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: $240,000

Universities: University of Florida

External Collaborators: N/A

Progress Summary

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: A near and mid-infrared spectrometer was purchased from Perkin-Elmer. The instrument is capable of collecting reflectance near and mid IR spectra from 96-well plates as well as individual sample near infrared (NIR) spectra with an integrating sphere and mid IR spectra with an attenuated reflectance probe. Calibration models have been built for predicting the lignin, cellulose and hemicellulose chemical composition of grass, loblolly pine and poplar wood biomass samples. A variety of spectra collection and analytical methods have been tested and the results show that NIR reflectance spectra collected with the 96 well plate reader gave good calibration models using the 2nd derivative of the spectra and partial least squares for grass and poplar biomass samples. For the grass biomass, calibrations were performed with a total of 116 samples, spanning 4 sites and 4 species. Strong calibration regression coefficients (r^2) were obtained with recovered glucose (0.92), xylose (0.93), fiber-glucose (0.90), total recovered (0.93) and total potential sugar (0.91).

With 396 poplar samples, the calibration regression models gave strong coefficients for total lignin (0.87), guaiacyl lignin (0.81) and syringyl lignin (0.91) and cellulose (0.80). In contrast, the calibration coefficient was moderate for xylan (0.68). These poplar calibration models gave strong prediction regression coefficients with new wood samples for total lignin (0.875), syringyl-lignin (0.83), guaiacyl lignin (0.69), and cellulose (0.74) content (Figure 1) while xylan (0.59) was only moderately well predicted. We are currently quantifying the ability of grass and pine calibration models to predict biomass lignin, cellulose and hemicelluloses content in grass and pine. The grass work is being done with the UF team led by L. Sollenberger, funded from the FESC. In addition, we are testing how well these calibration equations predict *Eucalyptus* wood chemical content.

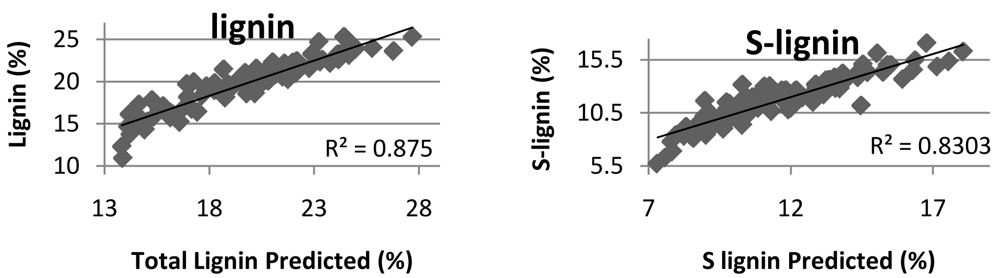

Figure 1: Prediction of total and syringyl lignin content of 100 poplar wood samples using NIR spectra with multivariate calibration equations developed from 396 samples.

<u>Objective 2:</u> 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. Height, diameter and biomass sampling will occur this fall and will provide the data for growth and yield estimates.