National Soil Dynamics Laboratory

Highlights

Fall 2015

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The American Coal Ash Association Awards ARS the "Champion Award" for Gypsum Research

The American Coal Ash Association (an organization supported nationally by the coal burning power industry) awarded the USDA-ARS the "2015 Champion Award" in recognition of its work on the use of flue gas desulfurization (FGD) gypsum in agriculture. Dr. Allen Torbert and Dr. Dexter Watts were specifically named among the ARS scientists for the award for their research efforts in this area.

Gypsum (calcium sulfate) has the potential to be used as a beneficial amendment for plant production in agriculture, providing plant nutrients, improved soil physical and chemical properties, and increased crop productivity. In addition to mined gypsum, which has been used as a fertilizer source since colonial times, recent industrial developments has led to the availability of gypsum as an industrial byproduct. FGD gypsum is produced as a byproduct of the process to reduce sulfur emissions from coal fired power plants.

Research (Figure 1) conducted at the NSDL focused on improving forage production and reducing P losses on areas receiving poultry litter (PL) as a nutrient source and also assessing any risk of using FGD gypsum in agriculture. Of particular interest was studying the potential to reduce soluble P contamination from areas receiving PL and evaluating the potential for loss of contaminants (such as microorganism, Hg, As, and other heavy metals) into the environment. Experiments demonstrated that water quality could be improved by reducing P runoff by 50 to 60 percent with gypsum use.

Figure 1. Bermuda grass harvest for the FGD gypsum study at the E.V. Smith Experiment Station in Shorter, AL.

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Dynamically Speaking

H. Allen Torbert
Research Leader

It has been a busy summer at the National Soil Dynamics Laboratory and we are still working in the fields collecting our harvest data from experiments across the state. If you come by our laboratory, you are sure to notice that we have significantly improved our "Curb Appeal". In cooperation with Auburn University landscaping and a few coats of paint on our soil bins, the lab has a brand new look, which is just in time for football season. Meanwhile, inside the lab we are maintaining the same dedication to our research efforts and our primary mission to solve problems for farmers in the southeast US. Currently, all of our programs are still in place and we continue to do research in the areas of Conservation Systems, Global Change, and Waste Management. We just look better while doing it.

I hope you enjoy reading about some of the research efforts we have included in this issue of National Soil Dynamics Highlights, and please visit our web site for more information about our ongoing projects (http://www.ars.usda.gov/sea/nsdl).

National Soil Dynamics Laboratory
http://www.ars.usda.gov/sea/nsdl
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Recent Publications

Way, T.R., Lamba, J., Srivastava, P. 2011. A method for installing zero-tension pan and wick lysimeters in soil. Transactions of the ASABE. 27(5):747-755.

Kornecki, T.S., Fouss, J.L. 2011. Sugarcane residue management effects in reducing soil erosion from quarter-drains in southern Louisiana. Applied Engineering in Agriculture. 27(4):597-603.

Watts, D.B., Arriaga, F.J., Torbert III, H.A., Gebhart, D.L., Busby, R.R. 2012. Ecosystem biomass, carbon, and nitrogen five years after restoration with municipal solid waste. Agronomy Journal. 104(5):1305-1311.

Runion, G.B., Butnor, J.R., Prior, S.A., Mitchell, R.J., Rogers Jr, H.H. 2012. Effects of elevated atmospheric CO_2 enrichment on soil CO_2 efflux in a young longleaf pine system. International Journal of Agronomy. doi:10.1155/2012/549745. 9p.

Tapley, M., Ortiz, B.V., Van Santen, E., Balkcom, K.S., Mask, P., Weaver, D.B. 2013. Location, seeding date, and variety interactions on winter wheat yield in Southeastern United States. Agronomy Journal. 105:509-518.

Aulakh, J.S., Enloe, S.F., Price, A.J., Loewenstein, N.J., Wehtje, G., Patterson, M. 2014. Pushing towards cogongrass patch eradication: The influence of herbicide treatment and application timing on cogongrass rhizome elimination. Invasive Plant Science and Management. 7:398-407.

Yakubova, G.N., Wielopolski, L., Torbert III, H.A., Prior, S.A. 2014. Field testing a mobile inelastic neutron scattering system to measure soil carbon. Soil Science. 79(12):529-535.

Runion, G.B., Prior, S.A., Price, A.J., Mcelroy, S., Torbert III, H.A. 2014. Effects of elevated CO_2 on biomass and fungi associated with two ecotypes of ragweed (Ambrosia artemisiifolia L.). Frontiers in Plant Science. 5:500. doi 10.3389/fpls.2014.00500.

Balkcom, K.S., Burmester, C. 2015. Nitrogen applications for wheat production across tillage systems in Alabama. Agronomy Journal. 107:425-434.

Marble, S.C., Prior, S.A., Runion, G.B., and Torbert, H.A. 2015. Control of yellow and purple nutsedge in elevated CO_2 environments with glyphosate and halosulfuron. Frontiers in Plant Science 6:1-6 doi:10.3389/fpls.2015.00001.

All of our publications are available on our web site:
http://www.ars.usda.gov/sea/nsdl

Upcoming Events

Dates	Meeting	Location
Oct 20-22	Sunbelt Ag Expo	Moultrie, GA
Nov 15-18	Agronomy, Crop Science, and Soil Science Societies' Annual Meeting	Minneapolis, MN
Nov 19-20	AL Fruit and Vegetable Growers Assoc. Conference and Tradeshow	Clanton, AL
Jan 5-7	Beltwide Cotton Conference	New Orleans, LA
Jan 21-22	Gulf States Horticulture Expo.	Mobile, AL
Jan. 27-30	Southern Sustainable Agriculture Working Group Annual Conference	Lexington, KY
Feb. 2-3	Conservation Prod. Sys. Conference	Douglas, GA

… Growth and Control cont.

In addition, all components in runoff were shown to be below levels of concern by EPA water quality standards.

These studies have been instrumental in setting key policies. The Natural Resources Conservation Service (NRCS), which sets national standards for maintaining soil, water, and air quality, used these ARS findings. The NRCS developed a new National Conservation Practice Standard for use of gypsum products entitled "Amending Soil Properties with Gypsum Products Code 333" (finalized in June 2015). Also, the Alabama NRCS incorporated gypsum into the "Alabama P index" as a method to reduce the risk of P losses from manure application.

Using Cover Crop Mixtures in Conservation Systems

A simple internet search for cover crop mixtures yields numerous documents over the last several years. Interest in adopting cover crops and the difference between single species and multi-specie mixtures has been increasing and producers want to know what the best options are for their operations. However, particularly in the Southeast, there is minimal published research on cover crop mixtures. Researchers in the Conservation Systems group located at the NSDL have ongoing research on cover crop mixtures and are planning four new studies to provide more information to producers on how mixtures perform in the Southeast as compared to single species.

Currently there are two ongoing experiments that include cover crop mixtures. Dr. Kip Balkcom is completing the first year of a cover crop mixture experiment in Headland, AL comparing a fallow treatment with two rates of cereal rye, a two-way mixture of black oats and Persian clover, and a three-way mixture of black oats, Persian clover, and lunch radish. Preliminary results from the first year (Figure 1) show that cereal rye, as a single species, produces more biomass than the mixtures. Dr. Ted Kornecki established research in the fall of 2014 on cover crop termination methods (rolling, rolling plus glyphosate, and planting into the standing cover crop) using cereal rye, crimson clover, and a mixture of cereal rye and crimson clover. In addition to the ongoing projects, four new cover crop mixture experiments are planned for this fall.

While there are numerous combinations of cover crop

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… Cover Crop Mixtures cont.

species and seeding rates that can be combined together into mixtures, there is a data gap related to how much biomass mixtures produce, the impact on the following crop and soil properties, and the financial feasibility of mixtures as compared to single species. For a baseline comparison using cover crops commonly adopted by producers, Drs. Kip Balkcom and Leah Duzy will establish an experiment at E.V. Smith evaluating cereal rye, crimson clover, forage radish, and combinations of these crops with varying seeding rates. The cover crop treatments will be part of a conservation system in a corn and cotton rotation.

Nitrogen fertilizer is a vital input for corn and cotton producers. One benefit of using legume cover crops is a potential reduction in commercial nitrogen for the following crop. Dr. Kip Balkcom will establish two experiments to investigate different ratios of cereal rye and legumes to determine if N rates can be reduced. In the first experiment, five cover crop treatments (fallow, cereal rye, crimson clover, and a mixture of cereal rye and crimson clover at two different seeding rates) will be established prior to corn. Corn will be fertilized at four different nitrogen rates. As similar experiment will be established prior to cotton with vetch in place of clover.

Forage radish used as a cover crop has been growing in popularity and one of the potential benefits is alleviation of soil compaction. In Alabama, soil compaction is a concern for producers, particularly in the Coastal Plains. Producers often ask if the use of forage radish will decrease the need for deep tillage. This fall at E.V. Smith in Shorter, AL Dr. Kip Balkcom will establish an experiment designed to answer this question. Main plots will be six cover crop treatments: 1) fallow, 2) cereal rye, 3) radish, 4) cereal rye and crimson clover, 5) cereal rye and forage radish, and 6) cereal rye, crimson clover, and forage radish. Cover crop treatments will be established as part of a continuous cotton rotation with two tillage systems (conventional tillage and conservation tillage) and two deep tillage treatments (none and in-row).

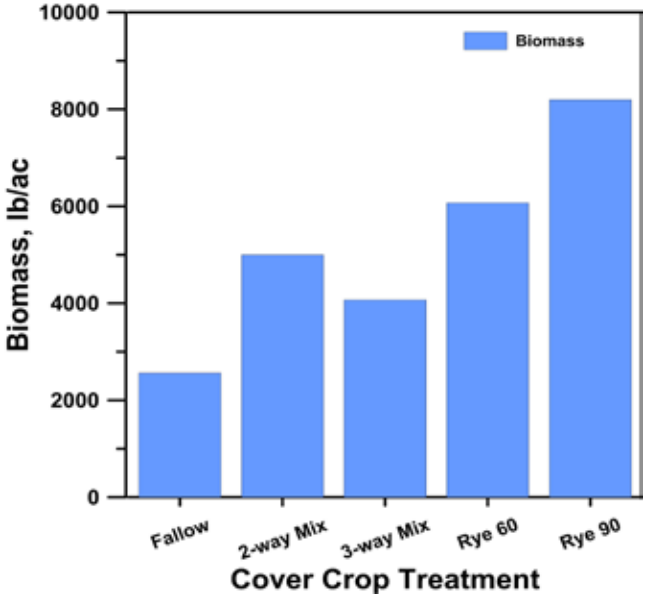

Figure 1. Cover crop biomass measured on April 23, 2015 for single species rye planted at 60 and 90 lb ac^{-1} compared to mixtures and fallow in Headland, AL.

To gather additional information from these experiments, Dr. Andrew Price will evaluate weed emergence and biomass to determine potential weed control difference among treatments in several of the mixture experiments. Dr. Leah Duzy will investigate the economic feasibility of adopting cover crop mixtures as compared to the fallow treatment and single specie treatments.

Researchers at the NSDL are striving to provide the agricultural community in the Southeast with timely information regarding the potential for using cover crop mixtures in conservation systems. Questions regarding any of the research discussed in this article can be directed to NSDL-Highlights@ars.usda.gov or the appropriate researcher.

Response of a Southeastern Bahiagrass Pasture to Elevated Atmospheric CO_2 and Nitrogen

Atmospheric levels of CO_2 continue to rise and it is well established that most plants exhibit a positive growth response to this increase. In the Southeastern US, pasture systems remain understudied agro-ecosystems in terms of the effects of elevated CO_2. Therefore, we initiated a long-term study of bahiagrass (Paspalum notatum Flüggé) response to elevated CO_2 using open top field chambers in 2005 on a Blanton loamy sand (loamy siliceous, thermic, Grossarenic Paleudults). The study has run for 9 years with biomass production and tissue carbon and nitrogen assessed. Plants were exposed to ambient or elevated (ambient plus 200 ppm) CO_2. After a one-year establishment period, an N treatment was applied where half of all plots received N [$(NH_4)_2SO_4$] at 90 kg ha^{-1} three times yearly; the remaining plots received no N fertilization. These two treatments represent managed and unmanaged pastures, both of which are common in the Southeast.

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… Bahiagrass Pasture cont.

Prior to N treatment initiation (establishment phase), biomass production was unaffected by CO_2 treatment. Harvests after N treatment initiation (2006) showed a strong effect of N treatment on cumulative biomass production (yearly average increase of 230% with N added). Elevated CO_2 also increased biomass production (yearly average 15%). Atmospheric CO_2 level had no impact on bahiagrass production when no N was added (as observed in establishment year); however, biomass production was increased under high CO_2 when N was added. In general, this same pattern of treatment response was observed throughout the 9 years of study. Tissue C concentration was unaffected by CO_2 treatment, while N concentration was slightly reduced under high CO_2. However, total C content was usually higher under elevated CO_2, while total N content was unaffected.

For C:N ratio, results showed that high CO_2 grown plants had lower C:N in the no N treatment, but the opposite was observed with N fertilization. As with biomass, this same general pattern was observed throughout the study. Results to date show that N fertilization can increase biomass productivity under elevated CO_2, but forage quality (in terms of C:N ratio) may decline slightly. In addition to C and N, forage will be analyzed for crude protein, acid detergent fiber, neutral detergent fiber, nitrate-N, ash, pH, crude fat, lignin, total digestible nutrients, other elemental contents, and overall relative forage quality. Efforts are also underway to assess impacts of these treatments on belowground biomass, soil trace gas efflux, soil carbon storage, and soil physicochemical properties.

Figure 1. Bahiagrass pasture on NSDL soil bin being treated with differing levels of atmospheric CO_2 using open top field exposure chambers.

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Happenings

ARS Agricultural Economist Leah Duzy made a presentation on "Economics of conservation systems research in the southeastern US" during the Economics of Soil Health Practices symposium at the 70th Annual Soil and Water Conservation Society meeting in Greensboro, NC.

ARS Agricultural Engineer Ted Kornecki gave a presentation titled "Evaluation of a custom residue manager to manage cover crops and its effects on cotton population and yield in a no till system" at the 2015 ASABE Annual International Meeting in New Orleans, LA.

ARS Scientists Kip Balkcom, Dara Boardman, Leah Duzy, and Ted Kornecki attended the 2015 Nitrogen Use Efficiency (NUE) meeting that will be held in Auburn, AL, August 4-5, 2015. The NUE meeting has been hosted annually for almost 14 years to discuss the latest on NUE research. This is the first year the meeting will be held in the Southeast. Dr. Kip Balkcom moderated a session during the meeting.

ARS researchers Kip Balkcom and Leah Duzy attended the MidSouth Association of Wheat Scientists (MAWS) annual meeting in Mdison, AL. Dr. Duzy presented on the economics of wheat production.

ARS researchers Kip Balkcom, Leah Duzy, and Ted Kornecki were guest lecturers for Dr. Eve Brantely's Soil Resource and Conservation course at Auburn University.

ARS researcher Kip Balkcom was invited to speak at AG Solutions Day: Technological Innovations for Sustainable Agriculture in the Southeast about conservation tillage and cover crops in Orange Beach, AL.

ARS researchers Brett Runion and Steve Prior presented "Cogongrass ecotypes respond differently to elevated atmospheric CO_2" at the 47th Annual Air Pollution Workshop and Symposium in Auburn, AL. They also gave a tour of NSDL facilities and research to workshop participants.

ARS researcher Brett Runion was invited to speak on "Growth and control of invasive weeds under elevated CO_2" at the American Society for Horticultural Science Annual Conference in New Orleans, LA.

ARS researchers Steve Prior and Allen Torbert attended the 20th International Conference of the International Soil Tillage Research Organization in Nanjing, China and presented "Response of a southeastern US bahiagrass pasture to elevated atmospheric CO_2 and N fertilization" and "Impact of soil amendment applications on soil quality".

ARS researcher Allen Torbert attended the 2015 American Coal Ash Association Meeting in Raleigh, NC.

Send updated contact information, questions, comments, and/or suggestions to: NSDL-Highlights@ars.usda.gov