National Soil Dynamics Laboratory

Highlights

Spring 2016

United States Department of Agriculture

Agricultural Research Service

Fate of Carbon from Horticultural Growth Substrates in the Soil

To help mitigate climate change, emissions from agriculture must be reduced along with increased long-term carbon (C) capture and storage. Agriculture is unique in that activities which were once carbon dioxide (CO_2) sources can become sinks by using management practices that increase C storage in biomass and soils. Most research has focused on reducing greenhouse gas emissions and increasing C storage in agricultural production. However, little work has investigated non-agricultural lands (e.g., urban and suburban) which comprise approximately 148 million acres and are often planted with ornamental trees and shrubs that can lead to increased C storage. In the Southeast, these plants are commonly grown in containers with pine bark (PB) growth media before planting into the landscape. However, increased demand for PB has led to the development of other suitable potting substrates, such as WholeTree (WT) and clean chip residual (CCR) which have similar C levels. Therefore, the objective of this work was to examine the effects of some common landscape plants and growth media on growth and soil C storage following transplanting of container-grown woody ornamental shrubs into the landscape.

Dynamically Speaking

H. Allen Torbert
Research Leader

The beginning of 2016 is a reminder that the NSDL has been on the Auburn University campus for over 80 years. Originally known as the Farm Tillage Machinery Laboratory, the iconic soil bins and first buildings were built in 1935 at the urging of Auburn University. The NSDL has been a close partner with Auburn University ever since. While traditionally aligned with the Departments of Crop, Soil and Environmental Sciences and Biosystems Engineering, our research efforts in Conservation Systems, Global Change, and Waste Management, have also allowed us to collaborate with Departments of Horticulture, Poultry Science, Entomology and Plant Pathology, Agricultural Economics and Rural Sociology, Materials Engineering, and the School of Forestry and Wildlife Sciences. Our scientists hold affiliate appointments in many of these departments. We hope these cooperative efforts will continue for another 80 years or more.

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

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Figure 1. Cleyera is an evergreen shrub with alternate, glossy, dark green leaves, and is found throughout the southern US as an accent or hedge plant, or in a mixed border.

Three woody shrubs [Cleyera (Figure 1), Indian hawthorn (Figure 2), and Loropetalum (Figure 3)] were container-grown for one growing season using either PB (industry standard), CCR, or WT (derived by-products from the forestry industry) as potting substrates, and

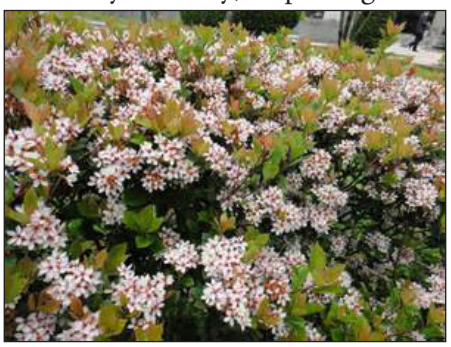

Figure 2. Indian hawthorn is a compact evergreen shurb with star shaped flowers followed by blue-black fruits.

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Recent Publications

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

Duzy, L.M., Reeves, J.M. 2015. Cropland rental tool (CROPRENT) for agricultural producers. Journal of Extension [On-line]. 53(5) Article 5TOT7. Available at: http://www.joe.org/joe/2015october/pdf/JOE_v53_5tt7.pdf.

Ferreira, C.F., Motta, A.C., Barbosa, J.Z., Dos Santos, N., **Prior, S.A.**, Gabardo, J. 2014. Maize (Zea mays L) cultivars nutrients concentration in leaves and stalks. Maydica. 59(1):65-71.

Gamble, A.V., Howe, J.A., Wood, C.W., **Watts, D.B.**, Van Santen, E. 2014. Soil organic carbon dynamics in a sod-based rotation on coastal plain soils. Soil Science Society of America Journal. 78:1997-2008.

Kornecki, T.S. 2015. Rye termination by different rollers/crimpers developed for no-till small-scale farms. Applied Engineering in Agriculture. 31(6):849-856. doi:10.13031/aea.30.10395.

Lamba, J., **Way, T.R.**, Srivastava, P., **Watts, D.B.** 2015. A method for subsurface-banding poultry litter in plots not accessible with conventional field equipment. Applied Engineering in Agriculture. 31(4):555-558.

Mourtzinis, S., Arriaga, F., **Balkcom, K.S., Price, A.J.** 2015. Vertical distribution of corn biomass as influenced by cover crop and stover harvest. Agronomy Journal. 107:232-240.

Runion, G.B., Prior, S.A., Price, A.J., Mcelroy, S., **Torbert III, H.A.** 2014. Effects of elevated CO2 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.

Yakubova, G.N., Kavetskiy, A.G., Prior, S.A., Torbert III, H.A. 2015. Benchmarking the inelastic neutron scattering soil carbon method. Vadose Zone Journal. doi:10.2136/vzj2015.04.0056.

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

Upcoming Events

Dates	Meeting	Location
May 3	AL Invasive Plant Council Annual Mtg	Montgomery, AL
June 8-10	Soil and Water Conservation Society (SWCS) - AL Chapter Annual Mtg	Auburn, AL
June 20-23	International Weed Science Society Meeting	Prague, Czech Republic
July 12-14	American Peanut Research and Eduction Society (APRES)	Clearwater, FL
July 17-20	Amer. Society of Agri. and Biological Engineers (ASABE)	Orlando, FL
July 18-19	2016 Southern Cover Crop Conference	Mount Olive, NC
July 21-24	Southern Peanut Growers Conf.	Sandestin, FL
July 24-27	SWCS International Annual Conf.	Louisville, KY
Oct 18-20	Sunbelt Ag Expo	Moultrie, GA

… Fate of Carbon cont.

then transplanted into the landscape. An Automated Carbon Efflux System continually monitored soil CO_2 emissions for one year. Changes in soil C as a result of potting substrate were assessed through soil sampling and plant C in biomass was determined at the end of the study. Results showed that soil CO_2 emissions were similar among all shrub types and potting substrates. Soil analysis showed that plots with PB contained higher levels of soil C at both the start and end of the study, suggesting that PB breaks down slower than CCR or WT, and consequently has greater C storage potential than the two alternative growth substrates. Results showed a net C gain for all shrubs and potting substrate combinations; however, plants grown in PB had the greatest potential for increasing soil C storage.

Figure 3. Loropetalum, also known as Chinese fringe-flower, is a finely textured evergreen shrub, and can have white or red flowers depending on variety.

Cover Crop Biomass Influences Weed Suppression

Resistance management has become the dominating weed science research and extension focus. In the Southeastern and Mid-South U.S., questions concerning management of herbicide resistant Amaranthus species, horseweed, and Italian ryegrass, comprise the majority of Cooperative Extension Service (CES) calls in these regions. The Weed Science Society of America (WSSA) ranked Palmer amaranth (Palmer pigweed) as the most troublesome weed in the US. Conservation agriculture (CA) practices are especially threatened by the emergence and rapid spread of glyphosate-resistant Palmer amaranth. Hundreds of thousands of CA acres are at risk of being converted to higher-intensity tillage systems due to the inability to reliably control herbicide-resistant weeds in CA systems, especially dry land systems where soil applied herbicides risk non-activation. Currently, integration of high-residue cover

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… Cover Crop Biomass cont.

crop systems, inversion of the soil profile facilitating burial of the surface seedbank, and overlapping residual herbicides are increasingly being recommended by state CES throughout the Southeastern Coastal Plain and Mid-South Delta for herbicide-resistance management. Surface tillage is also increasingly recommended by CES to enable increased preplant incorporated and preemergence herbicide use and activity. However, a major question concerning how much cover crop residue is needed to adequately suppress weeds remains.

Researchers at NSDL first began studying the use of cover crops as a weed control option in the early 2000's. Field experiments were conducted from autumn of 2003 through cash crop harvest in 2006 at three locations (Figure 4). Treatments were five cover crop seeding dates each autumn and four cover crop termination dates each spring. The five crimson clover or cereal rye seeding dates were: on the first average 32°F temperature date, two and four weeks prior and two and four weeks after the average 32°F temperature date. Termination dates were four, three, two, and one week prior to the average cash crop establishment date.

Results showed winter cover biomass production by winter covers decreased with even a week's delay in winter cover crop seeding and resulted in a corresponding increase in summer annual weed biomass. More than ten times difference in biomass produced by clover was observed when clover was planted on the earliest date and terminated on last date compared to late planting and early termination; rye eight times. Correspondingly, weed biomass was 496 lb/ac in the treatment with least rye biomass, 8 times higher compared to the treatment with greatest rye biomass.

Figure 4. Rotational field experiment evaluating cereal rye (foreground) and crimson clover (background) cover crop planting and termination dates and effects on weed emergence and cotton and corn yield.

In this experiment, earlier cover crop planting and terminating up to one week before planting corn and cotton increased cover crop biomass accumulation compared with planting later and terminating the cover crop four weeks before planting. Increased cover crop biomass suppressed subsequent total weed dry biomass. These findings indicate that high residue cover crops have predictable potential for suppressing early season weeds in corn and cotton. For farmers utilizing a glyphosate-resistant corn-cotton rotation system, these findings hold particular importance with current glyphosate resistant weed control issues. Because corn and cotton yields were not negatively impacted, we can conclude that high residue obtained by planting crimson clover or rye cover crops timely and terminating at least two prior to cash crop planting is feasible. Ideal management will result in maximum cover crop biomass production and subsequent weed suppression.

NSDL Receives Patent for a Method to Reduce Soil N_2O Emissions using a Microorganism

Ongoing research at the NSDL has demonstrated that there are some soil microorganisms that can promote plant growth. It has been speculated that one mechanism for this is increased nitrogen (N) in plants resulting from increased fertilizer N utilization efficiency. This research has been conducted in cooperation with Auburn University to examine potential soil fertility efficiency improvements by using microbial inoculants such as plant growth promoting rhizobacteria (PGPR). The NSDL and Auburn University have received a patent for a method of using microbial inoculants to reduce nitrous oxide (N_2O) emissions associated with N fertilizer application.

The research included greenhouse and field experiments to evaluate microbial inoculants, including the use of inoculants under different tillage and fertilizer application systems (Figure 5). Specifically, it is believed that plant roots are stimulated to take up more N and other nutrients when exposed to these microorganisms. Results showed that inoculants promoted plant growth and yields, and larger amounts of N, phosporus (P), and potassium (K) were removed from the soil with

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… NSDL Receives Patent cont.

inoculants, potentially reducing nutrient losses to the environment. This research lead to the discovery that a specific soil microorganism applied with the correct fertilizer can also reduce N_2O emissions, which was the basis of the patent.

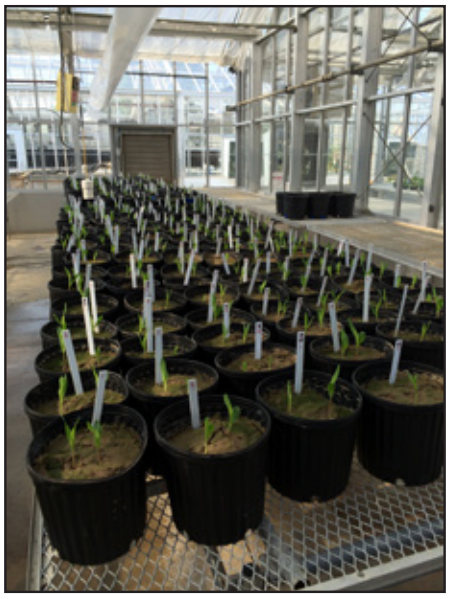

Figure 5. Greenhouse research in cooperation with Auburn University to examine potential soil fertility efficiency improvements by using microbial inoculants such as plant growth promoting rhizobacteria (PGPR).

The loss of N_2O is of particular concern not only because of the loss of N so that plants cannot use it, but also 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. However, losses of N_2O from fertilizer is considered to be one of the largest contributions to global warming from agriculture as a whole. Research with soil microorganisms determined that these inoculants could be used to reduce N_2O emissions in the presence of N fertilizers. As a result, new management tools were developed to reduce N_2O emissions from production agriculture.

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. Research at the NSDL will continue to test whether these microbial inoculants could be used to increase plant yield and enhance nutrient uptake, and thereby remove more nutrients and reduce fertilizer cost as well as reduce the potential negative impact to the environment.

Happenings

November 15-19, 2015, Agricultural Research Service (ARS) Research Scientists Kip Balkcom, Leah Duzy, Allen Torbert, Dexter Watts and Stephen Prior attended the 2015 ASA, CSSA, & SSSA Annual Meeting in Minneapolis, MN. Dr. Balkcom made a presentation titled "Soil Compaction across the Old Rotation," Dr. Duzy made a presentation titled "Summary of Cover Crop Effects on Cotton Production," Dr. Torbert made a presentation titled "Environmental Implications of Using Poultry Litter in Agriculture," Dr. Watts made a presentation titled "Broiler Litter Management Effects on the Nutrient Composition of the Litter" and Dr. Prior made a presentation titled "Effects of elevated atmospheric CO2 and N fertilization on bahiagrass pastures in the Southeastern U.S."

December 14-15, 2015, Agricultural Research Service (ARS) Agricultural Economist Leah M. Duzy and Agricultural Engineer Ted S. Kornecki were invited to speak at the 2015 Alabama Corn and Wheat Short Course in Auburn, AL. Dr. Duzy presented on wheat production and profitability across the Southeast, and Dr. Kornecki presented on equipment used to manage high residue cover crops."

January 12-14, 2016, Agricultural Research Service (ARS) Research Soil Scientist, Allen Torbert presented research results at the Annual National Conservation System Cotton and Rice Conference in Memphis, TN. Dr. Torbert made a presentation entitled "Enhanced Efficiency Fertilizer's Effect on Cotton Yield and Quality in the Coastal Plains".

January 27-30, 2016, Agricultural Research Service (ARS) Researchers Ted S. Kornecki and Corey Kichler attended the 25th Southern SAWG Conference: Practicel Tools and Solutions for Sustaining Family Farms in Lexington, Kentucky. Dr. Kornecki presented a poster "Multiple rolling/crimping effects on termination of two summer cover crops in a conservation system." Mr. Kichler displayed the ARS NSDL booth and demonstrated prototypes of the powered roller and powered coulter planting system for small walk-behind tractors.

February 10-11, 2016, Agricultural Reserach Service (ARS) Scientist, Andrew Price presented "Cover Crops and Weed Management" at the annual North Carolina Tomato Growers Association Meeting, held in Ashville, NC. The presentation highlighted high-residue cover crops weed suppressive attributes.

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