

# 2018 GLBRC Standard Sampling Report

## Biofuel Cropping System Experiment (BCSE)

### **Soil**

Soil was sampled just once in the BCSE plots in 2018. Samples were taken December 10 in all blocks or replicates (R) 1-5 of all treatments (G) 1-10. Soil was sampled using ¾" diameter push corers. Three cores (0-25cm) were taken from each of the three sampling stations and all 9 cores composited for each plot. On December 13, soil was sampled from the subplots. Nine cores (0-25cm) were composited from each subplot. Soil was also sampled from rainout sheltered areas of G5R2-5 on December 13. Three cores (0-25cm) were taken from each area.

Inorganic nitrogen extractions and soil moisture determinations were done on subsamples from all soil sampled. Analysis of the extracts for nitrate and ammonium will be completed by Cathy McMinn during winter 2018-2019. All samples were air-dried and archived. Also, a subsample from each was sent to the MSU Soil and Plant Nutrient Lab for standard analysis which includes pH, lime requirement, P, K, Ca, and Mg.

### **Gas**

Gas was not sampled in the BCSE in 2018.

The automated gas sampling and analysis system in block 1 was dormant in 2018.

### **Water**

From March through October 2018, 218 water leachate samples in total were collected from the BCSE and switchgrass gradient soil water samplers. These were analyzed for anions, cations, and NH<sub>4</sub>-N via ion chromatography. All sampling and analysis was completed by Dave Weed in the Hamilton lab.

New boxes were installed at all Block 3 and 4 collection sites. These were concrete and cast-iron enclosures used to replace the plastic green electrical burial boxes that were increasingly damaged by tractor activity. Tubing and fittings were also replaced at sites as needed. Lids were painted red to make sites easier to find throughout the growing season.

Time Domain Reflectometer (TDR) probes are installed in all plots in block 1. TDR soil water profile probes are installed horizontally at depth ranges from 10-20, 20-35, 35-50, 50-65, 65-95 and 95-125cm. A 0-10cm soil probe is installed vertically at the surface in the same plots. TDR profile probes are programmed to capture data every hour, storing soil water data on a CR1000 logger. In some of the plots where the existing TDR profile probes had been malfunctioning, Campbell Scientific Reflectometer, CS650 (30cm long probe) were installed in December 2018. Those plots in block 1 are continuous corn (G1), switchgrass (G5) and native prairie (G10). The CS650 reflectometers were installed at three depth ranges (5-35, 35-65 and 65-95cm). A Ditch-Witch was used to create a trench about 10 inches deep to run lines underground from the plot GHG utility box to these probes. The cables were then fed back to the logger at G5R1 via underground conduit. GPS location data for these trenches was collected. The intent is to connect these probes to existing CR1000 loggers and to run both TDR profile and reflectometer probes in these three plots. In June 2018, CS655 (10cm probe) reflectometers were installed in G5R3 and R4 under the rainout shelters,

as well as in an ambient and potentially irrigated area of the same plots. Probes were installed at two depths (10 and 25cm) in each area. All probes are connected to CR800 loggers.

### **Plants**

Plant biomass samples were taken from the BCSE plots at their peak to measure above-ground net primary production (ANPP). No species separations were completed on samples taken in 2018. Plots were sampled as follows: G8 on August 9-10; G9 on August 15-17; G5, 7, 10 on August 20-22; G1 on September 24; G6 on October 8-11 and G2 on October 22-23. Species composition and height were measured with three transects per plot following the line-point intercept protocol. Transects were completed around the same time that each treatment was sampled for ANPP, except for G1 where no transects were done. On December 17, the residue remaining following machine corn stover collection was sampled from the ground in G1 to evaluate collection efficiency. All plant material from all sampling was dried at 60°C for at least 48 hours. The dried biomass will be weighed, ground and archived. Combustion analysis for carbon and nitrogen determination will be completed by Stacey VanderWulp.

Staff from the Kellogg Forest harvested trees from all G8 plots from March 23 – March 28, 2018. All harvested trees were chipped into a truck that was driven over scales at the KBS Dairy farm and load weights recorded. Subsamples of the chips from each plot were bagged, weighed and dried for moisture determination. These dried samples will be ground, archived and analyzed for carbon and nitrogen. Since the trees had been harvested, there were no leaf litter traps deployed nor tree measurements taken in G8 in 2018.

Phenological development was tracked using phenocams positioned on each plot in block 1. In addition, Cheyenne Lei, graduate student with Jiquan Chen, installed albedo towers in G1, 2, 5, 6, 7, 9 and 10 of block 1. Instruments on these towers measured radiation, temperature, precipitation and recorded images of vegetative growth. Leaf Area Index (LAI) was measured periodically in all treatments in all blocks by personnel from the Chen lab.

Ten drone flights were completed over the BCSE during March – December, 2018 with the majority in July – October. Flights collected albedo data and visual/multispectral imagery. All flying was done by Kevin Kahmark and Sven Bohm.

Yield data was collected from all plots and subplots during mechanical harvest.

### **BCSE Subplots and Microplot**

**Stover non-removal subplot (G1 R1-5):** This is a 15 foot wide strip along the west edge of each G1 plot where corn stover is not collected. The corn stover in the rest of the plot is collected after harvest. Besides the soil samples collected in December (see BCSE soil), there was no other sampling done here. Yield data was collected at harvest here.

**Unfertilized subplot (G2, 5-9 R1-5):** This is a 15 foot wide strip along either the east or west edge of each G2, G5, G6, G7 and G9 plot where not nitrogen fertilizer is applied while the remainder of the plot is fertilized. In G8 this unfertilized subplot is 15ft along the southern edge of the plots. Besides the soil samples collected in December (see BCSE soil), there was no other sampling done here. Yield data was collected at harvest here.

**Fertilized subplot (G10 R1-5):** This is a 15 foot wide strip along either the east or west edge of each G10 plot where nitrogen fertilizer is applied while the remainder of the plot receives none. Besides the soil samples collected in December (see BCSE soil), there was no other sampling done here. Yield data was collected at harvest here.

**Rainfall Manipulation Experiment (G5 R2-5):** Beginning in 2018, rainout shelters were installed in G5R2-5. The shelters are 12' long x 12' wide and excluded about 60% of rainfall. The area under the rainout shelter and a comparable unsheltered area nearby were harvested by hand just prior to machine harvest in these plots. Soil samples were collected here in December (see BCSE soil).

## **Scale-up Fields**

### **Soil**

Soil sampling in the GLBRC scale-up fields at Lux Arbor and Marshall Farms typically happens in December but was delayed because the prairie and switchgrass fields had not been harvested. Sampling has historically been done after harvest of all fields (except M4, which does not get harvested). Since the prairie and switchgrass fields will likely not be harvested until spring 2019, soil was sampled on January 10, 2019. Samples were taken using 3/4" diameter push corers. Ten cores were taken to a depth of 25cm at each of the 10 stations in each plot. Inorganic nitrogen extractions and soil moisture determinations were completed on subsamples from all soil sampled. Analysis of the extracts for nitrate and ammonium will be completed by Cathy McMinn.

These soil samples were air-dried and archived. Also, a subsample from each was sent to the MSU Soil and Plant Nutrient Lab for standard analysis which includes pH, lime requirement, P, K, Ca, and Mg.

### **Gas**

Gas was not sampled in the Scale-up plots in 2018.

### **Plants**

Plant biomass samples for ANPP were not taken from any scale-up plots in 2018. Transects through the switchgrass, prairie and reference fields were used following the same line-point intercept protocol as on the BCSE to collect data on species composition and height.

The scale-up prairie fields were fertilized in the spring of 2018. At that time there were three unfertilized microplots (15 x 15 feet) established in each prairie field. In December 2018, hand samples were taken from each microplot area and a fertilized area nearby to look at fertilizer effect.

Two drone flights were completed at Lux Arbor and one at Marshall Farm by the Robertson lab. However, the Basso lab had the main responsibility of flying drones at these sites.

Yield data was collected from L1 and M1 corn when mechanically harvested. Yield data will be collected when the switchgrass and prairie fields are harvested as well.

## **Marginal Land Experiment (MLE)**

### **Soil**

Soil samples were taken from all MLE sites in the fall of 2018. They were sampled in this order between November 9 and November 20: WN (Rhineland), MN (Escanaba), WC (Hancock), WS (Oregon), MC (Lake City) and MS (Lux Arbor). Each half of the split plots was sampled separately with six 0-25cm cores/split plot composited. Beginning in 2018, as on the BCSE, a rainout shelter was installed in each G5 plot at all the MLE sites except WS. The shelters are 12' long x 12' wide, exclude about 60% of rainfall and are installed on the fertilized split plot. Soil was sampled in the sheltered areas on the same day as the split plots. Three cores (0-25cm) were taken from each sheltered area. Inorganic nitrogen extractions and soil moisture determinations were done on subsamples from all soil sampled. Analysis of the extracts for nitrate and ammonium will be completed by Cathy McMinn during winter 2018-2019. All samples were air-dried and archived. Also, a subsample from each was sent to the MSU Soil and Plant Nutrient Lab for standard analysis which includes pH, lime requirement, P, K, Ca, and Mg.

### **Plants**

Plant biomass samples were taken from all MLE sites (G5-7, 9-11) for ANPP in late August and September. Samples were not sorted to species. Species composition and height was evaluated in all plots in late August and early September in all Michigan and Wisconsin MLE sites using a line-point intercept protocol. Species were identified and height measured along two transects in both the fertilized and unfertilized split plots.

Yield data was collected from all of the mechanically harvested plots (G5-7, 9, 10) separately in the fertilized and unfertilized split plots. G11 was not harvested, so hand samples were taken there to look at production. Additionally, the area under the rainout shelter and a comparable unsheltered area nearby were harvested by hand. Subsamples of all harvested materials were saved and will be ground, cataloged and stored on MSU main campus. The majority of this work was done by personnel from Kurt Thelen's lab, led by Todd Martin. Species composition transects were completed by a four person crew from the Robertson lab. Poplar trees were harvested from all G8 plots at all sites during winter 2018-2019.

At least four drone flights were completed at each of the MLE sites between March and December 2018. Some sites were flown more than others due to weather conditions while visiting sites. Flights collected albedo data and visual/multispectral imagery. All flying was done by Kevin Kahmark and Sven Bohm.

### **Weather**

A weather station is installed at each Michigan site and Hancock and Rhineland in Wisconsin. Each weather station collects air temperature, precipitation, solar radiation, relative humidity, soil moisture and temperature at 10 and 25cm depths, and wind speed.

## **Switchgrass Nitrogen/Harvest Experiment**

### **Soil**

Soil samples were not taken in 2018. Soil will be sampled in the fall of odd-numbered years only. Samples in 2019 will be used to measure fresh pH, inorganic nitrogen and may be sent for agronomic soil analysis at the MSU Soil and Plant Nutrient Lab.

**Water**

Soil water samplers were used to collect water from the soil in blocks 2-4. Collections were made in March – October 2018. These were analyzed for anions, cations, and NH4-N via ion chromatography. They were also processed and analyzed for non-purgeable organic carbon (NPOC) and total dissolved nitrogen (TDN), and will be analyzed for total dissolved phosphorus (TDP). Many repairs were also performed at sampler access points so that 21 of 24 samplers yielded water on multiple occasions. All sampling, analysis and repairs were completed by Dave Weed.

**Plant**

Yield data was collected from all plots during mechanical harvest. A sub-sample from the machine harvest of these plots was saved. This biomass is dried and will be ground, archived, and analyzed for carbon and nitrogen.

Written by Stacey VanderWulp (with contributions from Zaman Hussain, Kevin Kahmark, and Dave Weed)

**Archived Material**

Experiment	sample type	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
GLBRC BCSE	plants											
GLBRC BCSE	surface soil											
GLBRC BCSE	deep core soil											
GLBRC Scale-up	plants											
GLBRC Scale-up	surface soil											
GLBRC Scale-up	microplot surface soil											
GLBRC Scale-up	deep core soil											
GLBRC Scale-up	microplot deep core soil											
GLBRC MLE	plants											campus
GLBRC MLE	surface soil											
GLBRC MLE	deep core soil											
GLBRC Switchgrass Gradient	plants											
GLBRC Switchgrass Gradient	deep core soil											

**Agronomic Soil Analysis**

Experiment	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
LTER MCSE											
LTER Resource Gradient											
GLBRC BCSE main											
GLBRC BCSE micro											
GLBRC BCSE deep core											
GLBRC Scale-up											
GLBRC MLE											
GLBRC Switchgrass Gradient											