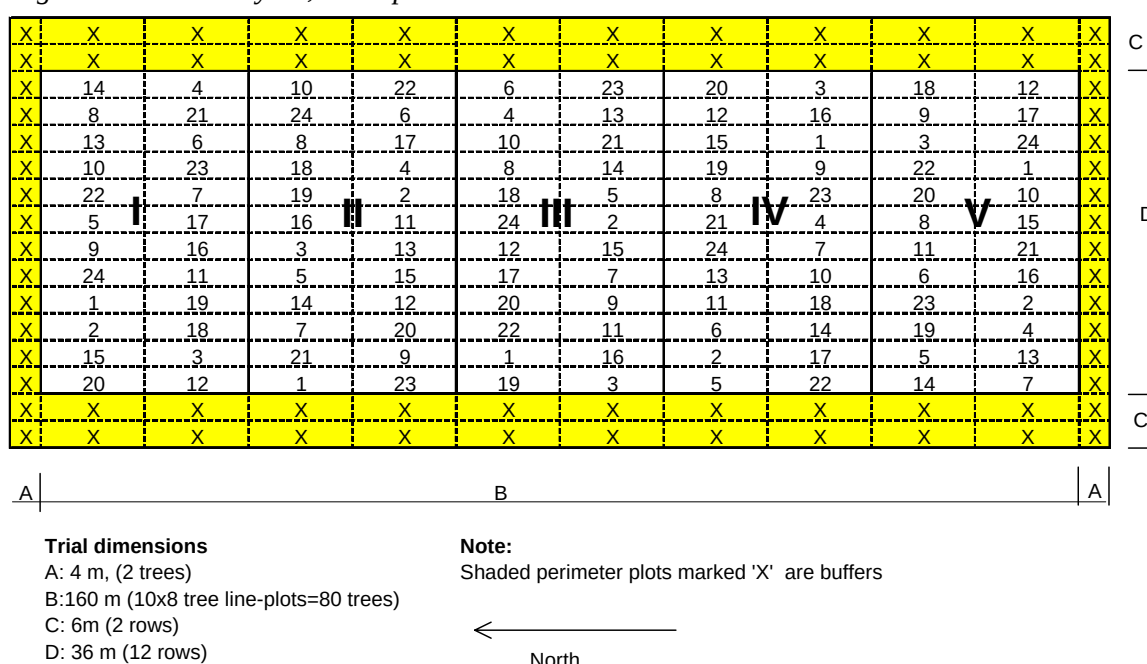
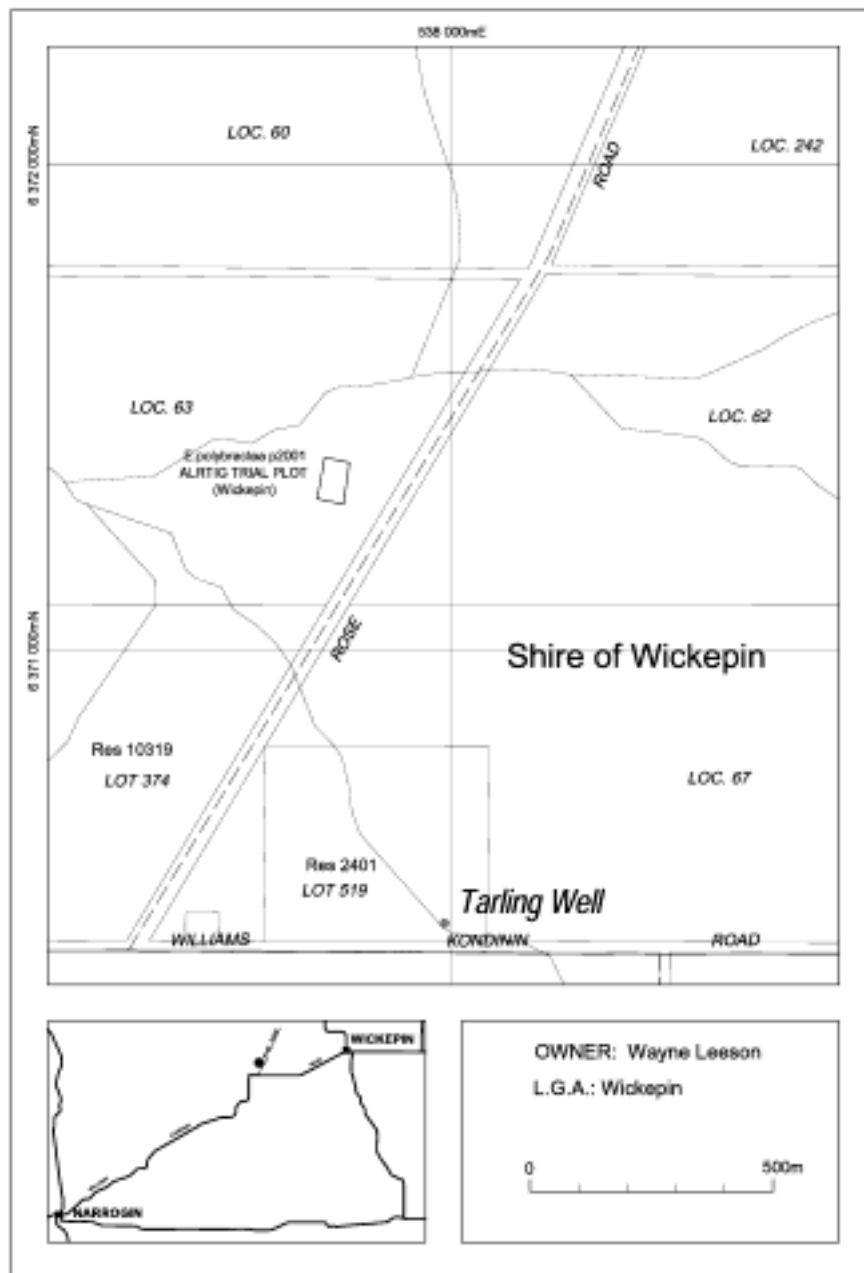


Figure A2.3. Site locality, Wickepin trial



A2.3. South Australia – Murray Bridge

A2.3.1 Site description

The site is situated at the PIRSA Murray Bridge site on Bremer Road, (35°07'S 139°16'E). It is very gently sloping (2%) with an easterly aspect. MAR is 342 mm. The site had previously been used for native plant trials and originally would have carried mallee *Eucalyptus*, *Acacia*, *Melaleuca* and *Dodonea* spp. The soil is a sandy clay loam. The two trial species are set out in separate trials each consisting of five block replicates (Figure A2.5. and Figure A2.6).

A2.3.2. Site preparation

The site was prepared on 13 June 2001 by scraping and disc plowing.

A2.3.3. Weed control

Blanket spray coverage of glyphosate at 2 l/ha was applied on 11 July 2001 to control winter grasses and broad leaf weeds.

A2.3.4. Planting method and date

The site was hand planted between 24-26 July 2001.

A2.3.5. Spring weed control, pest control and protection from grazing

Skeleton weed, Cape Tulip and Horehound were sprayed between the rows with glyphosate @ 2l/ha, BS1000 @ 2l/ha and Trifolamine @ 0.8 l/ha on 24 October 2001. Glyphosate and Trifolamine were used at a rate of 100 ml in 15 l of water to control weeds between rows on 25-26 October 2001. The site is part of PIRSA native plant trialling area, and no stock is kept in the area. Hares were shot prior to establishment.

A2.3.6. On-going monitoring and management

PIRSA will be responsible for continued monitoring and management of the planting.

Figure A.2.5. Layout of Murray Bridge trial site

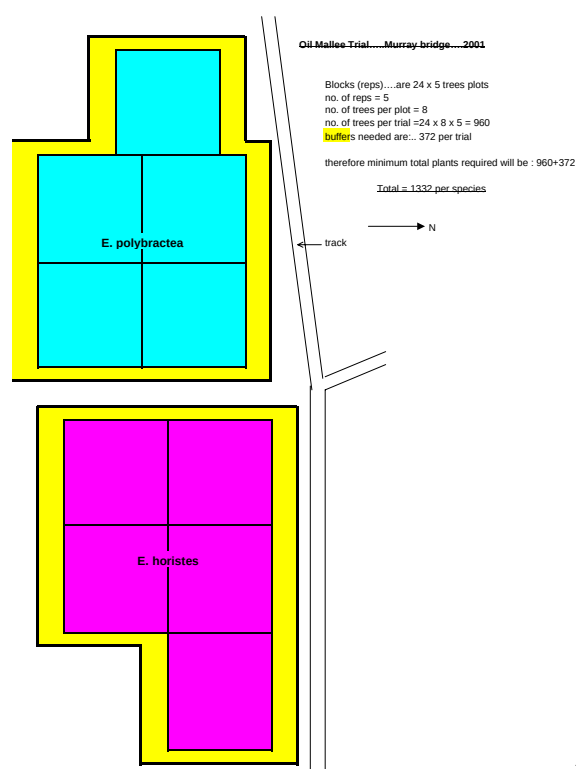
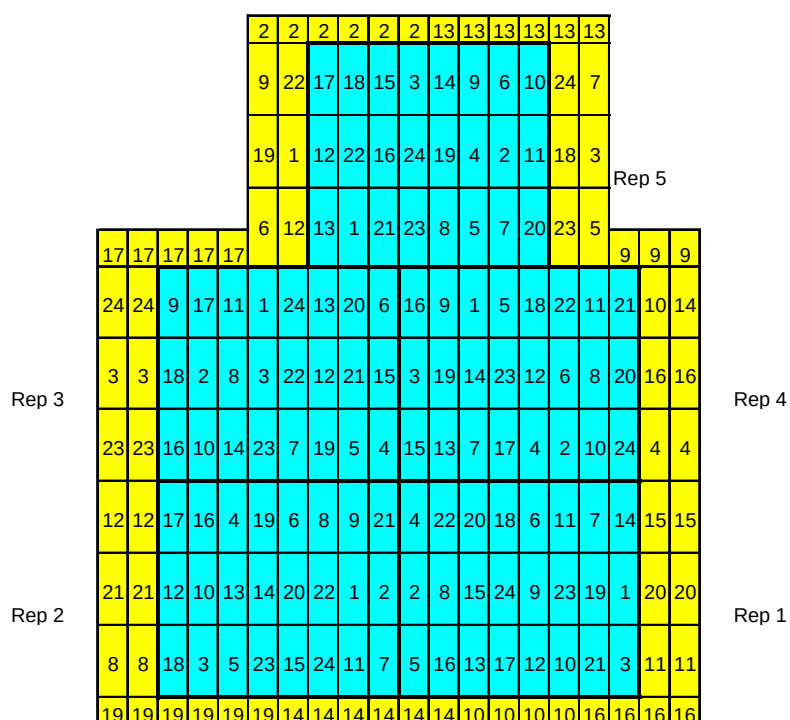


Figure A2.6. Trial layout detail for *E. polybractea*/*E. horistes* trial at Murray Bridge

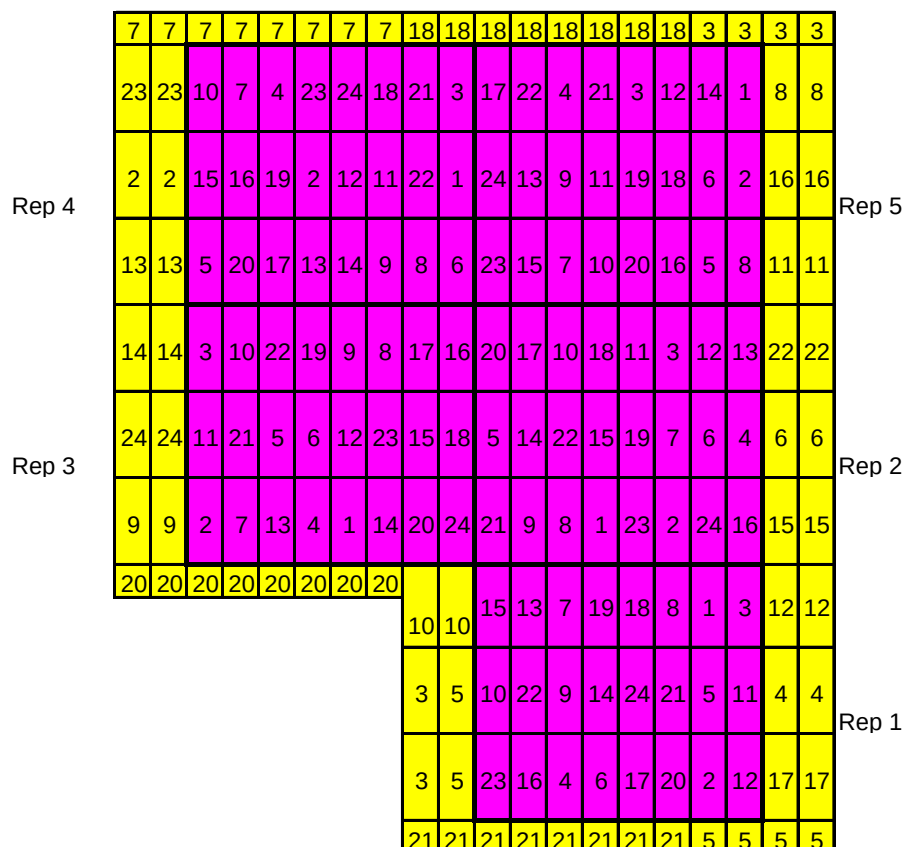
Euc. polybractea
planted 24 & 25/7 01

—————> N



Euc. horistes
planted 26/7/01

—————> N



A2.4. Victoria – Bendigo (Junortoun)

Information extracted from Stackpole (2002)

A2.4.1. Site description

The trial is located in an ex-native pasture paddock on the property of Mr. Jim Nielsen, at Junortoun, near Bendigo in Victoria (Figure A2.7.). 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. MAR is 551 mm. Judging from the incidence and distribution of remnant native trees, the site would have originally carried *E. macrorhyncha* and *E. goniocalyx* woodland, with a grass and native legume understorey.

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

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

A2.4.2. Site preparation

The site was ripped by the landholder in July 2001. The riplines were spaced 3 m apart. On 13 August 2001 riplines were pulverised by rotary hoe and bedded to form elevated mounds of light consistent texture.

A2.4.3. Weed control

On August 14 2001 the planting rows were sprayed with 3 L/ha Simazine to destroy germinating seeds.

A2.4.4. Planting method and date

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 A2.8.) was established on the site. Each plot pin was labelled with an adhesive label with the seedlot number prominently marked.
2. Planting spots were marked out at accurate spacing (1 m apart) by use of string lines.
3. After each replicate was planted each seedling was watered with 3-4 L of water. The following day each seedling was fitted with a 1 L cardboard milk carton tree guard, which was held in place by two bamboo stakes.
4. A single row of spare seedlings was planted around the trial. The seedlot identity was recorded as in Figure A2.8.

A2.4.5. Pest control and protection from grazing

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

A2.4.6. On-going monitoring and management

The site is managed by DNRE (Forest Science Centre). Matters to be addressed are summarised 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 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.

Figure A2.7. 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"

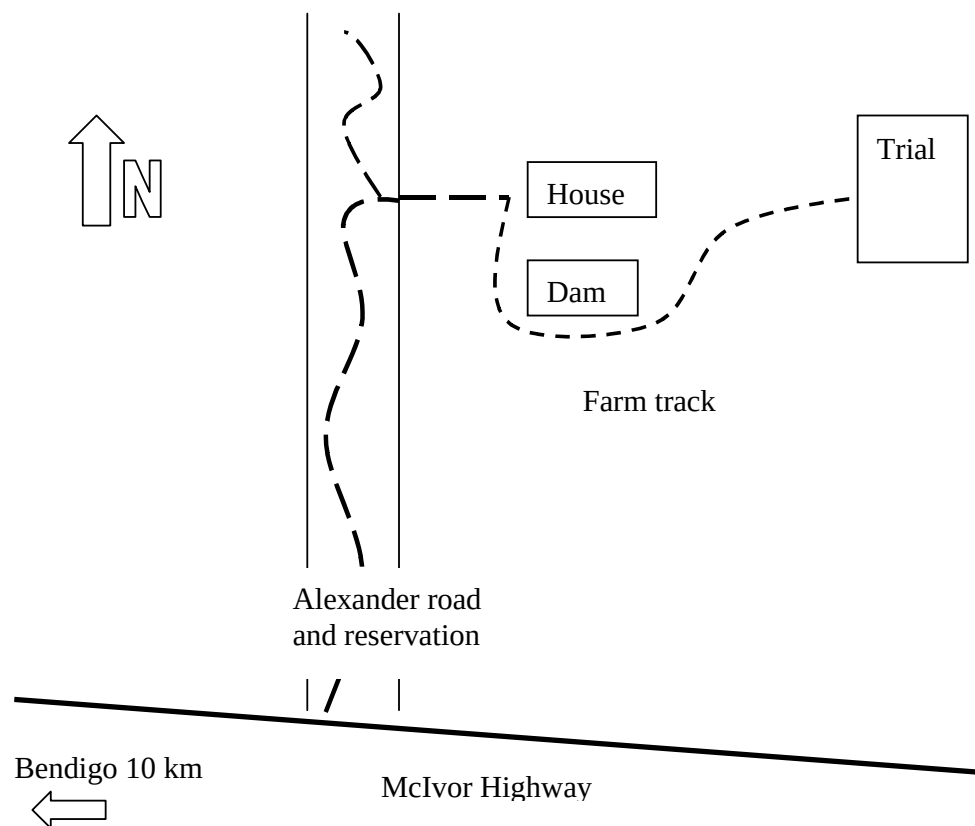
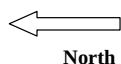


Figure A2.8. Plantation trial layout for *E. polybractea* and *E. horistes* trial established on the property of Mr Jim Nielsen, near Junortown, Bendigo.

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*.

<i>E. polybractea</i>							<i>E. horistes</i>						Block
14	16	20	8	6	1	21	16	2	20	11	8	10	17
24	4	13	1	23	10	7	15	21	5	22	24	4	21
11	16	5	6	3	14	21	14	2	20	8	10	23	15
4	11	20	9	17	19	22	13	16	18	11	1	6	13
20	2	18	15	8	12	24	3	19	7	9	12	17	1
13	8	9	22	12	1	23	22	15	23	21	20	5	9
9	18	3	5	24	7	4	1	8	24	14	4	11	5
2	6	11	17	2	16	13	17	18	3	7	13	19	10
23	19	21	14	15	20	10	2	12	16	6	9	10	20
3	14	17	12	7	18	20	24	5	17	4	7	12	2
10	3	15	13	10	22	2	19	9	21	18	15	14	16
21	1	4	21	6	11	8	20	23	13	10	11	16	8
1	24	19	16	5	23	9	6	1	8	3	2	22	18
7	7	23	11	19	5	15	21	7	1	16	6	9	15
6	12	6	20	22	4	16	11	22	4	15	3	2	23
15	9	14	24	13	8	3	12	13	19	20	8	24	17
12	17	2	10	1	21	18	23	10	14	17	5	18	21
16	20	22	3	4	6	12	16	14	9	5	22	3	22
18	23	16	19	18	24	1	7	24	15	13	23	1	12
19	21	10	2	9	17	5	4	11	6	12	18	20	19
22	15	8	7	14	13	11	8	17	10	2	19	21	6
13	19	18	22	12	17	15	0	3	7	18	22	12	16



A2.5. New South Wales

A2.5.1 Site description

The trial site is located at 'Tallimbalong', the property of G.R. Davis Pty Ltd., between Tallimba and West Wyalong (33°55'S 147°12'E) (Figure A2.9). Slope is negligible. The soil type is a light loamy sand overlying a shallow (60-80cm) quartz gravel hardpan. MAR is 486 mm. The property was originally *E. polybractea*/ *E. largiflorens* mallee woodland cleared for wheat farming, but is now used for oil mallee and tea-tree oil production. The site planted was previously planted to *E. polybractea*. The trial layout is shown in Figure A2.10.

A2.5.2. Site preparation

The soil was ripped to a depth of 50-70 cm, to break the hardpan, but not mounded.

A2.5.3. Weed control

Nil

A2.5.4. Planting method and date

The trial was hand-planted on 19 September 2001.

A2.5.5. Spring weed control, pest control and protection from grazing

The property is not used for grazing. No special measures taken.

A2.5.6. On-going monitoring and management

Overall responsibility for the trial will be with SFNSW, though the trial will be managed on a day-to-day basis by the Davis Company, as part of routine management of the mallee farming enterprise.

Figure A2.9. Location and access to the West Wyalong oil mallee family trial

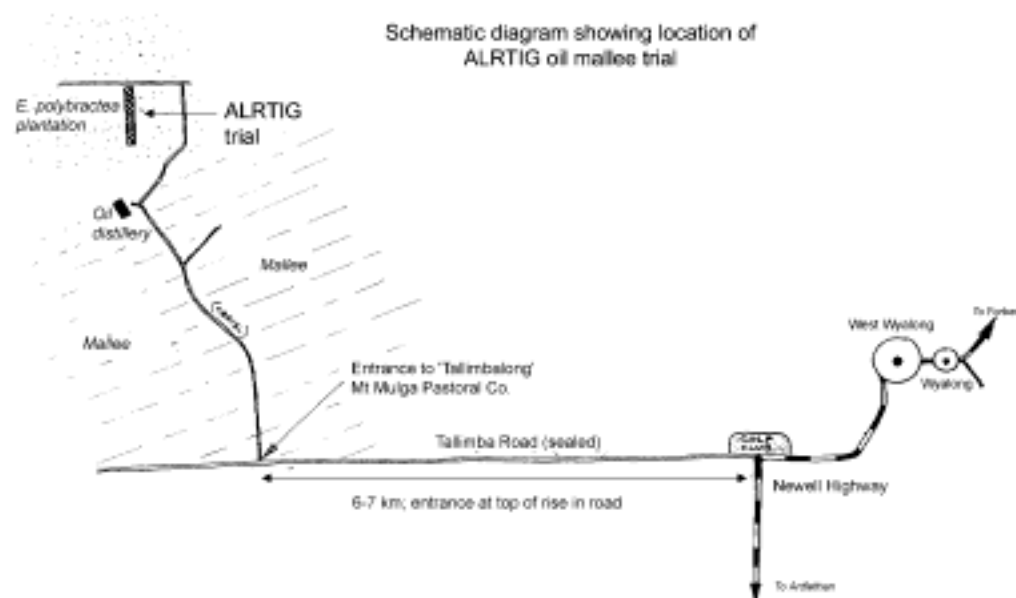


Figure A2.10a. General layout of the trial at West Wyalong

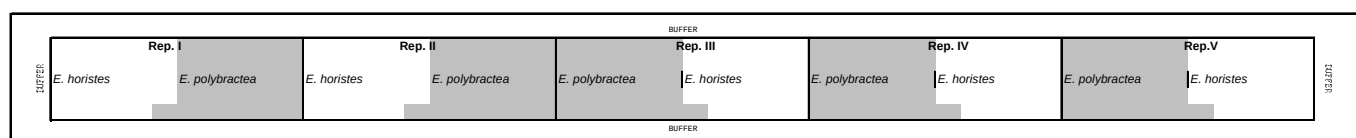


Figure A2.10b. Plot layout key

										Replicate
4	6	22	11	13	26	18	3	21	20	I
9	7	14	19	3	8	6	24	23	2	
20	5	21	18	10	7	10	17	13	15	
1	12	8	24	2	4	16	5	11	14	
15	16	23	17	1	25	22	9	12	19	
1	4	22	15	9	26	12	19	21	11	II
17	18	10	21	8	7	3	16	4	8	
6	3	2	5	20	25	6	24	17	14	
11	12	13	23	24	23	1	5	10	13	
14	19	16	7	18	2	9	20	15	22	
6	17	19	13	12	3	5	17	1	8	III
16	5	25	10	14	24	21	2	11	9	
3	24	15	9	21	22	23	13	16	15	
18	8	23	22	4	12	18	4	20	6	
26	1	20	2	7	11	7	19	10	14	
12	4	18	11	24	6	15	1	4	11	IV
7	19	8	21	14	3	14	9	10	8	
5	26	10	16	22	13	12	21	16	22	
13	17	25	20	3	20	24	23	7	19	
6	23	1	2	15	9	5	2	17	18	
11	6	25	18	3	22	1	19	24	8	V
22	23	8	19	9	9	12	20	13	7	
1	15	7	4	2	23	14	6	10	5	
21	10	5	20	12	17	3	21	16	2	
17	26	16	13	24	14	4	11	15	18	

Appendix 3. Non-Propagation Agreement

ALRTIG MALLEE GENOTYPE/ENVIRONMENT TRIALS 2001

ALRTIG partner:

Trial Location:

Landowner:

Trial N^o.:

Genetic Resource: consists of 5 replications of 8 tree plots of 24 family treatments planted in a randomised block design at each of 8 sites.

The **Genetic Resource Property Owner (GRPO)**² has provided you these seedlings on the understanding that:

The seedlings are only to be used for the establishment of this genotype/environment interaction trial.

Plant material cannot be cloned in form of grafts, cuttings or tissue culture. Neither can plant material be used for purpose of breeding or seed production, or on-sold to a third party.

Trees cannot be manipulated or treated in any way to produce a seed crop.

As this plant material is used for genotype/environment interaction trials, the **GRPO** requires right to access trial for inspection or non-damaging assessment of trees, with your knowledge.

The Landowner has the option to retain the trees and/or to use them for any purpose, other than as a source of germplasm, after completion of the trial .

In accepting these seedlings bred by the **GRPO** for planting in ALRTIG oil mallee genotype/environment interaction trials, (ALRTIG partner organisation) has sighted and agrees to abide by the conditions cited above.

Signed for and behalf of

.....

By

Date: __/__/__ **Name and title** _____

² The Genetic Resource Property Owner is CALM-WA for family codes 13-24 inclusive (Collie Orchard) of both the *E. polybractea* and *E. horistes* material. The GRPO is G.R. Davis Pty Ltd for family codes 25 and 26 of the *E. polybractea* material. ALRTIG retains the GRP rights to the remaining seedlots.