HARVESTING STUDIES

Following discussions with Dr. E.C. Franklin it was decided to try a harvesting method similar to that used to collect capsules from E.grandis in Florida. There an elevating platform or "bucket" had been used for sometime, the capsules being stripped from the branches by hand directly into the bucket.

In February 1979 an "Abbey Skyworker SW 500/40" mounted on a two wheel drive truck and with an operating height of 12.5 m. was hired to harvest our oldest (then 8.5 years) E.regnans seedling seed orchard VRD 1. Because seed was required for research as well as routine purposes seed was harvested on an individual tree basis, and it was stripped into small containers rather than directly into the bucket. The orchard was harvested the following year in the same manner accept that a four wheel drive truck and hoist with 15.5 m. reach was used, and capsules were stripped into bags similar to those used for picking apples and pears, but smaller. On both occasions no difficulty was experienced harvesting from the tallest trees and it has been decided to only pollard trees when absolutely necessary and coinciding with a peak yield of the current capsule crop. The first harvest was described by Ginn (1979).

For the harvest in 1979 at 8.5 years productivity was 37 gm of seed per machine hour and 10 gm of seed per man hour. These are low because of the need to harvest on an individual tree basis and all trees irrespective of seed yield, to assemble seed for future research projects. The productivity figures are also low because the average yield of seed was only 14 gm per tree (range 0.2 gm to 490 gm).

A detailed time study was carried out on five trees with relatively heavy but varying seed crops. The purpose was to examine the effect of seed yield per tree on harvesting efficiency; also to provide data to estimate costs for a normal commercial harvest; and identify areas worthy of closer attention in an effort to reduce costs.

TABLE 2

Time study of components of harvesting an E.regnans seed orchard with an Abbey Hoist.

Tree No.	Component of Time				Productivity
	a) Moving Bucket (mins.)	b) Stripping Capsules (mins.)	Total (mins.)	Seed Yield (gm.)	Seed/ Machine hr. (gm.)
entire orchard	-	-	-	14	37
1	1.2	19.5	20.7	37	107
2	6.0	31.5	37.5	46	74
3	2.6	34.5	37.1	54	87
4	1.3	47.6	48.9	125	153
5	5.9	72.1	78.0	180	138
average excluding entire orchard					112
Av.proportion of total time %	7.8	92.2	100		

Data in Table 2 indicates that harvesting productivity and thus cost are most sensitive to seed yields per tree particularly below 125 gm tree $^{-1}$. Also most time is used in stripping capsules rather than moving the "bucket" around the tree crown or moving the truck. Time involved in moving the truck is not shown but was less than moving the "bucket" and was helped by the ability to harvest entirely, four adjacent trees from one position of the truck.

For crops averaging 150 gm of seed per tree, harvesting costs as low as Aust. $162 kg $^{-1}$ are thought to be possible (based on Aust. $10 per machine hr. and Aust. $5.40 per man hr. for a two man operation). Achieving higher seed yields per tree and lower cost can be assisted by avoiding harvesting trees with very light crops particularly early in the orchard rotation; by only harvesting every second year preferably coinciding with a peak in yield of the current capsule crop; and by using ameliorative treatments such as fertilizer application (Cameron and Kube 1980) and irrigation.

ECONOMIC CONSIDERATIONS

Although harvesting costs for E.regnans seedling seed orchards are about six times higher than for Pinus radiata seed orchards at the current time, 1 kg of E.regnans seed used wisely is sufficient to establish about 100 ha while 1 kg of P.radiata seed would only establish about 10 ha or less. Harvesting costs for E.regnans should be cheaper on a per hectare of plantation basis.

Harvesting costs for E.regnans indicated above to be Aust. $162 kg $^{-1}$ are not considered sufficiently high to warrant only harvesting from felled trees in an "advancing front" orchard, with its consequential higher land, establishment, and maintenance costs.

The figure above for harvesting exceeds the price charged by contractors for routine seed. When other orchard and breeding costs are taken into account, cost of the orchard seed, as expected is substantially higher. But given that the orchard seed is used efficiently, our economic studies show that a gain in volume alone of about 2% would be sufficient to recover the higher seed cost and at least "break even". A gain in volume of about 13% and improvement in stem, branch and crown quality are expected.

REFERENCES

Ashton, D.H.,1975: Aust. J. Bot. 23.

Cameron,J.N., and Kube, P.D.,1980: Proc. IUFRO Symp."Fast Growing Trees", Sao Paulo, Brazil.

Carr, D.J., and Carr, S.G.M., 1959 :Aust. J. Bot. 7(2).

Cunningham, T.M.,1957: Aust. For. 21.

Doran, J.C., and Young, D.V., 1973: Unpublished F.R.I.(now CSIRO) report, Traralgon.

Ginn, P.N.,1979: Aust. Res.Work. Group on For.Gen.Newsletter No.79 - 1 May 1979.

Pederick,L.A.,1972: Unpublished Report.

PRODUÇÃO MASSAL DE *Eucalyptus spp* ATRAVÉS DE ESTAQUIA.

Edgard Campinhos Jr.

Yara Kiemi Ikemori

. Aracrus Florestal S.A.

Aracruz - ES

Brazil

Resumo

A propagação de Eucalyptus spp. por estaquia é um método que pode trazer ganhos substanciais nas florestas industriais, porque permite a utilização de plantas selecionadas por catacterísticas particulares logo na primeira geração.

O mesmo método permite a formação de bancos genéticos, pomares de sementes e pomares vegetativos. O presente documento mostra o método desenvolvido para servir às condições na região onde o trabalho tem sido feito e os objetivos da aplicação da madeira.

Os autores indicam os resultados obtidos pela aplicação do método ao estabelecer um banco clonal e adotando-o nas operações de plantio industrial.

MASS PRODUCTION OF *Eucalyptus spp* BY ROOTIN CUTTINGS.

Summary

Mass propagation of *Eucalyptus* spp. by rooting cuttings is a method that can provide substantial gains in industrial forests, because it permits the utilization of plants selected for particular characteristics in the first generation.

The same method permits the formation of genetic banks, seed orchards and vegetative orchards. A description is given of the method developed to suit the conditions in the region where the work is being done and for the objectives for wich the wood in intended.

The authors indicate the results obtained by applying the method in setting up an initial clone bank, and adopting it in industrial planting operations.

Introduction

The first contact the authors had with the rooting method was at Coff's Harbour, Australia (Burgess, I.P.) in 1973, when they were shown the results of work done on an experimental level.

In 1965, A. Franclet published his first conclusions and the experimental design for multiplication of homogeneous material from rooting of cuttings from *E. camaldulensis*. Experimental work done previously had permitted the identification of key factors in the method such as the physiological state of the parent plant, the selection of the cutting, the optimum hormonal treatment, the selection of high rooting capacity clones, the growing medium and, especially, the action to be adopted against the causes of rooting of cuttings, besides the best time of year for rooting.

In 1973, J. Davidson described a technique for rooting a large number of cuttings of *E. deglupta*, for research purposes and discussed aspects of preparation of the cuttings, hormonal treatment, containers, rooting media and spraying equipment. He reported on the growth of the cuttings and their performance after they had been planted in the field, and did not foresee problems in propagation on an industrial scale.

In 1969, B. Martin and G. Quillet started experiments at Pointe Noire, Congo, with a view to determining the proper conditions for rooting of cuttings from a number of forest species, including eucalypts. The success of the method developed permitted it to be applied by the U.A.I.C. (Unité d'Afforestation Industrielle du Congo) in industrial scale plantings.

In 1975, Y.K. Ikemori started work on rooting of cuttings from *Eucalyptus* spp. at Aracruz, in the State of Espirito Santo, Brazil, with a view to propagation of better quality plants for the formation of seed orchards and development of a method adapted to the climatic conditions prevailing in the region, to obtain rooted cuttings on a large scale by the use of plants meeting the requirements of production of high quality pulp. A study was made of conditions in the greenhouse, such as humidity, ventilation and spraying frequency. During the environment control tests use was made of fungicides, hormones, various types of cuttings, fertilization and a number of rooting media.

Work evolved up to 1978, by which time the results attained permitted application of the method in the production of rooted cuttings for planting on an industrial scale.

The interest in development and adaptation of methods of vegetative propagation by rooting of cuttings from eucalypts, in the Aracruz region, was due to the absence of seed improved with a view to the needs of that particular region, as well as the time that is normally expended in developing the classic method of improvement.

Notwithstanding the satisfactory results obtained in planting with seed produced in Brazil, South Africa and Zimbabwe (Rhodesia), three negative factors were observed in the various populations, in different degrees of intensity:

1. canker caused by the *Diaporthe cubensis* fungus;
2. phenotype variation;
3. variations in coppicing ability.

By rooting of cuttings, the aforesaid negative factors are eliminated and the whole of the desirable characteristics can be grouped together in the first selection, using individuals from original populations planted in the region and adapted thereto.

This method of propagation ensures the formation of forests of high economic value from a number of different aspects: survival, productivity, quality of lumber and high rate of regeneration of the forest after successive felling.

Sexual reproduction, currently in course of development, will yield pure or controlled hybrid individuals which may in turn be reproduced by rooting of cuttings.

Materials and methods

Various ecological characteristics of the region

Latitude	19°48'S
Longitude	40°17'W
Altitude	5 to 50 m
Average annual rainfall	1,364 mm
Average annual temperature	23.6°C
Average maximum temperature	29.3°C
Average minimum temperature	19.1°C
Relative humidity	80%

Origin of plus trees

E. grandis, *E. saligna* and *E. "alba"* (*E. urophylla*) are the species that were planted in Aracruz between 1967 and 1972, using seeds produced in São Paulo.

Amongst these populations, certain extremely vigorous hybrids have been identified and are being selected and propagated by rooting of cuttings.

Apart from the natural hybrids, controlled inter-specific hybrids of *E. grandis* x *E. urophylla* and *E. grandis* x *E. pellita* are being developed and propagated.

Criteria for selection of plus trees

Tree selection is aimed at production of bleached wood pulp as the primary purpose.

a) Volume
- DBH exceeding 28.0 cm and height exceeding 30.0 m, at ages of between 6 and 8 years;
- DBH exceeding 30.0 cm and height of more than 30.0 m, at ages of between 8 and 10 years;
- DBH greater than 32.0 cm and height above 30.0 m, at ages from 10 to 12 years.

b) Disease resistance
Particular attention is paid to natural resistance to *Diaporthe cubensis* (canker), which affects the bark, generally at the base of the tree. Plants must be completely resistant.

c) Straightness
Good shape is a "must", because this facilitates and renders less expensive both logging operations and chipping at the pulp plant. Moreover, a part of the forest may be used to supply sawmill operations.

d) Pruning ability
Selected trees must have complete natural pruning ability. Trees with thin branches usually have this feature, which facilitates felling operations and reduces the quantity of waste in industrial production because the lumber will contain less knots.

e) Form of crown
Trees with well-formed crowns and a large number of leaves foster shading of the soil and thus avoid burgeoning of weeds. Weeding is expensive, besides harming the soil and the roots. Moreover, the eucalypts is very sensitive to competition.

f) Bark
As the bark is also used to make pulp, the selected hybrids must have smooth bark so as to facilitate the process and improve industrial quality.

From the above-mentioned phase onwards, the tree must be felled so as to obtain information on the following characteristics:

g) Coppicing ability
One of the limiting factors in use of the method is the coppicing ability. Good coppicing ability is basic for the following reasons (Plate I):
- in case of formation of the eucalypts forest, it is hopped that successive rotations will be obtained from the same stump;
- in case a clone bank is formed, it is hoped that sound production of sprouts will occur, from which to obtain cuttings, a procedure that should be repeated in successive cuttings (Plate II).

h) Rooting capacity
Variation in root forming ability amongst the selected trees reaches extremes of 0 and 100 per cent. Those plants with a level of ability of 70% or better are utilized, inasmuch as production in mass of rooted cuttings from parents with low root-forming ability increases costs.

i) Basic density and pulp yield
Wood sample (disc) is collected at the DBH:
1) The basic density is determined with bark and without bark, as well as the percentage of bark. The basic density without bark has varied from 400 to 700 kg/m^3. Currently trees are selecting with densities of around 600 kg/m^3.

BASIC DENSITY	NUMBER OF TREES
400 to 450	100
451 to 500	617
501 to 550	979
551 to 600	616
601 to 650	164
651 to 700	43
701 to 750	13

2) The yield in unbleached pulp is determined by digesting the sample (15 grams) in micro-digesters and estimating the yield of bleached pulp. The latter has varied from 44.9 to 54.9%.

These yields at the DBH are being used as mere (approximate) indicators of the yield from the respective trees. It is realized that there is no correlatation between the yields obtained in the DBH region and the mean yield of pulp from the tree as a whole (Barrichelo, L.E.G., 1979).

j) Confirmation of the forest characteristics
After the trees have been subjected to the above-mentioned tests and approved, they are planted in vegetative orchards for confirmation of their phenotype. Two years are enough for the obtaining this information and to decide on the selection of the better, parent, trees

The clones are felled for the mass production of cutting. Use is made of those that afford bes characteristics for a particular purpose: pulp, sawmill operations, production of energy.

Present method of rooting cuttings

An endeavor has been made to develop efficient, low-cost

Plate I - Sprouts from a stump of a selected tree, two months after felling. Material used to produce cuttings.

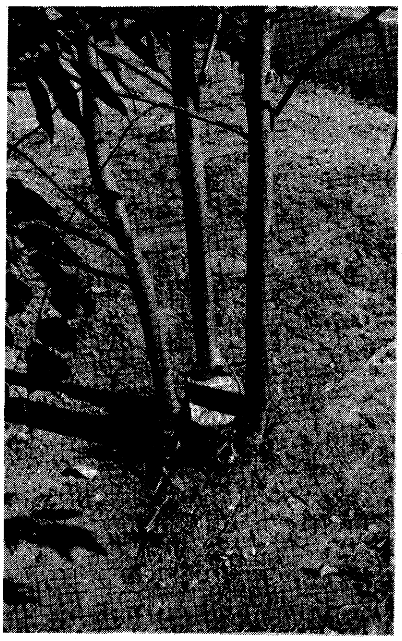

Plate II - Three coppice shoots correctly spaced on the stool.

Plate III - Shade house.

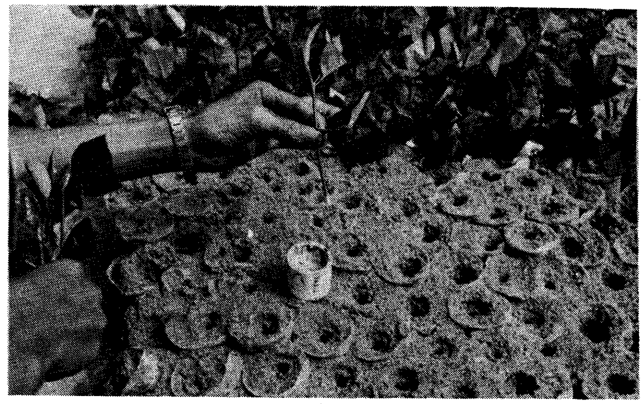

Plate IV - Hormone treatment and cuttings planting.

facilities for large-scale production of rooted cuttings.

1) Shade house

The best environmental conditions for rooting of eucalypts cuttings in this region were developed from use of shade houses covered with plastic net (50% shade). This protects the cuttings from direct sunlight, strong winds, heavy rainfall and also makes for a milder temperature.

The floor of the shade houses slopes at a 2% angle, and an automatic intermittent mist irrigation system keeps the leaves and the medium damp (Plate III).

2) Containers and medium

The container used is a plastic bag 5 cm in diameter and 10 cm high. The medium is sub-soil earth, free from organic matter and weed seeds. Absence of organic matter greatly reduces the risk of appearance of diseases.

The containers are organized in the form of plots 120 cm wide on the ground, spaced 45 cm apart (Plate III). Each container receives a 1 cm deep layer of sand, to foster better aeration around the base of the cutting.

The center of each container pack is perforated down to a depth of 4 cm, so as to prepare the location in which the cutting will be planted (Plate IV).

3) Harvesting of sprouts

Two months after cutting of the clones, sprouts with a height of about 60 cm, are harvested in the vegetative orchard, with two well-located sprouts maintained for formation of new trees.

Harvested sprouts are taken to the nurseries in buckets of water to avoid fading. Normally, five sprout -harvesting operations are effected on each stump, so that approximately 500 cuttings are produced from two-year -old stumps (Plate I)

4) Preparation of cuttings

The best results have been obtained with use of cuttings containing two pairs of leaves. If the cutting loses one or two leaves, the remaining ones ensure root formation. Cuttings with no leaves will not take roots.

When the internode distance is considerable (over 8 cm) the cutting is prepared with one pair of leaves. The apex and the base of the sprout are not suitable for cutting production, because they do not form good roots. The apex is too herbaceous and the base, too highly lignified.

If the cutting already has buds appearing, these are cut off at the leaf angle, because if they are too leafy they will die. New sprouts will emerge later.

There is considerable variation in leaf area from matrix to matrix. Large leaves should be reduced:

a) to avoid falling as a result of their own weight plus the water accumulating on them;

b) to avoid overlapping of leaves after planting in containers, in the interests of better lighting and irrigation.

The base of the cutting is soaked in a solution of systemic fungicide (Benlate 200 p.p.m.) for 15 minutes (Plate V).

5) Planting of cuttings in containers

The base of the cutting (2 cm) is treated with rooting hormone. Use is made of indolbutyric acid diluted in talc, at a concentration of 8,000 p.p.m. or a mixture of 6,000 p.p.m. of indolbutyric acid plus 2,000 p.p.m. of indoleacetic acid diluted in talc (Plate IV).

In both situations the results are the same. The former product is to be found in the market. The latter can be prepared on the spot and is therefore less expensive.

From this point onwards, the cuttings are subjected to intermittent spraying, which keeps them alive. On the

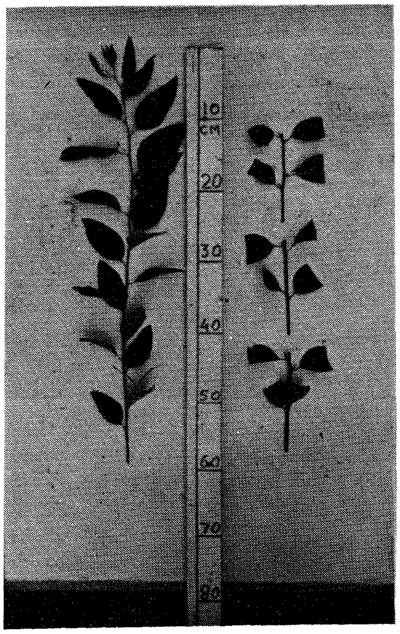

Plate V - Sprout and prepared cuttings.

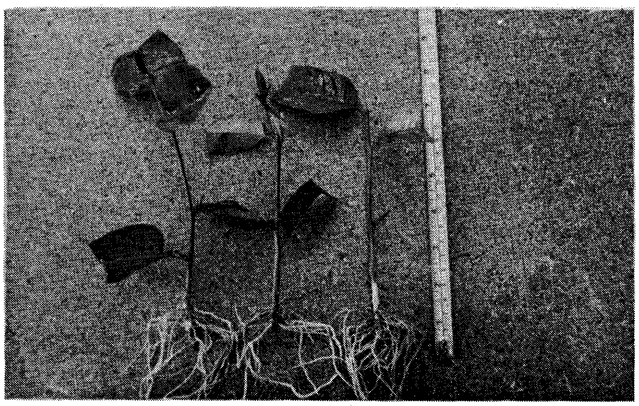

Plate VI - Root system of the cuttings after 40 days.

25th day, the cutting receive their first dose of fertilizer, namely: 3 kg, of N-P-K (5-17-3) diluted in 100 liters of water for 10,000 containers.
The total period under spray treatment is 40 days, sufficient to form a sound root system and commence the sprouting process (Plate VI).

6) First selection
After the period referred to, the rooted cuttings are selected for transfer to an uncovered area. In that area the irrigation system is designed to keep the medium damp.
In this phase the second fertilization is effected, being identical with the first one (Plate VII).

7) Second selection
Between 60 to 70 days the second selection is effected.
a) If the cutting contain more than one sprout, the more developed one is selected and the remainder removed.
b) The rooted cuttings are separated into groups of approximatel equal sizes (three groups).
After 70-90 days, the rooted cuttings area ready for planting in the field.

Plate VII - Rooted cuttings after 40 days transferred to an uncovered area

Plate VIII - Rooted cuttings ready for planting

Results

The first clone bank was set up three years and ten months ago, using material from the first trees selected in line with the criteria mentioned. It has been noted all, the trees in this bank strictly reproduce the characteristics for which they had been selected (Plates IX and X).
Vigorous hybrids, propagated by rooted cutting display the following rates of growth:

CLONE	$\bar{D}$ (cm)	$\bar{H}$ (m)	$\overline{AB}$ (m^2/ha)	M.A.I. (m^3/ha/yr.)
G 04	15.8	21.7	22.2	58.0
G 15	15.8	21.9	22.1	58.3
G 17	15.9	21.4	22.1	56.7
G 18	16.0	21.2	22.6	57.6
G 20	16.4	18.6	23.8	51.8
G 21	16.3	22.1	23.1	61.1
G 22	16.5	20.0	22.9	55.2
G 25	15.5	21.8	21.6	56.5
G 29	16.2	22.3	23.0	61.6
G 31	15.6	20.9	21.7	54.7
G 32	14.4	20.4	18.4	45.2
G 34	17.3	21.4	25.1	64.7
G 36	18.8	20.6	31.1	76.9
G 40	18.1	20.0	28.9	69.2
U 01	15.9	21.4	22.5	57.9
U 04	15.2	21.5	20.6	53.3
U 06	15.8	21.5	20.8	53.8
U 08	15.0	21.3	19.9	50.9

Table 1 - Hybrid eucalypts trees propagated by rooting of cuttings, after 3 years and 6 months of age. Spacing: 3 x 3 meters.

Plate IX - Clone banks, three years and ten months old (rooted cuttings)

Plate X - Clone bank, three years and ten months old (rooted cuttings)

For each plot of clones derived from a single parent tree, a high degree of uniformity is observed.

Plantings were effected with rooted clones derived from clone banks, for the formation of new clone banks or experimental plantings. Those plantings were cut in three short rotation (18 months after planting, 18 months after first cutting and nine months after second cutting) and showed 100% sprouting after each cut (Plate XI).

In routine planting operations, about one and a half million rooted cuttings have so far been planted, and the oldest individuals are a year and a half old. Survival rate of these trees is about one hundred per cent, and the same uniformity as occurs in the clone banks and experimental plantings has been observed.

The forest previously planted with seedlings has shown a mean annual increment of about 36 m^3/hectare/year, as of the seventh year. Although there are no plantings of rooted cuttings of the same age, the experimental plantings and clone banks with four years of age have shown a mean annual increment (see Table 1) which leads to expectation of minimum gains amounting to 28% per hectare per year as of the seventh year.

The use of parent plants that are in the phase of greatest increment (see Table 1), plus the results of spacing studies, may result in even higher gains. A study is being made of various spacings, (up to 5 x 5 m) and expectations are that the best result will be obtained at between 9 and 12 m^2 per tree.

As may be notes from Table 1, the variation in gain between parent trees as well as in certain other characteristics, is quite considerable, thus favoring the selection of plus trees. About five thousand parent trees are currently in course of testing.

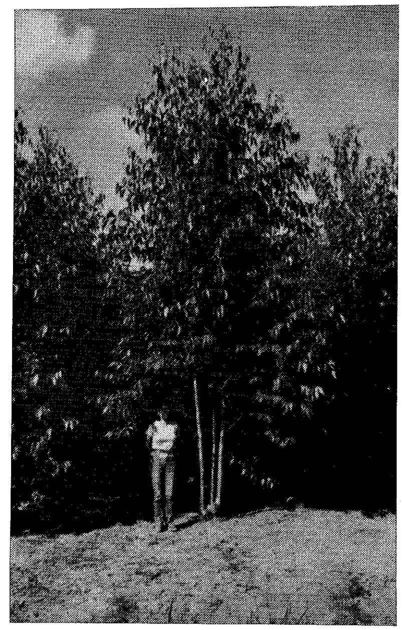

Plate XI - Coppice shoots, ten months old, from rooted cuttings

Cost of production of rooted cuttings is equal to that of producing seedlings. As this is a method still in course of development, certain nursery techniques will have to be improved with a view to their rationalization and consequent reduction in cost. Amongst the factors still in course of development are the following:

- type of container: mechanization of filling and best way of forming root system;
- type of medium : reduction in weight of medium and mechanization of planting.
- fertilization of rooted cuttings: type of fertilizer, form of application (leaf-spraying or otherwise), and period of application;
- control of luminosity: at the various periods of the year.

C o n c l u s i o n

Mass propagation of *Eucalyptus* spp. via rooted cuttings is feasible and is a means of obtaining high gains in the first generation.

Five thousand hybrids (controlled and not controlled) of *Eucalyptus* spp. trees have been selected. Each selected tree has, at the same time, a number of different characteristics, such as resistance to *Diaporthe cubensis*, coppicing ability, straightness, self-pruning ability and suitable density and cellulose content for pulpwood production.

Vegetative orchards for production of cuttings have already been planted.

One million rooted cuttings were planted in 1979, and five million will be planted in 1980.

The system permits use of vigorous hybrids, of well known behavior and quality, for planting fast-growing forests.

The tropical climate of Aracruz, Brazil, facilitates this strategy, whereby the mass production of rooted cuttings is practiced through simplified methods of environmental control.

L i t e r a t u r e

ALLARD, E.W. - *Princípios do melhoramento genético das plantas*. São Paulo, E. Blücher, 1971. 381 p. il.

BARRICHELO, L.E.G. - *Estudos de densidade básica, teor de holocelulose e rendimento em celulose de madeiras de Eucalyptus grandis*. Piracicaba, ESALQ. Departamento de Silvicultura, 1979. 89 f.

BURGESS, I.P. - (Oral communication).

BURLEY, J. & STYLES, B.T. - *Tropical trees*; variation breeding and conservation. London, Academic Press, 1976. 243 p. il.

CAMPINHOS, E., Jr. - More wood of better quality: intensive silviculture with rapid-growth improved *Eucalyptus* spp. for pulpwood. IN: *1980 ANNUAL MEETING OF THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY. - Proceedings of the* ... Atlanta, TAPPI, 1980. p. 351-7.

——— & IKEMORI, Y.K. - Tree improvement program of *Eucalyptus* spp.; preliminary results. IN: *WORLD CONSULTATION ON FOREST TREE BREEDING, 3rd., CANBERRA, 1976. - Documents.* Canberra, CSIRO, 1978. p. 717-38.

DAVIDSON, J. - Breeding *Eucalyptus deglupta* - a case study. IN: *WORLD CONSULTATION ON FOREST TREE BREEDING, 3rd., CANBERRA, 1976. - Documents.* Canberra, CSIRO, 1978. p. 1187-203.

———. - Exploration, collection, evaluation, conservation and utilization of the gene resources of tropical *Eucalyptus deglupta* Bl. IN: *WORLD CONSULTATION ON FOREST TREE BREEDING, 3rd., CANBERRA, 1976. - Documents.* Canberra, CSIRO, 1978. p. 75-102. il.

———. - Problems of vegetative propagation of *Eucalyptus*. IN: *WORLD CONSULTATION ON FOREST TREE BREEDING, 3rd., CANBERRA, 1976. - Documents.* Canberra, CSIRO, 1978. p. 857-82.

———. - *A technique for rooting seedling cutting of Eucalyptus deglupta Blume.* Bulolo, Forest Research Station, 1973. 10 p. il.

ELDRIDGE, K.G. - Genetic improvement of eucalypts. *Silvae Genetica*, Frankfurt a.M.,27(5): 205-9, 1978.

FAULKNER, R., ed. - *Seed orchards.* London, HMSO, 1975. 149 p. il. (Forestry Commission Bulletin, 54)

FRANCLET, A. - *Premiers travaux d'amélioration genetique des Eucalyptus.* /s.l., s.ed., 1965/ p. 64-91. (xerox copy)

———. - Technique de bouturage des *Eucalyptus camaldulensis. Note technique I.N.R.F.*, Tunis, 12, 1970. 55 p.

HARTMANN, H.T. & KESTER, D.E. - *Plant propagation;* principles and practices. 3.ed. Englewood Cliffs, Prentice-Hall, 1975. 662 p. il.

HODGSON, L.M. - Methods of seed orchard management for seed production and ease reaping in *Eucalyptus grandis. South African forestry Journal*, 100: 38-42, 1977.

———. - Some aspects of flowering and reproductive behaviour in *Eucalyptus grandis* (Hill) Mainden at J. D. M. Keet Forest Research Station. *South African forestry Journal* 97: 18-28; 98: 32-43, 1976.

IKEMORI, Y.K. - Resultados preliminares sobre enraizamento de estacas de *Eucalyptus* spp. *Informativo técnico Aracruz*, 1, 1975. 12 p. il.; 2, 1976. 9 p. il.

LAWRENCE, W.J.C. - *Practical plant breeding.* 3. ed. London, G. Allen & Unwin, 1965. 164 p. il.

MAHLSTEDE, J.P. & HABER, E.S. - *Plant propagation.* New York, J. Wiley, c.1957. 413 p. il.

MARTIN, B. & QUILLET, G. - Bouturage des arbres forestiers au Congo; résultats des essais effectués à Pointe Noire de 1969 à 1973. *Bois et Forêts des Tropiques*, 154: 41-57; 155:15-33; 156: 39-61; 157: 21-40, 1974. il.

MIKSCHE, J.P., ed. - *Modern method in forest genetics.* Berlin /etc./ Springer-Verlag, 1976. 288 p. il.

TINUS, R.W. & McDONALD, S.E. - *How to grow tree seedlings in containers in greenhouses.* Lakewood, USDA Forest Service. Rocky Mountain Forest & Range Experiment Station, 1979. 256 p. il. (General technical Report RM-60)

TISCORNIA, J.R. - *Multiplicacion de las plantas.* Buenos Aires, Albatros, 1974. 213 p. il.

VAN WYK, G. - *Early growth results in a diallel progeny test of Eucalyptus grandis W. Hill ex. Maiden.* Raleigh, North Carolina State University. Department of Forestry, 1975. 138 f. (Thesis submitted to the Graduate Faculty of North Carolina State University at Raleigh in partial fulfillment of the requirements for the Degree of Doctor of Phisolophy)

———. - Early growth results in a diallel progeny test of *Eucalyptus grandis* (Hill) Maiden.II. A greenhouse study. *Silvae Genetica*, 26(1): 44-50, 1977.

———. - Pollen handling, controlled pollination and grafting of *Eucalyptus grandis. South African forestry Journal*, 101: 47-53, 1977.

———. - *Report on pollen handling, control-pollination, and grafting of eucalypts.* /s.l., s.ed./ 1974. 10 f. il.

WELCH, H.J. - *Mist propagation and automatic watering.* London, Faber and Faber, 1973. 172 p. il.

WELLS, J.S. - *Plant propagation practices.* New York, Macmillan, 1975. 344 p. il.

WRIGHT, J.W. - *Introduction to forest genetics.* New York /etc/ Academic Press, 1976. 463 p. il.

CRIAÇÃO E MULTIPLICAÇÃO VEGETATIVA ATRAVÉS DE ESTAQUIA DE HÍBRIDOS DE *Eucalyptus* NO CONGO

J.C. Delwaulle

. Centre Techinique Forestier Tropical Congo.

Resumo

O aparecimento de híbridos de Eucalyptus naturais no Congo explica as primeiras investigações da Pesquisa Florestal na propagação vegetativa destes híbridos.

A técnica de estaquia de Eucalyptus está agora bem desenvolvida e é aplicada em larga escala.

A criação de novos híbridos (alguns podem ser mais produtivos que os híbridos naturais) traz um novo e grande interesse à Pesquisa Florestal e ao programa de reflorestamento nas savanas africanas.

CREATION ET MULTIPLICATION VEGETATIVE PAR BOUTURAGE d'*Eucalyptus* HYBRIDES EM REPUBLIQUE POPULAIRE DU CONGO.

Summary

Forest research has canned out the first investigations on vegetative propgation of natural Eucalyptus hybrids in the Congo.

The cutting technique for Eucalyptus is now well mastered and applied on a large scale

The creation of new hybrids, some of which will be more productive than the natural hybrids, gives Forest Research and the afforestation programm in African savannas new and very great interest.

2 - INTRODUCTION

La région de Pointe-Noire au Congo (4°45' de latitude Sud) est caractérisée par des plateaux d'altitude faible (80 m environ), au relief peu marqué, couverts de savanes faiblement arbustives. Les sols sableux, profonds (sols psammitiques) sont peu fertiles et ne font guère l'objet d'utilisation agricole ou pastorale.

Le climat est caractérisé par deux saisons bien tranchées, une saison chaude, pluvieuse (1254 mm de moyenne) de Novembre à Mai ; une saison plus fraîche, sèche, avec ciel généralement couvert de Mai-Octobre. L'hygrométrie de l'air demeure forte toute l'année.

Les surfaces relativement considérables de savanes (plus de 100 000 hectares) ont amené la recherche forestière à introduire des espèces susceptibles d'être adaptées à ces conditions dans l'objectif, initialement, de fournir du bois de feu pour la ville de Pointe-Noire et des traverses pour