## UNIVERSITY OF FLORIDA

## *Energy Intensive Crop Development*

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**Description:** To build a commercially viable, industrial scale system to produce transportation fuels and electricity from biomass requires both efficient conversion technologies and environmentally sustainable, cost effective supplies of biomass. In the US, Florida ranks first in its annual growth of plant biomass, because of its large cultivable land area and its subtropical climate, even though substantial land areas that can be planted are not currently in agricultural or forest production. The development of high yielding production systems for dedicated energy crops is considered essential for a sustainable, biomass to energy industry to be established, because the long-term availability of sufficient amounts of reasonably priced biomass is one of the most important factors in the site selection for new biofuel and bioenergy facilities. Dedicated energy crops are ones that 1) have high yields with minimum energy inputs in terms of agronomic practices, water and nutrient applications, 2) can be harvested, transported and processed efficiently into fuel or power, and 3) can be grown sustainably for generations without adverse environmental affects, or significantly impacting the food supply. We will evaluate likely energy crop species, *Eucalyptus* and southern pine to provide important yield and best management practices for growing these species for bioenergy conversion. We will also provide important chemical composition information that will impact the conversion efficiency of this biomass to ethanol, and identify and characterize important genes that regulate wood chemical composition

**Budget:** $432,000
**Universities:** University of Florida

## Progress Report

**Research Objectives for Current Reporting Period:** 1) To develop rapid methods for determining wood and grass (in collaboration with the team from Agronomy) cell wall chemical composition, and 2) To establish field plantings of Eucalyptus for testing agronomic practices acquiring yield information.

**Progress Made Toward Objectives During Reporting Period:**
Objective 1: Calibration models were previously built for predicting the lignin, cellulose and hemicellulose chemical composition of grass, loblolly pine and poplar wood biomass samples. We have now made progress developing a calibration model for predicting lignin, cellulose and hemicellulose content of Eucalyptus. Wood samples from 36 Eucalyptus trees were collected, ground and NIR spectra obtained. We are now determining the lignin, cellulose and hemicelluloses contents by traditional wet chemical methods and will use multivariate methods to develop calibration models for predicting lignocellulosic components. We also measured wood specific gravity and stiffness. Mean wood stiffness ranged from 26 to 11 $km^2/s^2$. Mean wood specific gravity varied from 0.3 to 0.5. As expected, specific gravity and stiffness were not correlated. Interestingly, the high stiffness indicates that Eucalyptus wood is suitable for solidwood products such as flooring, and the high density indicates its utility as a wood source for pulp and paper as well as bioenergy.

In wood, oleoresin has the highest heating value, similar to that of petroleum. Currently, Arizona Chemicals of Jacksonville, FL sells SYLVABLEND Pitch Fuel, which is composed principally of α-pinene and β-pinene. Using mid-infrared spectroscopy (FTIR), calibration models were built for

predicting α-pinene, β-pinene, and abietic acid content in pine oleoresin. These calibration models were validated with strong statistical support and used for studying the genetic architecture of pine oleoresin composition. Loblolly pine oleoresin was collected from ~4000 trees growing on three sites in a clonally replicated genetic test. Genetic control of α-pinene, β-pinene, and abietic acid were all high with 0.54-0.61 across site clonal repeatabilities and high type B correlations indicating very low genetic x environment interaction. Low genetic by environmental interactions and high levels of genetic control demonstrate that breeding for pine oleoresin composition is straightforward.

Objective 2: In 2009, field plantings were established in central Florida with half-sib seedlings and the four locally adapted UF-IFAS *Eucalyptus grandis* cultivars and in north Florida with half-sib seedlings and clones of *Eucalyptus amplifolia* cultivar. The north Florida planting is about 16 acres and was put in by Buckeye Cellulose. The central Florida planting was about 3 acres and was put in by Mosaic Corp. This planting tested the genetic material at 3 initial tree spacings 3 x 3 ft, 3 x 4.5 ft, and 3 x 6 ft. In addition, it contained a Nelder design to identify the most productive tree spacing. First year height and diameter data were collected in the winter. Next year second year growth and biomass data will be collected. These data will be used for growth and yield estimates.