National Soil Dynamics Laboratory

Highlights

Fall 2013

United States Department of Agriculture

Agricultural Research Service

Contents

Horticultural Practices Impact Release of Greenhouse Gases

Climate change and its potential global impacts are receiving significant attention from the scientific community. Increases in atmospheric carbon dioxide (CO_2) concentration, along with other trace gases [i.e., methane (CH_4) and nitrous oxide (N_2O)] are widely believed to be the driving factors behind global warming. Since little is known about the impact of the horticulture industry on these factors, the NSDL has engaged in an on-going joint effort with the Horticulture Department at Auburn University to measure greenhouse gas (GHG) emissions and develop strategies for soil carbon (C) storage.

Building on prior research into the effects of container size and fertilizer placement practices, a new project was recently initiated (July) to examine the interactive effects of irrigation and fertilizer placement on GHG emissions. In this study, Japanese boxwood are being grown in containers (three gallon) using standard potting media with two fertilizer and two irrigation treatments. Fertilizer is either broadcast directly onto the media surface or is thoroughly mixed with the media with all containers receiving the same type and amount of fertilizer. Containers are also exposed to either overhead or drip irrigation three times per day with all containers receiving equal amounts of water (0.25 inch per event). Trace gas emissions are assessed weekly from each container *in situ* using the static closed chamber method.

Irrigation system being used in the study

Gas samples for CO_2, CH_4, and N_2O are taken at 0, 20, and 40 min intervals following chamber closure to calculate gas flux rates and analyzed using gas

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Dynamically Speaking

H. Allen Torbert
Research Leader

The National Soil Dynamics Laboratory (NSDL) is continuing its efforts to conduct research for the American farmer. This year we welcomed Dr. Galina Yakubova, a nuclear physicist, to our staff; she will be working on a project to develop a measurement platform that measures soil elemental composition in the field. The system, developed at Brookhaven National Laboratory, has been transferred to NSDL for further development and is designed to non-destructively measure carbon and other elements belowground. A unique capability of the system is that it can measure large areas, statically or as a dynamic scan of an entire field, and provide a single measurement of the content of soil elements over its entirety (more details will be provided in later issues).

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

National Soil Dynamics Laboratory
http://www.ars.usda.gov/msa/auburn/nsdl
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Upcoming Events

Dates	Meeting	Location
Nov. 3-6	ASA-CSSA-SSSA Ann. Mtg.	Tampa, FL
Dec. 16-17	AL Corn & Wheat Short Course	EVS Research Center
Jan. 6 -8	Beltwide Cotton Conf.	New Orleans, LA
Jan. 15-18	Southern SAWG Conf.	Mobile, AL
Feb. 2-3	ASA Southern Branch Meeting	Dallas, TX
Feb. 7-8	AL Fruit & Veg. Growers Mtg.	Auburn, AL
Feb. 13	Conservation Prod. Sys. Conf.	Vidalia, GA
Feb. 21-22	GA Organics	Jekyll Island, GA

Recent Publications

Adeli, A., Tewolde, H., Shankle, M.W., Way, T.R., Brooks, J.P., McLaughlin, M.R. 2013. Runoff quality from no-till cotton fertilized with broiler litter in subsurface bands. Journal of Environmental Quality. 42:284-291.

Kelton, J.A., Price, A.J., Patterson, M.G., Monks, C.D., Van Santen, E. 2013. Evaluation of tillage and herbicide interaction for amaranthus control in cotton. Weed Technology. 27:298-304.

Kibet, L.C., Allen, A.L., Church, C., Kleinman, P.J., Feyereisen, G.W., Saporito, L.S., Hashem, F., May, E.B., Way, T.R. 2013. Transport of dissolved trace elements in surface runoff and leachate from a coastal plain soil after poultry litter application. Journal of Soil and Water Conservation. 68(3):212-220.

Kornecki, T.S., Arriaga, F.J., Price, A.J., Balkcom, K.S. 2012. Effects of different residue management methods on cotton establishment and yield in a no-till system. Applied Engineering in Agriculture. 28:787-794.

Marble, S.C., Prior, S.A., Runion, G.B., Torbert III, H.A., Gilliam, C.H., Fain, G.B., Sibley, J.L., Knight, P.R. 2012. Determining trace gas efflux from container production of woody nursery plants. Journal of Environmental Horticulture. 30(3):118-124.

Mourtizinis, S., Arriaga, F.J., Balkcom, K.S., Ortiz, B.V. 2013. Corn grain and stover yield prediction at R1 growth stage. Agronomy Journal. 105:1045-1050.

Ortiz, B.V., Balkcom, K.B., Duzy, L.M., Van Santen, E., Hartzog, D.L. 2013. Evaluation of agronomic and economic benefits of using RTK-GPS-based auto-steer guidance systems for peanut digging operations. Precision Agriculture. 14(4):357-375.

Torbert III, H.A., Watts, D.B. 2012. Nitrogen mineralization in production agriculture. International Journal of Agronomy. Article ID 989365, 2 pages, doi:10.1155/2012/989365. http://www.hindawi.com/journals/ija/2012/989365/.

Watts, D.B., Smith, K.E., Torbert III, H.A. 2012. Impact of poultry litter cake, cleanout, and bedding following chemical amendments on soil C and N mineralization. International Journal of Agronomy. Vol. 2012, Article ID 204629, 8 pages, doi:10.1155/2012/204629.

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

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chromatography. Containers without plants are also assessed to determine background trace gas emissions. Preliminary data suggest that drip irrigation tends to have higher CO_2 and N_2O emissions compared to overhead irrigation, regardless of fertilizer application method; CH_4 was unaffected by either treatment.

We are also continuing a long-term C sequestration study using 12 common landscape plants grown in containers with three different substrates (pine bark, clean chip residual, or whole tree) for one season prior to outplanting to the field. Initial soil samples were collected adjacent to all plants for determination of soil C, and were also collected at the end of each growing season. Automated Carbon Efflux Systems (ACES) were installed adjacent to three plant species to continuously monitor C lost through soil respiration. Biomass is assessed at the end of each growing season to determine the amount of C in plant material. Information on both inputs (biomass) and outputs (respiration) allows for determination of C sequestration potential in these potting media/plant species systems. While differences existed in biomass accumulation and CO_2 losses among plant species, soil analyses suggest that plots with pine bark had higher soil C, suggesting it decomposes slower than the other media and therefore has greater C storage potential. Plant biomass data show plants grew similarly regardless of original potting substrate. Results showed that all species and substrate combinations resulted in a net C gain; however, plants grown in pine bark had greater C sequestration potential due to its longevity following transplanting.

Trace gas sampling in the potting containers

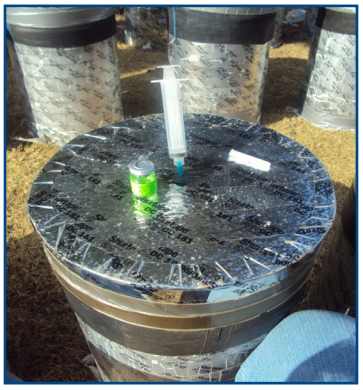
Soil Microorganisms Promote Crop Yields and Reduce N_2O Emissions

Fertilization is an essential practice to optimize crop productivity; however, fertilizer is also one of the most expensive inputs for farmers and excessive fertilization has been associated with nutrient contamination of surface and groundwater, especially when animal manures are used. Research at the NSDL is underway to test whether microbial inoculants could be used to increase plant yield and enhance nutrient uptake, and thereby remove more nutrients and reduce fertilizer cost.

In recent years, research has demonstrated that there are some soil microorganisms that can promote plant growth. It has been speculated that one of the mechanisms for this is increased nitrogen (N) in plants as a result of increased fertilizer N utilization efficiency. Specifically, it is believed that plant roots are stimulated to take up more N when exposed to certain microorganisms. Recently, the NSDL has been working in cooperation with Auburn University to examine potential soil fertility efficiency improvements by using microbial inoculants such as plant growth promoting rhizobacteria (PGPR). This research included greenhouse and field experiments to evaluate microbial inoculants, including the use of inoculants under different tillage and fertilizer application systems. Results showed that inoculants promoted plant growth and yields, and larger amounts of N, phorphorus (P), and potassium (K) were removed from plots with inoculants, potentially reducing nutrient losses to the environment.

Greenhouse study with microbial inoculants

One potential reason for increased plant N use efficiencies observed with the inoculant in addition to root stimulation is that it reduced N losses through other N cycling mechanisms, such as nitrous oxide (N_2O) emissions. The loss of N_2O is of particular concern due to its potential to contribute to global warming. Over the past few decades, N_2O emissions have increased worldwide due to several factors, including increases in cultivated crop area, excessive applications of N fertilizers, and livestock production. Research with soil microorganisms included determining whether these inoculants could be used to reduce N_2O emissions in the presence of N fertilizers. Overall, results of these studies demonstrated that microbial inoculants can reduce N_2O emissions associated with N fertilizer application, but this response varied with type of microbial inoculants and the type of N fertilizer used. As a result, new management tools were developed to reduce N_2O emissions from production agriculture and a patent was developed (patent pending).



Greenhouse gas emission sampling apparatus

Optimize Nitrogen Across Tillage Systems for Alabama Wheat

Recently, Alabama (AL) wheat farmers have changed management practices to maximize yields by using higher nitrogen (N) fertilizer, increasing wheat seeding rates (24 seeds/ft on 7.5" row spacing), and planting wheat in no-till (Limestone Valley) or non-inversion tillage systems (Coastal Plain). There are concerns that tillage systems that maintain surface residue will slow vegetative growth and tiller development in wheat. These tillage systems prompted questions about N fertilizer rates and application timings. As a result, scientists at NSDL, in conjunction with Auburn Univ., initiated experiments across multiple sites and years to examine how tillage practices, N rates, and fertilizer application timing affect AL wheat production.

Across Coastal Plain locations, fall N strongly influenced tiller density and tiller biomass, while tillage system had no effect on tiller density, N concentration, or biomass. Fall N increased tiller density 15% and tiller biomass 34% across Coastal Plain locations. In contrast, neither tillage system nor fall N application affected tiller density, N concentration, or biomass at the Limestone Valley locations. Wheat always followed cotton, a low residue producing crop, but this data indicates that

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non-inversion tillage or no-tillage did not hinder early season wheat tiller development across Coastal Plain and Limestone Valley regions in AL.

Wheat yields increased nearly 13% in non-inversion

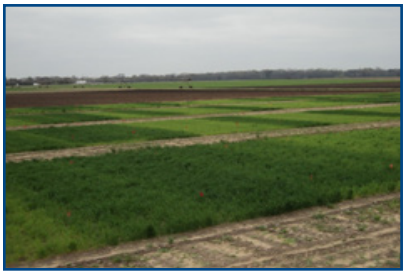
Non-inversion tillage

tillage compared to conventional tillage systems on the Coastal Plain, but no differences were observed between conventional and no-tillage on Limestone Valley soils. Fall N increased yields 10%, early spring N (early to mid-Feb.) increased yields nearly 18% compared to delaying spring N applications, and the optimal total N rate was 90 lb/ac across the Coastal Plain indicating no need to increase total N above current recommendations. None of these factors affected wheat yields on Limestone Valley soils, indicating that other variables not examined in these experiments appear to more strongly influence wheat yields.

In conclusion, reduced surface tillage (non-inversion and

Spring N fertilizer applications

no-tillage) produced comparable or superior wheat yields across AL compared to conventional tillage. Fall-applied N was not necessary to optimize yields on Limestone Valley soils, but necessary for Coastal Plain soils, while the N application window was wider for Limestone Valley soils compared to Coastal Plain soils. Future work will examine fall N rates and no-tillage on Coastal Plain soils.



Wheat growth differences attributed to tillage and N rates

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Happenings

Kirk Iversen, Soil Scientist, retired from Auburn University as of May 2013. Kirk facilitated the transfer of conservation systems technology from research conducted at the NSDL to the public. Kirk will continue to provide technology transfer support on a part-time basis, including attending selected conferences to help promote Conservation Systems.

Drs. Kip Balkcom, Ted Kornecki, Andrew Price and Tom Way, National Soil Dynamics Laboratory (NSDL) Auburn, AL hosted the Soil Resource and Conservation class from the Agronomy and Soils Department at Auburn University. The class viewed presentations about the benefits of conservation systems, equipment designed to manage high residue cover corps, and how cover crops can assist with weed control.

Drs. Kip Balkcom, Ted Kornecki, and Andrew Price and Ms. Leah Duzy, National Soil Dynamics Laboratory, Auburn AL attended a field day in Hartford, Alabama, organized by the Alabama Cooperative Extension System and USDA-NRCS. The topics were related to cover crop management and drip irrigation in no-till systems. Approximately 30 producers, agricultural extension service, NRCS and ARS attended the field day.

Drs. Kip Balkcom, Ted Kornecki, and Andrew Price made presentations at the 2013 Southern Agricultural Cover Crops Workshop in Jonesboro, Arkansas. The conference focused on integrating cover crops into production systems across various regions of the U.S.

Dr. Kip Balkcom attended the Improving Nitrogen Use Efficiency in Crop and Livestock Production Systems: Existing Technical, Economic, and Social Impediments and Future Opportunities Workshop in Kansas City, Missouri.

Dr. Kip Balkcom presented *Soil Sustainability in Peanut Production* at the Southern Peanut Growers Conference in Panama City Beach, Florida.

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