
PROJECT: Species Testing and Genetic Improvement of Forest Trees for the Northern Territory (RIRDC/LWRRDC/FWPRDC) Joint Venture Agroforestry Program

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Location: Top End of the NT and two sites in Northern Queensland.

Objectives:

Develop a farm forestry industry in the Northern Territory by providing information on the adaptability and potential growth rates of existing high quality native and exotic genotypes on a range of sites in the region.

Develop facilities suitable for genetic seed production and selection of superior plants for further breeding work.

Maintain the acacia and eucalypt genetic facilities of QFRI in North Queensland.

Improve the expertise of DBIRD staff in genetics and tree breeding.

The methodology for this project was based on a staged approach for the rapid development of high yielding forest tree varieties. These stages include:

- ? Parallel testing of 'best bet' taxa (species, provenances and hybrids).
- ? Development of commercial varieties matched to sites from the superior taxa identified in trials.
- ? Infusion of new genetic material including various locally produced hybrids.
- ? On-going breeding for refinement of superior varieties.

The approach also incorporates best practices in all aspects of the project, and maximises the publicity and effective 'take up' of the results.

Method:

Trees were planted for a taxa trial in the Darwin River region and a seedling seed orchard at Howard Springs during the 2000-01 wet season. The 1.7 ha area at Darwin River was planted with 32 different species, provenances, hybrids and clones of hardwood trees for evaluation in the NT environment (see Table 1 for species composition). At Howard Springs, the eucalyptus pellita seedling seed orchard was established on a 3-ha site comprising four provenances planted in a randomised complete block design replicated across the site. As the number of families varied between each of the provenances, it was decided to plant two rows of each of the Kiriwo and Goe (PNG) provenances per block and one row of each of the Melville Island and Serisa (PNG) provenances per block. The large number of families in the Kiriwo and Goe provenances is shown below.

- ? A bulk lot of 30 selected from a Melville Island provenance trial (seed lot 19718).
- ? A Kiriwo provenance from PNG (seed lot 19206) – 71 families.
- ? A Goe provenance from PNG (seed lot 19207) – 59 families.
- ? A Serisa provenance from PNG (seed lot 18199) – 12 families and a Serisa provenance from PNG (seed lot 18955) – 24 families. These two provenances were bulked together.

Seedlings were planted in 16 rows with six rows per block and a total of 36 blocks. The spacing was 4 m between rows and 2 m along the rows, resulting in a stocking rate of 1,250 stems/ha. After planting, 50 kg/ha of phosphorus was applied in a circle around each seedling at both sites. At both the taxa and the seedling seed orchard trials, preparation consisted of deep ripping and mounding rows and a pre-plant application of glyphosate along the rows at 1-2 L/ha. A post-planting spray of Simazine was applied only along the rows, approximately 1 m wide at 6 L/ha for residual weed control. Slashing the inter rows has been maintained at both sites to reduce weed growth. Hand spraying with glyphosate was necessary at both sites to reduce initial weed competition on the seedlings as the Simazine had minimal effect at the rate applied, especially on the heavier clay site.

Table 1. Species and provenance composition in the taxa trial at the Darwin River property

Species	Provenance	Seed lot No./Source	Experiment
<i>Eucalyptus pellita</i>	Melville Island, Serisa (PNG) and Qld SSO	19718, 18199/18955 and 5203	Taxa trial
<i>Acacia crassicarpa</i>	Oriomo (PNG) and Fiji SO	19731 and 20003	Taxa trial
<i>Acacia mangium</i>	Qld SO	10204	Taxa trial
<i>Eucalyptus camaldulensis</i>	Katherine and Thai SO	10537 and 20383	Taxa trial
<i>Eucalyptus cloeziana</i>	Herberton and Koorboora	137 and 10682	Taxa trial
<i>Corymbia citriodora</i>	Hughenden and Glenden	11148 and 10895	Taxa trial
<i>Eucalyptus tetradonta</i>	Darwin collection	Local Darwin region	Taxa trial
<i>Corymbia nesophila</i>	Cape York Qld	North Queensland	Taxa trial
Eucalypt hybrid clones	<i>E. camaldulensis</i> x <i>E. grandis</i> (C x G)	Kleinig collection clones No. 9,10,11 12,13 and 20	Taxa trial
Eucalypt hybrids seedlings	<i>E. urophylla</i> x <i>E. pellita</i> and <i>E. urophylla</i> x <i>E. grandis</i>	M1677 x lep6-034, M1677 x lep7-015, 012 U X G (B5993) and (B10509)	Taxa trial
<i>Khaya senegalensis</i>	Darwin collection		Taxa trial
<i>Khaya anthotheca</i>	Darwin collection		Taxa trial
<i>Pterocarpus dalbergioides</i> and <i>P. macrocarpus</i>	Darwin Collection		Taxa trial
<i>Chukrasia tabularis</i>	Thanh Hoa Vietnam	20035	Taxa trial
<i>Swietenia humilis</i>	Central America		Taxa trial

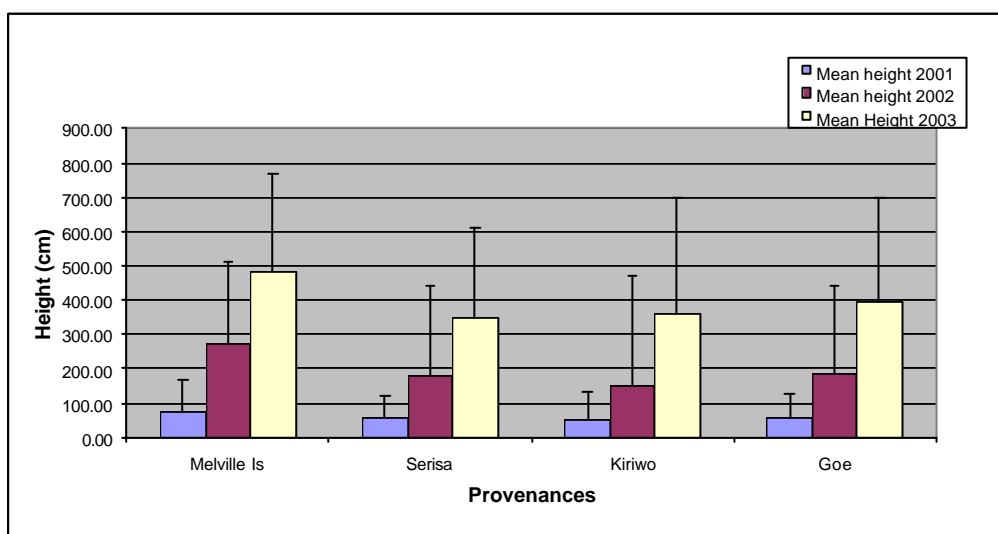
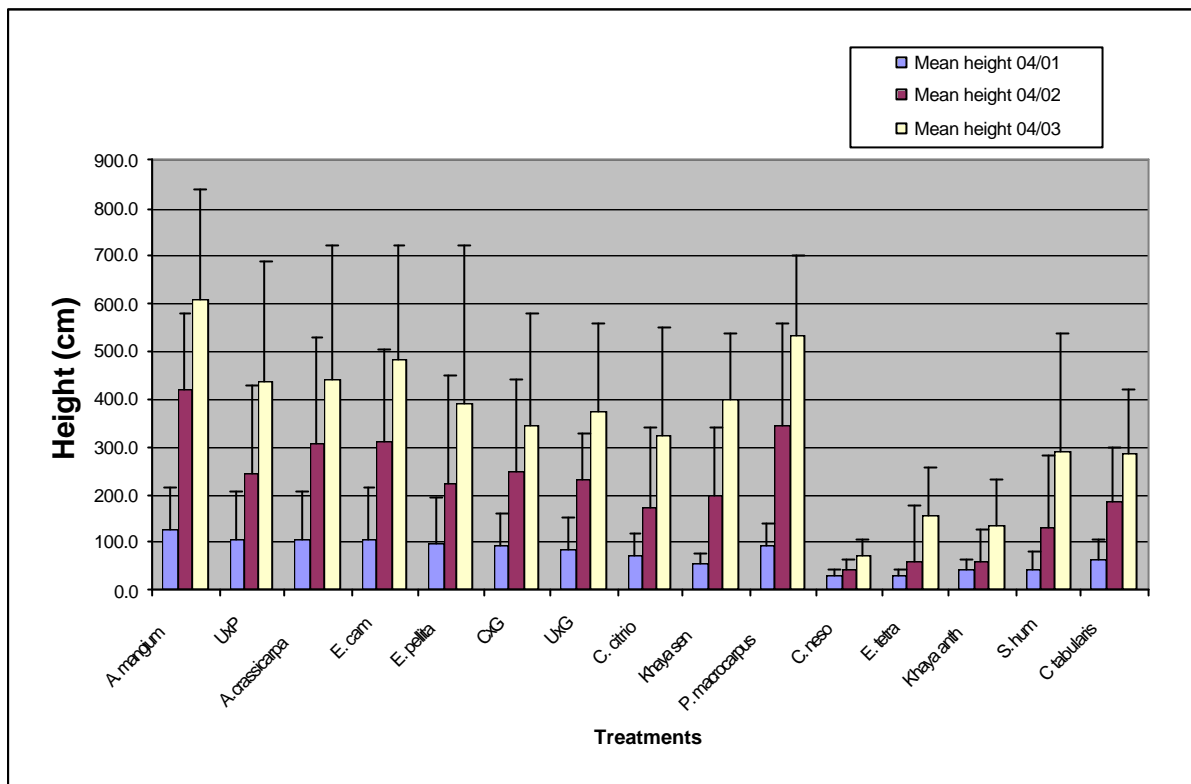


Figure 1. Mean height of *E. pellita* provenances at Howard Springs at 4, 15 and 27 months



Error bars indicate maximum heights

Figure 2. Mean height of species in NT taxa trial at the age of 4, 16 and 28 months

Figures 1 and 2 indicate very promising results for some species and provenances. In the *E. pellita* SSO the best performing provenance was the Melville Island provenance with an average height just under 5.0 m and maximum heights of over 7.5 m. The Goe provenance is next with an average height of 4.0 m with Serisa and Kiriwo having average heights over 3.5 m. Survival across the seven selected blocks (that were refilled after deaths) that are measured is very good but survival across the whole block is poor due to termite attacks that have now been controlled with the assistance of the Termite Group. Some trees have already been observed with seed at only three years of age. However, seed will not be collected until inferior trees are thinned so that only the best trees in terms of growth and form contribute to the breeding program.

The results of the taxa trial at 28 months are somewhat disappointing in that the genetically improved hybrids and clones are being out-grown by the unimproved pure species of *E. pellita* and *E. camaldulensis*. These species are both components of the G x U and U x P hybrids and the G x C clones. The best performing species is the fast growing *Acacia mangium* with an average height of over 6.0 m. The exotic species, *Pterocarpus macrocarpus* is the next in terms of growth and is the tallest of all the high value hardwood species with an average height over 5.2 m in 28 months.

In the second year of the project, it was decided that the African mahogany, *Khaya senegalensis* warranted further work to improve the form of the species and to conserve the genetic resource of a series of provenance trials at Gunn Point. There is uncertainty about the future of these valuable plantings at Gunn Point site due to wild fires, land tenure changes and development proposals in the area.

Khaya senegalensis or the dry zone mahogany from the Meliaceae family is a large semi-deciduous tree to 35 m in height and over 1 m in diameter. The timber is considered to be of very high quality and its uses include furniture making, plywood, counter tops, joinery, turnery and carving. In Africa it occurs in riverine forests and higher rainfall savannah woodlands. Its distribution is from Senegal on the west coast, to Sudan and Uganda on the eastern side of the continent. Khaya is adaptable to a wide range of soil types and will tolerate seasonal water logging. During the first year of growth, the tree develops a strong, deep taproot, which makes it the most drought-hardy of all the Khaya species - hence the common name, "dry zone mahogany".

To satisfy the needs of a number of prospective growers interested in planting and developing plantations of the species, we should be in a position to provide them with good genetic material. During 2001, we selected superior candidate trees on the Gunn Point site. Each selected tree was allocated a number and coordinates and measurements were recorded. Scion material was collected from these superior trees and grafted onto rootstock, (previously collected as striplings and grown in the nursery). Enough grafted clones were produced off a range of selected trees within each provenance to establish a 384 tree clonal seed orchard at Howard Springs and a 192 tree clonal seed bank at Berrimah Farm in the 2001-02 wet season.

Table 2. Provenances of *Khaya senegalensis* represented by year of planting at Gunn Point

(The number of selected trees from each provenance are in brackets)

Seed code	Provenance	1970/71 (EP 363b)	1971/72 (EP388)	1972/73 (EP420)
D391	Central African Republic	(7)	(1)	-
D407	Uganda	(5)	-	-
D408	Uganda (West Nile)	(3)	-	-
S9620	Uganda (West Nile)	(2)	(3)	-
S10053	Uganda	-	-	(4)
D411	Togo	(6)	-	-
D415	Upper Volta	(4)	(4)	-
D416	Upper Volta	(4)	(5)	-
D417	Senegal	(5)	(4)	-
S9392	Senegal (69)	(5)	-	-
S10066	Senegal	-	-	(5)
S9368	Sudan	(2)	-	-
S9687	Sudan	(5)	(5)	-
D477	New Caledonia	-	(3)	-
D487	New Cal.(ex Ivory Coast)	-	(6)	-
D522	Noumea New Caledonia	-	-	(4)
S10050	Ivory Coast	-	(5)	-
D480	Nigeria (Jos)	-	(6)	-
D486	Nigeria (Yola)	-	(5)	-
D500	Ghana	-	(5)	(6)

After planting, assessments for health and survival have been undertaken at regular intervals. Further height measurements in July 2003 indicated the top clones common to both the CSO and CCB were:

Clone No.	Seed lot No.	Provenance
8	D522	New Caledonia (ex Ivory Coast)
14	S10066	Senegal
17	S10066	Senegal
22	D480	Jos Nigeria
25	S9687	Sudan
34	D500	Ghana

The final taxa trial established in the series of genetic improvement trials was funded by RIRDC and located on a site at Howard Springs.

The second of the taxa trials was established over two days, on 31/12/02 and 2/1/03 on government land at the Howard Springs site adjacent to the *E. pellita* SPA. The design consisted of eight treatments with four replications. An individual tree application of 200 g of NPK fertiliser (6:14:14.2) was applied on 6/1/03. Superimposed on top of this in replications 1 and 3 was an application of agricultural lime at a rate of 3858 kg/ha applied into the deep ripped lines before planting. This rate was calculated so as to bring the soil optimum calcium level to 600 ppm. The initial soil test indicated a soil pH of 5.3 and the application of lime was intended to raise the pH to about 6.0

Overall survival at the April measurement (age four months) was good except for *E argophloia* (17%) and the Corimbia hybrid complex (67%). The two outstanding species for height growth were *A.crassicarpa* (mean height 148.5 cm) from the Fiji seed orchard, and *Pterocarpus indicus* (mean height 150 cm). Since the April recording there have been some losses to *Mastotermes darwinensis* (giant termite). A baiting program has commenced. The *E. pellita* SPA has similar termite problems, but seems to have slowed down after a concentrated baiting program.

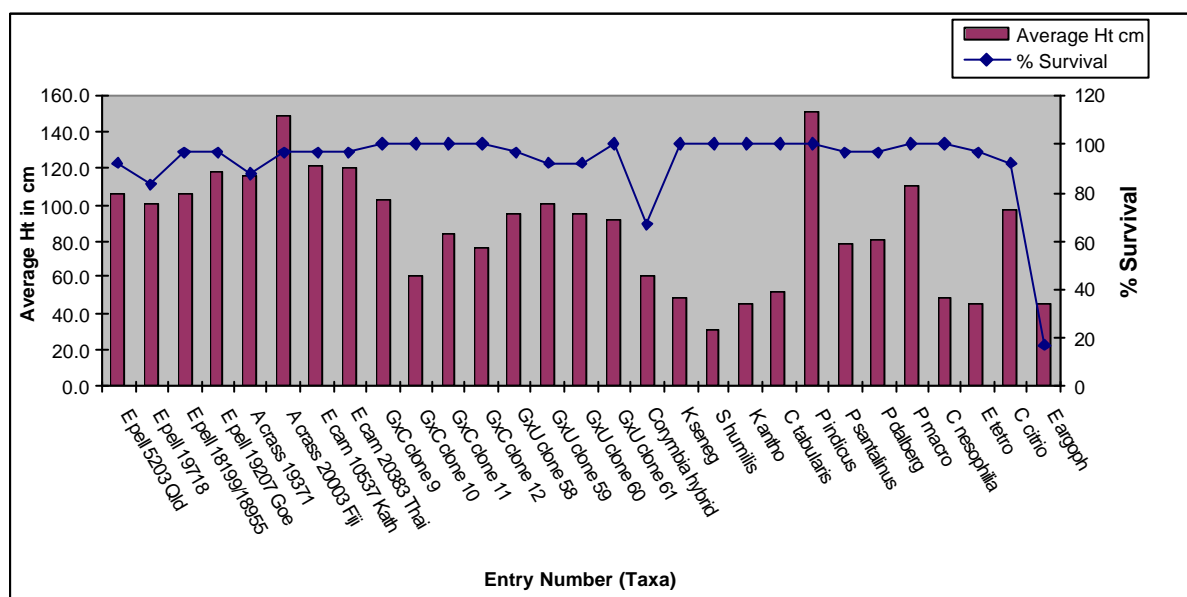


Figure 3. Howard Springs taxa trial - height (cm) and survival (%) at the age of four months