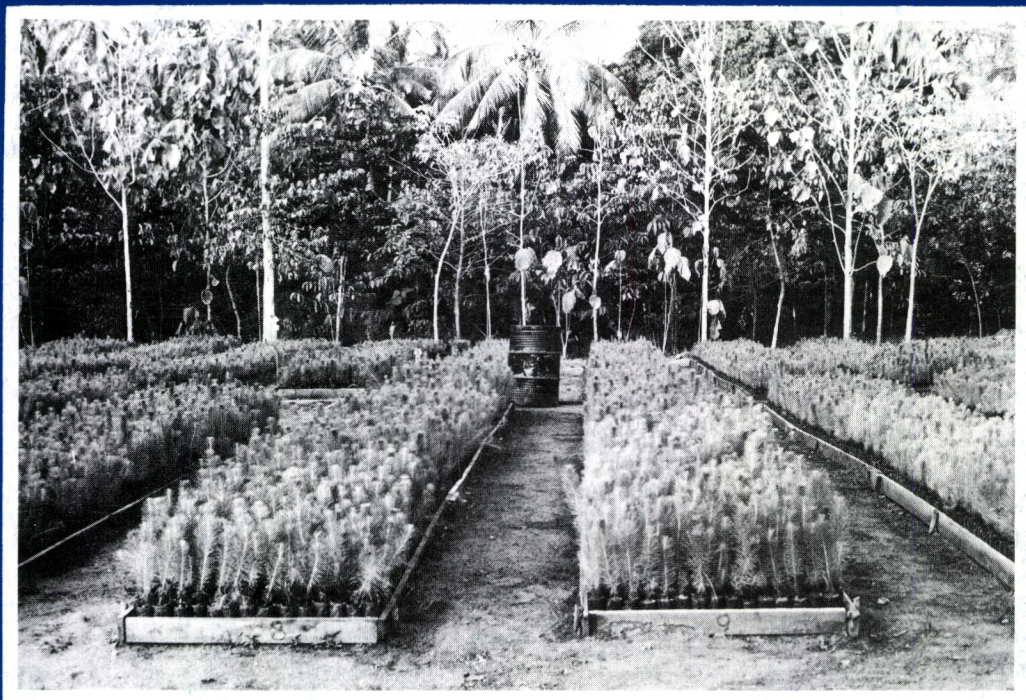


METSÄNTUTKIMUSLAITOKSEN
TIEDONANTOJA 127



Metsänhoidon tutkimusosasto



Veikko Silander

ZANZIBAR FOREST TREE NURSERIES
Report and guidelines
November 1980 — June 1982

HELSINKI 1984

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SILANDER, V. 1984. Zanzibar forest tree nurseries. Report and guidelines. November 1980 - June 1982. Metsäntutkimuslaitoksen tiedonantoja 127.

The report deals with nursery practice implemented by the Finnish Forestry Project in Zanzibar during the period November 1980 - June 1982.

The main species raised in the nurseries were Pinus caribaea Morelet var. hondurensis Barr & Golf and Casuarina equisetifolia L. Minor lots of 16 other tropical tree species were raised for species trials. Sowing times, length of raising period in the nursery and special remarks are given for all species.

Recordings of time consumptions and costs for different work operations in the central nursery are reported.

LIST OF CONTENTS

1. INTRODUCTION	5
2. THE PREPARATORY PHASE	7
3. NURSERY OPERATIONS,	
JULY 1981 - JUNE 1982	9
3.1. Number of plants produced	10
3.2. Timing of operations	12
3.3. General layout of Mwanyanya nursery	13
3.3.1. Germination shades	13
3.3.2. Tube-filling unit	15
3.3.3. Transplant area	17
3.3.4. Irrigation system	18
3.3.5. Housing and permanent buildings	19
3.4. Soils for sowing and transplanting	19
3.4.1. Soil analyses	20
3.4.2. Sowing mixture	20
3.4.3. Transplanting mixture	21
3.5. Sowing and pricking-out	21
3.5.1. Sowing methods	22
3.5.2. Sowing times	24
3.5.3. Transplant containers	26
3.5.4. Pricking-out method	26
3.5.5. Pricking-out times	29

3.6. Tending	29
3.6.1. Watering	29
3.6.2. Top-dressing	29
3.6.3. Protection and weeding	30
3.6.4. Root pruning	30
3.6.5. Plant despatch	31
3.7. Management	32
3.7.1. Labour output	32
3.7.2. Training	32
3.8. Labour input and nursery running costs	33
3.8.1. Labour input	33
3.8.2. Running costs in Tanzanian Shillings	33
4. RECOMMENDATIONS	35
5. BIBLIOGRAPHY	38
Acknowledgements	42
Appendix 1 Monthly distribution of labour input ...	43
(July 1981 - June 1982)	
Appendix 2 Nursery seminar	45
Appendix 3 Species	47

Correction p. 33

1 USD = 9,38 TSh

1. INTRODUCTION

Tanzania is the prime receiver of Finnish Development Aid. Since the beginning of this bilateral cooperation the Finns have served in many sectors of Tanzania's industry and economy. The largest proportion of Finland's economic aid has been allocated for the utilization and development of Tanzania's forests and other natural resources. In 1979 it was decided that a Finnish Forestry Development Project should be started in Zanzibar. The realization of this project began in November 1980. Initial project organization was undertaken by 3 Finnish experts: team leader, field expert and nursery manager. The objectives of the project were to:

(i) re-stock the existing natural high forests with both softwood and hardwood tree species.

(ii) maintain and increase the area of land under forest cover for both soil conservation and watershed management.

(iii) maintain and increase the amount of skilled employment for people who depend on forestry for their living.

(iv) through extension services encourage the general public to become more forestry conscious.

This report deals solely with the work of the nursery manager, from November 1980 to June 1982 inclusive. At the commencement of the project there were 3 operational forest nurseries on Zanzibar Island (see Fig. 1): Mwanyanya, Jendele and Jozani nurseries with production areas of 0,4 ha, 0,25 ha and 0,15 ha respectively. The then total annual production from these nurseries was estimated at 50 000 tree plants.

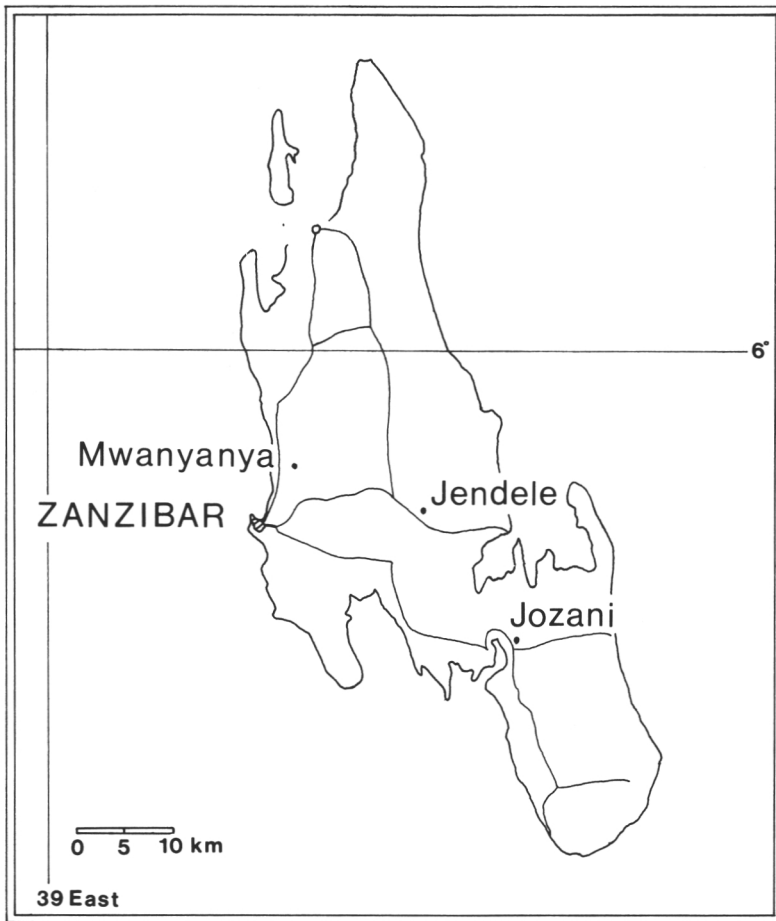


Figure 1. Locations of Zanzibar forest tree nurseries.

2. THE PREPARATORY PHASE

During the first year the objective was to produce as many plants as possible with no numerical target. In Mwanyanya, the main nursery, 54 000 plants were produced and in Jendele and Jozani nurseries a combined total of 25 000 plants.

Factors such as improper housing, delays in shipment of equipment from Finland and lack of transport and materials had a negative effect on plant production. In addition, much time was spent in becoming acquainted with local nursery practice and, on the basis of these observations and international literature (see Bibliography), a plan for Zanzibar forest tree nurseries was prepared by the nursery manager. The aim of the plan was to increase the plant production capacity of the nurseries to a level that will satisfy the project's future demands. The means to develop a nursery practice suited to Zanzibar conditions are outlined in the following 9 points:

1. One central nursery should be developed, with an annual production capacity of 600 000 plants. Two other storage/transplant nurseries should be begun, one in the South and the other in the North of the Island.
2. To provide all nurseries with the necessary basic constructions.

3. To equip the nurseries with good tools and the necessary equipment.
4. To train counterparts, foremen and nursery workers.
5. To develop and adopt practices that will increase management efficiency and labour productivity.
6. To keep records of mandays and costs.
7. To make observations on growing stock and carry out small experimental trials to increase knowledge of local characteristics and conditions.
8. To optimize the timing of nursery operations.
9. To purchase relevant literature on tropical nursery practice.

3. NURSERY OPERATIONS, JULY 1981 - JUNE 1982

This section outlines the major work operations in Mwanyanya nursery. Emphasis has been on developing a nursery practice especially suited to Zanzibar conditions. The system adopted follows the standard container method outlined in figure 2. Methods outlined here are under continual development and future changes are envisaged.

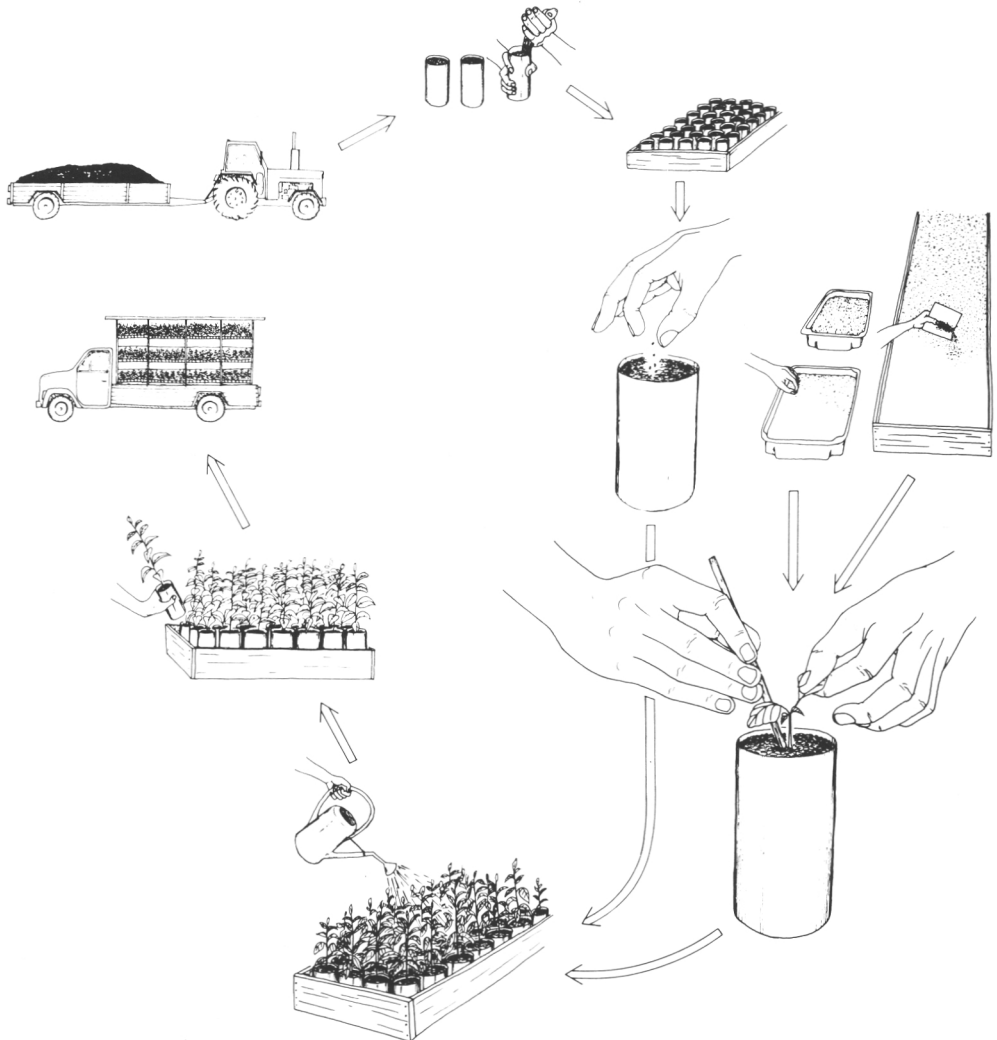


Figure 2. Container nursery system used.

3.1. Number of plants produced

The project operation plan set a production target of 217 000 plants for the period July 1981 - June 1982. This figure did not include the 20 000 plants that were produced in Jozani nursery. The target was reduced at the end of July 1981 with the permission of the Zanzibar Director of Forestry. Table 1 gives the number of plants produced in Jozani and Jendele nurseries for November 1981 plantings and April 1982 plantings. Table 2 gives corresponding figures for Mwanyanya nursery.

Table 1. Jozani and Jendele nurseries - production of forest tree seedlings.

Species	For November planting 1981	For April planting 1982
<u>Azadiracta indica</u>		2 000
<u>Eucalyptus "C" Zanzibar</u>	5 000	
<u>Casuarina equisetifolia</u>	5 600	25 000
total	10 600	27 000

Table 2. Mwanyanya nursery - production of forest tree seedlings.

Species	For November planting 1981	For April planting 1982
<u>Acacia auriculiformis</u>		2 800
<u>Albizia falcataria</u>		1 400
<u>Azadiracta indica</u>		500
<u>Casuarina equisetifolia</u>	16 100	13 000
<u>Cordia alliodora</u>		10 500
<u>Eucalyptus alba</u>		5 300
<u>Eucalyptus "C" Zanzibar</u>	2 100	29 400
<u>Eucalyptus grandis</u>		10 400
<u>Eucalyptus robusta</u>		4 200
<u>Eucalyptus urophylla</u>		1 900
<u>Gmelina arborea</u>		4 200
<u>Leucaena leucocephala</u>		100
<u>Pinus caribaea</u>		
var. <u>hondurensis</u>	12 700	45 000
<u>Pinus caribaea</u>		
var. <u>caribaea</u>		19 000
<u>Swietenia macrophylla</u>		2 000
<u>Tabebuia pentaphylla</u>		1 500
<u>Tectona grandis</u>		2 500
<u>Terminalia ivorensis</u>		1 500
total	30 900	155 200

During the stated period a total of 223 000 plants were produced for forest planting and an additional 20 000 seedlings were given to the Kichwele public tree nursery for transplanting.

3.2. Timing of operations

In Zanzibar there are normally two rainy seasons per annum. The long rainy season lasts from April to June and the short rainy season occurs in November and December. November rains are irregular and may even fail completely. Due to the limitations imposed by the rain cycle the major forest planting season had to begin in April. Only drought resistant species such as Casuarina equisetifolia and Acacia auriculiformis could be planted in November (cf. tables 1 and 2).

The optimum height for transplants leaving the nursery was judged to be 20 - 40 cm. In order to attain this height by the correct planting date, a schedule of nursery operations was prepared for each species. For example, Pinus caribaea var. hondurensis was raised in the nursery for 45 weeks whilst Gmelina arborea was at best ready for despatch only 5 weeks after germination.

3.3. General layout of the Mwanyanya nursery

In the beginning a detailed plan of the nursery area was drawn up, covering all the following essential components of a tropical tree nursery: shaded germination area, tube-filling unit, transplant area, irrigation system and buildings and other permanent constructions (plate 1).



Plate 1. Mwanyanya nursery in January 1982.

3.3.1. Germination shades

To protect sowings against strong sunlight, high temperatures and heavy rainfall, germination shades of two different designs were constructed (plates 2 and 3). A pole construction was used for sowings of pine and other species with large seeds. The frame of this type of shade

was covered with a "mat" roof made from stalks of the palm Phoenix reclinata and this reduced the penetration of daylight by about 50 %. For species with very small seeds, mainly Eucalyptus species, the shade was a board construction, the roof being covered with 0,20 mm polythene sheeting.

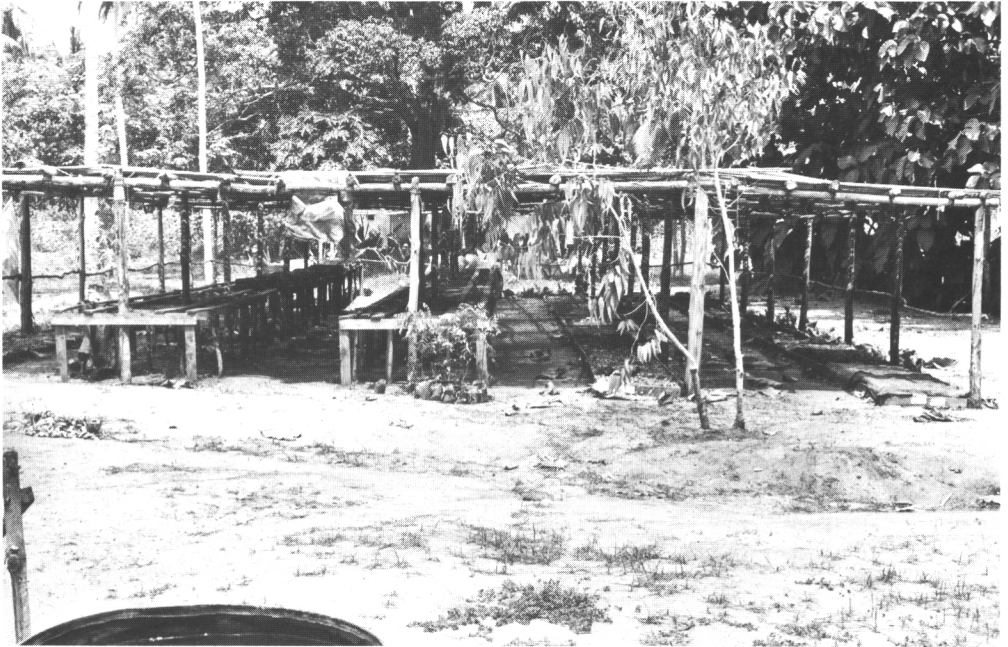


Plate 2. Germination shade for pines and other species with larger seeds.

Such shades provided tolerable but imperfect safety. As an improvement, an arch type construction should be tried. The roof could be covered on the outside with a special shade cloth and on the inside with a removeable polythene sheet. Suggested dimensions for this type of construction are height 5 m, length 20 m and width 10 m.

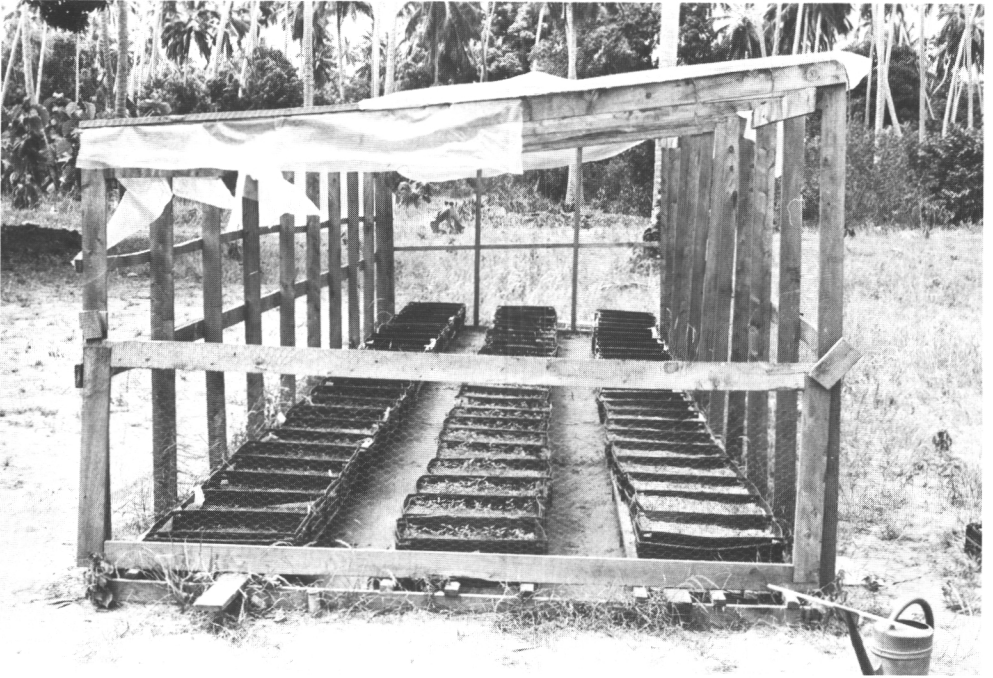


Plate 3. Germination shade for Eucalyptus spp.

3.3.2. Tube-filling unit

The tube-filling unit was housed under a roofed shelter (plate 4). The roof was covered with "Trevira" cloth and the work surface consisted of two mixing boards, each size 3 x 3 m. Soil for potting was sieved through a 2 cm iron mesh sieve and the necessary fractions mixed on the boards. Filling of tubes was also done on the boards, by 4 to 5 persons at a time (plate 5).



Plate 4. Tube-filling unit.



Plate 5. Tube-filling.

3.3.3. Transplant area

The transplant area was divided into blocks, sections and beds. A central road was built to divide the nursery into two blocks. A perimeter road was added to give tractor and trailer access around the blocks. Each of the blocks was divided into two sections by a 1,5 metre-wide centre path.

Sections in their turn were dissected into transplant beds, each of size 1 x 10 m (plate 6). A 70-centimetre-wide path separated the beds, which were aligned in an east-west direction.

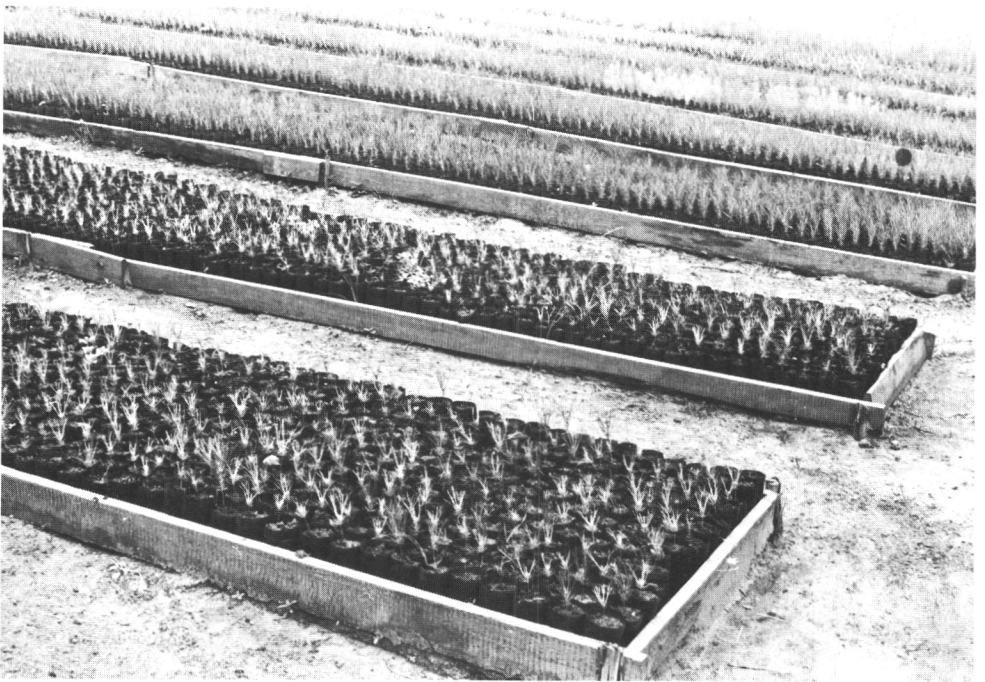


Plate 6. Transplant beds in the pine section.

3.3.4. Irrigation system

Delay in shipment of the water pumps was a setback to normal operation of the nursery. For the first 10 months all water had to be carried manually from a small stream situated 150 metres from the nursery.

After arrival of the water pumps a semi-manual irrigation system was installed (plate 7). A concrete well-ring was sunk into the stream bed and from this water was pumped to the nursery by means of a Desmi centrifugal pump, type 50T.

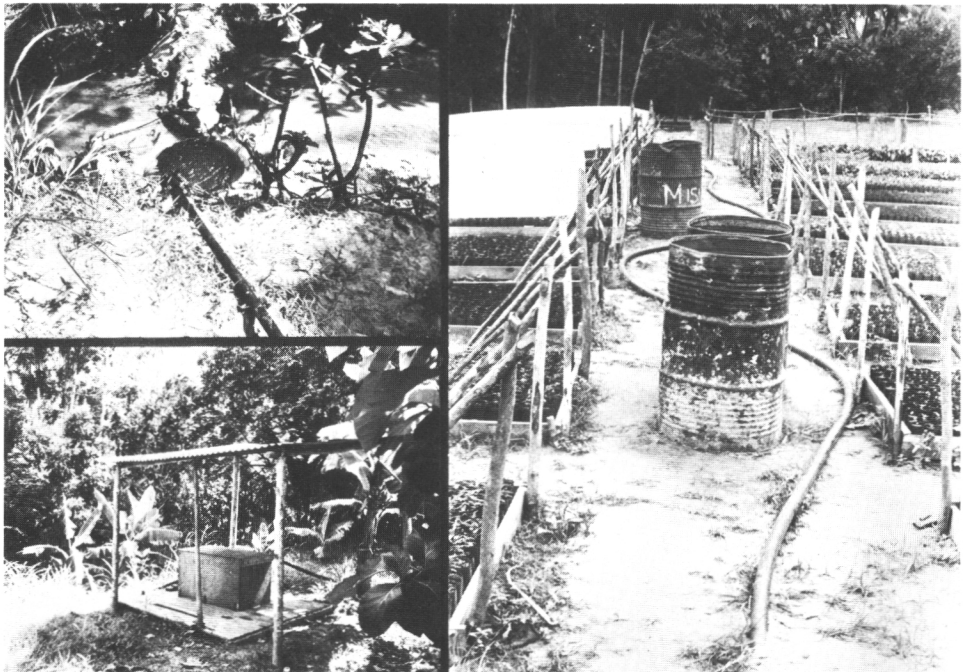


Plate 7. Semi-manual irrigation system in Mwanyanya nursery.

The pipeline system was made of 2" black PVC tubing. Water was fed from T-joint connections in the main pipeline into drums placed on the central pathway between sections. Distribution of water from the drums was by watering-can.

3.3.5. Housing and permanent buildings

At the commencement of the project there were 3 buildings on the nursery site, 2 houses for staff and one office/store. The latter has since been equipped with shelves for tools and documents and sanitary conditions in the houses have been improved. A perimeter fence has been planned for the nursery area and will be erected at a later date.

3.4. Soils for sowing and transplanting

Soil for the nursery was collected from a site 10 kilometres away (at the foot of a gentle slope), near to Dole Hospital. The topsoil at this location was a reddish-brown sandy loam with a weak granular structure. The soil for mycorrhiza inoculation of pine potting mediums was collected from a 15-year-old P. caribaea plantation situated in the Masingini area close to the TV-tower.

3.4.1. Soil analyses

In July 1981 three soil samples were taken from the soil collection area. At that time the available local facilities restricted the analyses to determination of soil pH (mean 6,4), organic matter content (mean 1,05 %) and the percentages of mineral soil fractions (given below).

Fraction	% volume
Coarse sand	89,2
Fine sand	4,0
Clay	6,0
Silt	0,8
total	100,0

All analyses were conducted by the Chemical Laboratory of the Department of Agriculture.

3.4.2. Sowing mixture

The sowing mixture used was a sieved, unfertilised forest topsoil. Aldrin insecticide was added at the rate of 400 g/m³ soil. Fungicide treatment was not necessary.

3.4.3. Transplanting mixture

Two different types of soil mixture were used for tube-filling, one for P. caribaea and the other for hardwood species. The proportions of the different constituents in the mixes are given below.

	Soil mixture	
	For <u>P. caribaea</u>	For hardwoods
Forest topsoil	7 parts	7 part
Mycorrhizal soil	2 parts	
Coir dust	1 part	2 parts
¹⁾ NPK (3:3:1) fertilizer	2 kg/m ³	
Chicken dung		1 part
Aldrin	400 g/m ³	400 g/m ³

3.5. Sowing and pricking-out

All sowings were made under the germination shades described in section 3.3.1. Most of the sowings were made broadcast in plastic trays standing on a raised base (plate 8). Only Tectona grandis, Terminalia ivorensis and Cordia alliodora were sown in ground level seed beds. Direct sowing into pots was practiced only with Gmelina arborea.

¹⁾ by volume (mixed in the nursery): 3 parts sulphate of ammonium, 3 parts superphosphate, 1 part muriate of potash.

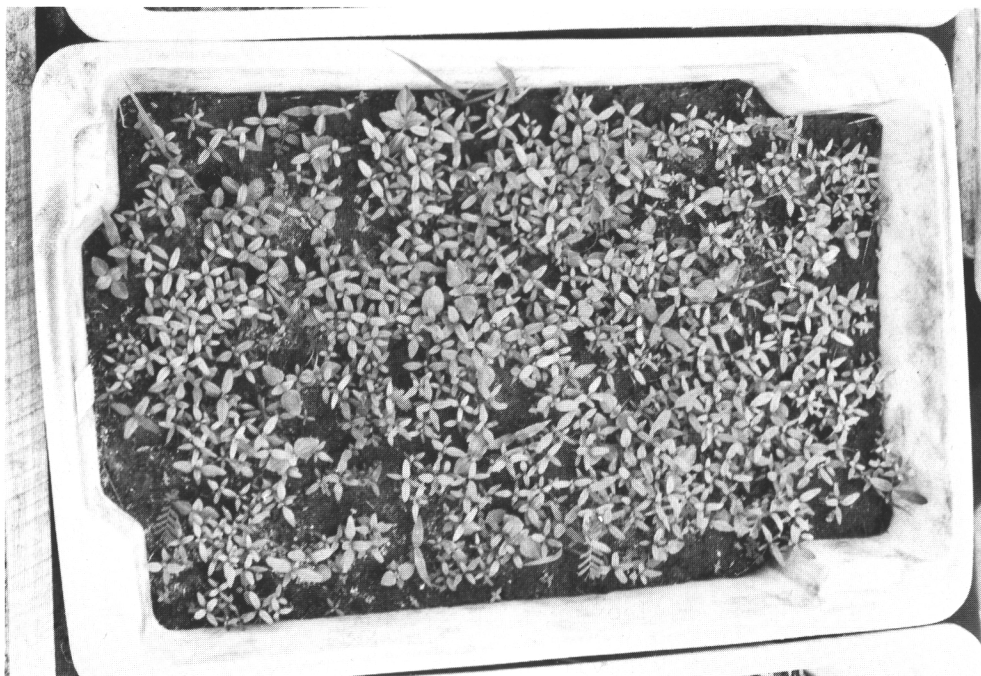


Plate 8. Sowing tray.

3.5.1. Sowing methods

The principle sowing method is described below.

1. Plastic trays of size 40 x 60 x 20 cm were filled with 20 litres of sowing medium (described in section 3.4.2.) and were then transported to and stacked out under the germination shades.
2. Trays were watered well on the day prior to sowing.
3. Seeds were broadcast into the trays and covered with sand sieved through a 2 mm iron mesh sieve.

4. Seeds were carefully sprayed with Dithane fungicide.
5. Trays were covered with black transpirant PVC film.
6. Sowings were inspected every day and watered when necessary.
7. At the first signs of germination the PVC film was removed and tending was begun.

The ground level beds were contained within 1 x 20 m frames made of wooden boards. The earth floors of the beds were covered with "Trevira" cloth and the frames then filled with sowing medium. Seed was sown broadcast and the beds then covered with gunny cloth. At the first signs of germination the cloth coverings were removed.

For Gmelina arborea 2 seeds were sown directly into every tube and these were then covered with gunny cloth and watered on demand (plate 9). Again, at the first signs of germination the cloth was removed and normal tending of the seedlings was begun.

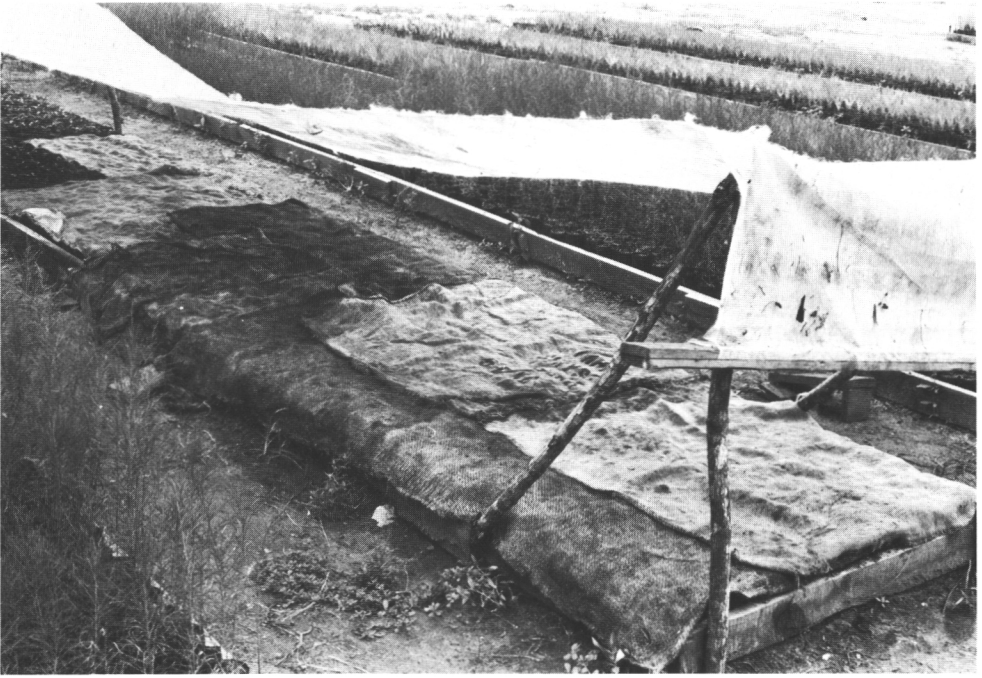


Plate 9. Direct sowings of Gmelina arborea.

3.5.2. Sowing times

Table 3 gives, for different species, both the actual sowing dates during 1981/82 and the recommended dates. The latter are only valid for April planting of seed having a germination percentage of over 90 and when using the sowing method described in the previous subsection.

Table 3. Recommended and actual sowing dates for different species 1981/82 in Mwanyanya nursery.

Species	Sowing dates	
	Recommended	Actual 1981/82
<u>Acacia auriculiformis</u>	1.1.-15.1.	6.1.-82
<u>Albizzia falcataria</u>	1.1.-15.1.	15.12.-81
<u>Azadirachta indica</u>		10.1.-81
<u>Casuarina equisetifolia</u>	1.12.-15.12.	1.1.-82
<u>Cordia alliodora</u>	1.1.-15.1.	21.11.-81
<u>Eucalyptus alba</u>	1.1.-15.1.	22.12.-81
<u>Eucalyptus "C" Zanzibar</u>	1.1.-15.1.	30.12.-81
<u>Eucalyptus grandis</u>	1.1.-15.1.	22.12.-81
<u>Eucalyptus robusta</u>	1.1.-15.1.	22.12.-81
<u>Eucalyptus urophylla</u>	1.1.-15.1.	22.12.-81
<u>Leucaena leucocephala</u>	15.1.-31.1.	6.1.-82
<u>Gmelina arborea</u>	15.1.-31.1.	10.1.-82
<u>Pinus caribaea</u> var.		
<u>caribaea</u>	1.8.-15.8.	22.9.-81
<u>Pinus caribaea</u> var.		
<u>hondurensis</u>	1.9.-15.9.	1.8.-81
<u>Swietenia macrophylla</u>	1.12.-15.12.	17.11.-81
<u>Tabebuia pentaphylla</u>	15.12.-31.12.	15.12.-81
<u>Tectona grandis</u>	1.11.-15.11.	2.11.-81
<u>Terminalia ivorensis</u>	1.11.-15.11.	19.11.-81

3.5.3. Transplant containers

Open ended black polythene (thickness 0,05 mm) tubes of diameter 6,3 cm and height 12,5 cm, were used for all transplants. Approximately 2 200 tubes were stacked out into each transplant bed (plate 10).

3.5.4. Pricking-out method

On the day prior to pricking-out the prepared tubes were watered to the equivalent of 20 mm rainfall. To provide shade for the tender transplants a Trevira-cloth was erected at a height of 70 cm above the tubes (plate 11). Prickers lifted (plate 12) and placed approximately 100 seedlings at a time into a small bucket containing wetted coir dust. Pricking-out was done by 2 workers at a time, seated on low stools on either side of the bed (plate 13). The pricking tool was a 15-centimetre-long pointed stick and seedlings were "firmed in" to a depth slightly deeper than that at which they had been growing in the sowing tray. After one week all transplants were inspected and dead plants removed and replaced. Shades were removed 1 - 2 weeks after pricking-out.



Plate 10. Stacking of tubes.



Plate 11. Shade over transplant bed.



Plate 12. Lifting of Cordia alliodora



Plate 13. Pricking-out.

3.5.5. Pricking-out times

Time of pricking-out varied according to species. With P. caribaea it was begun about 15 days after sowing, when the seedlings were at the "match stick" stage. Pricking-out of hardwoods was in general started when 3 pairs of secondary leaves were visible. Casuarina equisetifolia was pricked-out when secondary leaves were 1 cm or more in length.

3.6. Tending

Both direct sown beds and transplant beds were inspected daily and written instructions for the following day's work schedule were given to the tending foreman.

3.6.1. Watering

The transplants were watered twice daily just before 9 a.m. and after 4 p.m. The normal daily volume of water applied was 35 litres/1 000 plants. During the hot season this was increased to 45 litres/1 000 plants.

3.6.2. Top-dressing

A top-dressing of ammonium sulphate (21 % N) was given to transplants of P. caribaea only. The dilution was 1 g/litre

and the fertiliser was applied at the rate of 2 g/m^2 , once a week over a 7 week period from 20th October - 31st November. After application the transplants were rinsed with pure water from a watering can.

3.6.3. Protection and weeding

Except in the transplanting mixture there was little need for chemical protection in the nursery. When necessary the applied insecticide was "Kynandrin 45", obtained as a miscible liquid with Dieldrin as the active ingredient. The fungicide used was "Dithane M45" containing zinc- and manganese carbonate as the active ingredients and purchased as a wettable powder.

The transplant tubes were weeded by hand and soil aeration was improved by disturbing the upper soil layer (plate 14). The nursery roads, paths and open areas were weeded by hoe. Sickles were used to keep clean a 20-metre-broad swathe surrounding the nursery.

3.6.4. Root pruning

The development of transplant roots was inspected weekly. Root pruning began as soon as the roots emerged from the bases of the tubes and attempted to grow into the subsoil.



Plate 14. Weeding and airing of tubes.

Pruning consisted of moving the pots 20 cm and cutting all protruding roots with a sharp knife. Following this the plants were given a good watering.

3.6.5. Plant despatch

The night before despatch transplants were watered well and then next morning graded and packed into transport trays. If required, watering was repeated before the plants left the nursery.

3.7. Management

The expatriate nursery manager and his national counterpart were responsible for management of the nurseries. Labour was supervised by 2 foremen in Mwanyanya nursery and one foreman in each of Jendele and Jozani nurseries. Daily working hours were from 7.30 a.m. to 1.00 p.m.

3.7.1. Labour output

Labour output rates for various operations during 1982/83 are given below:

Operation	Output/manday
Soil collection	1 m ³
Tube filling	400 tubes
Stacking	2 000 tubes
Pricking-out	500-1 000 seedlings
Watering	50 000 plants
Weeding tubes and disturbing upper soil layer	1 000 plants
Root pruning	2 000

3.7.2. Training

Nursery instruction was given mainly as "in service training". A one day work course in pricking-out was

given to workers in August 1981 and a one day nursery seminar was held in Mwanyanya nursery for foremen and senior nursery workers in March 1982 (for topics see appendix 2). Rashid J. Hamad received 3 months study training at the Finnish Forest Research Institute's Suonenjoki research station and tree nursery, funded by the Ministry for Foreign Affairs of Finland.

3.8. Labour input and nursery running costs

During the production year all labour and material inputs for Mwanyanya nursery were recorded and classified according to operation type.

3.8.1. Labour input

Labour inputs were recorded daily and are summarized in appendix 1. A total of 5,985 man-days were spent in nursery work.

3.8.2. Running costs in Tanzanian Shillings (1 TSh = 9,38 USD August 1982)

Labour costs have been classified according to 7 groups of nursery work (appendix 1). The daily wage for nursery workers was TSh 18,45 and for foremen TSh 30,00. Material costs were

recorded monthly and cover polythene for tubes, rope, nails, board, petrol, fertilizer, insecticide and fungicide. Total expenditure on materials was TSh 51,951 and the percentage distributions of both total cost and cost per plant according to work groups are also given in table 4.

Table 4. Costs of nursery operations for Mwanyanya nursery 1981/82.

Work group	TSh	TSh/plant	%
Preparation of tubes	27 398	,147	16,14
Seed collection, sowing and covering	2 527	,014	1,49
Pricking-out	10 940	,059	6,44
Tending	47 324	,254	27,88
Protection	9 225	,050	5,43
Local supervision	19 200	,103	11,31
Miscellaneous	1 199	,006	0,71
Material costs	51 951	,279	30,60
total	169 764	,912	100,00

3. RECOMMENDATIONS

The project objectives formulated in 1980 are still valid. The 1982/83 plant production target has risen and it is expected that this will necessitate small changes in the production methods. With reference to the plan for nursery development outlined in section 1, special attention should be given to points 2, 3, and 5. The suggested improvement measures are:

(i) to ensure success of sowing, an arch shaped shade/shelter should be constructed.

(ii) efficiency of the watering system should be increased by the installation of a sprinkler system.

(iii) to save time in filling, plastic tubes should be replaced by a quick-filling tube system of the tray type, to be used for sowings and all transplants.

Management appears to be the most challenging aspect of nursery work for national staff and more consideration should be given to this important subject. In this context "management" refers to:

- skilful supervision
- efficient administration
- adequate planning
- comprehensive control of day to day running
- correct timing of operations

For the successful takeover by national personnel it is important that the nursery production unit should not be too large. The bigger the unit the more complex the level of management required. Experience has shown that following the withdrawal of expatriate involvement the output of many well-started nurseries has suffered badly or failed completely, the reason being that the unit has been too big for local management. It is recommended that the size of the nursery should be within the limits of the local management capacity and it is seen that this varies from region to region even within the same country. Whilst the project's objectives may be on the "big scale", for success practical organization should be divided into sub-units which can be operated locally. Much responsibility falls on the planners in the initial stages of the project. To safeguard lasting development they must carefully consider the optimum size of the production unit and make provisions for adequate training.

Finally, no technical problems were encountered in the production of forest planting stock during 1981/82. It is envisaged that also in the future the production of nursery stock will not be the limiting factor in the afforestation of Zanzibar.

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Acknowledgements

Special thanks are extended to Mr. Hilali Juma, Director of Forestry, Zanzibar, for all his help and encouragement. Thanks also to my colleagues Miss Anna-Liisa Raunio B.Sc.(For.), Mr. Rauno Laitalainen B.Sc.(For.), Mr. Rashid J. Hamad, Mr. Ali Muhammed and Mr. Arto Alapiha for their assistance and cooperation. I am greatly indebted to Mr. Michael Yuan who took all the photographs. I also acknowledge and thank Professors Pentti Hakkila and Erkki Lähde and Doctor Kari Löyttyniemi for their valuable comments on the manuscript.

APPENDIX 1 MONTHLY DISTRIBUTION OF LABOUR INPUT (JULY 1981 - JUNE 1982)

Group and type of work	Mondays/month												type total	group total
	J	A	S	O	N	D	J	F	M	A	M	J		
<u>Preparation of pricking-out containers</u>														
Soil collection	36	16	2	46	9				1				85	195
Transport of soil	22		11	12	21	21	6							93
Soil sieving	18	15	11	13	18	10	3	12	5					105
Soil mixing	54	50	17	16	19	8	2	10	5					181
Cutting polythene for tubes	13	25	25	1	21	18	3	6						112
Tube filling	137	188	89	56	58	15	8	40	5					596
Stacking	32	51	17	21	29	14	8	26	5					203
<u>Seed collection, sowing and covering</u>														
Seed collecting					4		4			4				32
Preparation of sowing trays	10	8	4		33	2	4							61
Broadcast sowing in trays	4	1		7	19	10	3							44
<u>Pricking-out</u>														
Lifting of seedlings and pricking-out		111	117	102	21	42	80	99	21					593
														137
														1485

APPENDIX 1 continued

Tending

Watering	70	110	90	73	50	51	89	103	99	9	3	747
Hand-weeding and soil disturbance			52	68	123	59	40	56	51	30		479
Root pruning					3	3	3	8	112	22	21	172
Weeding with hoes	14	17	107	123	64	109	78	31	65	88	67	34 797
Plant despatch					2	9			92	207	54	6 370 2 565

Protection

Construction of shades/
shelters
Protection against fungi,
insects and mammals

	38	56	63	58	28	31	24		15	20	32	45 410
		7	21	17	24	13	8					= 90 500

Supervision by nationals

	20	60	60	60	60	60	60	60	60	60	40	40 640 640
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Miscellaneous

	7	5	1	4	8	2			4	12	22	= 65 65
--	---	---	---	---	---	---	--	--	---	----	----	---------

total

	475	720	687	677	605	486	423	451	545	444	239	233
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

grand total = 5 985 =

APPENDIX 2 NURSERY SEMINAR

Mwanyanya nursery, Tuesday 16th March 1982

OBJECTIVE: To give nurserymen a general picture of nursery techniques as practiced in Mwanyanya

To give nurserymen detailed information on some techniques which vary from nursery to nursery, e.g. shading, watering, root/pruning, time of sowing and transplanting.

TOPICS

Introduction

The role of nurseries in afforestation work (A.-L. Raunio)

Introduction of various tree species in Mwanyanya nursery (V. Silander)

General lay-out of the nursery (V. Silander)

Preparatory works

Soil mixing, pot filling and

preparation of seedbeds (Rashid J. Hamad)

Nursery operations

Sowing and transplanting (Rashid J. Hamad)

Time of sowing and transplanting (V. Silander)

Tending

Tending of seedlings (Rashid J. Hamad)

Root pruning (V. Silander)

Management

Role of the nurseryman in plant production
(V. Silander)

Nursery management (Ali Mohammed)

Training of nursery workers (Ali Mohammed)

APPENDIX 3 SPECIES



Acacia auriculiformis A. Cunn ex Benth.

Natural occurrence: Australia (Queensland), Papua New Guinea and Solomon Islands

Plantable size in Zanzibar (ZNZ): 11- 14 weeks

Ease of raising: Very easy

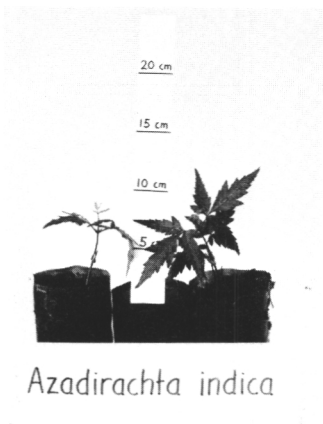


Albizzia falcataria Fosberg

Natural occurrence: North Moluccas, Indonesia

Plantable size in ZNZ: 11 - 14 weeks

Ease of raising: Very easy



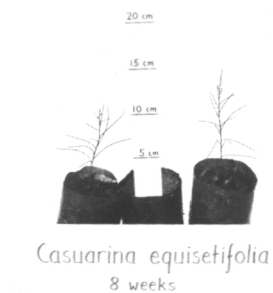
Azadirachta indica A. Juss

Natural occurrence: India and coastal S. E. Asia

Plantable size in ZNZ: 20 - 23 weeks

Ease of raising: Difficult on large scale, seed has shortlived viability

APPENDIX 3 continued

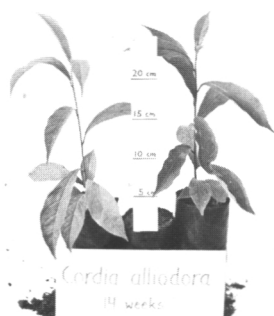
Casuarina equisetifolia L.

Natural occurrence: Costal S. E.

Asia and Australia

Plantable size in ZNZ: 13 - 16 weeks

Ease of raising: Easy, but risk of damping off and other fungal diseases

Cordia alliodora Cham.

Natural occurrence: Central America, West Indies, Peru, Brazil

Plantable size in ZNZ: 11 - 14 weeks

Ease of raising: Very easy

Eucalyptus alba

Natural occurrence: Australia (Queensland)

Plantable size in ZNZ: 11 - 14 weeks

Ease of raising: Easy, sensitive to insecticides

APPENDIX 3 continued

Eucalyptus "C" Zanzibar

Occurrence of provenances: Tanzania,
Kenya

Plantable size in ZNZ: 11 - 14 weeks

Ease of raising: Easy, sensitive to
insecticides

Eucalyptus grandis Hill ex Maiden

Natural occurrence: Australia
(coastal Queensland and N.S.W.)

Plantable size in ZNZ: 11 - 14 weeks

Ease of raising: Easy, sensitive to
insecticides

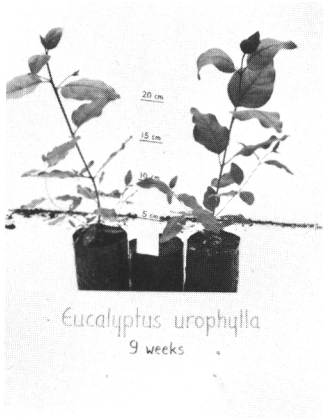
Eucalyptus robusta Sm.

Natural occurrence: Australia
(coastal Queensland and N.S.W.)

Plantable size in ZNZ: 11 - 14 weeks

Ease of raising: Easy, sensitive to
insecticides

APPENDIX 3 continued

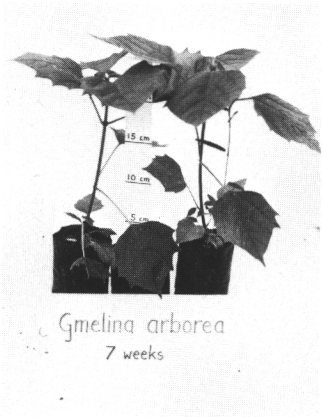


Eucalyptus urophylla S. T. Blake

Natural occurrence: Indonesia
(Western Sunda Islands)

Plantable size in ZNZ: 11 - 14 weeks

Ease of raising: Easy, sensitive to
insecticides



Gmelina arborea Roxb

Natural occurrence: Pakistan, S. E.
Asia, S. China

Plantable size in ZNZ: 9 - 12 weeks

Ease of raising: Very easy



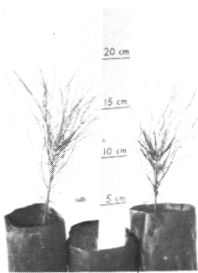
Leucaena leucocephala (Lam) de Wit.

Natural occurrence: Central America,
Philippines, Hawaii

Plantable size in ZNZ: 9 - 12 weeks

Ease of raising: Very easy

APPENDIX 3 continued



Pinus caribaea
v. *caribaea*
22 weeks

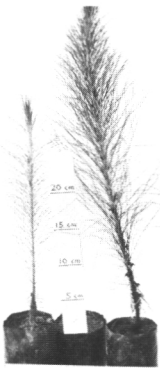
Pinus caribaea Morelet var. *caribaea*

Barr and Golf

Natural occurrence: Western Cuba,
Isle of Pines

Plantable size in ZNZ: 34 - 37 weeks

Ease of raising: Difficult, nutrient
problems



Pinus caribaea
v. *hondurensis*
30 weeks

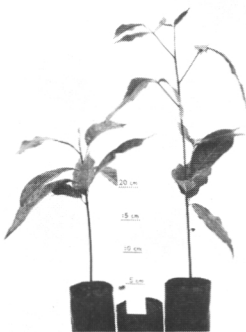
Pinus caribaea Morelet var.

hondurensis Barr and Golf

Natural occurrence: Atlantic Coast of
Central America

Plantable size in ZNZ: 31 - 34 weeks

Ease of raising: Very difficult, e.g.
damping off and nutrient problems



Swietenia macrophylla
15 weeks

Swietenia macrophylla King

Natural occurrence: Mexico, Central
America, Venezuela, Brazil

Plantable size in ZNZ: 15 - 18 weeks

Ease of raising: Some difficulties
with fungal diseases

APPENDIX 3 continued



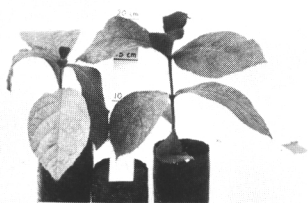
Tabebuia pentaphylla
11 weeks

Tabebuia pentaphylla (L) Hemsl.

Natural occurrences: Southern Mexico, Venezuela, Ecuador

Plantable size in ZNZ: 13 - 16 weeks

Ease of raising: Some difficulties with fungal diseases



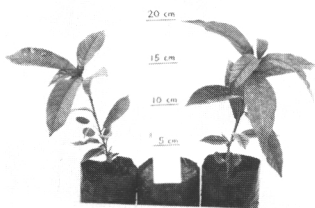
Tectona grandis
17 weeks

Tectona grandis L.

Natural occurrences: Burma, Cambodia, Thailand

Plantable size in ZNZ: 19 - 22 weeks

Ease of raising: Difficult on large scale, uneven germination



Terminalia ivorensis
14 weeks

Terminalia ivorensis A. Chev.

Natural occurrence: West Africa

Plantable size in ZNZ: 19 - 22 weeks

Ease of raising: Difficult on large scale, uneven germination

ISBN 951-40-0983-5
ISSN 0358-4283