National Soil Dynamics Laboratory

Highlights

Fall 2017

United States Department of Agriculture

Agricultural Research Service

Effects of Elevated CO_2 on an Industrial Sweet Potato Variety

The level of CO_2 in the Earth's atmosphere is rising due to burning of fossil fuels (gas, coal, etc.) and land use changes (deforestation, urbanization, etc.). Regardless of what effect this may have on climate change, rising CO_2 will have direct effects on plants. In general, most plants grown in high CO_2 show increased growth and yield, as well as better plant water use efficiency (that is, they produce more biomass with less water).

Table varieties of sweet potatoes have been shown to be a good source for production of bioethanol. In fact, they can out-produce other crop plant bioethanol sources such as corn, potatoes, sugar cane, and sugar beets. Recently, several varieties (called industrial varieties) have been bred just for bioethanol production. Further, the vines of one industrial variety (CX-1) have also been shown to be a good nutritional animal feed source. However, the effects of elevated CO_2 on these new industrial varieties of sweet potato have not been studied. We grew industrial variety CX-1 sweet potato plants in open top field chambers using either ambient air or air with added CO_2 (about 67 % higher than normal) for one growing season (Fig. 1). The higher CO_2 increased growth of the CX-1 sweet potato plants. Vine dry weight increased by 24% when grown in the higher level of CO_2. Also, the yield of tubers (or potatoes) - which is the main yield component and part used for making bioethanol - increased by 41% compared with plants grown in ambient air (Fig. 2).

Research has shown that the sweet potato industrial

Figure 1. Ambient (top) and Elevated (bottom) CO_2 grown CX-1 sweet potato plants

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Dynamically Speaking

H. Allen Torbert
Research Leader

Across the agricultural landscape it is time to harvest crops and prepare for winter. Similarly, the scientists at the National Soil Dynamics Laboratory are very busy gathering samples and measuring results from our experiments scattered all over Alabama. We are also preparing experiments for our cool season crops and planting cover crops for our conservation system studies. We continue our efforts to develop farming practices that will not only sustain but improve agriculture production across the Southeast.

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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…Effects of Elevated CO_2 cont.

variety CX-1 can be a good source plant for animal feed and bioethanol production. Our findings suggest that these benefits from CX-1 could become even greater as atmospheric CO_2 continues to rise.

Figure 2. Ambient (left) and Elevated (right) CO_2 grown CX-1 sweet potato tubers.

Equipment for Small and Urban Conservation Farming Systems

The number of local urban farms producing fruit and vegetables for local farmers' markets is on the rise. This increase is due to a consumer demand for healthy and fresh locally grown produce. These farms usually own small walk-behind tractors with interchangeable attachments. Because agricultural production must be sustainable, producers adopt conservation farming practices with cover crops.

A typical cover crop grown in the southern US is cereal rye which provides benefits such as reduced runoff and soil erosion, increased infiltration and water holding capacity, increased soil organic carbon, decreased soil compaction, and better weed control. To optimize these benefits, cover crops must be terminated at the appropriate growth stage and managed properly to avoid planting problems.

Small scale equipment such as a roller/crimper, no-till drill, and transplanter have been developed to reduce hand labor while increasing efficiency. Researshers at the NSDL evaluated the effectiveness of the small scale equipment for a BCS 853 walk behind tractor.

To evaluate effectiveness of these devices, a field experiment was initiated in the fall of 2017 on a Hiwassee sandy loam and Davidson clay soils by planting a cereal rye cover crop using a powered coulter no-till drill (Patent pending, Kornecki and Kichler 2014; Fig. 1). A patented powered roller/crimper for a walk behind tractor (Kornecki 2012; Fig. 1) was used to terminate cereal rye at the early milk growth stage, and a transplanter (Patent pending, Kornecki and Kichler 2016; Fig. 2) was used to transplant tomato seedlings into the rolled rye residue cover. All devices were compatible with an Italian BCS 853 walk behind tractor. Termination data were collected three weeks after cover crop termination.

Data has shown that a PTO driven experimental powered roller/crimper is as effective as a full size roller/crimper. Preliminary testing has shown that the powered coulter drill generated effective seed emergence (82%) for optimum cover biomass. The automatic transplanter operated as expected and exceeded 90% uniformity for transplanted tomato seedlings.

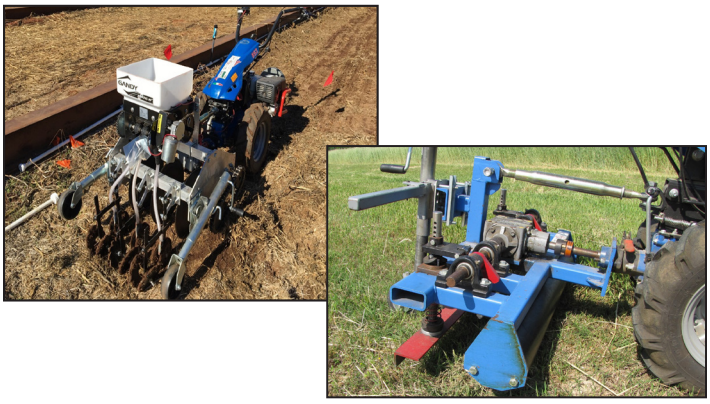

Figure 1. Powered active coulter no-till drill (1.1 m wide; Kornecki and Kichler, 2014; patent pending) and powered roller/crimper (Kornecki, 2012; US patent #7,987,917 B1) for a BCS 853 Tractor.

Upcoming Events

Dates	Meeting	Location
10/17-10/19	Sunbelt Ag Expo	Moultrie, GA
10/22-10/25	Agronomy, Crop Science, & Soil Science Societies' Annual Mtg	Tampa, FL
11/16-11/17	AL Fruit & Vegetable Growers Assoc. Conf. & Tradeshow	Clanton, AL
11/27-11/29	Southeast Vegetable and Fruit Expo	Myrtle Beach, SC
12/12-12/13	AL Row Crops Short Course	Auburn, AL
1/3-1/5/18	Beltwide Cotton Conf.	San Antonio, TX
1/21-1/24	Southern Weed Science Scoeity Annual Mtg	Atlanta, GA
1/17-1/20	Southern SAWG Conference	Chattanooga, TN
1/29-2/1	Weed Science Society of America Annual Mtg	Arlington, VA
2/2-2/6	Southern Association of Agricultural Scientistis Annual Mtg	Jacksonville, FL
2/16-2/17	Georgia Organics Annual Conf.	Augusta, GA

…Equipment Development cont.

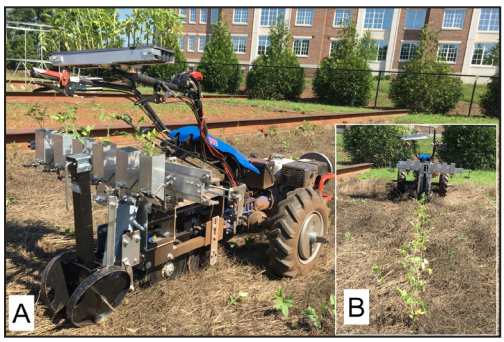

Figure 2. A) Transplanter for the walk behind tractor (Kornecki and Kichler, 2016; patent pending). B) Recently transplanted tomatoes in rolled rye residue cover.

Gypsum's Potential Benefits for Soils in the Southeast

Research at the NSDL strives to increase the productivity of agricultural soils because of its importance in sustaining food, feed, and fiber production for a growing global population. Recently, there have been claims indicating that gypsum could be used as a soil amendment to improve soil quality and crop productivity of some soils. Potential improvements in soil productivity are increases in soil Ca and S concentrations, promotion of soil aggregation, and reduced soil particle dispersion, which can lead to reduced surface crust formation, better seedling emergence, increased water infiltration, and reduced soil erosion. Alleviation of subsoil acidity by reducing Al toxicity has also been noted from gypsum applications. Scientists at the NSDL have undertaken research to evaluate gypsum's potential benefits for soils in the Southeast.

Gypsum has traditionally been mined; however, in recent years, large quantities of gypsum have been produced as a byproduct of coal burning for electricity production.

Figure 1. On-farm FGD gypsum research trials were conducted with collaboration with Mr. Brian Lecroix from Belle Mina, AL.

Recent Publications

Duzy, L.M., Price, A.J., Balkcom, K.S., Aulakh, J.S. 2016. Assessing the Economic Impact of inversion tillage, cover crops, and herbicide regimes in palmer amaranth (Amaranthus palmeri) infested cotton. International Journal of Agronomy. Volume 2016, Article ID 1524389, 9 pp. http://dx.doi.org/10.1155/2016/1524389.

Kornecki, T.S. 2016. The effects of combined cover crop termination and planting in a cotton no-till system. Applied Engineering in Agriculture. Vol. 32(5): 551-560. doi: 10.13031/aea.32.11568.

Lin, Y., **Watts, D.B., Way, T.R.** 2017. Poultry litter placement effects on cotton seedling emergence and early growth stage. Agronomy Journal. 109:1678-1686.

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. 2016. Species and media effects on soil carbon dynamics in the landscape. Scientific Reports. 6:25210. doi:10.1038/srep25210.

Stallings, A., **Balkcom, K.S.,** Wood, C.W., Guertal, E.A., Weaver, D.B. 2016. Nitrogen mineralization from 'AU Golden' sunn hemp residue. Journal of Plant Nutrition. 40(1):50-62.

Torbert III, H.A., Kurtener, D., Krueger, E. 2016. Examination of data collected from experiments on soil disturbance using fuzzy indicator approach. European Agrophysical Journal. 3(1):93-102. Available: http://www.agrophysical.eu/ojs/index.php/eajournal/article/view/52. doi: dx.doi.org/10.17830/j.eaj.2016.03.025.

Watts, D.B., Hess, J.B., Bilgili, S.F., **Torbert III, H.A.**, Sibley, J.L., Davis, J.D. 2017. Flue gas desulfurization gypsum: Its effectiveness as an alternative bedding material for broiler production. Journal of Applied Poultry Research. 26:50-59

Yakubova, G.N., Kavetskiy, A.G., Prior, S.A., Torbert III, H.A. 2017. Measurements of soil carbon by neutron-gamma analysis in static and scanning modes. Journal of Visualized Experiments. Issue 126. e56270. doi:10.3791/56270. Available: https://www.jove.com/video/56270.

All of our publications are available on our web site:
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Power companies removing S from combustion gases (flue gas) in the smoke stacks during coal burning produce Flue-Gas Desulfurized (FGD) gypsum. Gypsum is also produced from wallboard recycling. These products have greatly increased the availability of gypsum for agriculture use.

Previous studies at the NSDL have shown that gypsum can reduce soluble P loss from soils high in P or from runoff following manure applications. This work contributed to NRCS creating Conservation Practice Standard 333 (Amending Soil Properties with Gypsum Products). Some states implemented gypsum use for P reduction into their NRCS 590 Nutrient Management Standards and state agricultural extension systems recommend

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… Gypsum's benefits cont.

gypsum as a best management practice to minimize P loss from agricultural fields. However, there is limited information on the effect of gypsum on improving crop yield (except for peanuts) for soils in the Southeast. Thus, researchers are evaluating the influence of gypsum on crop productivity in the Tennessee Valley Region of North AL and Piedmont Region of North GA.

These studies consist of applying FGD gypsum at different rates in the spring of each year before planting (Fig. 1; Fig. 2). Each farmer managed the fields according to their current cultural practices. Gypsum applications increased soil Ca and S concentrations, decreased water-soluble P concentrations, and had minimal effect on soil pH. Presently, researchers are evaluating the influence of gypsum on soil compaction and water infiltration. Currently, there has been no observable effect on crop yield (Fig. 3). These studies were evaluated on highly productive soils, but future work will be conducted on less productive soils that have subsoil acidity problems.

Figure 2. Spreading FGD gypsum on Mr. Brian Lecroix's field in Belle Mina, AL.

Figure 3. Harvesting wheat from Mr. Brian Lecroix's field in Belle Mina, AL.

National Soil Dynamics Laboratory
411 S. Donahue Drive
Auburn, AL 36832-5806
334-887-8596
http://www.ars.usda.gov/sea/nsdl

Happenings

March 9, 2017, ARS employees hosted employees from AGCO Corporation (Duluth, GA). Drs. Kip Balkcom, Leah Duzy, Ted Kornecki, and Andrew Price presented on conservation systems in the Southeast.

April 18, 2017, ARS Agricultural Economicst, Leah Duzy, was invited to present on the economics of conservation systems at the Cover Crop Workshop and Field Demo in Americus, GA. Research Agronomist, Dr. Kip Balkcom, and Agricultural Science Research Technicians, Trent Morton and Jeffrey Walker attended the workshop and provided technical expertise during the field day.

April 18-21, 2017, ARS Research Soils Scientists, Allen Torbert and Dexter Watts attended the Waste to Worth 2017, an International Conference on Livestock and Poultry Environmental Quality, in Cary, NC. Dr. Torbert presented on "USDA-NRCS Conservation Practice Standard: Amending Soil Properties with Gypsum Products" and Dr. Watts presented on "Gypsum as a Best Management Practice for Reducing P Loss from Agricultural Fields".

May 8, 2017, ARS Research Soil Scientist, Allen Torbert, was invited to participate in the 2017 World of Coal Ash Workshop, Lexington, KY and made a presentation titled "FGD Gypsum uses in Agriculture: Status of Federal Regulations and Support". The presentation updated the attendees on the status of the joint USDA and EPA risk evaluation of FGD gypsum. Also included was an update on the adoption of the USDA-NRCS National Conservation Standard for the use of gypsum in agriculture.

May 23-25, 2017, ARS Research Agronomist, Kip Balkcom, was one of 25 people invited from across the U.S. to attend a tour of forage and cover crop seed production in the Willamette Valley of Oregon, sponsored by the Oregon Forage Seed Commissions. Dr. Balkcom was one of two participants chosen to make a presentation titled "Cover Crop Opportunities and the Southeast" during the tour.

June 13-15, 2017, ARS Agricultural Engineer, Ted Kornecki, attended the 37th CIOSTA & CIGR Section International Conference being held in Palermo, Italy. Dr. Kornecki made a presentation titled "Equipment Development to Manage Cover Crops for Small and Urban No-Till Farming Systems".

June 27, 2017, ARS Agricultural Economist, Leah Duzy, was invited to particpate in a webinar titled "Economic and decision barrier to soil health practice adoption: A role for public policy?". She presented on "Addressing the barriers to conservation systems adoption through research."

August 28-29, 2017, ARS employees met with and provided a tour of NSDL facilities to a group of Chinese scientists from the Chinese Academy of Agricultural Sciences.

September 22, 2017, ARS employees Kip Balkcom, Leah Duzy, Andrew Price, and Ted Kornecki were guest lecturers for Dr. Eve Brantely's Soil Resource and Conservation course at Auburn University.

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