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Low Lignin Eucalyptus Yields Twice as Much Sugar for Biofuels

As part of research agreement, various lines of Eucalyptus are being studied for their suitability as biomass for liquid biofuels

May 5, 2011 – (Seattle) Today at the 33rd Symposium on Biofuels and Chemicals being held in Seattle, Wash., researchers from the U.S. Department of Energy’s National Renewable Energy Laboratory (NREL) announced they have identified a tree that releases more than twice the usual amount of sugar, making it a promising option as a biomass feedstock for liquid fuel. The trees being studied by NREL are lignin-modified Eucalyptus lines that have been developed for research by ArborGen Inc. of Summerville, S.C.

“What makes this research particularly interesting is the increased ease with which the sugars are released. The challenge is not just how much sugar a plant contains, but whether or not the plant will release that sugar without excessive processing. That is what makes it valuable as a liquid fuels source,” says Dr. Angela Ziebell of NREL.

“Through genetic modification ArborGen has been able to alter the lignin content of a tree species, making the sugar much more accessible,” said Maud Hinchee, Ph.D. and chief science officer of ArborGen. “We think the result of this technology may increase the potential of Eucalyptus as a biomass source for liquid fuels. This result is particularly exciting given that efficient sugar release from plants is an obstacle to achieving affordable biofuels,” says Dr. Ziebell.

In the United States, cellulosic biofuels are advancing from grain-based production to production from non-food biomass feedstocks such as straw, grasses and trees. To process such feedstocks into fuel, they must be treated in order to release the sugars that

are bound up in the plant's cell walls. Once the sugars are released, a variety of biofuels can be generated.

However, releasing sugars is quite difficult because the cell wall has developed to resist processes that try to break it down. This resistance is known as recalcitrance. So to better release these sugars, biomass is pretreated at high temperatures and pressures (often with the addition of chemicals as well). The heat, pressure and chemicals all add to the cost of getting biofuels and add to the environmental impact of converting biomass to biofuels.

To help solve the problem, ArborGen scientists have developed a low lignin Eucalyptus (*E. grandis* x *E. urophylla*). Using plant biotechnology the modifications were made at two points in the lignin biosynthetic pathway, with the largest increase in sugar release coming from cinnamate-4-hydroxylase (C4H) down-regulation. Although some "low recalcitrance" plant lines suffer from reduced growth, many of the C4H down-regulated lines from the *E. grandis* x *E. urophylla* cross grow well. C4H lines have an estimated biomass productivity of ten dry-tons per acre per year, with the potential to produce about 1,000 gallons of liquid biofuels per acre.

Scientists from NREL have characterized the C4H lines as containing half the lignin of the unmodified lines. Using a high throughput sugar release assay developed at NREL (Selig et al, 2011 *Biotech. Letters* 1-7), the modified lines were found to release up to 99 percent of their sugars, up from 40 percent in the non-modified plants. This result translates to an improvement of 150 percent, a dramatic demonstration of the impact of lowering recalcitrance.

Further work by NREL and ArborGen on these and similar lines will aim to understand exactly how the recalcitrance is lowered and how this knowledge can be used to develop healthy low recalcitrance lines in an array of species.

About ArborGen

ArborGen is the largest global supplier of seedling products to the commercial forestry industry, as well as the leading developer of biotech seedlings. Through innovations in both conventional breeding and biotechnology, we develop high-value, technology-enhanced products that improve the productivity of a given acre of land by enabling our

customers to grow trees that yield more wood per acre with greater consistency and quality in a shorter period of time. For more information, please visit our website at www.arborgen.com.

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