**POWELL RIVER PROJECT**

*Progress report*

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

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## Summary

Biofuel species comparisons were begun at the Powell River Project in 2007 to determine yield capacity of several feedstock species with potential suitability for revegetating mined land. Feedstock treatments 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 on mined lands near the Powell River Project Research and Education Center on 30 May 2007. The original miscanthus species was mis-identified and thus removed and replanted in 2008. Establishment conditions were difficult due to drought, but about 70% of plants set out the previous season had new growth as of May 2009. Dead plants were replaced in May 2009. Initial survival and harvest data from the 2008 growing season suggested miscanthus might be well-suited to production on mine lands. Hardy sugarcane production has been marginal, and the plant has high losses on the worst soils at the site. Yield data for the 2009 growing season are not reported. Miscanthus yields in 2009 were uniform across plot replicates, but less than anticipated. Stand loss from mid-November to late-March averaged about 9% for miscanthus, compared with 46% for all seeded grass species. Both switchgrass first harvest yields (1.75 ton/acre) and over-winter losses (55%) were greatest among seeded species. Native grasses such as switchgrass currently appear to be front runners for bioenergy crops on reclaimed mine sites.

## I. Introduction:

Renewable energy sources and bio-based chemicals are of increased interest for national, environmental, and economic security and rural development. No other new agricultural enterprise has the potential for such large impact as the biorenewables industry, both in terms of economics or land-use change. The scale of the endeavor and the potential competition for crop land heightens the need to use marginal lands to avoid competition between food and fuel production. Finding species that are productive under mined land conditions may represent a win-win situation in meeting the nation's energy goals and utilizing the large marginal sites.

Yield per land area will be one of the most important determinants for economic viability of a biomass-to-biorenewables industry. Because raw biomass has low value (in dollars per ton)as a commodity, output per acre must be sufficient to warrant investment in growing the crop. Given the extensive nature of sometimes difficult terrain on mined lands, these sites must also 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. Determine yield as a function of harvest time.
3. Examine feedstock quality (cellulose, hemicellulose, lignin, nitrogen, and ash) of these potential biomass crops.
4. 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 plants were killed out and replaced in summer of 2008. In addition, switch- and panic grasses were overseeded in one replicate in 2008 due to stand loss from frost heaving.

Plants were not fertilized with N in 2007 or 2008 to help reduce weed competition. Fertilizer (50 lb N/ac) was applied in 2009.

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

Full-scale biomass harvests were conducted in Fall-Winter '08–'09 (three harvests) and '09-'10 (two harvests).

## IV. Brief progress report:

Hardy sugarcane, which was successfully established under drought conditions in 2007 has nearly disappeared from some plots due to frost heaving or winterkill or both (greater than 50% in two of three reps). The plant notably stays green at the base for much of the winter, likely increasing its sensitivity to cold temperatures. Sugarcane yields were marginal at best and considered nil in 2008. While we continue to measure those plants which survive, the limited plant material – coupled with the large death losses – leads us to abandon this species for use in mineland energy cropping. Production from 2008 was minimal and data are not reported.

Miscanthus yields following the establishment year (2008-2009) were about 0.5 tons/acre at the first harvest, with subsequent yields of about 0.24 tons/acre during winter and early spring. Yields declined largely due to leaf drop over the winter. This characteristic may improve feedstock quality by keeping minerals and silica (largely found in leaf tissues) out of the feedstock supply. However, 50% yield reductions probably would not offset the anticipated gains in feedstock quality. Yields following the 2009 growing season were lower than for the preceding year, and although the plants are not being lost as with sugarcane, it remains to be seen whether miscanthus will be viable on mined lands.

Panic and switchgrasses and the mixture of the two had great productivity gains from the 2008 to 2009 growing seasons. First-harvest yield for the three species treatments was similar (average = 0.55 tons/acre) following the 2008 growing season but declined more in

switchgrass and mixed plots (average = 0.33 tons/acre) than for panicgrass (0.52 tons/acre).

Much larger yields were observed for these plots following 2009 (1.5 tons/acre), but the pattern of larger declines for plots with switchgrass was again evident. A mid-season harvest was not possible this year due to snow cover or wet soils for much of the winter. Switchgrass yields were greatest among species treatments at harvest 1 (1.75 tons/acre) but declined the most (55%) to 0.79 tons/acre (~55%) by early spring. Panicgrass was less productive (1.26 tons/acre) compared with switchgrass, but losses over the winter were less (~38%) resulting in the same yield by early spring (0.79 tons/acre). The mixture was intermediate in terms of first yield (1.37) and over-winter losses (47%).

We anticipate collecting another season of production data and beginning feedstock analyses this fall. Soil data are to be collected after this season to determine feedstock effects on C sequestration.

## V. Acknowledgements

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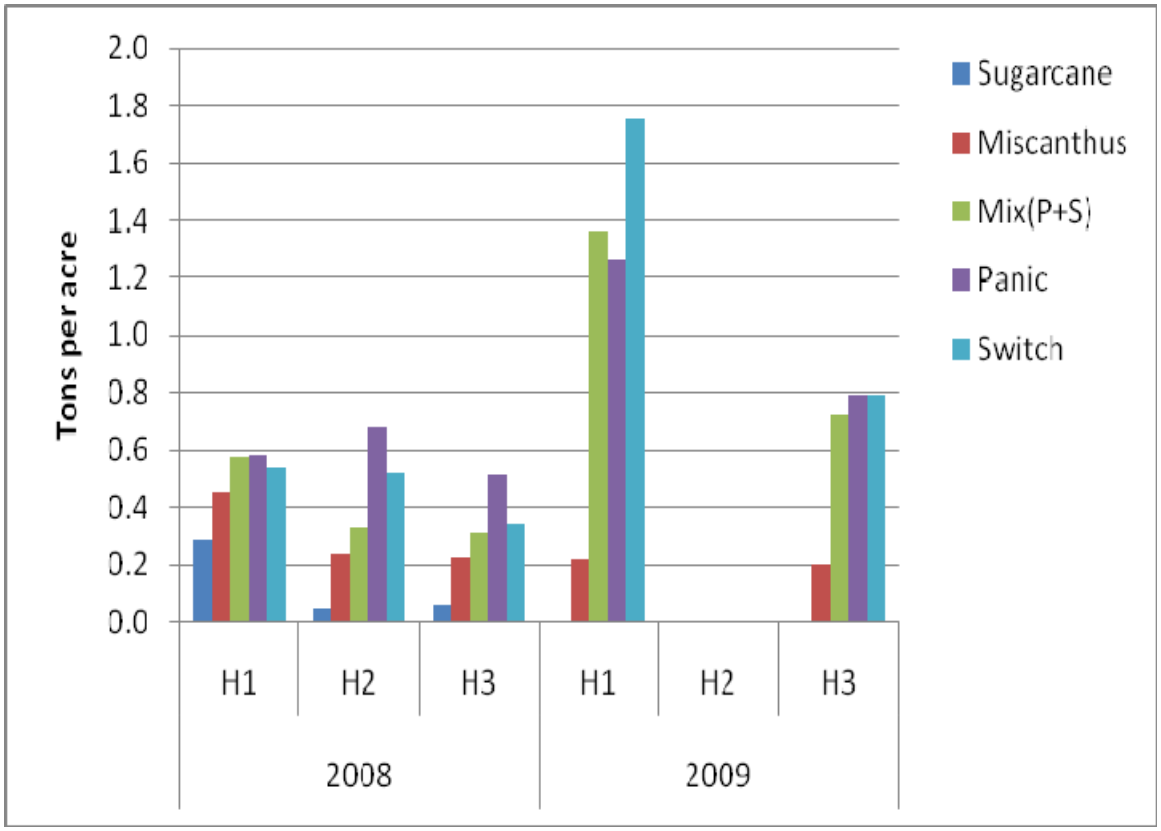


**Figure 1.** Biomass yields for each of three harvests (H1. H2, and H3) in 2008, and for two 2009 harvests (H1 and H3). Yields are on a dry-matter basis.