

# EUCALYPTS IN COSTA RICA

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fast growing species

Introduction of species from the genus Eucalyptus in Costa Rica date back to 1965, when a series of trials were started at CATIE, Turrialba. Among the better known species were: Eucalyptus deglupta, E. alba, E. citriodora. In 1968 small species and provenance trials were started of the more promising species being Eucalyptus deglupta, E. grandis and E. saligna. In the same year a FAO Forestry Project in Costa Rica started species trials in different sites throughout the country with special emphasis on Eucalyptus trials in the Meseta Central and in the Pacific lowland. When this project ended the trial plots were handed over to the Forest Department of the Costa Rica Ministry of Agriculture.

Due to lack of specific data of other Eucalyptus species the only eucalypt which is used locally for plantation purposes is Eucalyptus deglupta.

The following is a summary of data on this species accumulated through research carried out at CATIE by CATIE staff members and graduate students.

## 1. Seed

Two seedlots of E. deglupta have been imported by CATIE in 1965. Both came from Goroko, Papua, New Guinea. Since even young trees (3-4 years) produce viable seeds in appreciable quantities all the younger plantations have been established with seed locally harvested. There are said to be two cross-varieties: a pink bark and a green bark variety, of which it appears that the pink-variety grows extremely fast. This matter needs to be further investigated. The seed may be harvested nearly the whole year round, since flowers, immature fruits, mature fruits and opened capsules can be found on one branch throughout the year. The germination capacity is high and the seeds, if well dried, can be cold stored (+ 5°C, 15-20% rel. hum. of the air) for a reasonable period of time without losing too much of its viability.

### Nursery technique

The seed may be sown in sand-filled germination boxes, with or without additional heating by infrared or other lights. Care should be taken for damping off, avoiding excessive humidity and/or frequent spraying with Captan 50. The seedlings are pricked out in polythene tubes filled with a mixture of 75% nursery soil and 25% sand. After three months when the plants are 25-35 cm high they are ready for field planting.

### Plantation technique

Depending on the production objective the initial spacing should be at least 1,5 x 1,5 m. At the closer spacings of 1,5 x 1,5, 2 x 2 and 2,5 x 2,5 m, the growth rate is such that a thinning should be carried out after 9 months, 1 year and 1 1/2 year respectively. The product could serve for tomato or bean supporting sticks, banana props -presently much in demand- and small fence posts. Unless there is a market for these small dimension products the initial spacing should be at least 3 x 3 m, since the species shows good apical dominance with fine branching characteristics and is self pruning.

The species requires a fairly deep moderately fertile soil which must be well drained. Low fertility could be overcome by bimonthly doses of NP fertilizer (20-20-0), (Ammonium Nitrate 33,5% and triple superfosphate 46%), or even a MPK fertilizer. Due to the sensitivity to weed competition and other characteristics of the species, it offers excellent possibilities for plantation through the modality of the Taungya system as has been shown by various studies at CATIE. If planted at 2,5 x 2,5 or 3 x 3 m the canopy closure will be so rapid that agriculture can be practiced only during the first year. Possible crops are corn, beans, sweet potato, *maize* maybe the species will show good results with a cover crop such as Pueraria phaseoloides (tropical kudzu) eliminating the weeds, covering the soil and even improving it by means of nitrogen fixation. Small farmers could use the kudzu-leaves for additional cattle fodder. Direct grazing of kudzu is not recommended.

### Pruning and thinning

The species is self pruning. Only in very open stands could additional pruning be considered, especially if high quality timber is required.

A tentative thinning schedule for two different initial spacings is presented below, indicating the numbers of trees to be retained per hectare.

Initial spacing	2.5 x 2.5 m	3 x 3 m
age 1 1/2 yrs	800 tr/ha	555 tr/ha
age 5 yrs	500	375
age 8-9 yrs	350	250
age 11-12 yrs	250	200
age 15 yrs	clear felling	

Remarkable with this species is the presence of abundant undergrowth especially in the more widely spaced plantations. Apparently there is a complete absence of water stress. Although experience does not permit to state exact rotation ages it is thought that the following table could be useful as a guideline:

<u>Production objective</u>	<u>Rotation period</u>
banana props	1 - 2 years
fence posts	2 - 4 years
pulp and telephone poles	6 years
mine (pit) prop	6 - 8 years
sawtimber	12 -15 years

The species is not apt for plantation in pasture land or for plantation with limited grazing on the undergrowth. As has been shown by trees planted in pastures at CATIE farm, cattle will damage the bark and compact the soils resulting in adverse growing conditions.

Increments

Height increment of Eucalyptus deglupta is a spectacular 4-5 m. during the first year after transplanting in the field and 3 meters annually during the following 5 years. Diameter increment is less impressive but still appreciable with average 1 cm during the first year and 2,5 -3 cm/yr during the following 5-7 years. Exceptional trees reach much higher increments. Trees have been measured in plots at different sites near Turrialba and Limon. For comparison purposes growth data of other eucalyptus than E. deglupta have been included. The results are given in the table below:

Measurements in sample plots (established within plantations, thus eliminating edge effects)\*

Site	Plot size ha.	Age yrs	Initial spacing m.	Trees/ha ilo/ha	Mean DBH cm.	Mean Height m.	AB/ha m <sup>2</sup> /ha	MAI m <sup>3</sup> /ha/yr	S% %
1.a. Florencia Norte	0,15	1,8	2,5 x 2,5	1600	6,9	8,2	6,1	-	27,2
b. Florencia	0,15	1,8	3 x 3	1111	7,1	8,0	4,4	-	35,1
2. Bajo Toronto	0,1	5,2	2,5 x 2,5	820	13,7	17,8	12,1	19,2	18,8
3. Florenc. Norte	0,1	3,8	2,5 x 2,5(T)	270	25,3	22,3	13,6	15,9	28,4
4. Bajo Chino	0,1	8,8	2,5 x 2,5(T)	360	28,0	27,9	22,2	32,6	18,3
5. Florencia Sur	0,1	9,2	3 x 3 (T)	610	21,8	26,3	26,3	20,9	14,9
6. Moín (Limón)	0,1	7	2,5 x 2,5 after thinn.	1150 570	14,3 20,7	21,5 26,0	22,6 19,0	31,9 31,9	11,2 15,7

(T) = thinned

\* Site 1-5 in Turrialba; site 6 close to Limón. See detailed site descriptions below.

Measurements in species introduction plots (all trees measured, edge effect present)

7. Florencia Sur									
<u>E. deglupta</u>	0,03	9,0	2,5 x 2,5	1170	20,9	22,4	39,9	-	-
<u>E. saligna</u>	0,03	9,0	2,5 x 2,5	1030	27,4	30,4	60,8	-	-
<u>E. grandis</u>	0,03	9,0	2,5 x 2,5	1100	26,2	30,3	59,4	-	-
<u>E. maculata</u>	0,03	9,0	2,5 x 2,5	1200	18,3	18,4	31,8	-	-
8. Puente Cajón									
<u>E. deglupta</u>	0,04	11,3	2 x 2 (T)	575	20,5	17,5	19,0	-	-
<u>E. alba</u>	0,04	9,3	2 x 2	1325	17,7	17,2	32,6	-	-

Note: DBH taken over bark, Height is total height;

Volume calculated with formula:  $V = AD \times \text{Height} \times f$

Form factor  $f = 0,46$

?

### Site descriptions

With the exception of site N<sup>o</sup> 6 all the plots are situated near Turrialba, at elevations between 580 and 680 m.a.s.l.

The total annual precipitation is 2700 mm and is well distributed throughout the year. The "driest" month is March with an average of 75 mm.

The mean annual temperature is 22.°C and the average relative humidity of the air is high at 88%.

The soils are generally deep, loamy to clayey, derived from volcanic material. Drainage is good where not stated specifically.

1. Florencia Norte. Established on gently sloping terrain. Taungya system, with corn during the first year. Very homogeneous stand, thinning is needed.  
Turrialba
2. Bajo Toronto. Plantation established on steep roadside. Formerly used as pasture (degraded). Bad drainage. Undergrowth of wild banana. Never thinned, a lot of suppressed trees, some trees crooked.  
Turrialba
3. Florencia Norte. Nearly flat terrain. Thinned systematically eliminating alternate lines in both directions. Leaving very open stand, trees with relatively wide crowns and some big branches. Reasonable stem form. Undergrowth of Impatiens balsamina and ferns.  
Turrialba
4. Bajo Chino Replication of plot 3. Very steep slope (80-100%).  
Turrialba Relatively open stand, reasonable stem form. Heavy weed undergrowth.

5. Florencia Sur Plantation on gently sloping terrain. Thinned in alternate lines in one direction. Good stem form. Heavy undergrowth of grasses and broadleaved saplings.
6. Limón (Moín) Plantation on gently sloping terrain, formerly used as cacao plantation. Poor drainage. A lot of suppressed and broken (wind) trees due to lack of thinning.  
Annual precipitation 3850 mm, no dry months.  
Mean annual temperature 25,5°C. Elevation 25 m.a.s.l.
7. Florencia Sur  
Turrialba Species trials on moderately fertile soils with reasonable drainage, nearly flat terrain. Grassy undergrowth.  
E. saligna and E. grandis outgrow E. deglupta on this site.
8. Puente Cajón  
Turrialba Species trials on poor soils with extremely bad internal drainage. Grassy undergrowth. Disease problems due to waterlogging.

#### Other Eucalyptus introductions in Costa Rica

Introductions of other Eucalyptus species in Costa Rica have been established in the period 1964/65 by the "Defensa Civil" Project at the slopes of the Irazú Volcano (where strong ash deposits resulted from the eruptions of Volcano Irazú in the previous 3 years), and in the period 1967/68 by the FAO Forestry Project on different sites at the Pacific side of the country. A brief appraisal of these introductions is given below, together with a table representing climatic data.

1. Irazú Volcano, S-W slopes, Sanatorio Durán altitude 2600-2800 m.  
Promising results with Eucalyptus globulus. Good stem form and good increment. This is an old plantation possibly over 30 years of age. The trees were cut in 1961 and they coppiced back.
2. Cartago, 1750 m.s.n.m. FAO plots 1967, adequate maintenance has only been given during the period of establishment of the trials. A very heavy undergrowth with creepers has developed since then.  
Eucalyptus camaldulensis (tereticornis?, grandis?) shows good results, with straight boles and high increments.  
Eucalyptus alba has a reasonable form and good growth rate.  
Eucalyptus citriodora shows straight stems and reasonable growth rate.  
Eucalyptus grandis (?) has a reasonable form, low increment and is suffering due to phytosanitary problems.  
Eucalyptus globulus failed although some trees survived.
3. Santa María Dota, 1850 m. FAO plots 1967, adequate maintenance has only been given during the establishment period. Noteworthy are:  
Eucalyptus camaldulensis, reasonable stem form and increment.  
Eucalyptus citriodora, good straight stems but lower increment than the former.
4. Juan Viñas, 1200 m. Plots established with assistance of CATIE, Turrialba in 1966/67 on the Finca El Sitio/Peet.  
Eucalyptus grandis/saligna, straight boles, impressive increment.  
Eucalyptus maculata, straight boles, good increment.  
Eucalyptus robusta, reasonable form and growth rate.  
Eucalyptus deglupta, moderate growth rate, poor form (crooked and whippy).

5. Liberia, 120 m. Plantation established by the landowner.

Eucalyptus deglupta, in spite of good maintenance the plants do not grow well and this species is not promising for plantation under these ecological conditions.

Site data

Corresponding trial plot N <sup>o</sup>	Site	Elevation	N <sup>o</sup> of dry months +	Precipitation per annum
1	Sanatorio Durán	2340 m	4	1528 mm
2	Cartago	1440 m	4	1316 mm
3	San Marcos T.	1430 m	4	2065 mm
4	Juan Viñas	1160 m	0	4287 mm
5	Liberia	140 m	5	1635 mm

+ Precipitation less than 50 mm/month.

With the assistance of Diversificación Agrícola, Turrialba, several plantations of Eucalyptus deglupta have been established under different ecological conditions in the valley of Turrialba and vicinity. The best results have been obtained in areas with a uniform rainfall distribution at elevations below appr. 800 m.a.s.l. A full evaluation of eleven of these plantations in different locations is due in the next 6 months.

Discussion of results and conclusions

As a result of trials carried out in Costa Rica since 1964 with species of the Genus Eucalyptus, it could be stated that Eucalyptus camaldulensis and Eucalyptus citriodora show promising results in areas with a well pronounced dry period and on altitudes between 1200 and 1600 m.a.s.l.

At higher elevations Eucalyptus globulus seems to be the most appropriate species at the moment.



In areas with high precipitation and absence of dry months Eucalyptus grandis/saligna, Eucalyptus maculata and Eucalyptus robusta have proven to be well adapted especially on altitudes above 1000 m.a.s.l. However, Eucalyptus grandis and Eucalyptus saligna grow also very well at altitudes of 600 m.a.s.l., and perform even better than Eucalyptus deglupta. The best results with the latter were obtained in areas with a uniform rainfall distribution at altitudes below 800 m.a.s.l.

Under these ecological conditions Eucalyptus deglupta grows well on deep, well drained soils of moderate to good fertility. Very uniform stands may be obtained if good care is provided during the first years the Taungya system may be successfully used to establish the plantation spaced at 3 x 3 m as a minimum (Plot N° 1 b). On poorer soils a fertilizer should be given with a high P-content.

A first thinning could be effectuated when the trees reach an average height of 10 m, when planted at 2,5 x 2,5 or 3 x 3 m initially. Nearly always this will be the case two years after transplanting in the field.

Half of the number of trees could be removed. Five years after planting in the field a thinning is recommended which will bring the relative spacing index to 25%. At age 9 a moderate thinning could lower the S % to 20, a percentage that could be maintained till the final harvesting for timber. On normal sites, the Mean Annual Increment will be approx. 30 m<sup>3</sup>/ha/yr approximately with rotations of 12 to 15 years when the trees reach an average diameter at breast height of about 35-45 cm.

The species regenerates naturally from seed provided by trees of 4 years of age and over, especially on open, light textured soils without competition by weeds. Eucalyptus deglupta does not coppice like most other eucalypts, although some resprouting of stumps has been observed.

Phytosanitary problems occurred in plots at waterlogged sites only.

Termites have been reported on some younger trees. Formerly healthy looking trees died suddenly. There is no explanation as yet.

A better stem form could be obtained by means of proper selection of provenances and genetic improvement. Proper plantation maintenance (cleaning and thinning) also plays an important role.

Eucalyptus poles are easily preserved with pentachlorophenol in Diesel, using the open tank method. The logs are easily sawn and dried without excessive splitting.

The timber can be used for a variety of purposes s.a. flooring, panelling, ordinary furniture.

There is presently much local demand for seedlings and small groves by farmers are scattered throughout the country.