2012 LTER Baseline Sampling Report

Main Field, Successional, and Forest Sites

Stacey VanderWulp

Soil

Soil was regularly sampled on the LTER to a depth of 25 cm at each of 5 stations in all replicates (R) of all treatments (T) 1-8, CF, DF, and SF. Samples were taken about twice each month, for a total of thirteen times between March 26 and November 13. When soil conditions allowed, a ¾" diameter push corer was used to sample and two cores taken from each station. However, on seven of the thirteen sampling dates, a bucket auger was necessary in order to reach the 25cm depth on the main site due to low soil moisture. The bucket auger sample diameter was 2 ¾", so two cores were taken from only two of the five stations. Inorganic nitrogen extractions and soil moisture determinations were done on subsamples from all soil sampled. Analysis of the inorganic nitrogen extracts for nitrate and ammonium will be completed by Cathy McMinn during winter 2012-2013.

The first sampling in April was air-dried and archived. A subsample, from each of the July 9 samples, was incubated in the field for 21 days and then inorganic nitrogen extracted to evaluate mineralization potential. Samples taken on October 15 were analyzed for pH in the lab.

Additionally, a postharvest extensive grid soil sampling was done in all replicates of T1-6 on November 19. This soil was air-dried and sent to the MSU Soil and Plant Nutrient Lab for standard analysis which includes pH, lime requirement, P, K, Ca, and Mg.

Lastly, soil samples for inorganic nitrogen, soil moisture, and air dried archive were collected twice from the T7 microplots in 2012 - March 27 and September 17. Five soil cores were taken to a depth of 10 cm in the 3 x 3 meter center of each experimental plot and composited.

Gas

Gas was sampled throughout the LTER using static chambers (square) between March 29 and November 14. Main site plots that were sampled on a regular basis include T1-7 R1-4, as well as the fertilized, untilled microplots in T7 R1-4. Static chambers were also sampled in T8 R1-4 and all replicates of successional and forested sites, CF, DF, and SF. Sampling in the forest sites included the nitrogen deposition study microplots. With a sample frequency of about twice each month, gas samples were taken fourteen times. The main site (including T8) was sampled in the morning and forest sites sampled in the afternoon of the same day. Square chambers were removed in late November and replaced with round chambers in T1-7 and DF. Round chamber sampling began December 18 and should continue monthly through the winter. All gas samples were analyzed for nitrous oxide, carbon dioxide and methane by Kevin Kahmark and Cathy McMinn using the Agilent/Gerstel automated GC in Academic 330.

Soil temperature and soil samples to determine moisture content were taken from each plot where gas was sampled. Additionally, beginning this year air temperature and humidity were measured with digital thermometer/hygrometers both inside and outside of some chambers.

Water

Soil water samplers (also known as low-suction quartz lysimeters) were used to sample water from the soil in T1-7 R2-4 and all replicates of CF, DF, and SF. Samplers were evacuated and leachate

collected about twice a month. Thirteen collections were made between March 21 and November 15. The volume of leachate collected was recorded. When 20mL or more of leachate was collected, the sample was filtered and frozen for analysis and archive. Inorganic nitrogen analysis for these samples will be done by Cathy McMinn during winter 2012-2013.

Plants

Plant biomass samples were taken from plots prior to tillage or harvest in T1-6, or at peak biomass in T7, 8 and SF, and species separations completed. Just prior to tillage, on May 3 and 8, cover crop (cereal rye) was sampled in T3, T4, and the weed control microplots in each. Alfalfa was sampled four times - on May 11 and 14, June 7, July 24 and September 10, just prior to machine cutting each time. In the main part of T5, understory was sampled June 27 and leaves were collected in traps on the ground as they fell from the trees between June 27 and November 5. Live leaf samples were taken from the T5 microplots on July 12. Leaf litter was collected in traps in CF, DF, and SF starting July 13 and finishing November 30. All leaf litter traps were checked and leaves collected weekly. At peak biomass in late July and throughout August, plant samples were taken from T7 (including microplots), T8, and SF. Soybeans and weeds were sampled from T1-4 during the week of September 24, immediately followed by sampling in T3 and T4 microplots. On November 27, post-frost biomass samples were taken from T7. Species separations were not made on post-frost biomass, but surface litter was collected. All plant material was dried at 60ºC for at least 48 hours. All dried biomass will be weighed, ground and archived. Subsamples will be analyzed for carbon and nitrogen by Stacey VanderWulp.

In CF and DF, all trees with a DBH greater than or equal to 5cm were measured from January 4-6. The diameter of poplar trees in T5 were measured at 15cm above the ground on December 4 in the main plot and December 19 in the microplots (established summer 2011).

Yield data was collected from all of the mechanically harvested fields.

All replicates (1-6) of T7 were burned on March 19 to help control woodies.

Scale-up Fields

Stacey VanderWulp

Yield data was collected from all of the scale-up fields when harvested mechanically.

Biodiversity Study

Tim Dickson, Carol Baker

Cover crop biomass was harvested May 11-14, 2012. Treatments B3, B4, B6, B7, B15, and B16 had cover crop in 2012. Eight 25 x 25 cm areas in each plot were harvested at ground level and sorted in the field to dicots, grass, Trifolium pretense (red clover), and Secale cereal (cereal rye). Plant material was dried and weighed.

Weed biomass was harvested in all treatments. The weeds in two 25 x 100 cm areas were harvested in each plot and sorted in the field to dicots, grass, and Trifolium pratense. Plant material was dried and weighed. Weeds in 2012 wheat crop treatments (B5, B8, B11, B14, B17, B20) were harvested June 25. Corn, soybean, and fallow treatment weeds were harvested October 2.

Soil samples for inorganic nitrogen, soil moisture, and air dried archive were collected October 31. A total of four soil cores per plot were taken to a depth of 25 cm at two points and composited.

Nitrogen Fertility Gradient

Kevin Kahmark, Iurii Shcherbak, Stacey VanderWulp

In December 2011, a freeze-thaw experiment was installed for Leilei Ruan which included 12 chambers deployed in Block 4, treatment F-6. The automated system trailer was moved from block 2, treatment F-4, to just south of block 4, treatment F-1. The trailer is placed here so morning sunlight and typical winds would not be obstructed from the chambers in F-6. Resin strips and Hobo loggers were also deployed in each chamber. The research project utilizes the automated trace gas sampling system and sampled from chambers with ambient snowfall, no snowfall, and double ambient snowfall. No chamber extensions were added during the sampling season. Campbell moisture and temperature probes (x3) were deployed near each type of chamber.

On April 15 (2012), the chambers were removed and reconfigured for Neville Millar's irrigated/non-irrigated crop study (in soybean). The automated chambers were reinstalled in Blocks 2 and 5, treatments R-F1, 3, 4, 5, 6, 8 and I-F1, 3, 4, 5, 6, 8 to assess GHG emissions in natural and irrigated moisture regimes. Campbell moisture and temperature sensors were placed in the buffer plot near block 5, F1 and in block 2, F6, F4 and F8. No soil samples were collected for this project. The system was reconfigured to collect samples every four hours instead of the normal six hour increment.

The irrigated/non-irrigated study was removed six times during the growing season for various field operations. No plant or soil material was collected by Neville Millar.

The project was dismantled on December 10 and reconfigured for the freeze-thaw study in Block 4, F6. Again, 12 automated chambers were installed in varying snow accumulations (4-0x, 4-1x, 4-2x) configurations. Soil samples were collected on B4, F6. Resin strips and duplicate Hobo loggers placed in each chamber.

These semi-continuous gas samples were taken using an automated chamber system with on-site GC analysis for nitrous oxide, carbon dioxide, and methane. Four time series samples (T0-T3) and an air sample were collected on each of 12 chambers for each configuration above. Each sampling configuration was run on six hour increments, four times per day. Individual chamber closure periods varied depending on the study.

Also in 2012, Iurii Shcherbak continued analyzing concentration profiles, collected in 2010 and 2011 in the Resource Gradient experiment, and will relate the results to the automated surface GHG flux results. During 2012 he performed two related experiments: microcosm and soil air diffusivity experiments. The experiments were conducted in Block 2 and 5. Iurii's microcosm experiment was directed at testing the potential for nitrous oxide (N_2O) consumption in the soil at different depths. Eight soil cores were taken (to 1 m depth) in duplicate at 4 locations within the block 2 and 5. Three samples of soil at 5-15, 30-40, and 70-80 cm depth were taken from each core. Experiments with 24 1L mason jars containing 150 g of this soil and 75 ml of water showed that N_2O consumption (N_2O added at 50 ppm) did not occur.

Experiments to measure diffusivity were conducted 3 times under dry soil conditions (06/20, 06/27, 07/03) and under wet conditions (10/19, 11/01) and consisted of 28 measurement profiles (5 sampling depths each). Injections were made at various depths and concentrations of nitrous oxide and an inert tracer (hexafluoride) were tracked across time. Iurii will conduct modeling to establish diffusivity parameters that best fit the observed changes in concentrations. Once finished, this should provide a better justification for the diffusivity used in other experiments involving nitrous oxide concentrations in soil.

In order to check pH in the Resource Gradient plots, on October 24, soil was sampled to 25cm in all 72 plots in the experiment. In addition to pH analysis, inorganic nitrogen extractions and soil moisture determinations were done on subsamples from all soil sampled.

Nitrogen Deposition Study

Stacey VanderWulp

Fertilizer solutions were applied to the 1F, 3F and 10F plots in this study on three dates. Ammonium Nitrate (34% N) was used to fertilize on April 13. Urea (46% N) was applied on July 9 and October 22. The type of fertilizer used was dependent on availability. Rates of fertilization are $1g/m^2$/year for the 1F plots, $3g/m^2$/yr for the 3F plots, and $10g/m^2$/yr for the 10F plots. Gas was sampled on a routine basis; see the Gas section under the Main Field, Successional, and Forest Sites summary.

Living Field Laboratory

John Green

In March, soil was sampled to 25 cm in plots for CN analysis and archival purposes.

All cropping system treatments and practices were implemented and maintained throughout the growing season.

Yields for corn, wheat, and soybean were determined by mechanically harvesting two center rows in each sub-treatment (cover and no cover).

Cellulosic Biofuel Experiment

Tim Dickson, Stacey VanderWulp

Yield data was collected from all of the treatments through machine harvest.

Megan Hourigan, REU, set up an experiment in the Cellulosic Biofuel Experiment to study how non-planted weed abundance and diversity (invasibility) varies in response to planted species diversity. Megan's research expands on Sara Fout's (2011) and Richard Gaillard's (2010) REU projects and was conducted in four treatments of varying diversity and functional groups—C5, C8, C10, and C12. In Megan's research, she:

- Collected all aboveground biomass to ground level from a 2m x 0.5m quadrat and analyzed effects of treatments on planted and non-planted biomass. Biomass was clipped from June 26 – July 5.
- Collected soil samples on July 23 (1.91 cm diameter, 20 cm depth) and added soil and appropriate buffer solution to Biolog plates to analyze soil microbes' ability to utilize different carbon sources.

Timothy Dickson, postdoc, set up an experiment in the Cellulosic Biofuel Experiment to study the effects of carbon addition via sucrose on the interaction of legumes and other species. A 6m x 1m plot was set up 1.5m from the northern edge and 1m from the western edge of appropriate plots (7m south of the white plastic marker in the strip between blocks). The plot was orientate so that it ran east to west on its longest axis. The treatments in the experiment were C5, C8, C9, C10, C11, and C12. 712.6g m^{-2} of sucrose (300g m^{-2} of carbon) was added to a randomly chosen 3m x 1m half of the plot in early June. Unfortunately, the sucrose had no discernible impact on the plants. We did harvest all aboveground biomass in a 2m x 0.5m quadrat from treatments C5, C7, C9, and C11 in late September from within the sucrose plots, however.