National Soil Dynamics Laboratory

Fall 2023

Highlights

USDA Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

Louisiana Field Days Focus on No-Till Tools for Small-Scale Farmers

Small-scale farmers are looking for ways to implement conservation agriculture techniques into their operations. Cover crop benefits include increased soil organic matter and soil moisture retention while decreasing soil erosion, surface water runoff, and weed emergence. However, equipment designed to operate in heavy surface residue is limited on the small-scale, including roller/crimpers and no-till planters. Other than equipment, farmers often question key concepts that include cover crop selection, how to terminate cover crops effectively, and how to efficiently plant into heavy surface residue.

For these reasons, Dr. Ted Kornecki and Mr. Corey Kichler participated in two workshops in Eros, LA (April 3, 2023) and Alexandria, LA (April 4, 2023) with the theme "No-Till Tools for Small-Scale Applications" that focused on no-till conservation agriculture equipment and soil health. The workshops were organized by the NSDL, NRCS Soil Health Division (SHD), Louisiana NRCS, and Campti Field of Dreams, a non-profit organization dedicated to improving quality of life for Louisiana residents.

Figure 1. (a) Field day attendees listening and viewing field demonstrations of small-scale equipment in Eros, LA. (b) Dr. Kornecki describing the 2-stage ride-on roller/crimper for walk behind tractors in Eros, LA. (c) Equipment developed by Kornecki and Kichler for walk-behind tractors including powered roller/crimper, no-till vegetable transplanter, and ride-on 2-stage roller/crimper on display in Alexandria, LA.

Dynamically Speaking

H. Allen Torbert
Research Leader

Football season has kicked off, which is a true sign that Fall is here in the Southeast. Another sign is the National Soil Dynamics Laboratory's personnel are busy collecting and processing samples collected from our various research projects across Alabama. I would like to welcome a new scientist to our research team: Dr. Chaoyang Zhao. Dr. Zhao is a Research Entomologist who has joined the NSDL to initiate a new research focus area associated with insect and disease control in cotton. His research will focus on aphids which are the main method of spreading the virus responsible for "Cotton Blue" disease, which has recently become a big concern for cotton production in the Southeast. We are excited about this new area of research that he will be initiating. I hope you enjoy reading about some of the research efforts we have included in this issue of the National Soil Dynamics Highlights.

National Soil Dynamics Laboratory
https://www.ars.usda.gov/sea/nsdl
334-844-4741

Continued on p.2

Many local farmers and ag professionals attended the field days to gain knowledge through the equipment and soil health demonstrations. Mr. Kichler performed field demonstrations of the 2-stage ride-on roller/crimper and no-till transplanter for small scale two-wheeled walk-behind tractors, both developed and patented at the NSDL by Kornecki and Kichler (Fig. 1). Although field conditions were wet at the Eros location, the roller/crimper was still able to effectively crimp the rye cover crop without negative impacts often caused by larger equipment in wet conditions.

Dr. Kornecki also gave a "lunch and learn" presentation at both field days. He emphasized proper methods of using both the roller/crimper and transplanter as well as information regarding optimum cover crop growth stage for termination and other methods for successful adoption of cover crops and no-till vegetable growing systems. These well attended events helped transfer knowledge about integrating conservation systems into small-farming operations.

Mass Balance Model of a Pilot-Scale Aquaponics System

This work represents the second in a three-part series investigating aquaponics, which is the practice of combining aquaculture and hydroponics. Aquaponics presents a viable solution to water pollution from aquaculture by utilizing nutrient-rich effluent for crop production, thus representing a potential to reduce environmental impacts of food production. This collaborative effort (with the Departments of Biosystems Engineering and Horticulture and the School of Fisheries, Aquaculture & Aquatic Sciences at Auburn University) represents the development of a mass-balanced process model (Fig. 2) based on a pilot-scale aquaponics facility growing Nile tilapia and cucumbers to better understand downstream processes and how these affect nutrient availability to plants and losses to the environment.

Upcoming Events 2023/2024		
Dates	**Meeting**	**Location**
Oct. 29 - Nov. 1, 2023	Agronomy, Crop Science & Soil Science Societies' Annual Meeting	St. Louis, MO
Dec. 3-5, 2023	Alabama Farmers Federation Annual Meeting	Montgomery, AL
Dec. 14-15, 2023	AL Row Crop Short Course	Auburn, AL
Jan. 3-5, 2024	Beltwide Cotton Conf.	Ft. Worth, TX
Jan. 18, 2024	Georgia Peanut Farm Show and Conference	Tifton, GA
Jan. 30-31, 2024	27th Annual National Conservation Systems Cotton and Rice Conf.	Jonesboro, AR
Feb. 1-6, 2024	Southern Branch - ASA Meeting	Atlanta, GA

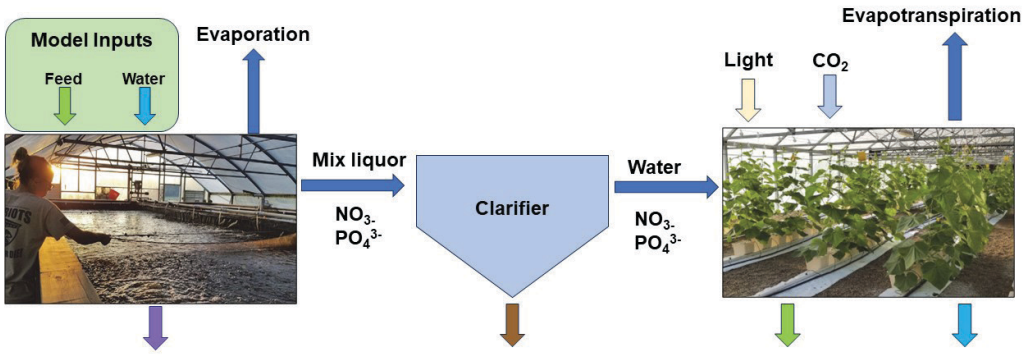

Figure 2. Major operation components in the pilot-scale aquaponics systems.

Continued on p.3

Major components include a biofloc fish tank stocked with tilapia, a biosolid settling clarification system, and a climate-controlled greenhouse in which cucumber plants were grown in the nutrient-rich waste water flowing out of the fish tank. Data were collected for a full calendar year and included weekly water quality, direct greenhouse gas emissions, water flows, along with bio-solids, fish yield, and plant yields with associated nutrient analysis. These measurements were used to create the mass-balanced process for this system.

This research indicated that only 21.6% of the N and 33% of the P applied in the fish feed was assimilated in the tilapia, while only 2.8% of the N and 2.6% of the P were assimilated by plants. This indicated there is significant room for improving nutrient utilization, particularly by increasing the scale of the plant production system to better utilize nutrients available from the aquaculture system. Better use of sludge material produced in the clarifier could also make more nutrients available for plant production.

Our model was effective in simulating long-term effects associated with altering feed and water inputs but was not effective at predicting short-term transient responses of the aquaponic system. This model helps in further understanding how aquaculture wastewater systems work so they can be redesigned for better fish and plant production.

Soil Rut Effects on Planter Performance for Cotton in a Conservation Tillage System

Soil rutting commonly occurs during harvest and can adversely affect row crop planter performance at the start of the subsequent cropping season. We conducted a three-year experiment on a sandy loam and a clay soil to investigate (1) effects of soil ruts on row crop planter performance while planting cotton into a rolled rye cover crop, and (2) effects of planter depth setting on planter performance when planting through soil ruts. We formed four different ruts in the soil, prior to planting the rye cover crop in the fall. The four rut types used were a single tire rut, the rut from two side-by-side tire passes, and two rut types formed by cutting the soil 1 in. and 2 in. deep and removing soil from the ruts (Fig. 3). A tire, similar to a pickup truck tire, was used for two of the rut types.

National Soil Dynamics Laboratory
411 S. Donahue Drive
Auburn, AL 36832-5806
334-844-4741
http://www.ars.usda.gov/sea/nsdl

Recent Publications

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

Adesemoye, A.O., Kodati, S., Watts, D.B., Maharjan, B. 2023. Differential shifts in microbiome and pathogen populations associated with suppressive soil in long-term continuous corn field compared to rotation corn field. Applied Soil Ecology. 192:105093. https://doi.org/10.1016/j.apsoil.2023.105093.v

Anas, M., Diniz, W.J., Menezes, A.C., Reynolds, L.P., Caton, J.S., Dahlen, C.R., Ward, A.K. 2023. Maternal mineral nutrition regulates fetal genomic programming in cattle: a review. Metabolites. 13(5):593. https://doi.org/10.3390/metabo13050593.

Balkcom, K.S., Read, Q.D., Gamble, A. 2023. Rye planting date impacts biomass production more than seeding rate and nitrogen fertilizer. Agronomy Journal. 115(5):2351–2368. https://doi.org/10.1002/agj2.21418.

Biswas, B., Rahman, T., Sakhakarmy, M., Jahromi, H., Baltrusaitis, J., Adhikari, S., Torbert III, H.A. 2023. Phosphorus adsorption using chemical and metal chloride activated biochars: Isotherms, kinetics and mechanism study. Bioresource Technology. 9(9):e19830. https://doi.org/10.1016/j.heliyon.2023.e19830.

Chakraborty, D., Prasad, R., Watts, D.B., Torbert III, H.A. 2023. Effectiveness of flue gas desulfurization gypsum in reducing phosphorus solubility in poultry litter when applied as an in-house amendment. Waste Management. 171(1):1-9. https://doi.org/10.1016/j.wasman.2023.08.014.

Consalter, R., Motta, A., Barbosa, J.C., Vezzani, F.M., Rubilar, R.A., Prior, S.A., Bassaco, V.M. 2023. Pine root exploration of standing dead tree trunks: a short cut biocycling process. Forest Systems. 32(2):eSC01. https://doi.org/10.5424/fs/2023322-19715.

Heilsnis, B., Mahas, J., Conner, K., Pandey, S., Clark, W., Koebernick, J., Srinivasan, R., Martin, K., Jacobson, A. 2023. Characterizing the vector competence of Aphis gossypii, Myzus persicae and Aphis craccivora (Hemiptera: Aphididae) to transmit cotton leafroll dwarf virus to cotton in the United States. Journal of Economic Entomology. 116(3):719-725. https://doi.org/10.1093/jee/toad080.

Iboyi, J., Mulvaney, M., Leon, R., Balkcom, K.S., Bashyal, M., Devkota, P., Small, I. 2023. Double-cropping effects of Brassica carinata and summer crops: I. Effects of summer cropping history on carinata production. Industrial Crops and Products. 194:116364. https://doi.org/10.1016/j.indcrop.2023.116364.

Iboyi, J., Mulvaney, M., Leon, R., Devkota, P., Bashyal, M., Balkcom, K.S., Small, I. 2023. Double-cropping effects of Brassica carinata and summer crops: II. Effects of winter cropping history on subsequent summer crop production. Industrial Crops and Products. 197:116609. https://doi.org/10.1016/j.indcrop.2023.116609.

Jjagwe, P., Tekeste, M., Alkhalifa, N., Way, T.R. 2023. Modeling tire-soil compression resistance on artificial soil using the scaling law of pressure-soil sinkage relationship. Journal of Terramechanics. 108:7-19. https://doi.org/10.1016/j.jterra.2023.02.002.

Continued on p.4

Recent Publications
Continued

Kalvakaalva, R., Smith, M., Ayipio, E., Blanchard, C., Prior, S.A., Runion, G.B., Wells, D., Blersch, D., Adhikari, S., Prasad, R., Hanson, T., Wall, N., Higgins, B.T. 2023. Mass-balance process model of a decoupled aquaponic system. Agricultural Systems. 66(4):955-967. https://doi.org/10.13031/ja.15468.

Kaur, P., Lamba, J., Way, T.R., Sandhu, V., Balkcom, K.S., Sanz-Saez, A., Watts, D.B. 2023. Cover crop effects on X-ray computed tomography-derived soil pore characteristics. Journal of Soils and Sediments. https://doi.org/10.1007/s11368-023-03596-7.

Kavetskiy, A.G., Yakubova, G.N., Prior, S.A., Torbert III, H.A. 2023. Neutron gamma analysis of soil carbon: post-irradiation physicochemical effects. Environmental Technology & Innovation. 31:103219. https://doi.org/10.1016/j.eti.2023.103219.

Recent Publications
Continued

Kumar, V., Kumari, A., Price, A.J., Bana, R.S., Singh, V., Bamboriya, S.D. 2023. Impact of futuristic climate variables on weed biology and herbicidal efficacy: a review. Agronomy. 13(2):559. https://doi.org/10.3390/agronomy13020559.

Rodrigues, V., Motta, A.C., Barbosa, J.Z., Ercole, T.M., Prior, S.A. 2023. Wood production and nutritional status of Pinus taeda L. in response to fertilization and liming: a meta-analysis of the Americas. iForest. 16(4):195-201. https://doi.org/10.3832/ifor4296-016.

Roy, P., Jahromi, H., Rahmvan, T., Baltrusaitis, J., Hassan, E., Torbert III, H.A., Adhikari, S. 2023. Hydrotreatment of pyrolysis bio-oil and triglyceride blends. Fuel Processing Technology. 245:107753. https://doi.org/10.1016/j.fuproc.2023.107753.

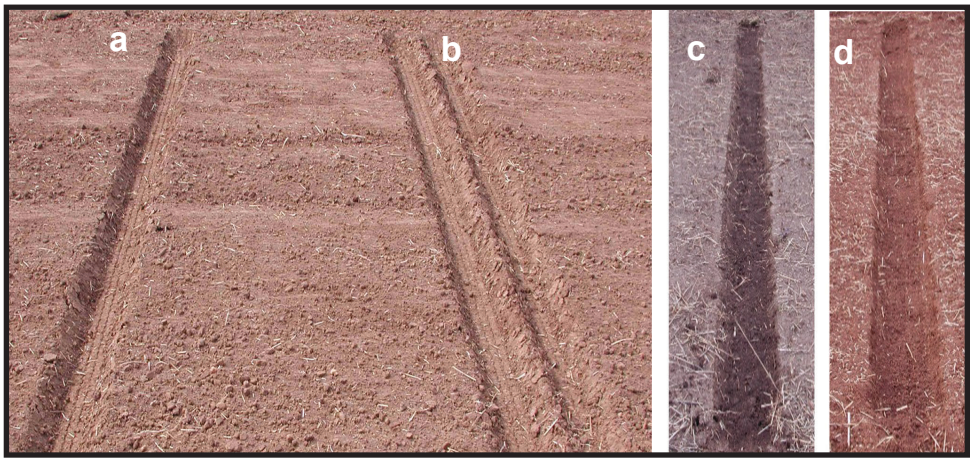

Figure 3. Ruts which were formed in two soils each fall, prior to planting cotton the following spring. (a) Single tire pass (Single Tire). (b) Two side-by-side tire passes (Dual Tires). (c) Rut formed with sheet metal rut cutter at 1 in. depth (Shallow Cut). (d) Rut formed with sheet metal rut cutter at 2 in. depth (Deep Cut).

The following spring, we rolled the rye cover crop and planted cotton. Three planter depth settings positioned the bottom peripheries of both disks of the double-disk opener 1.1, 1.4, and 1.6 in. beneath the bottom peripheries of the depth-gauge wheels, providing those nominal seeding depths. Our target emergence was 4.8 emerged seeds per ft of row, and with a cotton seed germination rate of 80%, we planted 6 seeds per ft of row.

Results show that for five of the six treatment combinations, cotton seedling emergence at 15 days after planting was greater when the soil had no rut than when the planter traveled across soil ruts while planting. In four of the six combinations of year and soil, emergence was significantly greater for the no rut soil condition than for a rut which was formed the previous fall.

The planter depth setting did not significantly affect emergence at 15 days after planting for any of the six year and soil combinations.

Happenings

In celebration of Earth Day, we toured the Auburn University Davis Arboretum. Patrick Thompson, our guide, explained the layout of the arboretum, the diversity of plants within the collection and future plans.

Drs. Kip Balkcom and Andrew Price were invited to present at the Alabama Experiment Station sponsored 2023 Wiregrass Crops Field Day. Dr. Balkcom presented information on cover crop seeding rates, while Dr. Price discussed peanut weed control.

Dr. Ajay Sharma (College of Forestry, Wildlife and Environment) requested a tour of the NSDL for a Forest Soils undergraduate class (~40 students). The main topic was discussing research efforts in Global Change, Waste Management, and Conservation Tillage. Laboratory research equipment was highlighted along with machine shop capabilities, the outdoor CO_2 exposure facility, and newly developed mobile equipment to measure soil carbon non-invasively.

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