JAO
KJS

SUMMARY:

"EUCALYPTUS SEED SUPPLY FOR MINAS GERAIS, BRAZIL"
ELRIDGE 1979

Public and Private Forests:

From 1909 to 1966 there was 470,000 hectares of eucalypt plantations established, from 1967 to 1977 there was 1,493,000 ha and a rate of 200,000 hectares/annum likely to continue.

Most of the plantations are privately owned but the Federal Government maintains some control through it's Fiscal Incentive Schemes.

Fiscal Incentive for Afforestation

The incentives are tax relief from plantation establishment expenses. The minimum area for eligibility is 1,000 ha in one or more tracts within 100km radius. Several persons or entities can combine to achieve an aggregate of 1000 ha.

About 75% of the plantings are eucalyptus, 25% are pines.

Advantages claimed for this incentive is:

1. more rural economic development and employment which reduces migration to cities.

2. more revenue to the Government through taxes from productivity created on marginal land.

3. new export potential for steel from charcoal and for pulp and paper.

Plantation Practice

Establishment preparation is intensive-areas are cultivated before planting, seedlings are raised as container stock in nurseries, fertilising-watering-weed control-and insect control are all practiced.

These activities cost the same when either poor or chosen seed is used, therefore, the marginally higher expenditure for provenance seed purchase yields disporportionate gains, hence the Brazilian research to produce improved provenances and hybrids.

Uses of Eucalypt Wood

FAO estimates (1979) of domestic and industrial fuelwood plus charcoal production was 10% of the total world production in 1977. (116 million tonnes) total wood pulp production in 1977 was 1.6 million tonnes (1% of the total world production).

The largest eucalpyt plantations are committed to single use, either charcoal or pulpwood on 5 to 8 year rotations. It must be remembered by tree breeders that this may change; rotations to sawlog stage may be required and plantations may be required to produce, motor spirit, transmission poles, honey, eucalypt oil, or other products.

Identification

The identification of existing plantation species is difficult due to the poor record keeping plus hybridisation.

The control of correct seed collection, nursery sowing and planting is essential.

Best Sources of Seed for Current Planting Programmes

The choice of seed source is very important as it can determine the profitability of a plantation. It takes less than 5 years to obtain secure information for such a decision by planting well - replicated trials on several sites comparing a few alternative commercial-scale seed sources. These trials should be planted nearly every year as new and better seed sources become available from tree breeding programmes.

There is always risk when buying from someone else, the best way to avoid this risk is to grow your own seed.

Need for more investment in seed quality

Although there have been rapid advancement in tree growing in Brazil the Brazilians are not the best tree breeders in the world, these people are to be found in North America and Europe. Several circumstances make Brazil the best place in the world for progress in eucalypt breeding:

1. There is a great need due to the immense scale of investment in forestry in Brazil at present plus the current dissatisfaction with many present seed sources.

2. Sufficient funds would be available by re-location of a very small percentage of current plantation investment.

3. Education is available in Brazil and other countries.

4. Principles of tree breeding are fairly well established and are being tested in many countries.

5. Methods of tree breeding are well advanced (controlled pollination, vegatative reproduction,). Genetic information is accumulating in Brazil. The rapid growths plus heavy, early seed production allows for rapid selection of breeding stock.

Personnel and Training

There are 25 graduates working full-time on tree breeding, which is only a relatively small number when compared to the number of metalurgists and chemists. Company executives must realise that tree breeders are as important to the profitability of the company as are chemists and metalurgists.

It was proposed that a seed supply officer in each company - this would require additional training of graduate forest engineers and supporting technicians. Couses to achieve this have been run in Brazil (One has also been run in Australia by FAO.)

Breeding Stations

Breeding stations set up at various locations could play an essential role for co-ordination of seed importation and conduct co-operative trials of species and provenance to develop the genetic base for future requirements.

Eucalypt breeding strategies

There is a wide range of breeding strategies and techniques available for improving eucalypt plantations, wider than for pines for which selection of plus trees and making grafted seed orchards is the standard practice.

Imported E. grandis plantations have resulted from grafted seed orchards (S. Africa), from 3 generations of selection through seedling seed orchards (U.S.A.), from rooted cuttings from selected trees some of which are hybrids and from seed production areas.

The development of an effective breeding strategy requires expert knowledge of certain principles as well as the recognition, and being able to distinguish between, 4 different types of population.

1. Natural populations, the source of variation, represented in Brazil by planted genetic base populations.

2. Breeding populations, usually planted in progeny tests and clone banks and used for continued selection over several generations.

3. Seed production populations for "packaging" selected genes in large No. of seeds, (or cuttings).

4. Wood production populations, which are not a desirable source of seed in most cases.

A strategy requires (also) local knowledge plus time for thinking and discussion.

Species and provenance trials

Trials should be well replicated, an inadequately represented trial provides no means to discriminate between species and provenances whose performance is fairly similiar because the environment within trial sites is never quite uniform.

Precision in climatic matching should not be carried too far. Most species and provenances have some degree of plasticity, a capacity to adapt to environments which differ somewhat from the natural one. Assessment of placticity is one of the purposes of species and provenance trials.

Seed production areas

The various seed production areas in Brazil have similiar characteristics these being:-

1. Thinning had not been early enough or heavy enough to retain a low, green, fruit bearing crown.

2. The trees had a fine form for wood production and had not been mutilated to increase seed production.

3. Collection was by climbing alternate trees every second year (to as high as 30 metres).

Seed orchards established

Of the seven grafted orchards established between 1967 and 1971 there were few successes. More successful orchards were established in the late 1970's. The clonal seed orchards are not yet of a scale to supply a substantial part of the Minas Gerais requirements, however within the next 5 years it seems desirable and likely that more eucalypt seed orchards will be established.

Densities

400 E. grandis trees were sampled at 5 years of age from Bom Despacho (Brazil), these are very similar to results obtained by S. African Forest Investments from 200 E grandis trees at 17 years near Sabie (East Transvaal).

Source	No. trees	Age (yr)	Range (kg/m^3)	Average (kg/m^3)
Bom Despacho	400	5	420-590	480
Sabie	200	17	310-590	444

An idea of scale

Forestal Acesita produces charcoal for steel production. In 1980 the mill was expected to produce 3,000,000m^3 charcoal. Acesita plants at least 15,000 hectares each year (since 1975) and is the largest of any company in Brazil at present.

Seed certification

Brazil has a commission for seed control, this commission controls the quality of seed sold in Brazil by checking seed prior to its use for plantation establishment. Should the seed not be of reasonable quality then no payment of tax incentives by the Federal Government is allowed - this usually means that no planting occurs.

Records of seed origin

This, in general has not been actively pursued until recently. If a pure stand is inbred then plus tree selection should be minimal, but if the stand has a wide genetic base (which maybe less uniform in appearance) then many more unrelated plus trees should be selected. Repeated crossing of closely related trees and self pollination lead to poor quality offspring.

Coppicing ability

The ability of E. grandis to coppice varies in Brazil, in Northern Minas Gerais there is concern about it's ability to coppice whereas in Southern Minas Gerais it is consistently good. The original seed source for South and North Minas Gerais are probably from one source (Northern New South Wakes). Clearly, E. grandis ability to coppice varies with environment.

Efficient seed useage

Nursery practice of discarding up to 80% of seedling containers has been justified in the belief that a more productive forest results, this has now been refuted. A trial showed that the rejected small seedlings produced much the same productivity as the larger, selected seedlings.

Grading the seed into 3 or 4 size classes and pelletising (as in southern Florida) would lead to great savings in seed.

Drought and Fire

Although there was assurances that prolonged drought is not likely in Northern Minas Gerais there should be predictions made from long term weather records as to the likilhood of drought and days with a combination of high temperature, low humidity and strong winds after a long dry period (a "blow-up" day). Should the predictions show a high probability of these occuring within 10 years then the objectives of selection criteria may have to be adjusted towards trees which can better survive drought and fire.

This same logic should apply to nutrient drain conditions caused through short rotations.

Pests and diseases

The likelihood of pest and diseased being introduced are always high, therefore a wide genetic base as possible should be maintained for selection of resistant trees.

Steps to augment the availability of better quality eucalypt seed from within Brazil

As stated in earlier parts of the report, in my opinion, the main responsibility for supply of high quality eucalypt seeds should be with the afforestation companies. Several of the larger companies have already taken one or more of the following steps:-

1. Seed supply officer - designate one forest engineer as seed supply officer working full-time (at least for the first 3 or 4 years) with supporting staff to establish a tree breeding programme;

2. Training - to provide the seed supply officer with appropriate training and technical literature, and opportunities for consultations;

3. Species and provenance trials - determine the best species and provenances by review of trials on comparable sites in the region of the company's operations, and establish additional trials in collaboration with EMBRAPA of species and provenances not yet adequately tested;

4. Seed production areas - establish seed production areas of the best provenances of 4 or 5 species in each region in existing or specially planted stands of suitable provenance and genetic history, i.e. stands established from seed which can be traced back, perhaps over several generations, to an original collection from a large number of trees in a suitable natural stand.

5. breeding strategies - prepare separate, long-term breeding strategies for each species and region in collaboration with consultants from Brazilian forest research and development organizations and possibly from abroad, and review the strategy every two years;

6. co-operation - co-operation with such organizations as IPEF, SIF, EMBRAPA and IUFRO so that each company can benefit from the accumulated experience of many Brazilian and other eucalypt forestry enterprizes by free exchange of information and plant material.

Steps for better supply of eucalypt seed from within Brazil

1. Seed supply officer - 1 man full time for 3 - 4 years with supporting staff to establish a tree breeding programme.

2. Training - to provide the seed supply officer with appropriate training, literature and opportunities for consultations.

3. Species and provenance trials - to collate information and determine the best species and provenances already under trial on comparable sites and to establish new trials of species and provenances not yet adequately assessed.

4. Seed production areas - establish seed orchards from the best provenences of 4 or 5 species.

5. Breeding strategies - prepare separate and long-term breeding strategies for each species and region and review this strategy every 2 years.

6. Co-operation - co-operate with other companies, government departments and institutions.

RECOMMENDATIONS

As a result of my visit I submit 17 recommendations which were presented at the meeting in Belo Horizonte on March 29, 1979. Most of the 50 people present had shown me their work in the field during the previous 4 weeks.

The recommendations are mainly addressed directly to the large companies planting euclypts in Minas Gerais and adjacent areas of Brazil, and to the Brazilian research and educational institutions which give technical advice and guide the research and development programs of the afforestation companies. It is the companies which are best able to assess the advantages of improved seed for their own plantations, and, with appropriately trained staff and the best advice available, carry out the tree breeding work themselves. Some of the larger companies have already adopted this policy.

In summary, I recommend that all the afforestation companies accept the policy GROW YOUR OWN IMPROVED SEED.

Short term (1979-1980):

If local supply of improved seed is not sufficient and seed must be purchased from within Brazil or from another country:

1. Choose the best seed source by investigating the performance of various seed sources in areas closely similar to the proposed planting site,

2. Purchase seed of the best available source, not the cheapest, and insist on knowing the exact origin of the seed.

Make seed production areas by heavy, early thinning in stands of the best growth and form, preferable more than 5 ha each, of known genetic origin (of wide genetic base and not hybrid), and aim for fewer than 150 trees/ha by age 5 years.

Medium term (1980-1985):

In co-operation with other organizations select and acquire grafts of selected superior trees of the 4 or 5 best species for each region for grafted seed orchards in each company.

Develop techical skills in making grafts and cuttings, controlled pollination, management of trees for seed production, and observe flowering times.

Reactivate the PRODEPEF/EMBRAPA screening trials of species and provenances, particularly in the cerrado areas, both in the present planting areas and in possible areas for future planting.

Long term (1980-2000):

Invest heavily in education of specialist tree breeders by (i) training courses of 3 to 5 weeks, (ii) M.Sc. in Brazilian universities, (iii) Ph. D. in Brazil and abroad, for employment within the afforestation companies, as well as in government and universities.

Develop a breeding strategy within each company in co-operation with such organizations as IPEF, SIF and EMBRAPA. Different plans and intensities of effort will be required for the 4 or 5 species in each region.

Collect seed from many more natural stands in Australia and to the north, to establish much wider genetic base populations for future improvement of Brazilian plantations.

Support the Seed Control Commission in establishing a seed certification scheme.

Establish a eucalypt breeding station staffed by 3 or 4 specialists whose first duties would be to co-ordinate importation of eucalypt seed for research and development, conduct co-operative trials of species and provenances, and develop genetic base populations.

General recommendations:

Keep good records of the exact origin of seed used in each compartment of the plantations.

Plant well-replicated trials every year comparing alternative commercial-scale seed sources.

Distinguish clearly between the genetic base population, breeding population, seed production population, and wood production population.

Be aware of the bad effects of self pollination in eucalypts and do not use seed from isolated trees.

Support the Seed Section of CSIRO Division of Forest Reasearch Canberra (Partly financed by FAO and ADAB) in continued collection and supply of eucalypt seed for trials and genetic populations.

Read technical publications - see attached list for important books and papers in English.

Publish more reports on Brazilian eucalypt breeding in international scientific journals and through conferences, and include English summaries in reports published in Brazil.