National Soil Dynamics Laboratory

Highlights

Fall 2018

United States Department of Agriculture

Agricultural Research Service

Gypsum as an Alternative Bedding for Broiler Production

A part of NSDL research is to find ways to improve agricultural production from animal and industrial waste utilization. Research at the lab has shown that using gypsum as bedding for broiler production holds promise as an alternative replacement for wood shavings and could also potentially reduce the environmental footprint associated with land application of poultry litter.

Poultry is the largest agricultural commodity for many southeastern states. The industry is heavily influenced by broiler production, with more than two thirds of the nation's broilers being produced annually from this region. Thus, poultry litter (manure and used bedding material) is abundant in many regions of the Southeast and commonly used as a fertilizer. However, one of the greatest challenges for researchers in this region is finding ways to reduce P loss from agricultural fields receiving poultry litter. Excess P entering rivers, lakes, and streams can hasten growth of algal blooms which can deplete oxygen in water, causing fish and other aquatic organisms to die off. Recent research discoveries from the NSDL have shown that flue gas desulfurization (FGD) gypsum can be used as a soil additive to curb P losses from agricultural fields. Like poultry litter, large amounts of FGD gypsum are produced annually, as a byproduct of coal-fired power plant's electricity production, from emission control systems (scrubbers) used to remove sulfur and oxides from the flue gas. There is no shortage of this synthetic gypsum source; half of this material has to be landfilled. The FGD gypsum reduces soluble P loss by forming insoluble P compounds in soil. These findings have been instrumental in setting key USDA's NRCS policies. For instance, these research findings were incorporated into a National Standard as a best management practice for maintaining soil quality and reducing the risk of P runoff from manure applications. Alabama has also included gypsum use into the "P Index" guideline for determining P runoff risks in specific fields.

Presently, the recommended practice for reducing P loss from agricultural fields receiving poultry litter is to apply gypsum after litter in a second operation. This increases the cost for the producer who is trying to manage their field in an environmentally friendly way. A more efficient and economical way would be to mix the FGD gypsum

Figure 1. FGD gypsum bedding (left) vs. pine wood shavings (right).

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Dynamically Speaking

H. Allen Torbert
Research Leader

Another growing season is ending and the National Soil Dynamics Laboratory continues to process research data collected from across the state on our various projects related to Conservation Systems, Global Change, and Waste Management. In this letter, I would like to note some professional recognition for scientists at the laboratory. This summer, Dr. Tom Way received the 2018 Distinguish Engineer Award from the Alabama section of the American Society of Agricultural and Biological Engineers. Also, Dr. Hugo Rogers who retired from our lab, was officially given the title of "Research Leader, Emeritus" in recognition of his 35 years of federal service with USDA-ARS. We are fortunate to have such prominent scientists working now and in the past at NSDL.

I hope you enjoy reading about some of the research efforts we have included in this issue of the National Soil Dynamics Highlights, and please visit our web site for more information about our ongoing projects.

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...Gypsum cont.

Figure 2. Two-week old broiler chicks.

directly with the poultry litter. Thus, NSDL researchers evaluated the effectiveness of using gypsum instead of wood shavings as an alternative bedding material for broiler production (Fig. 1). This research showed that broiler chickens could be successfully reared on gypsum bedding (Fig. 2), with multiple tests showing broilers performed as well as those on pine shavings. In fact, footpad quality was improved and ammonia levels were reduced when compared to that of shavings (Fig. 3). While in general, broiler performance was similar or better, some issues emerged such as slightly poorer chick starts and increase caking was observed compared to shavings. Overall, these finding have shown that gypsum holds promise as alternative bedding for poultry production. Future research will focus on identifying best management practices for optimizing gypsum bedding use to improve broiler performance and reduce ammonia production from litter, as well as, developing the best method for managing litter caking.

Figure 3. Ammonia measurements from the litter. greenhouse soil containers, simulating poultry litter application methods.

Upcoming Events

Dates	Meeting	Location
Oct 16-18	Sunbelt Agricultural Expo	Moultrie, GA
Nov 4-7	Agronomy, Crop Science, & Soil Science Societies' Annual Mtg	Baltimore, MD
Nov 15-16	AL Fruit & Vegetable Growers Assoc. Annual Conf. and Trade Show	Clanton, AL
Dec 13-15	Southeast Vegetable and Fruit Expo	Myrtle Beach, SC
Jan 8-10, 2019	Beltwide Cotton Conf.	New Orleans, LA
Jan 23-26	Southern SAWG Conference	Little Rock, AR
Feb 2-5	Southern Assoc. of Agricultural Scientists Ann. Mtg	Birmingham, AL
Feb 3-6	Southern Weed Science Society of America Annual Mtg	Oklahoma City, OK
Feb 8-9	Georgia Organics Annual Conf.	Tifton, GA
July 16-17	Southern Cover Crops Conf.	Auburn, AL

Fertilization Placement affects Greenhouse Gas Emissions from Sun and Shade Grown Ornamentals

Agriculture is second to energy production in atmospheric emissions of three major greenhouse gases [carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O)]. These emissions have steadily increased in recent times. To date, very little research has focused on contributions from specialty crop industries such as horticulture. Reports from 2010 indicate that greenhouse, nursery, and floriculture industries in Alabama were valued at $629.2 million per year. Production contributes to value-added economics and allows these industries to support C sequestration by planting ornamental trees and shrubs into rural, suburban, and urban landscapes.

While previous studies examined container-grown woody ornamentals, this work focused on two common perennial herbaceous ornamentals that are produced in either full sunlight ('Stella D'Oro' daylily) or shaded conditions ('Royal Standard' hosta) (Fig. 4). Greenhouse gas emissions were evaluated for these two species under three common fertilizer placement methods (dibble, incorporation, or top-dressing).

Shade-grown hostas were larger than sun-grown daylilies and had higher cumulative CO_2 loss. However, these larger hostas took up more N than smaller sun-grown daylily that resulted in less cumulative N_2O loss. Overall, loss of both CO_2 and N_2O were least for the dibbled fertilizer method for both plants. Total CO_2 losses were highest for plants fertilized by incorporation, followed by those fertilized by top-dressing.

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Figure 4. Hosta (top) and daylily (bottom).

No differences were seen in N2O loss for plants fertilized by either incorporation or top-dressing. Methane was low throughout the study and not affected by species or fertilizer placement. These findings suggest that dibbling fertilizer could significantly decrease release of both CO2 and N2O to the atmosphere.

A PTO-Driven No Tillage Micro-Transplanter for a Self-Propelled Walk-Behind Tractor

The Challenge

In no tillage and conventional vegetable production, one process that is especially tedious and time consuming is setting vegetable transplants into the soil. Hand transplanting involves physically strenuous work due to continuous bending, stooping and kneeling that might cause lower back discomfort or pain. To relieve this physical exertion, small farm producers who already have walk-behind tractors expressed a need to develop an effective transplanting tool to mechanically transplant vegetables into cover crop residue.

The Solution

To address this need, a PTO-driven micro-transplanter was developed by agricultural engineers at the NSDL-Conservation System Research group in Auburn, Alabama. On June 26, 2018 this unique device was granted a US patent (Kornecki and Kichler, 2018). The transplanter was designed to work with self-propelled walk-behind tractors and to serve no tillage and/or small vegetable farms. This implement has a set of six vertical transplant feeders/holders that are traversing back and forth continuously to the direction of travel so the tractor operator can feed each feeder while operating/steering the walk-behind tractor. In contrast to this simultaneous operation by one person, larger commercial transplanters must be operated by at least two people; one for the

Recent Publications

Kavetskiy, A., Yakubova, G.N., Prior, S.A., Torbert III, H.A. 2018. Energy correlated timing spectra in target neutron techniques. Nuclear Instruments and Methods in Physics Research, Section B: Bean Interactions with Materials and Atoms. 433:80–86. https://doi.org/10.1016/j.nimb.2018.07.028.

Murphy, A., **Runion, G.B., Prior, S.A., Torbert III, H.A.,** Sibley, J., Gilliam, C. 2018. Greenhouse gas emissions from an ornamental crop as impacted by two best management practices: Irrigation delivery and fertilizer placement. Journal of Environmental Horticulture. 36(2):58-65.

Bassaco, M.V., Motta, A.C., Pauletti, V., **Prior, S.A.,** Nisgoski, S., Ferreira, C.F. 2018. Nitrogen, phosphorus, and potassium requirements for Eucalyptus urograndis plantations in southern Brazil. New Forests. 49:681-697. https://doi.org/10.1007/s11056-018-9658-0.

Salama, M., Vantsevich, V., **Way, T.R.,** Gorsich, D. 2018. UGV with a distributed electric driveline: Controlling for maximum slip energy efficiency on stochastic terrain. Terramechanics Journal. 79:41-57.

Li, X., Grey, T., Vencill, W., Freeman, M., Price, K., Cutts III, G., **Price, A.J.** 2018. Evaluation of cotton responses to fomesafen -based treatments applied preemergence. Weed Technology. doi: 10.1017/wet.2018.31.

Balkcom, K.S., Duzy, L.M., Arriaga, F.J., Delaney, D.P., **Watts, D.B.** 2018. Fertilizer management for a rye cover crop to enhance biomass production. Agronomy Journal. 110:1233-1242. https://doi:10.2134/agronj2017.08.0505.

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

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… Walk Behind Tractor continued.

Figure 5. Transplanting tomatoes into rolled cereal rye.

transplanter (e.g. RJ Canadian made, single row transplanter) and one person to drive the tractor.

The PTO-driven transplanter attached to a BCS 583 walk -behind tractor (Fig. 5) has been tested during the 2017 and 2018 growing seasons in the soil bins plots at the NSDL in Auburn, AL to transplant lettuce in different residue cover management (rolled, flail mowed and incorporated cereal rye) (Fig. 6) and to transplant tomato seedlings into rolled cereal rye residue cover. The experimental no tillage transplanter functioned as intended with minimal mechanical problems or malfunctions and shows the realistic capability to help small scale farms become more efficient and profitable. The transplanter is designed with off the shelf mechanical components without complicated hydraulic or electronic controls, making it applicable in low tech agricultural environments in the USA and abroad.

The no-till transplanter exceeded 90% uniformity for transplanted tomato and lettuce seedlings. The average spacing between plants was 60.6 cm for sandy loam soil (8.6% coefficient of variation) and 59 cm for clay soil: (9.3% coefficient of variation).

Kornecki, T.S. and Kichler, C.M. 2018. Transplanter for a walk-behind tractor. Patent # US Patent No: 10,004,174 B2. Date of issuance: June 26, 2018.

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Happenings

April 6, 2018: Dr. Thomas Way, Agricultural Engineer at the NSDL, Auburn, AL, received the 2018 "Distinguished Engineer Award" from the Alabama Section of the American Society of Agricultural and Biological Engineers (ASABE) during the 2018 annual section meeting in Auburn, AL. Dr. Way was recognized for research on traction and soil compaction of tires and rubber tracks, his leadership in developing a prototype implement for shallow subsurface band application of poultry litter, and his work for ASABE.

August 12-17, 2018: ARS Ag. Engineer Ted S. Kornecki of the NSDL, Auburn, Alabama attended the 21st World Congress of Soil Science in Rio De Janeiro, Brazil. He presented a paper titled "Multiple Rolling/ Crimping Effects on Cover Crop Terminations, Soil Moisture and Strength in a Conservation System".

August 30, 2018: Drs. Kip Balkcom and Andrew Price were invited to present at the Central Alabama Crops Tour in Shorter, AL. Dr. Balkcom discussed ongoing cover crop mixtures, and Dr. Price discussed weed suppression benefits from cover crops.

August, 24, 2018: Dr. Kip Balkcom was invited to present at the Wiregrass Crop's Field Day in Headland, AL. Dr. Balkcom discussed ongoing research focused on comparisons between single species and cover crop mixtures.

August 4, 2018: Dr. Allen Torbert presented research at the Alabama Farmer's Federation 2018 "Alabama Farm & Land Expo" in Montgomery, AL. The presentation was on soil carbon mapping using soil scanning equipment developed at the NSDL.

July 18, 2018: Dr. Kip Balkcom was invited to present research results from his cover crop research projects to 35 participants of the Soil Health and Sustainability Course for NRCS field staff at the Wiregrass Research Station in Headland, AL. He provided an update on studies focused on cover crop management for cereals, 3 way mixture species research, and cover crop mixtures designed to reduce cotton N requirements.

July 12, 2018: Dr. Kip Balkcom and Dr. Audrey Gamble (Auburn Univ.), hosted 35 board members from the Southern Cover Crop Council. Activities included a one day meeting and a half day to allow board members to tour current cover crop research plots being conducted by ARS and Auburn Univ. They also organized a tour of the Old Rotation, the oldest cotton experiment in the world, and the Cullars Rotation, a long-term fertility trial, to demonstrate conservation systems in these experiments.

Figure 6. Transplanted lettuce into incorporated cereal rye residue.

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