

***Eucalyptus benthamii*: considerations on the genetic improvement program carried out by Embrapa and its partners in Brazil**

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Eucalyptus benthamii has been indicated for planting in the Southern Region of Brazil at altitudes ranging from 800-1,400 m, which are normally prone to frosts of up to -6°C. Technological assessments of the wood (density, calorific power, lignin and carbohydrates contents) have showed a particular aptitude of this species for energetic purposes. It has been also observed a continuous expansion of the planted area during the last five years and recent estimates show that approximately 15,000 ha are currently occupied by this species.

The genetic improvement program carried out by Embrapa has completed 23 years, and the first experimental field (0.5 ha) was established in Colombo-PR (25°19'5"; 49°09'W; 941 m) in 1988. Successive thinnings allowed transforming that area in a "Selected Mother Trees" category of Seed Collection Area, containing 120 plants at present. A second seed production field, originated from the latter, is located in Ponta Grossa-PR (25°09'5"; 50°04'W; 880 m). This Clonal Seed Production Area (1.09 ha, 160 plants) was formed by planting rooted stems of 16 clear-cut trees after selection at the age of eight years for growth rate, stem form and sanity.

As the original population (Wentworth Falls-NSW, Australia: 33°48'5"; 150°24'E; 150 m) exhibits a narrow genetic basis (7-10 trees), Embrapa has decided to make efforts to enlarge it. To do so, 30 open pollinated progenies from Kedumba Valley-NSW (33°49'5"; 150°23'E; 140 m), six from Bents Basin-NSW (33°52'5"; 150°38'E; 40 m) and also seed lots in bulk from Crossley SSG (33°28'5"; 145°00'E; 90 m) and SSG Barclays Deniliquin (35°01'5"; 145°13'E; 100 m) were imported from CSIRG in 2005, contributing to achieve an appropriate genetic basis available for the long-term institutional multi-generation recurrent selection program focused in better adaptation, growth rate and wood quality.

In order to evaluate the performance of these new introductions, two progeny tests were established in State of Parana in 2007, at the localities of Ponta Grossa (25°10'5"; 50°03'W; 890 m) and Guarapuava (25°40'5"; 52°06'W; 880 m). The assessment for DBH in Ponta Grossa (32 months) showed the following statistical-

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genetic parameters: mean, 12.51 cm; narrow sense coefficient of heritability (h^2_a), 0.47; among progenies coefficient of heritability (h^2_{mp}), 0.84; individual genetic coefficient of variation (CV_{gi}), 9.86%; among progenies genetic coefficient of variation (CV_{gp}), 4.93%. The assessment for Cylindrical Volume in Guarapuava (40 months) showed the following statistical-genetic parameters: mean, 0.56 m³; h^2_a , 0.31; h^2_{mp} , 0.81; CV_{gi}, 13.05%; CV_{gp}, 6.52%. These results are very promising to attend the purposes highlighted above and also oriented the initial thinnings by the elimination of the trees with lesser individual additive values, including those ones forked, broken and diseased.

Concerning the hybridization strategy, two approaches are being adopted. One of them includes the spontaneous hybrid *E. benthamii* x *E. dunnii*, which has been studied since 2006, showing a high heterosis for growth rate in comparison with the parent species. Besides, the observed maintenance of the cold tolerance of the maternal species, *E. benthamii*, has been of great importance. At the moment, nine genotypes are under inspection by means of a clonal test established in Ponta Pora-MS (22°33'5; 55°39'W; 632 m), in 2010. The other approach is to get hybrids by using controlled pollination. The first crosses between *E. benthamii* (as male parent) with *E. grandis* and *E. "urograndis"* were performed in 2008, originating hundreds of seeds, whose respective plants are under evaluation in a field trial established in Guarapuava in 2010.

Despite of the progress on the knowledge of this species, some aspects must be emphasized in future researches. For instance, during the last two years (2010 and 2011), the winter was notoriously cold in the States of Parana and Santa Catarina. In some sites the temperatures have reached very low values of up to -12°C, causing the complete loss of aerial parts of the plants of young plantations of up to eight months of age. The immediate consequence was the delay on their growth and, in some degree, the reduction of the stands due to the death of less tolerant plants, indicating that more efforts are necessary on this topic in the next steps of the breeding program.

The use of genome-wide selection (GWS) method in this species, in association with NIR technology, is other important and pioneer initiative of the Program, the first example of the simultaneous use of the traditional and innovative techniques in charge of a public company in Brazil. The basic idea is the development of models for ultra-early selection of the offspring for adaptation, growth and physical and chemical properties of the wood, saving time and money in the recurrent selection and also bringing benefits for the identification of elite clones in the next future.

Keywords: adaptation, progeny test, hybridization, genome-wide selection.