



Contents

Dynamically Speaking.....	1
Three Soil-Engaging Devices: Cutting through Crop Residue	1
Upcoming Events	2
Recent Publications.....	2
Elevated CO ₂ Effects on Common Ragweed	3
Conservation Systems and Tomato Production.....	3
Happenings	4

Three Soil-Engaging Devices: Cutting through Crop Residue

At the NSDL, the soil bins are used to improve farm machinery performance. In conservation systems with crop residue on the soil surface, it is important that soil openers on planters perform well by cutting through residue during planting. An experiment was conducted by the Waste Management group in the soil bins on a sandy loam soil and a clay soil to determine performance of a double-disk opener, a single-disk opener, and a prototype trencher device. Double-disk openers are the furrow openers used on many planters, while single-disk openers are used on some planters or seeders, particularly outside North America. The prototype trencher device is used for subsurface band application of poultry litter. All three devices are shown in Figure 1.

The specialized testing equipment at the NSDL was used to make important measures of performance for these implements. For example, the dynamometer vehicle (Figure 2) runs on the NSDL soil bins and measures forces applied by soil to the implements. The measurements include the pulling force, or draft,

Dynamically Speaking

Spring planting season is here again and the staff of the NSDL is once again headed out across Alabama to establish our experiments. Funding for the NSDL comes primarily from the Federal Government and funding has decreased over the last few years. I am happy to say that this year we received an increase in funding. While it will not replace amounts we have lost over the last few years due to ongoing pressure to reduce spending, we are happy to be on the positive end of funding again. We are also in the process of getting a new roof on our main building, which should keep us nice and dry for many years to come, as we continue to do research in the areas of Conservation Systems, Global Change, and Waste Management.



H. Allen Torbert
Research Leader

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>).



Figure 1. Double-disk opener of a row crop planter (top), single-disk opener (center), and trencher device from the prototype implement for subsurface band application of poultry litter (bottom).

Continued on p. 2

Recent Publications

- Affuso, E., Duzy, L.M. 2013. The impact of the U.S. biofuels expansion on non-point source pollution from nitrogen in a marginal agricultural area. *Economics Research International*. vol. 2013, Article ID 521254, 16 pages, 2013. doi:10.1155/2013/521254.
- Balkcom, K.S., Arriaga, F.J., Van Santen, E. 2013. Conservation practices to enhance soil carbon sequestration across the southeastern Coastal Plain. *Soil Science Society of America Journal*. 77:1774-1783.
- Calvo, P., Watts, D.B., Kloepper, J.W., Torbert III, H.A. 2013. Microbial-based inoculants impact N₂O emissions from an incubated soil medium containing urea fertilizers. *Journal of Environmental Quality*. 42:704-712.
- Chen, G., Tian, H., Prior, S.A., Pan, S. 2013. Integrating a process-based ecosystem model with Landsat imagery to assess impacts of forest disturbance on terrestrial carbon dynamics: Case studies in Alabama and Mississippi. *Journal of Geophysical Research-Biogeosciences*. 118:1208-1224.
- Kornecki, T.S., Arriaga, F.J., Price, A.J., Balkcom, K.S. 2013. Effects of recurrent rolling/crimping operations on cover crop termination, soil moisture, and soil strength for conservation organic systems. *Applied Engineering in Agriculture*. 29(6):841-850.
- Price, A.J., Norsworthy, J.S. 2013. Cover crop use for weed management in Southern reduced-tillage vegetable cropping systems. *Weed Technology*. 27(1):212-217.
- Watts, D.B., Runion, G.B., Smith Nannenga, K.E., Torbert III, H.A. 2014. Enhanced efficiency fertilizer's effects on cotton yield and quality in the Coastal Plains. *Agronomy Journal*. 106:745-752. doi:10.2134/agronj13.0216
- Way, T.R., Watts, D.B., Tewolde, H., Sistani, K.R., Torbert III, H.A. 2013. Implement with adjustable band spacing for subsurface band application of poultry litter. *Applied Engineering in Agriculture*. 29(6): 831-839.

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

Upcoming Events

Dates	Meeting	Location
May 20	Alabama (AL) Invasive Plant Council Annual Meeting	Huntsville, AL
May 29	Canola Field Day - Riverbend Farms	Florence, AL
June 11-13	Soil and Water Conservation Society (SWCS) - AL Annual Meeting	Huntsville, AL
June 22-27	International Symposium on Earthworm Ecology	Athens, GA
June 22 - 26	6th World Congress on Conservation Agriculture	Winnipeg, Manitoba
July 6-10	International Conference of Agricultural Engineering	Zurich, Switzerland

... Three Soil -Engaging Devices cont.

needed to move the implement forward, as well as the vertical force, which is the force necessary for keeping the device at the desired soil depth. The three devices, one at a time, were mounted on the dynamometer and the draft and vertical force were measured as each device was run through the soil. Before each run, crop residue was placed on the soil surface, so the performance of each device in cutting through the residue could also be determined. For the single-disk opener, the vertical force of the soil lifting upward on the device was greatest for corn residue, intermediate for soybean residue, and least for wheat residue. For the double-disk opener of the planter, the trend was similar, but differences in the upward forces were not as great as they were for the single-disk opener. The draft of the double-disk opener and the trencher were approximately equal to one another, while the draft of the single-disk opener was less than the draft of the other two devices. This information can be used to improve design criteria for developing and/or manufacturing implements.

Dr. Ahmet Çelik was a visiting scientist at the NSDL during this project and worked with the NSDL staff to conduct the project. He is on the faculty in the Department of Agricultural Machinery at Ataturk University in Erzurum, Turkey.



Figure 2. The dynamometer vehicle is the middle vehicle here and is shown with a subsoiler (the yellow device) mounted to the dynamometer.

Upcoming Events

Dates	Meeting	Location
July 8-10	American Peanut Research and Education Society (APRES) Annual Meeting	San Antonio, TX
July 27 - 30	SWCS Annual Meeting	Lombard, IL
Aug 25	Big Data: Managing Your Most Elusive Farm Asset	Ames, Iowa
Oct 14-16	Sunbelt Ag Expo	Moultrie, GA

Elevated CO₂ Effect on Common Ragweed

Ragweed is a common weed problem in many cropping systems in the southeastern US, and it has been recognized recently that some ragweed populations exhibit resistance to herbicides such as glyphosate. Within this context, the Global Change group decided to evaluate how growth under high CO₂ conditions may interact with the effectiveness of herbicides on such a problematic weed. We collected seed from two populations of ragweed: a glyphosate resistant line and a glyphosate susceptible line. These seeds were germinated in a greenhouse and transferred to open top field chambers for exposure to a normal atmospheric CO₂ level and an elevated (+ 200 ppm) atmospheric CO₂ level (Figure 1). The first step in our investigation was to examine the growth effects of CO₂ on these two populations of ragweed, prior to studies which will examine the effects of herbicides. During this initial evaluation, it was noted that susceptible plants had higher levels of disease symptoms than did resistant plants. Thus, at harvest, we not only evaluated growth response to CO₂, but also collected tissue to screen for frequency of fungi. Leaf, stem, and root sections were examined microscopically to identify various fungi.

Plants growing under elevated atmospheric CO₂ had significantly greater top, root, and total biomass compared with plants growing under CO₂. In addition, plants resistant to glyphosate had greater top, root, and total biomass than plants susceptible to the herbicide. Thirteen different fungi were observed on these ragweed plants. Carbon dioxide concentration had no effect on the frequency of any fungus, but differences were seen between the two lines. In particular, powdery mildew (a common foliar disease known to occur on ragweed) was higher on glyphosate susceptible plants. Although pathogenicity tests were not conducted, these fungi were most probably infecting ragweed leading to a decline in plant health. In addition, *Rhizoctonia* and *Fusarium* (which are common pathogens in agricultural systems) differed among the two populations. As with powdery mildew, *Rhizoctonia* was more frequent on susceptible plants whereas *Fusarium* was more frequent on resistant plants. Future work will examine how these observations may impact herbicide application to plants grown under differing levels of atmospheric CO₂.

The Global Change Research Program is continuing to examine long-term effects of elevated CO₂ on a bahia-

grass pasture with and without fertilization. They are also continuing examinations of horticultural management effects on greenhouse gas release to the atmosphere. The recognition of these collective efforts has recently resulted in a permanent budgetary increase to this program.



Figure 1: Growth response of glyphosate susceptible and resistant ragweed.

Conservation Systems and Tomato Production in Alabama

Tomato production is a relatively small portion of agricultural sales in Alabama; however, demand for locally grown vegetables is increasing. Tomato producers are faced with uncertain yields and prices, and utilizing a production system that will reduce economic risk while maintaining yield, may keep tomato producers economically sustainable into the future. A conservation system utilizing a cover crop instead of disposable plastic mulch may be a viable option for vegetable producers.

Scientists in the Conservation Systems group compared no-till tomato production (utilizing cover crops) and conventional tomato production in northern Alabama from 2005 to 2008. No-till tomato production included the use of either a rye or clover cover crop and a no-till transplanter (Figure 1) with three different types of shanks (no shank, narrow shank, and wide shank). Cover crops were terminated using a mechanical roller crimper and a glyphosate treatment. Conventional tomato production included deep tillage and bedded plastic mulch. Figure 2 shows tomatoes growing in rolled rye residue planted using the no-till transplanter shown in Figure 1.

Under drought conditions, tomatoes planted into rye without a shank produced the highest marketable yields, as compared to the plastic mulch and clover cover crop. In two out of the four years, there was no difference between treatments. Plastic mulch produced the highest marketable yields in one out of the four years.

Continued on p. 4

... Tomato Production cont.



Figure 1.
Planting tomato seedlings into rolled rye residue cover using a no-till transplanter

Plastic mulch is expensive, labor intensive, and, if not properly disposed, can create environmental problems; however, establishing a cover crop is not without costs, including seed, planting, fertilizer, and termination. In two out of the four years, net returns from tomato production using a rye cover crop were higher than tomato production using plastic mulch. The use of a cover crop decreased production costs compared to plastic mulch. Cover crops reduced yield variability and increased yields in later harvest periods. The use of a rye cover crop has the potential to be an equally profitable, less risky alternative to plastic mulch in Alabama tomato production.



Figure 2.
Tomatoes planted in rye residue cover using a no-till transplanter

Results of this research are found in the articles “Impact of different cover crops and types of transplanter mounted subsoiler shanks on tomato yield” (Kornecki, T.S. and F.J. Arriaga. 2011. HortSci. 46:715-720) and “Net returns and risk for cover crop use in Alabama tomato production” (Duzy, L.M., T.S. Kornecki, K.S. Balkcom, and F.J. Arriaga. Renewable Agriculture and Food Systems, doi: 10.1017/S1742170513000227, Published online by Cambridge University Press 17 July 2013).

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Research investigating the use of conservation systems in vegetable production is ongoing at the NSDL. Scientists have developed and are continuing to develop new equipment for small vegetable producers who utilize conservation systems. Research exploring weed control options in conservation systems for vegetable production is in progress. The results of this research will be disseminated through Highlights, fact sheets, field days, and other outlets as it becomes available.

Happenings

Dr. Dexter B. Watts received the Inspiring Young Scientist Award from the Environmental Quality Section of the American Society of Agronomy. Dr. Watts was presented the award at the 2013 Annual Meeting of the American Society of Agronomy in Tampa, FL.

Mrs. Leah Duzy attended the Beltwide Cotton Conference in New Orleans, LA. Mrs. Duzy made a presentation entitled, “Renting Cropland: Choosing the Best Option using a Decision Tool,” during the Cotton Economics & Marketing session.

Dr. Andrew Price presented “Herbicide Application Volume Effects on Weed Control in Conservation Tillage Cotton” at the Southern Weed Science Society Annual Meeting held in Birmingham, AL. This research was sponsored by Cotton Incorporated and the Alabama Farmer’s Federation.

Drs. Kip Balkcom and Dexter Watts attended the Southern Branch American Society of Agronomy meeting held in conjunction with the Southern Association of Agricultural Scientists in Dallas, TX. Dr. Balkcom sponsored a graduate student, Anna Stallings, from the Department of Crop, Soil and Environmental Sciences at Auburn University. She presented a paper entitled, “Sunn Hemp as a Cover Crop to Reduce Nitrogen Inputs for Winter Wheat.” Dr. Watts presented a paper that was co-authored by Dr. Allen Torbert entitled, “Use of FGD Gypsum to Reduce P Loss from Agricultural Fields.” Dr. Watts was also elected the incoming Secretary for the Southern Branch American Society of Agronomy.

Drs. Kip Balkcom, Ted Kornecki, and Andrew Price, Mrs. Leah Duzy, and Mr. Corey Kichler attended the Alabama Cover Crop and Soil Health Forum held in Auburn, AL. This forum was held concurrently as part of the National Cover Crop and Soil Health Conference in Omaha, Nebraska.

Dr. Andrew Price presented “Integrated Palmer Amaranth Management in Glufosinate-Resistant Cotton” at the Weed Science Society of America annual meeting held in Vancouver, BC.

Dr. Ted S. Kornecki and Mr. Corey Kichler attended the annual Alabama Fruit & Vegetable Growers Conference & Tradeshow. Dr. Kornecki presented cover crop management in conservation tillage systems, and Corey Kichler operated rollers/crimpers during the field demonstration. During the meeting, the ARS, Conservation Systems Research booth was also displayed with video, fact sheets and brochures. Besides producers, this meeting was also attended by Auburn University extension, USDA, NRCS and supporting industry.

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

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