Eucalyptus tree genome deciphered

May 12 2011

The key to the survival of forestry in South Africa as well as many new possibilities for renewable bioproducts like biofuels and biopolymers may now be available with the click of a mouse.

This follows on a team of international researchers, led by Prof Zander Myburg from the Department of Genetics and the Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria (UP) – in collaboration with the US Department of Energy (DOE) Joint Genome Institute (JGI) – making available the complete genome sequence of the forest tree species, *Eucalyptus grandis*. It took the team, who had the support of a network of more than 130 *Eucalyptus* researchers from 18 countries, four years to complete the genome sequence and annotate more than 40,000 genes contained within it. According to Prof Myburg, these scientists, as well as countries with commercial eucalypt plantations will be the primary beneficiaries of the genome sequence now available on the internet (http://www.phytozome.net/eucalyptus.php). The *Eucalyptus* research community will continue to add value to the genome sequence in order to make it more accessible to the broader scientific community. Publication of the genome sequence in a scientific journal is expected to take place by early 2012.

A genome sequence can be compared to a blueprint or very complex programming code containing a complete set of instructions for the development and functioning of an organism. The code is written in DNA, which is organised into chromosomes and genes and can be found in every cell of a living organism. But it is the unique sequence and

expression of the genes in eucalypt trees that make them such efficient producers of woody biomass.

Once an organism's genome is sequenced (E. grandis' genome is about 640 million DNA base pairs long), researchers can trace genes involved in important characteristics like growth, wood quality and resistance to disease. Ultimately, this will result in more efficient tree breeding programmes. Comparative genomic studies, for example between woody and herbaceous plants, can also be used by scientists seeking genes that are unique to trees and wood-forming processes. All of these are important factors in the universal search for alternative, renewable sources to replace fossil fuels and chemicals.

According to Prof Myburg, the USA aims to replace about 30% of its fossil fuels with biofuels and other alternative energy sources within the next two decades. Research is done on plants rich in cellulose (the main chemical component of wood), because glucose - the building block of cellulose - can be used in the production of biofuels and other renewable products. *Eucalyptus* trees grow very fast and can deliver the necessary biomass for making these bioproducts. "Trees are advantageous when it comes to producing biomass. Unlike seasonal crops, they can be harvested year-round to supply a stable supply of biomass. In general they also don't compete with food crops. In addition, wood processing is well established in the pulp and paper industry. Similar processing can be used to isolate the cellulose from the wood for biofuels and other products," Prof Myburg explained.

All of the above was enough reason for the DOE JGI to support the *Eucalyptus* Genome Project under its Community Sequencing Program selections for 2008 (http://www.jgi.doe.gov/News/news_6_8_07.html). Locally the Department of Science and Technology (DST) has awarded strategic funds to UP in support of Prof Myburg's leadership role in the genome project and to promote local *Eucalyptus* genome research.

In South Africa, eucalypt plantations form the basis of commercial forestry, and specifically of multi-billion Rand industries like the pulp and paper industry. With the sequencing of the eucalypt genome, this industry now has access to information and technology to breed trees with desirable properties for a range of end products.

"Ultimately it is about the competitiveness of the forestry industry in South Africa," Prof Myburg says. He explains that, due to favourable climate conditions and rapidly growing eucalypt plantations, the Southern Hemisphere currently supplies most of the world's demands in terms of wood pulp and fibre. Areas for forestry cultivation in our country can, however, not really expand – a scenario much different from other countries investing in commercial forestry within the BRICS economical grouping like China, India and Brazil. Locally, the potential area that can be used for forestry may even decline due to factors like land claims. The availability of water in South Africa may also limit forestry activities in future. This means that the quality of trees will have to improve to ensure economic competitiveness, a challenge that has received a head start with the sequencing of the Eucalyptus genome and South Africa's strategic participation in the project.

Provided by University of Pretoria