POWELL RIVER PROJECT

Project Update

Herbaceous Crops for a Biofuels/Bioproducts Industry on Reclaimed Mine Lands

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Summary

In 2007, we began a project to investigate yield capacity of several feedstock species with potential suitability for revegetating mined land. Seeded species included panicgrass, switchgrass, a 1:1 seed mix of panic- and switchgrasses, and two species established from vegetative propagules: hardy sugarcane and miscanthus. Plants were established at the Powell River Project Research and Education Center on 30 May 2007 and stand survival and plant measures were taken 4 October 2007. A single biomass harvest was taken 11 January 2008, and estimates of frost heaving were made at that time as well. Of the plant species tested, hardy sugarcane had the greatest stand success (97% survival) and sugarcane plants were the most robust as measured by plant size. Biomass yields of the larger, vegetatively propagated species (miscanthus and sugarcane) were limited by the number of plants established within a plot (100). Although panicgrass and switchgrass were smaller in size, establishment by seed conveyed a yield advantage because plants were well-distributed across the plots. Drought conditions limited growth of all plants (based on crop performance at other research sites) and may have contributed to susceptibility to frost heaving for smaller plants (panic- and switchgrasses) on wet, poorly drained sites. Although sugarcane appeared the best plant for establishment under the difficult conditions of 2007, preliminary observations in March 2008 suggest it may not have survived the winter.

I. Introduction:

Interest in renewable, bio-based energy sources is driving current research on plant resources for bioenergy cropping systems. Species that can be productive on sites with limited production capacity are of particular interest, because such land use could bring reclaimed mine lands back into production and will not contribute to competition between food and fuel production. Such systems may also bolster rural economies, given that few other new agricultural enterprises have the potential for such broad-scale impact as biorenewables industries.

Yield per land area will be an important determinant for economic viability of a biomass-to-biorenewables industry. Because raw biomass will be a low-value commodity (in dollars per

ton), yields must be sufficient to warrant producer adoption and market entry. Given the extensive nature of sometimes difficult terrain, these sites will also need to be productive with minimal inputs.

II. Objectives:

1. Evaluate and compare stand establishment of potential biofuel/bioproduct crops (switchgrass, coastal panicgrass, and a mix of these two native grasses, along with two non-natives, miscanthus, and hardy sugarcane) on reclaimed mine lands in Southwest Virginia.

2. Evaluate these crops for growth traits such as plant height, crown width, tiller number, lodging, and leaf:stem ratio that relate to yield and feedstock quality.

3. Quantify yields in the establishment year and succeeding years.

4. Examine feedstock quality (cellulose, hemicellulose, lignin, nitrogen, and ash) of these potential biomass crops.

5. Determine the carbon sequestration potential of these biomass crops.

III. Methods and Procedures:

Plant species:

Switchgrass, coastal panicgrass, and a 1:1 mixture of these species were seeded into plots with a plot seeder on 30 May 2007. At the same time, 100 plants/plot were established for both miscanthus and hardy sugarcane. Subsequent research determined that the miscanthus species planted in 2007 was not the species intended, and these plots were killed out and replanted in summer of 2008.

Measurements:

Stand counts and plant growth measurements such as plant height, crown width, and tiller number were in October 2007. Biomass samples were collected in January 2008, and plots also were evaluated for frost heaving. In March 2008, plots were evaluated for winter kill.

Plant measures and biomass harvests will again be conducted in Fall 2008 and Winter 2009.

IV. Brief progress report:

Hardy sugarcane plants (Table 1) were the largest, and most vigorous of the biomass plantings, being about 30% taller than miscanthus plants. Stems size and tiller numbers were also much greater than for any other planting. Despite persistent drought, stand percent was greatest among all crops as of October 2007. However, winter kill – which was quite variable by replicate – will be a substantial obstacle to utilization of hardy sugarcane. In March 2008, sugarcane survival (estimated as plants with live green tissue) ranged from 18 to 54%. Limited amount of material for replanting – coupled with the large death losses – is leading us to abandon this species for use in mineland energy cropping.

About 70% survival during the establishment phase was noted for miscanthus, and the plant did not winter kill. Establishment success rates were greater than at other sites where weed pressure was greater. Observation suggests miscanthus is quite drought tolerant once established, but it is sensitive to drought during the establishment phase.

Despite these potentially promising results, these observations were not taken on *M.* × *Giganteus*, but likely rather on a large form of *M. sinensis*. *M. sinensis* can produce viable seed and has displayed invasive potential in other ecosystems. Thus all *M. sinensis* plants established in 2007 were killed in 2008 and plants were replaced with *M.* × *Giganteus*.

Table 1. Plant growth measures, establishment, frost heaving, and yield values for energy crops established at Powell River Project.

Species	Height (m)	Stem diameter (mm)	Tiller no.	Stand (%)*	Frost heaved (%)	Yield (kg/ha)
Panicgrass	0.44	1.85	3.2	70	38.2	129
Switchgrass	0.50	1.90	3.0	81	11.5	139
Mix**	0.38	1.52	2.5	76	30.9	83
H. sugarcane	0.66	4.27	10.8	97	0	66
Miscanthus	0.51	2.71	3.0	81	0	15

*Reflects cover in seeded plots or percent survival of 100 vegetatively established plants
**Mix = Panic + Switchgrass (1:1 seeding)

Despite smaller plant sizes and moderate establishment success, panic and switchgrasses produced greater amounts of biomass on a land area basis due to their distribution across the plot. Mortality rates were high due to frost heaving, however, and these plots were overseeded with un-stratified seed in March 2008. It appears that portions of the soil in this replicate are limiting, as overseeding has failed to produce a good stand this spring and summer.

The variability of stand establishment (see Fig. 1) and production results highlights the inconsistent nature of mine land soils and the challenge of producing a dependable crop in these sites.

Figure 1. Stand success is variable. Hardy sugar cane (far left) appears productive on some sites but much was subject to winter kill (inset). Panic- and switchgrasses (right) also have displayed sensitivity to site of establishment.