National Soil Dynamics Laboratory

Highlights

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Contents

Gypsum can Improve Alabama Water Quality

Poultry litter has long been used as a fertilizer source in Alabama and is an excellent way to provide needed nutrients for farming and to improve soil quality. However, there is also a growing public concern that long–term use may cause problems for surface water quality. Specifically, phosphorus (P) has been identified as the most critical nutrient posing a threat to surface water quality by accelerating eutrophication.

Traditionally, poultry litter has been applied to pastures and hayfields based on crop nitrogen demand rather than P requirement, thereby contributing to a buildup of soil P and increased risk of P in surface water runoff. Our research has focused on developing best management practice (BMP) methods for controlling excessive P loss from agricultural fields, especially those utilizing poultry litter.

One promising BMP we're studying is the use of gypsum applied along with poultry litter. Gypsum is a fertilizer containing sulfur (S) and calcium (Ca), and is commonly used in peanut production to provide Ca for pod development. Gypsum can also reduce losses of P from agricultural fields receiving poultry litter because it binds with P in the soil and litter to form insoluble Ca–phosphate complexes, decreasing the amount lost in surface water runoff.

Spreading gypsum

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Dynamically Speaking

H. Allen Torbert
Research Leader

The National Soil Dynamics Laboratory is busy with the harvest season on the many experiments we have scattered across the state as we continue our efforts to conduct research for the American farmer. As the season changes, so do the seasons of our lives. I would like to note some changes in our staff. This summer Dr. Francisco Arriaga left our staff and has joined the University of Wisconsin as an extension soil science specialist. Dr. Arriaga is a great scientist and his research work is greatly respected. We wish him the best in his new role. I am also saddened to write that we lost Mr. Jerry Carrington due to his untimely death after a long illness. Mr. Carrington was a hard worker and well–liked member of our staff and he will be greatly missed. On a positive note, we would like to welcome Mr. Russell Drury, who has transferred to us from an ARS lab in New Orleans, LA.

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

National Soil Dynamics Laboratory
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Upcoming Events

Dates	Meeting	Location
Oct. 16-18	Sunbelt Ag Expo	Moultrie, GA
Oct. 21-24	ASA-CSSA-SSSA Ann. Mtg.	Cincinnati, OH
Oct. 25-27	ASAN Food & Farm Forum	Gulf Shores, AL
Nov. 3	Auburn Univ. Taste of AL	Auburn, AL
Dec. 13-14	SWCS Cover Crops	Altoona, IA
Jan. 8-10	Beltwide Cotton Conf.	San Antonio, TX
Jan. 24-26	SSAWG Ann. Mtg.	Little Rock, AR
Jan. 29-30	SWCS Cover Crops	Decatur, IL
Feb. 8-9	AL Fruit & Veg. Growers Mtg.	Auburn, AL
Feb. 19-20	SCASC	Norman, OK
Feb. 22-23	GA Organics	Atlanta, GA

Recent Publications

Ducamp, F., F.J. Arriaga, K.S. Balkcom, S.A. Prior, E. van Santen, and C.C. Mitchell. 2012. Cover crop biomass harvest influences cotton nitrogen utilization and productivity. Int. J. Agron. 2012: doi:10.1155/2012/420624.

Kelton, J.A., A.J. Price, and J.A. Mosjidis. 2012. Allelopathic weed suppression through the use of cover crops. In A.J. Price (ed.) Weed Control. Intech Press, Rijeka, Croatia. ISBN 978-953-51-0159-8.

Kornecki, T.S., F.J. Arriaga, and A.J. Price. 2012. Evaluation of methods to assess termination rates of cover crops using visual and non-visible light active sensors. Trans. ASABE 55:733-741.

Marble, S.C., G.B. Fain, C.H. Gilliam, G.B. Runion, S.A. Prior, H.A. Torbert, and D.E. Wells. 2012. Landscape establishment of woody ornamentals grown in alternative wood-based container substrates. J. Environ. Hort. 30:13-16.

Mathew, R.P., Y. Feng, L. Githinji, R. Ankumah, and K.S. Balkcom. 2012. Impact of no-tillage and conventional tillage systems on soil microbial communities. Apl. Environ. Soil Sci. 2012: Article 548620. doi:10.1155/2012/548620.

Price, A.J., K.S. Balkcom, L.M. Duzy, and J.A. Kelton. 2012. Herbicide and cover crop residue integration for Amaranthus control in conservation agriculture cotton and implications for resistance management. Weed Tech. 26:490-498.

Prior, S.A., G.B. Runion, H.A. Torbert, S.B. Idso, and B.A. Kimball. 2012. Sour orange fine root distribution after seventeen years of atmospheric CO_2 enrichment. Agric. For. Meteor. 162-163:85-90.

Runion, G.B., J.R. Butnor, S.A. Prior, R.J. Mitchell, and H.H. Rogers. 2012. Effects of atmospheric CO_2 enrichment on soil CO_2 efflux in a young longleaf pine system. Int J. Agron. doi:10:1155/2012/549745.

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

Gypsum can Improve AL Water Quality …

Gypsum has traditionally been mined, but gypsum is also produced as a byproduct of coal burning power generation. Power companies remove S from smoke stacks of the burning coal and produce Flue-Gas Desulfurized (FGD) gypsum as a by-product. Gypsum is also produced from wallboard recycling. These products have greatly increased the availability of gypsum for agriculture use.

Recently, we applied three gypsum sources (mined gypsum, FGD gypsum, and FGD gypsum + fly ash) at different rates to pastures following manure application, and measured water soluble P in the soil during the growing season. All gypsum sources effectively tied up water-soluble P concentrations in soil; the greatest reductions occurred with the highest rate. However, the adsorbing capacity of gypsum was greatly reduced during the second season, when poultry litter was applied without gypsum. This suggests that gypsum is needed at the time of poultry litter application to achieve the greatest benefits in P tie-up. A series of rainfall simulations were also conducted at different times following poultry litter application. Regardless of when rainfall simulations occurred, gypsum was effective at reducing soluble P concentrations in surface water runoff. Reductions up to a 60% were observed, suggesting that FGD gypsum use should be encouraged on fields vulnerable to P loss.

Developing BMPs to reduce P losses from fields receiving poultry litter will reduce surface water quality degradation. The use of gypsum as a soil amendment is a promising method to reduce P losses. Our research will provide valuable information needed to develop these practices.

Measuring surface water runoff

Controlling Herbicide–Resistant Weeds

Herbicide resistance management threatens conservation agriculture sustainability. The practice of conservation tillage is threatened by the emergence and rapid spread of glyphosate-resistant weeds such as Palmer amaranth (Amaranthus palmeri [S.] Wats.), one of several amaranths commonly called pigweeds. First identified in Georgia, it now has been widely reported in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Tennessee.

Inversion of the soil profile and burial of the surface seedbank and surface tillage to enhance preplant-incorporated and preemergence herbicide use and activity is increasingly recommended by some weed managers. In some heavily infested areas, conservation tillage has been nearly eliminated because inversion tillage was the most effective option to supplement other, mostly chemical based tactics for Palmer amaranth control

Palmer amaranth

We conducted experiments to evaluate the effect of integrated weed management practices on pigweed population density and biomass, cotton yield, and economics in glyphosate-resistant cotton. Treatments evaluated winter cereal rye biomass amounts compared to a conventional tillage system. In addition, we evaluated four herbicide regimes. Our results revealed that early-season pigweed density was reduced in high-residue conservation agriculture in comparison to the conventional tillage winter fallow systems in 2 of 3 years. Pigweed densities in herbicide treatments that included a broadcast preemergence application were lower at three of five sampling dates compared to banded preemergence applications; however, the differences were not significant during the late season and cotton yields were not affected by preemergence herbicide placement. High-residue conservation tillage yields were 515 to 802 lbs/acre more than conventional tillage, except at one site in 1 year when conventional tillage treatment yields were higher. Conservation systems utilizing high-residue cover crops increased net returns over conventional tillage by $40/acre or more 2 out of 3 years at both locations.

The use of a high-residue cereal cover crop in cotton production potentially can aid in early-season pigweed suppression. Traditional and alternative weed control strategies, such as the utilization of crop and herbicide rotation and integration of high residue cereal cover crops introduced and continually refined by ARS researchers in Auburn, AL, are necessary in order to sustain conservation tillage practices. Currently, integration of high-residue cover crop systems and overlapping residual herbicides are increasingly being recommended by state cooperative extension. If tillage increases, producers will suffer a significant setback in reducing soil erosion and protecting soil and water quality.

Rising Carbon Dioxide and Plant Disease

The concentration of carbon dioxide (CO_2) in the atmosphere is rising due mainly to fossil fuel burning and land use change (e.g., deforestation, urbanization). Plants growing under elevated CO_2 can fix more carbon and generally show increased growth and yield. Increased plant growth and having extra carbon to use in production of defense compounds could affect plant diseases. However, limited experimentation has occurred to date and the manner in which increases in atmospheric CO_2 will affect major diseases of the world's plants are largely unknown. This is important since billions of dollars in plant yield are lost to diseases and millions more are spent managing them each year. We hypothesized that elevated CO_2 would have differing effects on diseases caused by obligate vs. facultative pathogenic fungi.

We exposed loblolly pine seedlings to ambient and twice ambient levels of atmospheric CO_2 for 6 weeks in open-top field chambers. Seedlings were then inoculated with fungal spores of either fusiform rust (an obligate pathogen) or pitch canker (a facultative pathogen). Plants were placed back into the open-top chambers and exposed to the two levels of CO_2 until disease symptoms appeared. We monitored both disease incidence (the percentage of plants infected) and disease severity (the proportion of each plant affected). Disease severity

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Rising Carbon Dioxide and Plant Disease …

was determined by measuring gall size and length for fusiform rust and lesion length for pitch canker. We expected fusiform rust to increase under elevated CO_2 since added biomass would give the pathogen more tissue available for infection. Conversely, we expected reduced levels of pitch canker because the plants would be healthier and better able to "defend" themselves against the fungus.

Pitch Canker

Fusiform Rust

Loblolly pine seedlings grown under elevated CO_2 were larger in diameter and height and weighed more than seedlings grown under ambient CO_2. Counter to what we expected, incidence of both diseases was lower for plants grown in elevated CO_2. Disease severity was not changed by exposure to high CO_2 for either disease.

We also looked at red oak seedlings because they play a critical role in the fusiform rust reproductive cycle; spores go from pines to oak leaves and back to pines. As with pines, red oak seedlings grew larger under elevated CO_2. Growth in elevated CO_2 also lengthened the interval between inoculation and spore formation on red oak seedlings. It is possible that the delay in spore formation on oaks could result in lower infection levels in pines if the delay causes spores to be dispersed after pine tissues have begun to harden and become less succulent. These findings were detailed in the journal New Forests. This research is continuing and we plan to explore the role of plant defense compounds (tannins, phenols, and other metabolites) on other plant – disease interactions under elevated CO_2.

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Happenings

Dr. Francisco Arriaga spoke at the annual conference of the Southern Chapter of the International Society of Arboriculture on *The Effectiveness of Mulch for Reducing Soil Compaction During Construction*.

Dr. Thomas Way worked with Auburn University engineering students on the development of a lunar excavator for the NASA Lunabotics Mining Competition at the Kennedy Space Center.

Drs. Kip Balkcom, Andrew Price, and **Ted Kornecki**, and **Ms. Leah Duzy** presented research information at a field tour stop at the Joint Alabama, Florida, Georgia Soil and Water Conservation Society Annual Meeting held in Eufaula, AL. Technical support was provided by **Corey Kichler, Karl Mannschreck, Trent Morton,** and **Jeffery Walker**. Ms. Duzy also presented *An Introduction to Water Quality Trading and Agriculture*.

Kirk Iversen and **Corey Kichler** presented information on summer cover crops and rolling technology for managing cover crops in conservation systems at Organic Farming Workshops and Field Days organized by the Alabama Cooperative Extension System (ACES) and the Alabama Agriculture Experiment Station (AAES) in Cullman, Birmingham, and Thomaston, AL.

Dr. Ted Kornecki presented *A Powered Roller/Crimper for Walk-Behind Tractors to Terminate Cover Crops in Conservation Agriculture* at the 2012 International Conference of Agricultural Engineering in Valencia, Spain. He also moderated a scientific session, *Conservation Tillage II*, during which researchers from Great Britain, Germany, Israel, and Spain presented results from site specific conservation tillage of their field experiments.

Dr. Allen Torbert spoke in a webinar entitled, *Knowing Why, When and How to Use Gypsum - Research Evidence to Support Using Gypsum in Agricultural Production*, sponsored by the NoTill Farmer magazine. Dr. Torbert also presented *Agriculture Use of Gypsum Implications for Water Quality*.

Drs. Allen Torbert and **Dexter Watts** attended the Fertilizer Industry-ARS Scientist meeting for Nitrogen Source vs N_2O Emissions in Fort Collins, CO. Dr. Watts presented *N Source Effects on N_2O Emissions from Cotton with Supplemental Irrigation in A Humid Climate near Auburn*.

Dr. Allen Torbert presented *Research Activities for Use of Agricultural Gypsum* at the Midwest Soil Improvement Symposium: Research and Practical Insights into Using Gypsum.

Drs. Ted Kornecki and **Andrew Price, Corey Kichler,** and **Kirk Iversen** presented information about conservation production systems at Organic Vegetable Production field days at Red Root Farm and Whirlwind Farm. Drs. Kornecki and Price also presented information at the Auburn University Horticulture team meeting in Auburn.

Dr. Kip Balkcom spoke at the Wiregrass Wheat Producer meeting in Headland, AL. **Kirk Iversen** provided information about conservation systems.

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