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Mississippi Biomass Feedstock Variety Trials, 2013

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Introduction

In Mississippi, traditional energy sources include coal, natural gas, oil, and nuclear power. However, there is much interest in locally produced energy sources that can reduce dependence on energy that originates outside of Mississippi. Solar power, corn-based ethanol, and biomass production are examples of locally produced, alternative energy sources that can be grown and/or harvested and converted into fuel for Mississippians.

There are potential energy sources from dedicated plants, primarily perennial grasses, which are referred to as biomass crops, biofuel crops, bioenergy crops, or feedstocks. These plants can be burned to produce heat or electricity, treated with enzymes to produce sugars that can be distilled into ethanol, or converted into a form of renewable crude oil through an intense pressure and temperature treatment called catalytic cracking. In Mississippi, two plant species have been identified by their ability to produce large amounts of biomass on a wide range of soil conditions and require few external inputs. These crops are switchgrass (*Panicum virgatum*) and giant miscanthus (*Giant Miscanthus* x *giganteus*).

Switchgrass is a native, warm-season, perennial, bunch-type grass that produces viable seed. This grass can be found across North America. It has two ecotypes: upland (Northern U.S.) and lowland (Southern U.S.). Lowland switchgrass yields can reach 6–10 dry tons per acre. Since switchgrass produces viable seed, it can be established by planting seed with traditional sowing equipment (i.e., grass seed drill, broadcast spreader, etc.).

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A seeding rate of 8–10 pounds per acre is sufficient when seeding switchgrass. However, pure live seed (PLS) can be as low as 3 percent, consequently increasing the amount of seed needed. In addition, most switchgrass varieties are slow to establish and usually need an establishment year before being harvested. The slow rate of establishment can cause issues in weed control during this first year. There are a few herbicides that can be used to control weeds in switchgrass, but the best method is proper seedbed preparation. Creating a sterile seedbed in which the soil has been cultivated and allowed to settle for a year while continuously sprayed with glyphosate is the most effective means of weed control.

Giant miscanthus is native to China. It is a warm-season, perennial, deciduous (drops leaves when entering dormancy) grass that does not produce viable seed. Giant miscanthus is sexually sterile, thus it must be planted vegetatively by rhizomes. Yields are usually greater than switchgrass, often producing 12–15 dry tons of biomass per acre per year.

This report contains data for biomass feedstock crop trials conducted at Starkville and Newton. Plots were first planted in the spring of 2012 at Holly Springs, Starkville, Newton, and Poplarville. However, only Starkville and Newton successfully established the first year. Poplarville and Holly Springs were replanted in 2013 and allowed to establish without harvest. Rainfall data for 2012 and 2013 are presented in Tables 1 and 2.

Table 1. Monthly rainfall totals for Starkville and Newton in 2012.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	in	*in*	*in*	*in*	*in*	*in*	*in*	*in*	*in*	*in*	*in*	*in*
Newton	4.89	6.98	7.90	2.15	6.38	5.28	12.19	10.13	3.32	5.36	2.68	10.18
Starkville	3.01	4.05	7.39	3.74	3.30	2.84	9.34	7.76	5.36	4.91	2.23	6.93
30-yr. avg.	5.30	4.70	5.80	5.60	5.10	3.30	4.50	3.80	3.60	3.30	4.80	5.90

Table 2. Monthly rainfall totals for Starkville and Newton in 2013.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	in	*in*	*in*	*in*	*in*	*in*	*in*	*in*	*in*	*in*	*in*	*in*
Newton	8.95	6.78	1.56	8.28	4.89	4.13	8.25	6.05	—	1.27	3.66	—
Starkville	8.49	3.98	5.66	7.19	7.23	2.76	4.00	2.27	4.90	3.20	5.08	4.95
30-yr. avg.	5.30	4.70	5.80	5.60	5.10	3.30	4.50	3.80	3.60	3.30	4.80	5.90

Protocol

Trials were planted with a plot drill in 6-by-11-foot plots arranged in a randomized complete block design with four replications. Switchgrass was planted at a seeding rate of 10 pounds of PLS per acre, and giant miscanthus was transplanted into plots in three rows of five plants spaced approximately 2 feet apart. Plots were not amended with fertilizer or lime at any time. Seedbed was cultivated 5 months before planting and allowed to settle, receiving glyphosate treatments as needed to eliminate weeds and create a stale seedbed. Plots were harvested in the fall after the first frost and plants had become dormant. Harvesting was done using a Wintersteiger Cibius S (Austria) harvester, and fresh yield was quantified by weighing the harvested material from the entire plot. To determine dry matter concentration, subsamples were taken from each plot and weighed wet and then dried in a forced-air oven at 120°F until weight remained constant. Statistical analysis was performed using PROC GLM in SAS and means were considered different at $P < 0.05$.

Results

In general, giant miscanthus produced more biomass than switchgrass at both locations. The relatively quick growth of giant miscanthus, once established, produced enough shade to block any sun to the ground, thus discouraging weed growth. The 'Freedom' variety of giant miscanthus produced more than 'Illinois' in Starkville, but yields were similar among the three varieties in Newton.

Switchgrass was more variable between locations. The variety 'Miami' produced less than half the yield in Starkville compared with Newton. The variety 'Alamo' was the only switchgrass variety in Starkville that preformed over the mean of the trial. In Newton, 'Miami' and 'Stuart' were the only varieties that produced yields above the mean. However, when averaged between locations, 'Stuart' and 'Alamo' produced superior yields. Much of the variability in switchgrass yield is likely due to the rate of establishment. Plots that established well in the first year were able to achieve more growth the second year (2013), rather than relying on hard seed yet to have germinated.

Table 3. Dry matter yields for switchgrass and giant miscanthus varieties in Starkville and Newton, 2013.

Variety	Newton	Starkville	Avg.
	lb/A	*lb/A*	*lb/A*
Switchgrass			
Alamo	8337	10220	9605
Blackwell	5235	6733	6973
BoMaster	7644	8136	7922
Cave 'n' Rock	9466	6640	7112
Colony	7745	8260	7682
Kanlow	5738	7411	6756
Miami	11304	4606	6255
Performer	7971	8252	8316
Stuart	11208	8796	9957
Giant Miscanthus			
Freedom	16811	17823	17317
Illinois	13143	12420	12782
Nagara	14143	14234	14188
Mean	9895	9461	9572
$LSD_{0.05}$	5034	3858	3056
CV%	31	28	22

Newton: Planted April 25, 2012; Harvested November 8, 2013; Soil type, Prentiss fine sandy loam.
Starkville: Planted April 27, 2012; Harvested October 22, 2013; Soil type, Marietta fine sandy loam.

Table 4. Mean dry matter yields of giant miscanthus and switchgrass in Newton and Starkville, 2013.

Species	Newton	Starkville	Avg.
	lb/A	*lb/A*	*lb/A*
Switchgrass	8160	7672	7842
Giant Miscanthus	14699	14825	14762
Mean	11657	9460	9572
$LSD_{0.05}$	1069	1993	1599
CV%	31	31	25

Species	Variety	Company/Origin
Giant Miscanthus	Freedom	Mississippi State University
	Illinois	Chicago Botanical Gardens
	Nagara	Mendel Biotechnology Seed Division
Switchgrass	Alamo	Ernst Seed
	Blackwell	Ernst Seed
	BoMaster	Ernst Seed
	Cave n Rock	Ernst Seed
	Colony	Ernst Seed
	Kanlow	Ernst Seed
	Miami	Ernst Seed
	Performer	Ernst Seed
	Stuart	Ernst Seed

Table 5. Giant miscanthus and switchgrass germplasm sources.

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