Despite a long history of growing Populus, the tree can be sustainably harvested without replanting in coppice style cultivation. Despite a long history of using the paper and pulp industry, details of Populus biomass accumulation for biofuel or ethanol in field settings are minimal, especially on marginal lands where incidents of biofilm and abiotic stress are common. Pre-harvest treatments with the ethylene blocking agent 1-methylcyclopropene (1-MCP) may reduce stress and total lignin content of biomass tissues in Populus. We have established a series of hybrid poplar plantations on woody biomass and to determine methods farmers can maximize biomass yields for ethanol production.

**Project Overview**

We have established a series of hybrid Populus biomass plots to determine the best growth considerations with regard to the maximization of biomass. In addition to planting regimes, the presence of a nitrogen fixing legume, (Robinia pseudacacia), and the below-ground microbial composition of the research plots is being investigated. The role of a ethylene blocking agent (1-methylcyclopropene; 1-MCP) is being investigated for drought protection and reduced lignin synthesis.

- **Year One Goals**
  1. Establish field plot with Poplar hybrids at three spacing treatments and apply ethylene blocker 1-MCP to specified plots.
  2. Conduct suite of biological measurements to assess the growth characteristics of year one.
  3. Sample soil at various seasonal times for metagenomic analysis.

- **Year Two Goals**
  1. Interplant fast growing nitrogen fixing legume tree (Black Locust) in designated field plots.
  2. Apply 1-MCP to treatment plots, sample soil, and conduct measurements to assess growth characteristics.
  3. Measure biomass components from each treatment plot.

- **Year Three Goals**
  1. Continue field measurements and soil sampling, +/- 1-MCP treatments.
  2. Assess biomass accumulation from each treatment plot at rotation.
  3. Study expression of soil microgenes during stress-induced secondary growth in poplar using both microarray and chemical analysis

Despite a long history of growing Populus in the paper and pulp industry, details of biomass accumulation in field settings are minimal, especially on marginal lands.

- **Pre-harvest treatments with the ethylene blocking agent 1-methylcyclopropene (MCP; Choi & Huber 2009), may reduce stress and total lignin content of biomass tissues in Populus (Carroll & Somerville 2009, Hendricks & Zeeman 2009).**

We set up a two-factor completely randomized design consisting of planting space (1X5, 3X5, and 5X5 foot spacing), 1-MCP treatment (half treated at 1,000 nL/L application), and presence or absence of the nitrogen fixing legume, Black Locust (Robinia pseudacacia) treatments (Kumar et al 2009). Poplar trees were planted as unrooted dowels and were clonally propagated from identical parent material (Neumann et al 2009). These trees were planted on a fallow field that had been mowed and reflected marginal crop production land.

- A large array of field measurements were taken during the field seasons of 2009 and 2010. The measurements included tree height (Figures 1, 2, & 3), total number of leaves per tree, stem diameter (Figure 4), leaf weight, leaf area removed by insect herbivory (Figure 5), and average number of leaves per tree (Figure 6).

- Soil samples were collected for a metagenomic study of fungi (mycorrhizal and non-mycorrhizal) and bacteria associated with the low input conversion of a marginal agricultural land site into a poplar biomass plantation. Metagenomic data reflects control plots of 10 and 30 year old poplar trees.

- This study reflects preliminary data of currently ongoing research plots. No data regarding the affect of 1-MCP or Robinia on growth was observed in the first year of growth.

**Above-Ground Measures of Poplar Growth**

- **Plot Height Variation In Clonal Plant Material**
  1. After two years of growth, average tree height and standard error varied and was not completely correlated with spacing regime or plant growth characters measured in our plots (below).

- **Variation In Plant Growth Characters in 1 ft, 3 ft, and 5 ft spacing regimes**
  1. Poplar planted at both 3 and 5 foot spacing had a greater height in both the 2009 and 2010 growing seasons.
  2. Stem diameter (Figure 4), Leaf Area Removed (Figure 5), and number of leaves per tree (Figure 6) were measured on row 1 of each replicated plot. Leaf area and leaf weight were measured but are not shown.

- **These results suggest that numerous environmental factors, such as above ground stresses and below ground nutrient availability, are influencing the above ground biomass accumulation.”**

**Below-Ground Measures of Microbial Diversity**

- To understand below ground microbial diversity in Poplar monoculture, we sampled from 10 and 30 year old hybrid Poplar plantations as both a proof of principle and experimental control. We sampled from the O and A horizon of the two Poplar types.

- We also have sampled seasonally from each of our plots to determine microbial diversity and patchiness on a plot level scale.

- The analysis of this data is pending.

- Total DNA was extracted from soil and sequenced directly with 454 pyrosequencing techniques. We also used both 16S and ITS primers to select for the Bacterial and Archaea (16S) and Eukaryotic (ITS) microflora.

**Literature Cited**


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