The era of transgenic eucalyptus

IMAGE BANK ABTCP/ RODRIGO MORAES

With excellent knowledge of the eucalyptus genome, Brazil is poised to continue its work aimed at obtaining trees with superior characteristics. With this, the pulp and paper sector already envisions significant gains in terms of productivity and wood quality

By Rodrigo Moraes

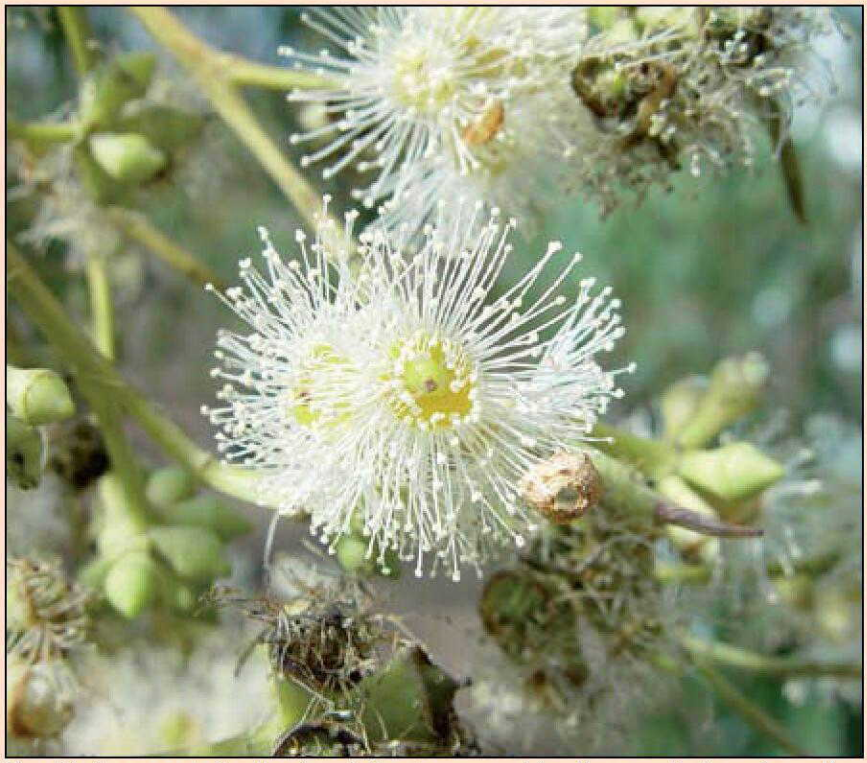
Imagine the ideal eucalyptus tree... It would certainly have infinitely better wood quality, possess balanced lignin content and that is more easily removable during the pulping process. Its photosynthetic capacity would be superior, ensuring the ideal cut with accelerated growth rates and, consequently, a productivity superior to what is obtained today. The same tree would also serve as an interesting source of biomass for producing energy.

Now, imagine this same tree "planted" in an industrial segment that, according to Bracelpa 2007 data, possesses 1.7 million hectares of planted area for industrial purposes and is growing at an accelerated rate, leveraged by the increase in pulp demand from countries like China and India. It may seem like a dream, but it is precisely towards this end that genetic research and experiments with genetically modified eucalyptus are advancing in Brazil. "We're in a good situation in relation to researching the genetic transformation of eucalyptus. Brazil is quite knowledgeable about the tree, since companies have

Benefits achieved from the genetic improvement of eucalyptus:

1. Increase in total forest productivity;
2. Better wood quality (density, type of fiber, pulp and lignin content) for industrial applications;
3. Greater raw material homogeneity for industry;
4. Better operation yield (forest and industrial);
5. Better utilization of less valuable areas (less productive);
6. Better production planning and forecasting;
7. Significant reduction in production costs and environmental impact in the industrial process.

Source: Eucalyptus Guide – Biosafety Information Council (CIB)



GENOLYPTUS.ORG.BR/ GIANCARLO PASQUALI

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been engaged in a major genetic improvement program. An entire genetic base has been built based on important programs such as Forests and Genolyptus, and with this we'll be able to advance even further in this transgenic research", says Carlos Alberto Labate, Genetics Department Professor at Escola Superior de Agricultura Luiz de Queiroz (Esalq/USP).

At present, it is perfectly possible to create new eucalyptus clones or even redesign other more efficient species, combining biotechnology and biosafety aspects. "From organisms already selected genetically due to conventional improvement, with a high yield and productivity, it is possible to add or alter the expression of a single gene – or a few – in a very specific manner, improving some characteristics even more", says Giancarlo Pasquali, a researcher at the Federal University of Rio Grande do Sul's (UFRGS) Biotechnology Center and member of the National Biosafety Technical Commission (CTNBio).

Forests and Genolyptus

The two eucalyptus genome research projects carried out in Brazil at the beginning of this decade achieved important results for the future development of genome research and presently stand as the base for DNA sequencing activities. The programs are characterized by the generation of an integrated platform of experimental resources and genomic databases to discover, map, validate and understand the genetic variation of eucalyptus.

Initiated in 2000, Forests was financed by the State of São Paulo Research Foundation (Fapesp) in conjunction with Duratex, Ripasa, Suzano and VCP. The project announced in 2002 the completion of a base with 120 thousand gene sequences of the *Eucalyptus grandis* species, which represents an important initiative by the private sector to explore modern technologies in the genomic area to improve eucalyptus for pulp and paper production.

In turn, Genolyptus, which started up in 2002, is fruit of a partnership between the Federal Government's Ministry of Science and Technology, the academic sector (seven universities), three research centers and the private sector (14 companies involved in forest planting). In 2004, the project completed a collection with more than 130 thousand sequences, covering 30 to 40 thousand eucalyptus genes from the DNA of four eucalyptus species. In an article published earlier in the beginning of this year, Dario Grattapaglia, Coordinator at Genolyptus, points out that the work goes beyond a typical genome project, "for it is based on an interconnection strategy between the different genomic technologies, field experimentation, wood technology and phytopathology".

LINES OF RESEARCH

Transgenic research with eucalyptus is part of the second generation work being done with genetically modified plants. "The first generation included plants improved primarily for agricultural and agribusiness purposes. The focus resides in reducing field losses – for example, with plants resistant to insects, viruses and bacteria, as well as plants capable of competing with weeds", explains Alda Lerayer, executive director of the Biotechnology Information Council (CIB).

With regards to eucalyptus, in addition to agribusiness aspects, there is specific concern with productivity. Genetic transformation research is first seeking to improve wood quality, which basically must satisfy industry needs pertaining to pulp production. Following this line, research takes two paths into account. First, improve eucalyptus pulp yield through genes that modify proteins, which in turn alter – or reduce -, lignin content. Second, maintain the same quantity of lignin, seeking to increase the proportion of a specific type of this polymer, extracted more easily in the pulping process. Both lines have provided for gains in energy consumption, reduced utilization of chemical products in the process and, lastly, improvement in the yield itself of the plant pulp.

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Manager, points out that the sector's concern with lignin is justified by the fact that its removal is one of the lengthiest and most expensive stages in the pulp production process, in addition to being directly associated to environmental issues. He also informed that there are other work fronts in the sector that are in their development, testing and experimentation phase, one of which is tolerance to water stress, wood quality, growth speed and resistance to cold weather and diseases, like blight.

BIOSAFETY

Perspectives point towards the multiple use of plants that can simultaneously perform the role of being a source of energy, food and supplemental compounds. However, in order to achieve such levels of diversity and productivity, countless studies, tests, experiments and approvals need to be carried out related to biosafety. Between 1999 and 2008 alone, 12 processes for the planned field release were realized for varieties of transgenic eucalyptus. "In these planned releases, which tests are totally monitored by the proponents, the objective is to prove through field studies and analyses that genetically modified organisms do not present any type of negative impact to the environment, society and human health", summarizes Juliana Vansan, ArborGen's Public and Government Relations.

According to the Eucalyptus Guide recently published by CIB, seven of these processes have been effectively approved, while three are still in the process of being analyzed by CTNBio and two were rejected exclusively due to an amendment from Law No. 8.974/95 to Biosafety Law No. 11.105/05, which limited the use of certain technologies.

After the planned field release tests have passed, a new and important phase takes place: the commercial release of the transgenic. The planned release is just one of CTNBio's requirements for obtaining commercial release. After this, it is still necessary to comply with a resolution of standards that includes different requirements for the stages that so far have already been submitted to field tests. "With this quantity of field tests with eucalyptus and considering the current stage of research, we can project that Brazil will commercially approve transgenic eucalyptus within the next two to three years", says Pasquali.

THE FUTURE OF TRANSGENICS

Even though transgenics is already demonstrating the possibility of obtaining better and more competitive plants without causing damage of any sort, it still needs to break some barriers in society – since a large number of people are not aware of the benefits in question and base themselves on outdated paradigms and myths.

However, this scenario is slowly changing and should evolve even more with the development of some current issues, such as the lack of food to meet the increase in global demand, climate change and the increased dispute for land. "In the next 20 years, we are going to need to increase food production. For such, it's necessary to use technology and, consequently, modify plants and improve productivity based on transgenics. This means we are going to have to develop an agriculture and forest area that adapt to these changes. All this is part of a broader vision – it's not about only looking at the horizon, but rather looking even beyond", says Labate.

Betting on eucalyptus research, Brazil's pulp and paper sector is observing this scenario and preparing for a change in perspective. "From a technical point of view, the sector has already undergone a very significant change in eucalyptus planting, when seeds migrated to clone planting. Even though I understand that the growth of transgenics will occur in a gradual manner, I believe that companies in the pulp and paper sector are already prepared for this change", concludes Gomes, from ArborGen.