FORESTRY PRODUCTIVITY IN THE TROPICS: ARACRUZ EXPERIENCE

Edgard Campinhos Junior
Aracruz Florestal S.A.
Aracruz – ES – Brasil

1986
SPRING
MEETING

Forestry productivity of deciduous and conifers can be extremely high in tropical regions where climate and soil conditions for biomass development are more favorable when compared to regions where forest plantations for industrial purposes are already traditional.

Natural forest species coming from hot an humid regions are normally distinguished due to their quick development, once the metabolism is stimulated by these factors. To produce pulp, *Eucalyptus* can be harvested at the age of 7 years and the *Pinus* at the age of 12 years.

The forest management must be done carefully in order to avoid the development of undesirable organisms such as pests, diseases and other plants, that compete with the culture in subject. It is essential to mantain biological balance so as to prevent the large monocultures destroying the local flora and fauna.

The action of microorganisms, rain and high temperature also deteriorate the soil when conservation practices are not adopted. To preserve the soil and guarantee a continuous forest growth it is necessary to maintain the covering vegetation, avoid erosion, return lixiviated and withdrewn nutrients, avoid soil compaction resulted from improper dimensioned equipment, avoid fire usage, etc.

The concept of forest productivity is being continuously enlarged with the intention of producing better quality wood instead of emphasizing only volume production per area and time units.

The wood quality must be the highest as possible to give most competitive final products.

The main factor that qualifies the wood is the permanent uniformity of its characteristics.

Many are the factors that cause variation in the wood characteristics. Regarding a specific forest specie we can point out the following:

- Genetic quality constitution.
- Tree improvement level.
- Variation between provenances.
- Environmental differences and between stands.
- Age differences.
- Silvicultural treatment such as fertilization, site preparation, pest control, etc.

Aracruz Experience

Based on the already mentioned premises Aracruz Florestal was settled in a region with propitious environmental conditions for the growth of *Eucalyptus* for pulp production.

In addition to the ecological conditions, a region formed by plain sites and next to the sea was selected, what favored the forestry, industrial and commercial operations.

The Aracruz project started in 1967, with the planting of *Eucalyptus* forests in two different regions in Espirito Santo State, on the eastern coast of Brazil, north of Rio de Janeiro. The forest is in Aracruz county with a gross area of 55,000 ha and the second is in Sao Mateus and Conceição da Barra counties including 45,000 ha. The total net area planted with forest is 72,00 ha while the remaining area contains native forests, rivers, lakes, roads and buildings.
In 1967 Aracruz started its work. At that time, Aracruz had *Eucalyptus* seeds from Brazil available, which had not specific environmental improvement for its ecological region.

In an advance stage, seeds from the Republic of South Africa and Zimbabwe were imported obtaining better results.

In 1973, pure genetical seeds were collected in Australia and in Timor Island with the objective of developing its forest improvement program. The regions had similar climate with potential species.

A classic tree improvement program strictly achieved demands many years of work. With *Eucalyptus* which is a fast growing specie it takes around 25 years.

Simultaneously, *Eucalyptus* cloning technology by rooting cutting technique was introduced and developed, according to the region's ecological conditions. The target was to propagate plus trees. The cloning technique promotes imediate gains.

a) **Clone.** All plants (ramets) reproduced asexually from a common ancestor ortet and having identical genotyps.

b) **Genetical Material Origin.** Based on the adaptation principle, mother trees were selected among company's plantation seeking for a best "site x clone" interaction. The main specie is *E. grandis* and inter specific hybrids like. *E. grandis* x *E. urophylla.*

c) **Mother Tree Selection Criteria.** The cloning technique promotes maximum gain, therefore it is necessary to select trees with the highest number of desirable characteristics. In order to produce *Eucalyptus* bleached pulp, the following criteria were adopted:

1. **Volume.** The selected tree must contain more than 1 m^3 including both wood and bark.

2. **Diseases and Insects.** The selected tree must be free of disease and insect attack, with emphasis on immunity to the canker disease caused by the fungus *Cryphonectria cubensis.*

3. **Straightness and Limb Size.** The selected tree must be straight and have small limbs. Such trees have good self-pruning and a minimum of tension wood which are normally associated with heavy branches and crooked trees.

4. **Crown Shape.** The crown should be well shaped, having a large leaf volume which provides better and earlier shade over shich supresses weeds and other vegetation which compete with the young trees.

5. **Wood Density and Pulp Yield.** Trees having suitable phenotypes are felled and the wood is analysed for basic density and cellulose yields. The basic density must be between 480 to 570 kg/m^3 and the pulp yield greater than 50%.

Table 1

Frequency distribution and range of variability in wood specific gravity and bleached pulp yield (without bark) from eucalyptus with excellent growth and form.

WOOD DENSITY		BLEACHED PULP YIELD	
Kg/m^3	No. of Trees	%	No. of Trees
301 – 350	0	40.1 – 41.0	2
351 – 400	70	41.1 – 42.0	2
401 – 450	305	42.1 – 43.0	1
451 – 500	479	43.1 – 44.0	7
501 – 550	461	44.1 – 45.0	17
551 – 600	355	45.1 – 46.0	42
601 – 650	120	46.1 – 47.0	57
651 – 700	22	47.1 – 48.0	91
701 – 750	4	48.1 – 49.0	174
751 – 800	0	49.1 – 50.0	272
		50.1 – 51.0	187
		51.1 – 52.0	229
		52.1 – 53.0	208
		53.1 – 54.0	136
		54.1 – 55.0	62
		55.1 – 56.0	21
		56.1 – 57.0	2
		57.1 – 58.0	1
TOTAL	1816	TOTAL	1511

6. **Anatomical and Morphological Analysis of Wood and Paper Properties.** If the basic density of the wood and cellulose yield are acceptable, the tree is then submitted to an anatomical and morphological analysis by the Aracruz Industrial Research Center. Characteristics measured are: fiber length, wall thickness, extractive content, hemicellulose content, lignin content, etc.

7. **Coppicing and Rooting Ability.** In Eucalyptus the ability to coppice determines the number of cuttings that will be obtained. Additionally, it must be determined how easily the cuttings will root; this is of key importance. The rooting ability of cuttings should exceed 70% if the operational program is to be feasible.

When ability to coppice and/or root is poor, the way of micropropagation can be used. In the future tissue culture will also be a possibility.

8. **Clonal Tests.** The rooted cuttings of each clone are planted on the different sites present on Aracruz lands in order to check their growth potential, resistance to pests, wood properties and general adaptability to each site. Assessment of the clones is made after one half rotation (3 to 4 years) and the best clones are then propagated for multiplication. These are then planted in larger areas called clonal multiplication areas which provide the many cuttings needed for an operational planting program.

Results

Since 1979, 44,000 ha were planted with clones, totalizing 48,8 million trees disposed within a spacement of 3 x 3 m.

The volumetric results from unimproved seed plantations are compared to those from clonal research as follows:

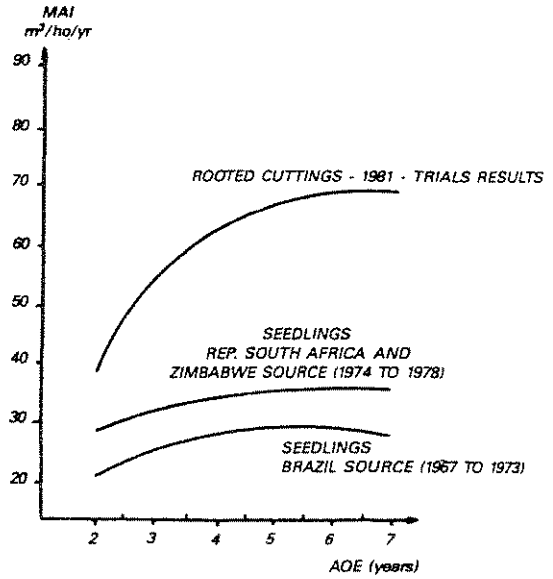

Figure 1. Development of Eucalyptus plantation. Mean annual increment (m^3 /ha/year)

The selected quality of Aracruz eucalyptus wood is compared as follows:

Table 2
Comparison of Eucalyptus wood quality from different sources

	BRAZILIAN SOURCE	ZIMBABWE AND SOUTH AFRICA SOURCES	ROOTED CUTTINGS 1st. STAGE	ROOTED CUTTINGS 2nd. STAGE
BASIC DENSITY (kg/m^3)	480	490	490	520
PULP YIELD (%)	47	47.4	49	51.8
BARK CONTENT (%)	18	15	12	10
SPECIFIC WOOD CONSUMPTION* (m^3/t_{90} pulp)	4.87	4.56	4.26	3.71

* specific consumption of wood with bark per ton of pulp.

Appropriate nutrition, site preparation and weed control are very necessary to obtain maximum productivity along with the best "clone x site" interaction, natural tree vigour and pest and disease resistance.

March 1986