A Manual for Planted Farm Forestry for the Northern Inland of New South Wales

Appendix I

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APPENDIX I: Summary of the "Low Rainfall Farm Forestry on a Landscape Scale" project.

(NHT Project No. NW0852.99)

Summary Report

Project proponent:	Greening Australia NSW Inc. (Northwest)
Principal funding source:	Commonwealth Government Natural Heritage Trust Fund
In-kind support:	Participating Landholders of North West NSW, Greening Australia NSW Inc. (GA), State Forests NSW, Department of Land & Water Conservation NSW, Liverpool Plains Land Mgt Committee, NSW Agriculture and North West Regional Development Board (Forestry Investment Group).
Project duration:	March 2000 to August 2003

Project description

The project addressed the lack of management information and landholder experience with farm forestry as a land use in the medium to low rainfall areas of Northern NSW. Farm forestry is seen as one of the commercial land uses capable of alleviating salinity and many other environmental problems (biodiversity decline, soil erosion). Its adoption rate is slow however and some of the principle reasons for this are the lack of information available to landholders and the availability of suitable demonstration sites for promotion. There are few if any large-scale demonstration farm forestry plantings in the region.

Project objectives

This project attempted to resolve the above situation by: working with collaborating landholders to establish large scale demonstration plantings of timber and fodder species and smaller plantings of bushfoods; establishing tree guarding and species trials; promoting farm forestry via field days and media and journal articles; collecting seed from suitable local provenance native trees; providing technical advise and responding to information requests from interested landholders; and monitoring past plantings and trials to gain information on the growth characteristics of potential species for the region. The information collected during the project was used to produce a farm forestry manual for the Northwest of NSW.

Summary of results

No. of participant landholders providing sites:	31
Total No. of plantings:	36
Total area of plantings:	108ha*
Size of plantings:	1 to 10ha
No. sites that include species trials:	11
No. sites that include tree guarding trials:	2
No. sites that include mounding and spacing trials:	1
No. field days held & total No. of attendees:	4 & 165 respectively
No. of media, newsletter and journal articles produced:	7
Kg. of native tree and shrub seed collected:	20
No of landholder enquiries responded to:	120+

***The revised project target (2001 – 2002) was 120ha, drought during 01 to 03 was responsible for several landholders withdrawing or reducing their project commitments.**

The ultimate measure of success of the project will be the adoption rate of farm forestry in northwestern NSW over coming years. The project has resulted in the establishment of very useful extension tools in the form of demonstration plantings, the collection of information from past plantings, and the pooling of this information within the farm forestry manual. There is also a growing

pool of interested landholders getting first hand experience in tree growing and management for forestry.

Staff involved

Project Manager – Anne Gibbs (Mar00 to June01)
Project Manager– Shane Andrews (June 01 - Aug03)
Project Officer/Works Assistant – Helen Ward
Admin/Database – Joy Kirby & Jillian Foley
Casual Tree Planters – James Cronin, Adam Helion, Keith and Laben Burgess, Katryn Ziegler, Danny Towns and most landholders.
Contract Tree Planters – Fields Native Nursery, Uralla.

Landholders involved

Janice and Mike Davey, Ritchie Collins (DLWC), Rob Segboer, Stan and Isabelle Lee, Rhonda and Jim Cameron, Andrew and Fran Robertson, Robert Cull, Ian Thompson and Chris Perry, Ron Caccianiga, John and Reyna Barrie, Jacqui and Scott McIntosh, Phillip and Diane Sanderson, Lindsay Doyle, Stephen Sunderland, Brian Tudgey, Richard and Robina Burns, Tanya and Tony Haling, Bill and Gai Schubert, Jim and Katrina McDonald, Anthony Signor, Bruce Tyrrel, Noel Murphy and Brendon George (NSW Agriculture), Elizabeth and Doug Mailer, Cyril Sampson and the Walhollow community, Ian Klein, Michael Ticehurst, Kay Marshall and Gordon Tighe, Geoff Doak, David and Sue Mack, Peter Hook, Peter and Catherine Lane, Emma and David McCathie and Lincoln Ward.

Site selection and landholder agreements

The project was initially advertised in the regional media calling for expressions of interests. Sites were selected via inter-agency (State Forests – which were also establishing salinity trial sites at the time, and DLWC) and community (Liverpool Plains Land Mgt Committee- Northwest Vegetation Mgt Committee) consultation. Where possible, sites were preferentially selected in recharge areas or at break of slope locations to assist with salinity control. To provide region-wide comparisons of different species performances, sites were also geographically spread throughout the region

Landholders agreeing to participate in the project were asked to sign a landholder agreement which outlined their and GA's project responsibilities. In general landholders agreed to fence the planting site, prepare the site to an acceptable standard prior to planting, maintain the site post-planting (water plants and control weeds as necessary) and allow access to the site for monitoring and field days. GA prepared a site plan in consultation with the landholder, purchased and established the seedlings, monitored their performance, interpreted the results and kept appropriate records of the site.

Media and Extension

Extension of the project was achieved through field days, media releases, radio interviews, newsletters, journal articles and by responding to landholder enquiries. Available information on farm forestry was also distributed through these means. An assessment of each field day was conducted by way of questionnaire survey. The survey results suggested that over 90% of people attending field days thought the information provided was useful to them and presented competently.

Up to date information on farm forestry for the region has been compiled from literature review, monitoring past plantings and the early monitoring results from this project. This information has been summarised and interpreted and is now available in the form of a farm forestry manual for the Northwest of NSW. The farm forestry manual represents the main output from the project in terms of written extension material.

Monitoring and Early Results

To gauge the early performance of plantings and the species used – sites were monitored each year post planting. Monitoring was undertaken by taking measurements from a representative sub-sample of trees from each species from each planting (or by measuring all trees in a plot in the case of trials).

Data was recorded on survivorship and plant height for all sites. On some sites where appropriate; stem diameter, crown health, stem form and frost damage was also recorded. In order to evaluate each planting and compare early results to what other farm-tree growers have achieved in the past, the growth rates of some species planted during the project were compared with the growth rates of the same species recorded during a previous NHT project "Optimising the Growth of Trees Planted on Farms" (Andrews 2000). The "Optimising Growth" project recorded the growth rates of trees from 60 previously established environmental plantings spread across the Northwest. A summary of the Low Rainfall Farm Forestry planting's performance follows:

Total No of sites with monitoring data*:	29
No of sites with survivorship >90%	10
No. sites with survivorship 70-90%	9
No. sites with survivorship 50-70%	5
No. sites with survivorship <50%	2
No. sites with failed plantings	3
Indicator species# (I.S.) average annual hgt growth rate: (from Andrews 2000).	94cm/year
No. sites with (I.S.) growth rates 20% or more above average:	5
No. sites with (I.S.) growth rates within + or – 20% of average:	15
No. sites with (I.S.) growth rates 20% or more below average:	9
Average growth rate of (IS) on the best performing site:	176cm/year

*** bush foods sites and plantings established during autumn or winter 2003 not included in analysis.**
 # Indicator species in this case was River Red Gum *Eucalyptus camaldulensis*.

The best performing species was usually River Red Gum *Eucalyptus camaldulensis*. Except for one site, River Reds were the fastest growing species and had the highest survival overall. Other species that performed well in terms of early survival and growth included Chinchilla White Gum *E. argophloia*, River Oak *Casuarina cunninghamiana*, White Box *E. albens*, Mugga Ironbark *E. sideroxylon*, Silverleaf Ironbark *E. melanophloia* and Western Grey Box *E. microcarpa*. Narrow-leaved Red Ironbark *E. crebra* was 'patchy' and Spotted Gum *Corymbia maculata* and the stringybarks *E. macrorhyncha* and *E. laevopinea* performed poorly. Spotted Gum, once considered a good prospect for timber production in low to medium rainfall areas, was devastated by frost – especially in the extreme drought winter of 2002. Even well established Spotted Gum trees several years old suffered considerable damage.

See attached charts for summary results and early results from some of the trial sites.

Project Evaluation

***The performance of onground works*:**

Most sites (19 out of 29) had a 70% survivorship rate or better, and average or better than average growth rates when compared to the results of Andrews (2000). The best performing sites had the following characteristics: were grown on good agricultural soil types; the landholder prepared the sites well and/or was committed to post-planting weed control; and were planted at a time of good soil moisture or had an effective fallow prior to planting to conserve moisture. Poorly performing sites were: hastily prepared with little commitment to post planting weed control; and/or occurred on poor soils (particularly sandy types with little water holding capacity, or poorly drained sites); and/or suffered from kangaroo, rabbit, hare or livestock damage. A lack of appropriate equipment being made available to some landholders and ineffective extension (emphasis) on ground preparation and the level of commitment required for post-planting maintenance, may have also contributed to some of the sites performing poorly.

***Effectiveness in meeting objectives*:**

The project was largely successful in establishing suitable farm forestry demonstration sites geographically spread throughout the Northwest. It was also effective in collecting information on species early performance and good establishment practice and making this information available (i.e.

farm forestry manual). A number of species suitable for farm forestry in the northwest can now be recommended with some confidence (and a few species that should be avoided).

The acceptance of farm forestry as a land use in the northwest is, however, a long way off. Only 3 of the participating landholders for instance have demonstrated any wish to make commercial use of their planting or are conducting farm forestry under their own initiative anywhere else on their properties. The majority of participating landholders established woodlots principally for property amenity or other environmental objectives. The Project Managers had difficulty in finding collaborating landholders – responses to initial advertisements for the project were poor. Field day attendees demonstrated polite interest but few expressed any real desire to implement farm forestry on their properties. The project also established farm forests in a limited number of configurations (ie either belts or woodlots), other configurations such as wide spaced plantings, agroforests or alley farms were not represented.

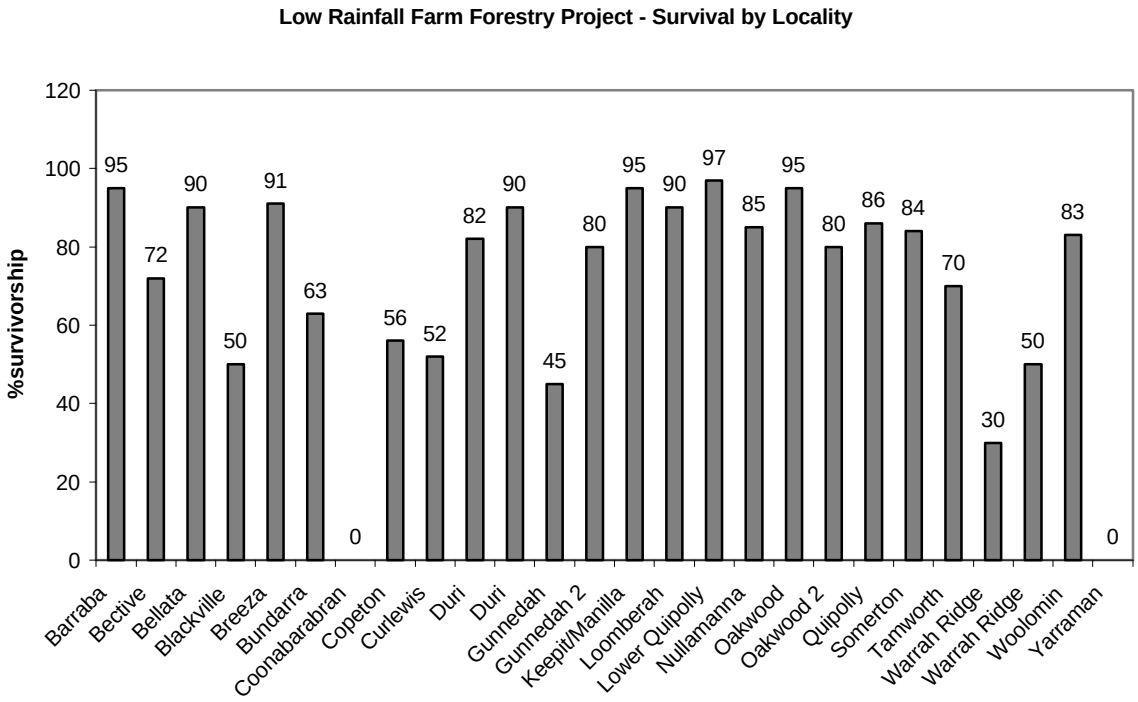
Suggested Improvements for Future Projects.

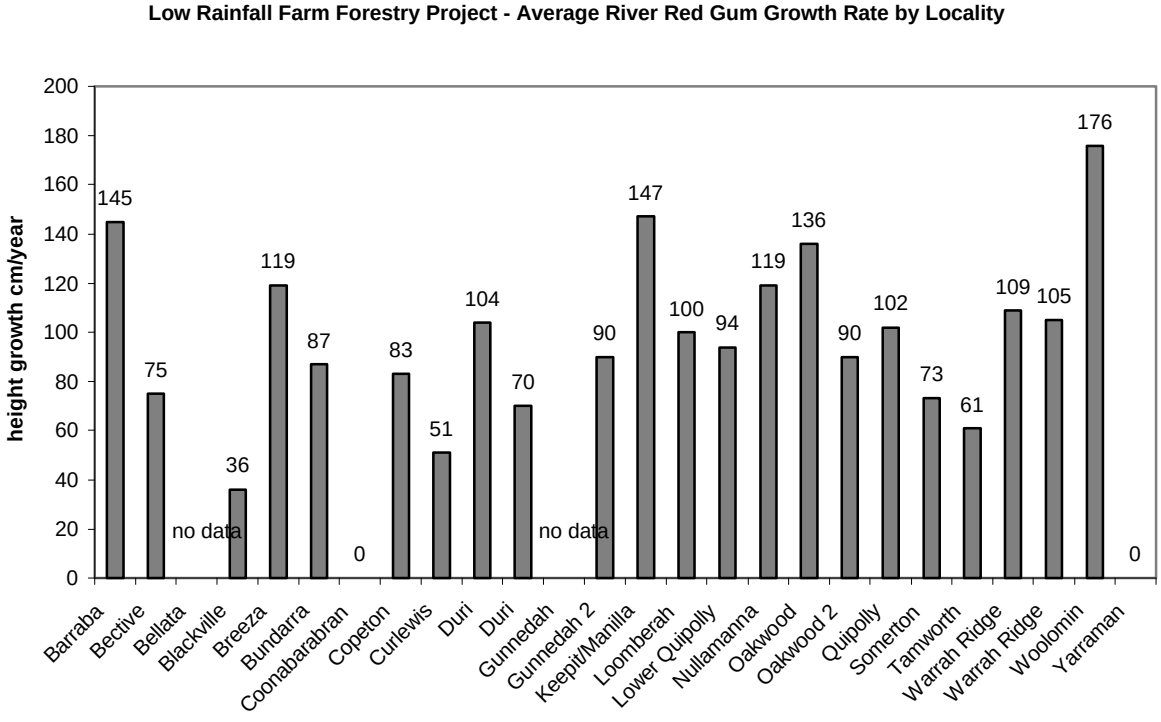
The Low Rainfall Farm Forestry on a Landscape Scale project has resulted in the establishment of a number of useful demonstration sites and the collection of a large body of technical information. However, in terms of its broader long-term objectives it represents a humble beginning. For farm forestry to be useful in this region, in terms of providing sufficient timber producing scale for industry viability and to have landscape wide effectiveness in improving recharge control, it must have a much larger adoption rate. Future projects will be required to build on this current project if this is to happen.

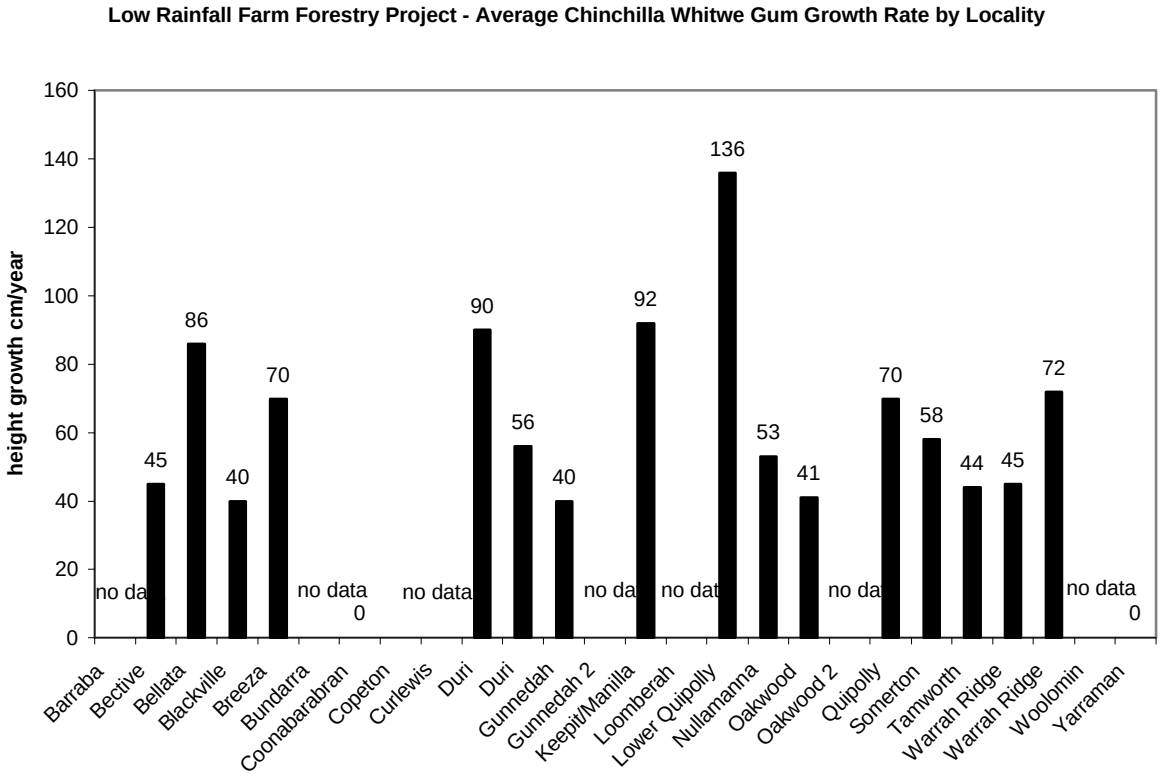
Suggestions for improving future projects include:

1) Utilising landcare or other natural resource management networks to promote the project and enlist landholder partners – including making use of existing group facilitators for this type of promotion;
2) More effectively networking participating landholders and engendering exchange of information and the development of peers;
3) Establishing cluster groups of close neighbour participants targeting known recharge areas in high salinity hazard landscapes;
4) Conducting group learning into farm forestry (e.g. “Master Tree Growers” course) alongside onground works. (i.e. Utilise “Sustainable Grazing Systems” or “Living Landscapes” experiential learning approach);
5) Ensuring a full range of ground preparation, tree planting and post planting maintenance equipment is available to participants;
6) Offering and promoting a range of farm forestry planting configurations, configurations that integrate trees into other forms of agricultural production may well appeal to a wider group of farmers; and
7) Building on past projects – there are now many trials and demonstration sites established by various organisations (albeit all based on the woodlot/plantation model) throughout the Northwest. As they mature, these sites will be useful for group learning and demonstration in later age stand and stem management and ultimately harvesting and sawing studies.

Attachments – Summary data all sites
- Some of the early trial results







Mike and Jan Davey, Lower Quipolly - tree guard trial.

Established in spring 2000 this trial aimed to assess the impacts of different tree guards on the growth and form of three different farm forestry species. The site occurs on flat arable land on alluvial clay/loam adjacent to Quirindi Creek, Lower Quipolly. The site was ripped and cultivated and fallowed for 9 months prior to planting. Seedlings were drip irrigated for the first year or so after establishment and several post-planting shielded sprays of glyphosate kept weeds under control. The trial was established using a randomised block design with three replicates of each tree guard by species treatment with 25 trees for each plot. They were - species: *Eucalyptus camaldulensis*, *E. argophloia* and *E. sideroxylon*; - guards: milk cartons + 2 stakes, plastic 'gro-tube' sleeves with 3 stakes; and no guards.

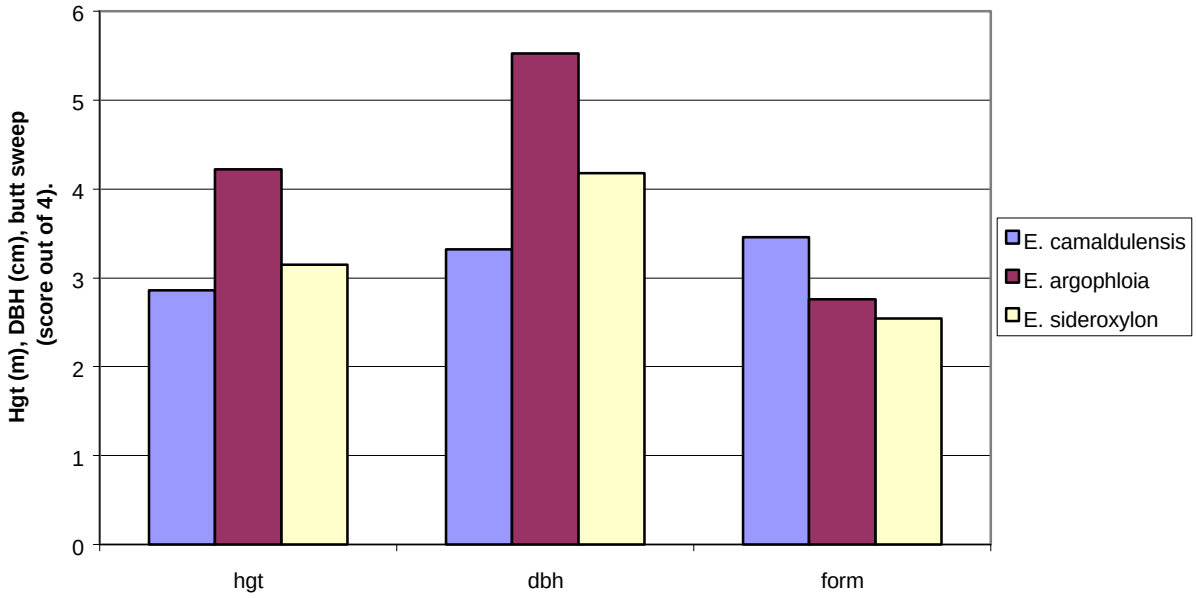
The site was monitored several times during the establishment phase, the last being in June 2003, where tree height, DBH and degree of butt sweep were measured for a representative sample of 10 trees in each of the 27 plots. Previous tree planting surveys have linked the incidence of butt sweep with the use of guards, one of the objectives of this trial was to substantiate or otherwise this relationship.

Butt sweep was scored using the following system:

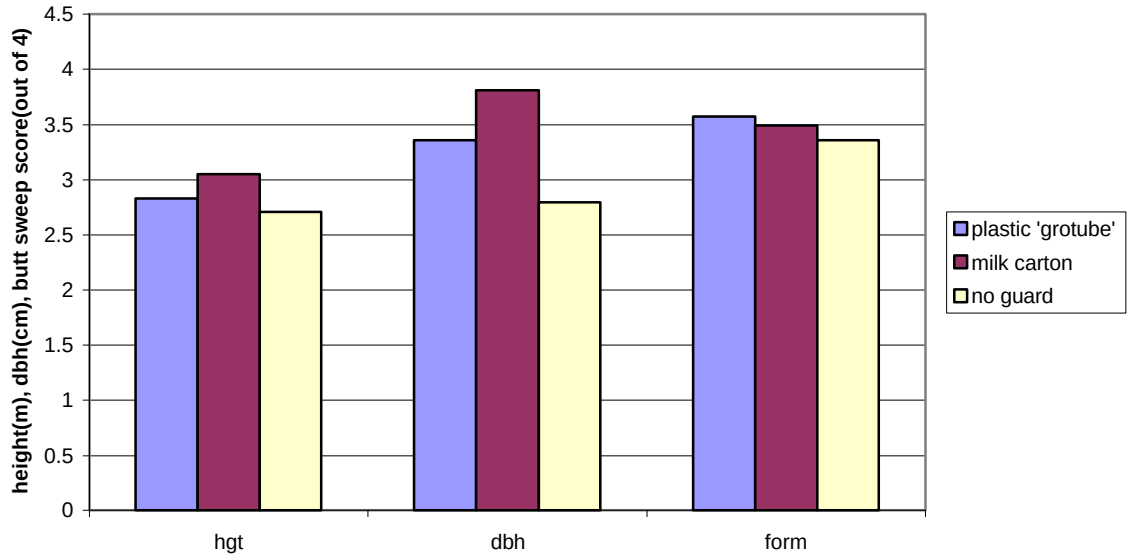
1- Significant butt sweep - centre line of stem at breast hgt deviates by more than 20cm from the centre line of the stem at ground level.
2- Moderate butt sweep - centre line of stem at breast hgt deviates by 10 to 20cm from the centre line of the stem at ground level;
3- Slight butt sweep - centre line of stem at breast hgt deviates by less than 10cm from the centre line of the stem at ground level;
4- No butt sweep – stem progresses directly vertically from ground level.

Results from the last measurement (June 2003) are summarised in the following histograms.

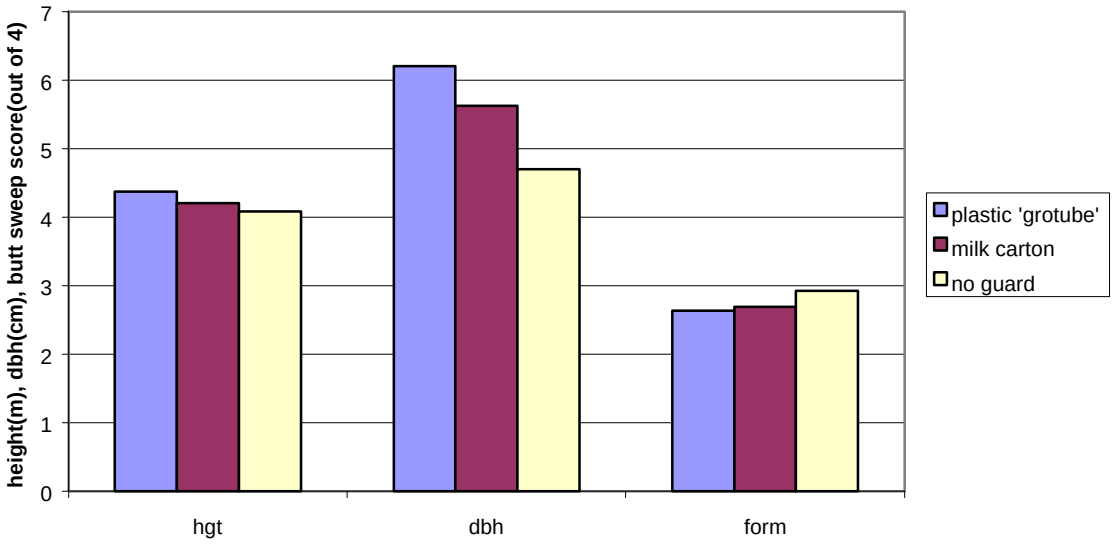
Comparative height, trunk diameter and form score of three farm forestry species age 2.7years - Greening Australia species x tree guard trial, Lower Quipolly.



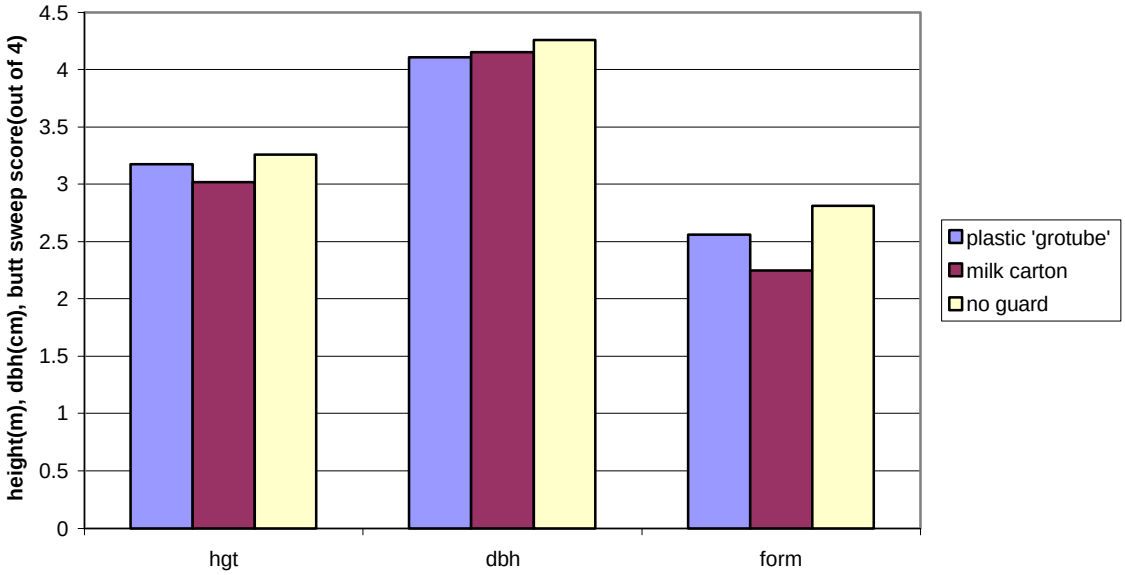
Comparative height, trunk diameter and form of *Eucalyptus camaldulensis* age 2.7years according to how they were guarded - Greening Australia species x tree guard trial, Lower Quipolly.



Comparative height, trunk diameter and form of *Eucalyptus argophloia* age 2.7 years according to how they were guarded - Greening Australia species x tree guard trial, Lower Quipolly



Comparative height, trunk diameter and form of *Eucalyptus sideroxylon* age 2.7years according to how they were guarded - Greening Australia species x tree guard trial, Lower Quipolly



Main findings:

There was no association between species and the type of guard used and survivorship – this was universally high in the trial overall (>97%). There were significant growth and form differences between species in the trial. *E. argophloia* generally grew faster than *E. sideroxylon*, which outperformed *E. camaldulensis* (in both hgt and DBH growth). *E. camaldulensis* had significantly better form (lower degree of butt sweep) than the other two species ($P<0.01$).

The use of guards was associated with different growth and form attributes for each tree species.

For *E. camaldulensis* and *E. argophloia* there was no association between tree hgt or degree of butt sweep with any guard treatment. However unguarded trees had a lower DBH on average than guarded trees ($P<0.01$).

For *E. sideroxylon* there was no association between tree height or DBH with any guard treatment, however trees guarded with milk cartons had a significantly higher degree of butt sweep than unguarded trees ($P< 0.05$).

The planting was notable for the very high growth rates achieved (no doubt assisted by the drippers and excellent post-planting weed control) and the poor performance of a northern Australian provenance of *E. camaldulensis* (Mareeba). Such provenances are now not recommended due to their poor performance in other trials in southern Australia (ALRTIG, 2002). The main findings concur with previous survey results that milk carton guards are associated with slightly higher levels of butt sweep in one of the species trialled (Mugga Ironbark *E. sideroxylon*) but not in the other two species. The guards appear to have enhanced early diameter growth in *E. camaldulensis* and *E. argophloia*.

Breeza species trial – NSW Agriculture, Liverpool Plains Field Station.

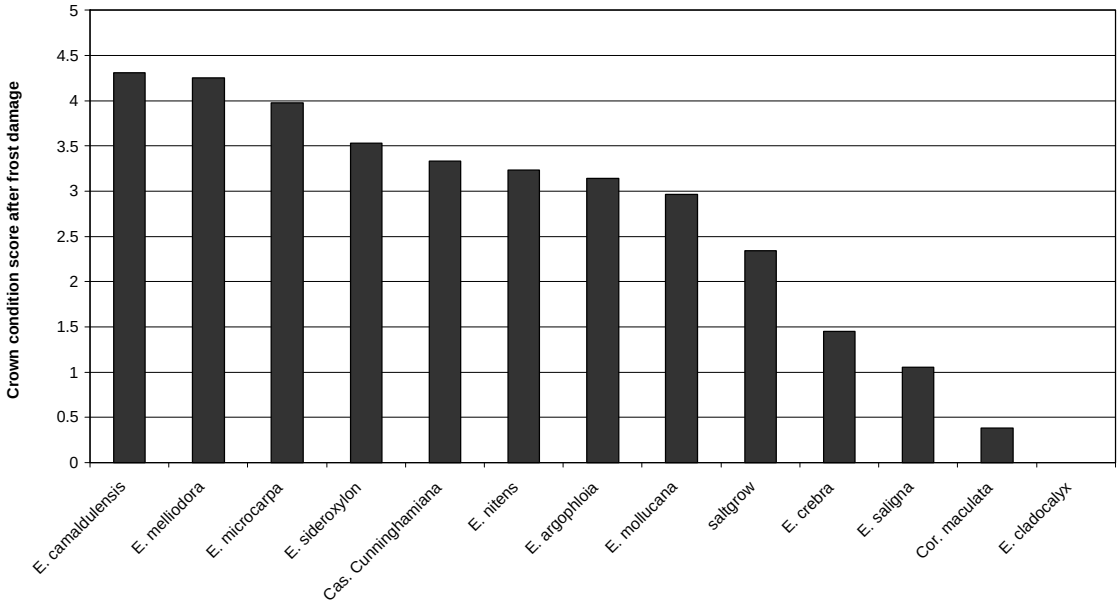
This trial aimed to compare the growth and survival of 13 different potential farm forestry species on the black soil of the Breeza plain. It was established in June 2002 after thorough planting bed preparation and long fallow in a paddock designed for flood irrigation. The planting was irrigated several times in the growing season that followed to ensure establishment but will not be irrigated after this. It was laid out in a rectangle shaped randomised block design with 4 replicates. Each plot was established with 40 seedlings of each species (spaced at 3m between plants and 3.6m between rows) in lots of five rows of eight plants. The following species were established:

River oak *Casuarina cunninghamiana*
Spotted Gum *Corymbia maculata*
Chinchilla white gum *Eucalyptus argophloia*
River red gum *E. camaldulensis*
"Saltgrow" hybrid *E. camaldulensis x E. grandis*
Sugar gum *E. cladocalyx*
Narrow-leaved ironbark *E. crebra*
Yellow box *E. melliodora*
Western grey box *E. microcarpa*
Grey box *E. mollucana*
Shining gum *E. nitens*
Sydney blue gum *E. saligna*
Mugga ironbark *E. sideroxylon*

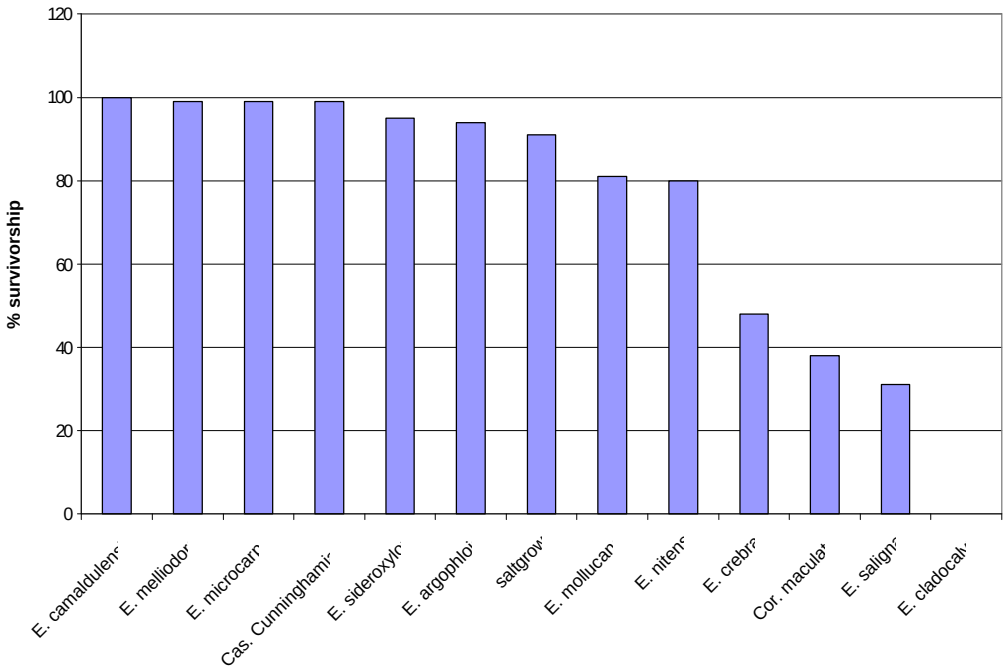
As it happened the winter of 2002 was a significant drought winter with very little rainfall and many severe frosts. This coincidence allowed species comparisons under severe frost conditions. The trial was monitored in October 2002 after the last frost, for % survival and crown condition. For crown condition each plant was assessed and scored using the following scale for frost damage: score 0=dead, 1=original crown dead resprout from base, 2=crown dead resprout along stem, 3=>50% original crown frosted, 4=<50% of original crown frosted, 5= leaf tip damage only, 6=no apparent damage.

The results of the first monitoring are summarised in the following histograms.

Mean crown condition scores after frost damage for 13 farm forestry tree species in a replicated trial at NSW Agriculture's Breeza Research Station - planted June 2002 monitored Oct 2002



Mean % survivorship after frost damage for 13 farm forestry tree species in a replicated trial at NSW Agriculture's Breeza Research Station - planted June 2002 monitored Oct 2002



Main findings:

There were significant differences in survival between species over the winter of 2002 in the trial. Sugar gum was badly affected by frost with 100% losses, as was Sydney Blue gum with 69% losses. However this may have resulted from the small development of the nursery stock of these species. Both the Sugar gum and Sydney blue gum seedling stock was acquired just before trial establishment and had only a week of hardening off on site before planting. The seedlings of all other species were robust and well hardened prior to planting. Of the well-hardened species Spotted gum was badly affected by frost with only 37.5% survival overall and a very low crown condition score at the time of monitoring, most plants of this species were re-sprouting from the base with total loss of the original leaves. E. crebra also suffered significant losses (47.5% survival) and had a low mean crown condition score. E. mollucana and E. nitens were intermediate in terms of survival (81% and 80% respectively) both had significantly higher survival rates ($P<0.05$) than the four previously mentioned species, but significantly lower survival compared to all other species. The remaining species River oak, Chinchilla white gum, 'Saltgrow', Mugga, Western grey box, Yellow box and River red gum all had relatively high survival rates and there were no significant differences between them. In terms of crown condition for this group of species, River red gum had the highest mean score with most plants having only part of their crown or the leaf tips damaged by frost with many plants apparently unaffected. Of this group "saltgrow' plants had the highest degree of crown damage due to frost.

Tamworth species, spacing and mounding trial. – Tangarrata Stock Feeds.

Established at Tangarrata Stockfeeds 8km west of Tamworth in September 2002. This trial was designed to examine the effect of spacing and the type of planting bed design on the survival and growth of six potential farm forestry species. The 2ha trial was part of a ten-hectare demonstration planting. It was layed out using a full 'Nelder Fan' circle where planting beds formed 36 radii 80m long. Two sets of three radii were randomly allocated to each of the following tree species (ie two replicate plots for each species in the trial).

River oak Casuarina *cunninghamiana*
Chinchilla white gum *Eucalyptus argophloia*
River red gum *E. camaldulensis*
"Saltgrow" hybrid *E. camaldulensis x E. grandis*
Western grey box *E. microcarpa*
Mugga ironbark *E. sideroxylon*

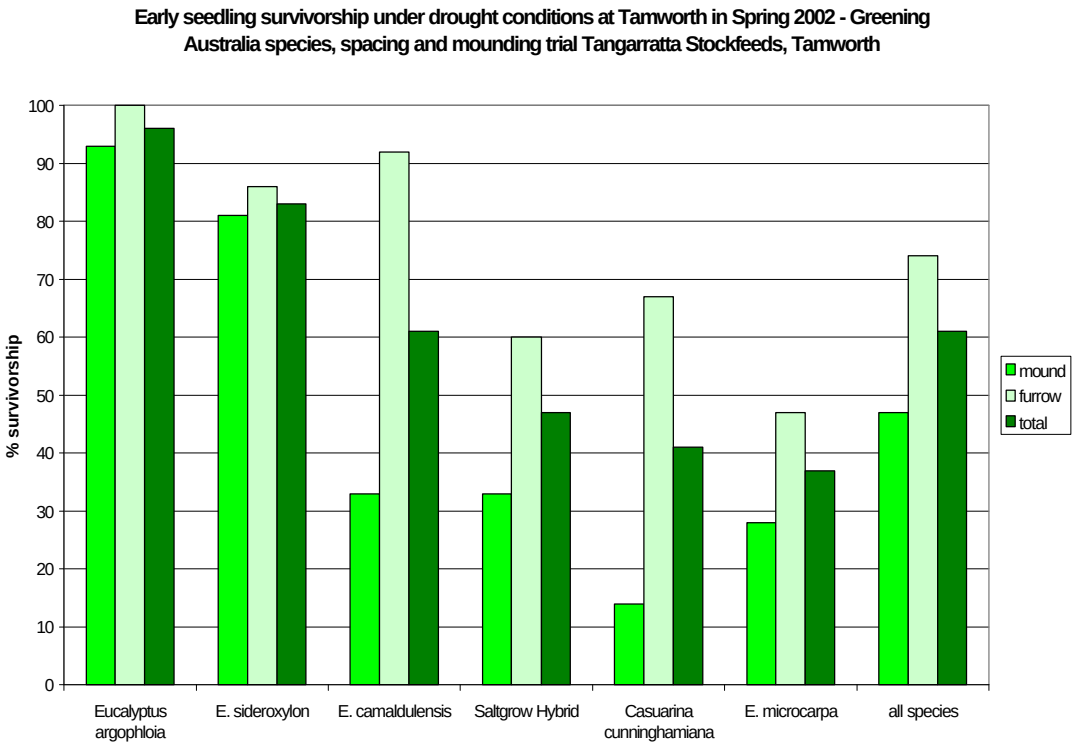
Planting beds were approximately 1m apart close to the centre of the fan (the central circle of 10m in diameter was not planted) and 14m apart at the edge of the circle. Seedlings were planted at increasing distance apart along each radii so that the effective plant spacing varied along a gradient from 1m apart (10,000 stems/ha) out to 14m apart (51 stems/ha). The 1.2m wide cultivated planting beds were alternatively formed into either a mound (approx 250mm high) using a twin disc mounding plough, or a furrow (approx 150mm deep) using a grader. The beds were established with approximately 18 months fallow on a poorly structured red brown earth. The seedlings were planted on the 24th September in the drought of 2002. No rainfall was recorded at all for the first 3 weeks, and no significant rain was recorded until Feb 2003, 3 post-planting waterings by hand were conducted during this period. Survival monitoring was conducted in October 2002, after which the considerable losses (39%) were replanted (any further losses over the summer (around 20%) were replanted in April 2004 –losses from this point on were minimal) and height growth was measured in June 03. The results of both measurements are summarised in the following histograms. The effect of spacing has yet to be assessed.

Main Findings:

There were significant differences between species in their early survival under drought conditions. *E. argophloia* and *E. sideroxylon* both had relatively high rates of survival (>80%) whether they were planted on mounds or furrows. *E. camaldulensis* planted in furrows also had high survival rates (>80%) but drought losses were high when planted on mounds (33% survival). *E. microcarpa* had the lowest average survival rates (37%) overall while *C. cunninghamiana* had very low survival rates when planted on mounds (14%), but moderate survival rates when planted in furrows (67%). The other

species had intermediate mean survival rates. All species had higher early survival rates when planted in furrows when compared to mound planting during this drought season.

Interestingly after 9 months, mound planted seedlings were on average taller than furrow planted seedlings (despite the higher rate of replacement plantings on mounds, and hence younger plants at the June measurement). This trend was consistent for "Saltgrow" hybrids, River oak, Mugga ironbark and Western grey box. There was no significant difference in height between mound and furrow planted River red gum or Chinchilla white gum at age 9 months.



Comparative early height growth of tree species measured at age 35 weeks, June 03 - Greening Australia species, spacing and mounding trial Tangarratta Stockfeeds, Tamworth