National Soil Dynamics Laboratory

Highlights

Spring 2013

United States Department of Agriculture

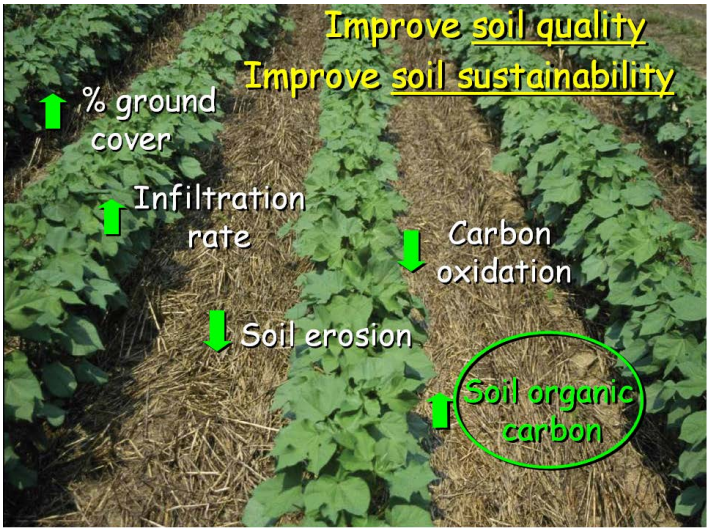
Agricultural Research Service

Contents

CSR Plans Future Research

As discussed in the spring 2012 issue of Highlights, the Conservation Systems Research (CSR) unit is planning our next 5-year research cycle of the Agricultural System Competitiveness and Sustainability National Program (NP) 216. The process consists of four steps: (1) gathering input; (2) planning; (3) implementing; and (4) documenting success. The customer workshop we hosted in February, 2012 was to gather input from our customers/stakeholders (Step 1) to assist in the research planning process (Step 2). We have completed our project plan, and are currently in the peer review process (Step 2). Once the project plan has been reviewed and certified, the CSR unit will initiate the research starting in October, 2013.

The title of our proposed research plan is "Sustainable Production, Profit, and Environmental Stewardship through Conservation Systems." The research objectives of our project are specifically designed to develop conservation systems that will improve soil quality, conserve natural resources, and increase production efficiency, considering input costs and profitability.



Overall, our research will focus on (1) developing conservation systems that integrate cover crop management and equipment for maximum soil protection and weed suppression; (2) developing, evaluating, and providing decision support for cropping systems that increase soil organic matter accumulation,

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Dynamically Speaking

H. Allen Torbert
Research Leader

As the weather warms and the spring planting season approaches, we are busy preparing to continue our experiments scattered across Alabama. As I have mentioned previously, funding for the NSDL comes primarily from the Federal Government and, consequently, we were subject to the recent Federal Government funding reductions (also known as sequestration). While the cuts have not been inconsequential, we are glad to still be here and able to continue the important work of agricultural research. The NSDL's primary mission is to solve problems for farmers in the southeast US and we continue to be dedicated to this mission. Fortunately, our scientists have been very good at attracting outside funding for our research, including welcomed support from farmer supported research funds, which has allowed us to absorb some of the reductions in our base funds. 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. I hope you enjoy reading about our ongoing research efforts in this issue of National Soil Dynamics Highlights.

National Soil Dynamics Laboratory
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Upcoming Events

Dates	Meeting	Location
May 8	AL Invasive Plant Council Annual Meeting	Columbiana, AL
Jun. 12–14	SWCS-AL Annual Meeting	Birmingham, AL
Jul. 11	Sunbelt Ag Expo Field Day	Moultrie, GA
Oct. 15–17	Sunbelt Ag Expo	Moultrie, GA

Recent Publications

Aulakh, J.S., A.J. Price, S.F. Enloe, G.R. Wehtje, and M.G. Patterson. 2013. Integrated Palmer amaranth management in glufosinate-resistant cotton: II. Primary, secondary and conservation tillage. Agronomy. 2013: 28-42.

Chen, G., H. Tian, C. Zhang, M. Liu, W. Ren, W. Zhu, A.H. Chappelka, S.A. Prior, and G.B. Lockaby. 2012. Drought in the southern United States over the 20th century: Variability and its impacts on terrestrial ecosystem productivity and carbon storage. Climatic Change 114:379-397.

Dijkstra, F.A., S.A. Prior, G.B. Runion, H.A. Torbert, H. Tian, C. Lu, and R.T. Venterea. 2012. Effects of elevated carbon dioxide and increased temperature on methane and nitrous oxide fluxes: Evidence from field experiments. Front. Ecol. Environ. 10:520-527.

dos Santos, N.Z., S.A. Prior, J. Garbardo, J.C. Valaski, A.C.V. Motta, and A. Ferreira Neto. 2012. Influence of corn (Zea mays L.) cultivar development on residue production. J. Plant. Nutr. 35:750-769.

Ferreira, C.F., A.C.V. Motta, S.A. Prior, C.B. Reissman, N.Z. dos Santos, and J. Gabardo. 2012. Influence of corn (Zea mays L.) cultivar development on grain nutrient concentration. Int. J. Agron. 2012: Article ID 842582.

Marble, S.C., S.A. Prior, G.B. Runion, H.A. Torbert, C.H. Gilliam, G.B. Fain, J.L. Sibley, and P.R. Knight. 2012. Effects of fertilizer placement on trace gas emissions from nursery container production. HortSci. 47:1056-1062.

Price, A.J., J.A. Kelton, and J.A. Mosjidis. 2012. Utilization of sunn hemp for cover crops and weed control in temperate climates. *In* A.J. Price (ed.) Weed Control. Intech Press, Rijeka, Croatia.

Smith, K.E., D.B. Watts, D.A. Way, H.A. Torbert, and S.A. Prior. 2012. Impact of tillage and fertilizer application method on gas emissions in a corn cropping system. Pedosphere 22:604-615.

Tian, H., C. Lu, G. Chen, B. Tao, S. Pan, S.J. Del Grosso, X. Xu, L. Bruhwiler, S.C. Wofsy, E.A. Kort, and S.A. Prior. 2012. Contemporary and projected biogenic fluxes of methane and nitrous oxide in North American terrestrial ecosystems. Front. Ecol. Environ. 10:528-536.

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

… CSR Plans cont.

enhance productivity, and maximize profitability of degraded southeastern soils; and (3) integrating existing production agricultural and conservation system research using analysis tools and/or models to evaluate profitability and risk associated with conservation systems. Below are several examples of the type of research we will conduct over the next five years to evaluate:

- cover crop termination using different types of rollers designed for walk-behind tractors;
- managing cover crop residue using custom designed residue managers compared to commercially available row cleaners with coulters;
- cover crop and herbicide management intensity in corn, cotton, soybean, and peanut;
- high residue cover crop mulch systems in tomato and watermelon as compared to a traditional system;
- nitrogen fertilizer sources, rates, and time of application for a rye winter cover crop to optimize biomass production;
- tillage and nitrogen requirements for wheat; and
- net returns of different conservation cropping systems.

We feel that the successful completion of our research will benefit producers directly through equipment advances, management techniques to maximize benefits associated with improved soil quality, and economic comparisons to illustrate profitability associated with these systems. Entities, including other government agencies and university extension services, will also benefit through access to scientifically based results and recommendations related to conservation systems that can be transferred to various clientele.

Invasive Weed Response to Elevated CO_2

Plants use carbon dioxide (CO_2) to build tissues and the rising level of CO_2 in the atmosphere (due largely to human activities) usually leads to larger plants. Plants vary in their growth response to higher levels of CO_2 with C4 grass-type plants (like corn and sorghum) showing 10-20% increases in growth and yield and C3 flowering plants (like cotton and soybean) increasing around 30%. Unfortunately, this is true for weeds as well as crop plants. In fact, weeds may respond to increases in atmospheric CO_2 even more than crop plants. Exotic weeds (those not native to a country or area), are becoming an increasing concern and cost U.S. agricultural and forestry producers billions of dollars annually from decreased productivity and increased weed control costs. Although the negative impacts of invasive weeds are recognized, the effects of the rising levels of atmospheric CO_2 on these invasives have not been extensively investigated.

We investigated the effects of ambient and elevated (ambient + 200 ppm) CO_2 on several common invasive weeds important to agriculture in the southeastern US. Virtually all invasive weeds grew larger when exposed to elevated CO_2 and increased biomass by between 11-42%. However, not all weeds responded in the same manner. For example, purple nutsedge showed greater leaf area, leaf dry weight, root length, root dry weight, number of tubers, tuber dry weight, and number of tillers under high CO_2, while only leaf dry weight, tuber number, and tuber dry weight went up in yellow nutsedge. Six ecotypes of cogongrass also showed a wide range (0-20% increase) in growth response to elevated CO_2. Yellow nutsedge (11%) and Johnsongrass (12%) showed the least responsiveness to elevated CO_2, while tropical spiderwort (41%) and Chinese privet (42%) were at the upper range of responses reported for most plants; sicklepod (23%) and purple nutsedge (25%) were in between. The potential damage to crops these invasive weeds represent will depend on their ability to become established and grow. As atmospheric CO_2 continues to rise, these plants (tropical spiderwort and Chinese privet, in particular) will likely become worse and more costly problems for farm and forest managers.

It has been suggested that weeds may be less responsive to herbicidal controls when grown under elevated CO_2. This could be due to larger plants requiring more herbicide for adequate control or to other changes in plant growth and chemistry resulting from exposure to elevated CO_2. At NSDL, we are beginning to investigate the effects of standard herbicides on control of invasive weeds grown in ambient and elevated CO_2. Further, we will also study combinations of crops and invasive weeds grown together to determine the negative impacts of invasive weeds on crop growth and yield under elevated CO_2.

Subsurface Band Application of Poultry Litter Reduces Nutrients in Runoff Water

Production of broiler chickens is a major agricultural industry in the southeastern US. Broiler production produces broiler litter which is a mixture of manure and bedding material. Nationwide, poultry production generates about 17 million tons of litter per year and the conventional method of applying litter is broadcast application on the soil surface. Application of poultry litter in shallow subsurface bands has been shown to reduce nutrients in runoff water, relative to surface broadcast application.

A prototype implement for applying litter in shallow subsurface bands has been developed at the NSDL. The implement applies litter 2 to 3 in. below the soil surface in four subsurface bands and the band spacing is adjustable, so the implement can be used in row crops or pastures. Broiler litter was applied in subsurface bands in tall fescue pasture plots in northeastern Alabama at the Sand Mountain Research and Extension Center of the Alabama Agricultural Experiment Station. The subsurface band application was compared with the conventional surface broadcast application, in terms of nutrients in runoff water. To do this, we sprayed water on the plots to simulate rainfall, runoff water was collected, and nutrients in the runoff water were analyzed. Concentrations of phosphorus and nitrogen nutrients in the runoff water were substantially lower for the subsurface banded litter than for the conventional surface broadcast litter. Also, the nutrient loading, which is the total amount of a nutrient in the runoff water, was lower for the subsurface banded litter than for the conventional surface broadcast litter.

This experiment shows that subsurface band application of litter can substantially reduce nutrient losses in surface runoff water. Subsurface band application also has the

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… Subsurface band application cont.

advantage of placing the nutrients near crop roots in row crop production, thereby improving nutrient use efficiency, compared to surface broadcast application of litter.

Rear view of subsurface band litter applicator implement side dressing corn with broiler litter

Subsurface band of broiler litter side-dressed parallel to a corn row. A small pit in the soil shows the cross-section of the band.

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Happenings

Dr. Allen Torbert presented *Development of a Soil Test for Determining the Impact of Soil Disturbance* at the Triennial ISTRO Conference in Montevideo, Uruguay.

Drs. Kip Balkcom, Ted Kornecki, Andrew Price, and Ms. Leah Duzy hosted 16 undergraduate students from the Universidad Nacional de Agricultura, Catacamas, Honduras. The students learned about the scientists' research in conservation systems. Dr. Juan Rodriguez translated the presentations and discussed similarities and differences in laboratory procedures in the U.S. and Honduras.

Dr. Allen Torbert, National Soil Dynamics Laboratory, Auburn, AL spoke on *Effects of Conservation Tillage on Your Land* at the Univ. California Coop. Ext. Winter Ag Meeting in McArthur, CA.

Dr. Dexter B. Watts received the *Early Career Award* from the Southern Branch American Society of Agronomy at the 2013 Annual Meeting.

Dr. Andrew Price presented *Herbicide and Cover Crop Residue Integration for Amaranthus Control in Conservation Agriculture Cotton and Implications for Resistance Management* at the Weed Science Society of America Annual Meeting in Baltimore, MD.

Dr. Ted Kornecki and Corey Kichler demonstrated innovative equipment used in conservation systems including a tractor–mounted two-stage cover crop roller/crimper, a BSA walk behind tractor–mounted roller/crimper, and a no-till modified transplanter with subsoiler.

Drs. Kip Balkcom and Ted Kornecki attended the 2013 Southern Conservation Agricultural Systems Conference in Norman, OK as a part of the No-till Oklahoma 2013 Conference. Dr. Balkcom presented two papers: *Nitrogen Rates for Biomass Sorghum Production across Tillage Systems* and *Conservation Systems in the Southeast*. Dr. Kornecki presented *Cotton Population and Yield following Rye and Crimson Clover Termination with Roller/Crimper and Herbicides in an Alabama No-till System*.

Dr. Andrew Price presented *Weed and Herbicide Management in Today's Row Crops* at the East-Central Alabama Row Crops Workshop, E.V. Smith Research and Education Center, Shorter, AL.

Drs. Kip Balkcom and Andrew Price spoke at the 13th Conservation Tillage Production Systems Training Conference in Tifton, GA. Dr. Balkcom's presentation was entitled *Conservation Production Systems – A Basic Review*. Dr. Price's presentation was entitled *Weed Management in Conservation Production Systems*.

Dr. Allen Torbert presented *Current Research Activities for Agriculture Uses of Gypsum on Highly Erodible Soils* at the 2013 Midwest Soil Improvement Symposium in Ada, Ohio.

Ms. Leah Duzy presented *Impact of Alternative Land Rental Agreements on the Profitability of Cotton Producers across the Cotton Belt* at the Beltwide Cotton Conferences in San Antonio, TX.

Drs. Kipling Balkcom, Ted Kornecki, Andrew Price and Ms. Leah Duzy spoke about cover crop management at a field day organized by the AL Coop. Ext. System and USDA-NRCS in Hartford, Alabama.

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