National Soil Dynamics Laboratory

Fall 2024

Highlights

USDA Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

NSDL Technology Recognized by USDA Secretary of Agriculture

A team of NSDL scientists were presented with the 2023 USDA Secretary's Honor Award, the highest non-monetary form of recognition at the Department of Agriculture, for their innovative accomplishment in developing the "MINS" soil C measurement technology (Fig 1). Figure 2 shows a diagram of the equipment along with a picture of the current commercially available scanner in use. MINS is a new and unique technology that allows soil to be scanned for elemental content while driving across a field and then producing an elemental distribution map as soon as the scan is completed (Fig 3). The technology uses gamma ray analysis of soil elements at the atomic level. This technology has been licensed by a company called Carbon Assets Solutions (CAS) which is currently using it commercially in Australia, Canada and the US.

Fig. 1. MINS development team (pictured from left to right) Dr. Aleksandr Kavetskiy, Dr. Galina Yakubova, Dr. Stephen Prior, and Dr. Allen Torbert.

To highlight this technology, NSDL and CAS hosted a symposium on June 27, 2024, to discuss the potential market for farmers to sell certified C credits on the global market based on this technology. The symposium included opening remarks from **Robert Bonnie**, USDA Under Secretary for Farm Production and Conservation, talking about the impact that this technolgy will have on farming and research. The featured speaker was **Dr. Rattan Lal**, winner of the UN World Food Prize and a pioneer in soil carbon sequestration as a solution for climate change dialogue, sharing his thoughts on the importance of this technology.

The symposium included an explanation of how MINS can non-destructively measure soil carbon. New advancements in the technology which has greatly improved measurement accuracy, was discussed and compared to soil testing. Field studies have shown that measuring soil carbon with the MINS can improve accuracy by 80%. The symposium included a live demonstration of the system measuring a field while participants watched remotely and then finished by providing a carbon distribution map of the field scanned only a few minutes after completion. For more information regarding this technology, please visit the CAS website at: https://carbonassetsolutions.com

Dynamically Speaking

H. Allen Torbert
Research Leader

Fall is here and the National Soil Dynamics Laboratory's personnel are wrapping up field work from this summer's growing season. In this issue, we would like to introduce our newest employees at NSDL. Henry Torbert came on board to support our forage improvement research program and Jimmy Bracht has joined us to support the MINS technology (featured in this issue) development team. Both Henry and Jimmy are not new to NSDL, having worked for us as student workers and temporary positions for several years. We are glad to have them join us as permanent ARS employees. I hope you enjoy reading about some of the research efforts we have included in this issue of the National Soil Dynamics Highlights.

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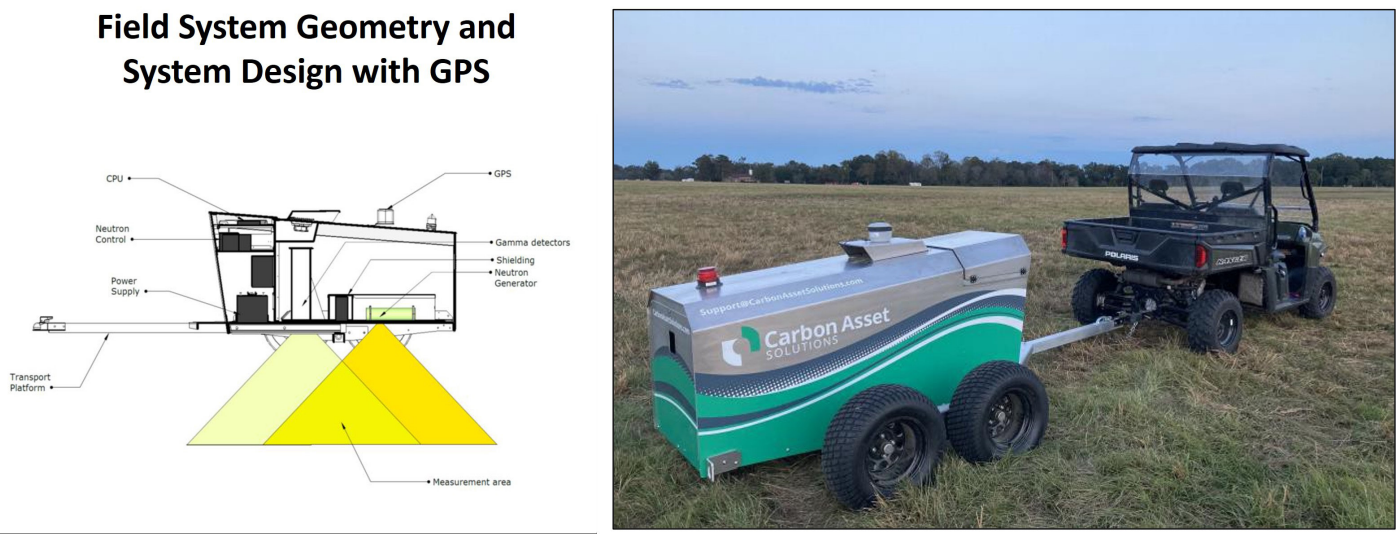

Fig. 2. Diagram of MINS system design and current picture of the commercially available scanner in use.

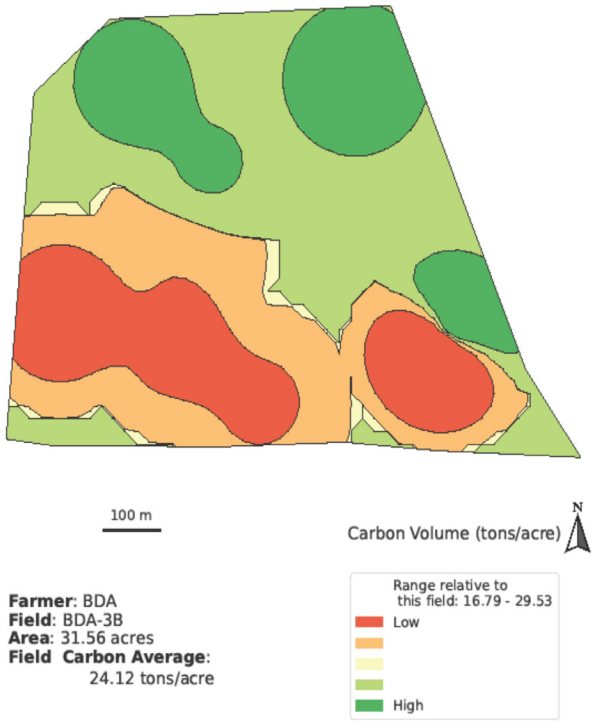

Fig. 3. Soil carbon distribution map generated with the MINS technology.

Upcoming Events 2024/2025		
Dates	**Meeting**	**Location**
Nov. 10 - 13	Agronomy, Crop Science & Soil Science Sod-cieties'Annual Meeting	San Antonio, TX
Dec. 8-10	ALFA Annual Meeting	Montgomery, AL
Jan. 14 - 16	Beltwide Cotton Conference	New Orleans, LA
Jan. 16	Georgia Peanut Farm Show	Tifton, GA
Jan. 21 - 22	Alabama Row Crops Short Course	Huntsville, AL
Jan. 27 - 28	28th Annual National Conser-vation Systems Cotton and Rice Conf.	Memphis, TN

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Microbial Community of Cotton Aphids Collected in South AL

The cotton aphid is a worldwide distributed agricultural pest that can feed on a broad range of host plants. It causes severe yield losses in numerous economically important crops such as cotton, cucumber, and citrus. In Alabama, cotton is one of the main host plants for the cotton aphid (Fig. 4). By feeding on different plants, the cotton aphid can spread diseases, further reducing crop yields. For example, cotton leafroll dwarf virus (CLRDV), responsible for cotton blue disease (CBD) and substantial yield losses in South America, is exclusively transmitted by cotton aphids.

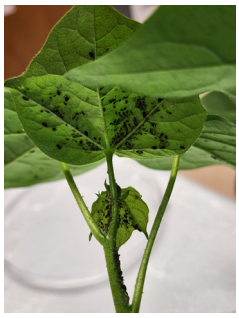

Fig. 4. A cotton seedling heavily infested by cotton aphids.

Like all animals, cotton aphids live in coexistence with a diverse microbial community. This community includes three main groups: aphid-transmitted plant pathogens such as CLRDV, insect pathogens that infect the aphids themselves, and beneficial microbes that support aphid health. To investigate the microbial community of cotton aphids in Alabama, we collected samples from cotton fields in South Alabama during 2020-2021 and performed genetic analyses.

We initially obtained genetic sequences from the whole bodies of aphids, analyzing both RNA and DNA levels. By excluding sequences originating from the aphids themselves, we determined the taxonomy of the remaining non-aphid sequences. Although no CLRDV sequences were identified, a diverse array of bacterial, fungal, and viral species was detected. These microbial cohabitants formed complex relationships with cotton aphids: some acted as potential pathogens to the aphids, others might benefit the aphids, and some could be spread by the aphids and infect plants. Notably, these potential aphid pathogens could be developed for managing cotton aphid populations in the field.

We also found plant sequences from various families, likely representing remnants of plant hosts fed upon by aphids. This information can help explore the host range of cotton aphids in South Alabama and investigate transmission routes of aphid-vectored plant diseases among different hosts.

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Recent Selected Publications

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

Ayelo, P.M., Adesemoye, A.O., Xiong, C., Fadamiro, H.Y. 2024. Plant growth-promoting rhizobacteria differently influence crops growth and physiology depending on cultivar and rhizobacteria consortium's composition. Biologia. https://doi.org/10.1007/s11756-024-01710-9.

Biswas, B., Ammar, M., Adhikari, S., Baltrusaitis, J., Jahromi, H., Torbert III, H.A., Linhoss, J., Lamba, J. 2024. Magnesium doped biochar for simultaneous adsorption of phosphate and nitrogen ions from aqueous solution. Chemosphere. 358:142130. https://doi.org/10.1016/j.chemosphere.2024.142130.

Ercole, T.M., Gomes, J.B.V., Rodrigues, V.S., Trentin, N.S., Junior, J.C.O., Pereira, G.A., Filho, M.T., Moura, A.P.C., Maeda, S., Prior, S.A., Consalter, R., and Motta, A.C.V. 2024. VARI as an indicator of site productivity of Pinus taeda L.: soil, litter, and plant nutrition. European Journal of Forest Research. https://doi.org/10.1007/s10342-024-01711-y.

Escalante, C., Sanz-Seaz, A., Jacobson, A., Otulak-Koziel, K., Koziel, E., Balkcom, K.S., Zhao, C., Conner, K. 2024. Plant virus transmission during seed development and implications to plant defense system. Frontiers in Plant Science. 15:1385456. https://doi.org/10.3389/fpls.2024.1385456.

Escobar, C., Watts, D.B., Torbert III, H.A., Bailey, M.A., Krehling, J.T., Landers, D., Jackson, A.P., Gilpin, M., Still, K., Munoz, L.R., Orellana, L., Adhikari, Y., Macklin, K.S., Baker-Cook, B. 2024. Evaluation of the impact of gypsum as a novel bedding material on broiler performance, foot pad health, and fear response. Poultry Science. 103:103676. https://doi.org/10.1016/j.psj.2024.103676.

Kafle, B., Adesemoye, A.O., Fadamiro, H.Y. 2024. Cuticular hydrocarbons as host recognition cues in specialist and generalist endoparasitoids. Chemoecology. https://doi.org/10.1007/s00049-024-00410-9.

Kavetskiy, A.G., Yakubova, G.N., Prior, S.A., Torbert III, H.A. 2024. Carbon analysis of large soil samples using the tagged neutron method: Accounting for radiation attenuation. Applied Radiation And Isotopes. 209:111332. https://doi.org/10.1016/j.apradiso.2024.111332.

Kumari, A., Price, A.J., Gamble, A., Li, S., Jacobson, A. 2024. Integrating cover crops and herbicides for weed control in soybean. Weed Technology. 38:1-8. https://doi.org/10.1017/wet.2024.24.

Lacroix, E.M., Gomes, A., Barratt-Heitmann, G., Schuler, D., Dekas, A., Liptzin, D., Aberle, E., Watts, D.B., Nelson, K., Culman, S., Fendorf, S. 2024. Microbial proxies for anoxic microsites vary with management and partially explain soil carbon concentration. Environmental Science and Technology. 58(26):11459-11469. https://doi.org/10.1021/acs.est.4c01882.

Malhotra, K., Lamba, J., Way, T.R., Williams, C., Karthikeyan, K.G., Budhathoki, S., Prasad, R., Srivastava, P., Zheng, J. 2024. Preferential flow of phosphorus and nitrogen under steady-state saturated conditions. Vadose Zone Journal. 23:e20331. https://doi.org/10.1002/vzj2.20331.

Watts, D.B., He, Z., Yin, X., Torbert III, H.A., Senwo, Z., Tewolde, H. 2024. Long-term cropping management practices affect the biochemical properties of an Alabama Ultisol. Soil Systems. 8(2):41. https://doi.org/10.3390/soilsystems8020041.

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New Drone Research Funding and Focus

Interest and use of agriculture drones in row crops, pasture, and specialty crop systems is increasing as technology for sensing, mapping, pesticide application and seeding, among other functions, continue to develop. Drones offer potential time and cost savings over traditional scouting and ground equipment for acquiring crop, pest, and soil information in addition to conducting field operations such as pesticide applications and cover crop seeding. As drone sensor technology, artificial intelligence capabilities, and payload capacities evolve, farm utility will increase.

NSDL recently received congressional funding to pursue drone research in collaboration with Auburn University, other USDA ARS locations, private businesses, and other research organizations as relationships develop. Initial research will focus on 1) detecting pests and agronomic nutrient deficiencies with artificial intelligence using scout drones and conduct precision applications to optimize chemical and fertilizer usage in ways that can mitigate pesticide drift and nutrient losses, 2) evaluate new spray/spread drone uses in a variety of settings to reduce production costs, 3) evaluate drones for field operations such as cover crop seeding and other crop production operations, and 4) utilize drones to monitor environmental conditions to enhance system sustainability, such as soil moisture and ground cover status for water runoff and soil erosion forecasting and mitigation. Data collected in these studies will also be used to develop strategies, methods and recommendations for drone data processing and management.

Happenings

Drs. Kip Balkcom and Andrew Price were invited to present on cover crop management and weed concerns at the 2024 Wiregrass Crop's Field Day in Headland, AL.

Dr. Kip Balkcom was one of four people invited to present at the general session of the American Peanut Research and Education Society in Oklahoma City, OK. Dr. Balkcom spoke on "Considerations to Maximize Soil Health Benefits of Conservation Practices in the Southeast US".

Dr. Ted Kornecki and Mr. Corey Kichler performed field demonstrations with both a small-scale roller/crimper and no-till vegetable transplanter powered by walk-behind tractors at the West Madison Ag Research Station in Verona WI.

NSDL toured the Auburn University Davis Arboretum as part of Earth Day. Our tour guide explained the layout of the Arboretum, diversity of plants within the collection, and future plans.

Dr. Anthony Adesemoye participated in "Plants, insects, and microbes symposium" organized by the Auburn University Department of Entomology and Plant Pathology.

Dr. Anthony Adesemoye was invited to make a presentation to researchers interested in plant growth-promoting rhizobacteria (PGPR) in Dadeville, AL.

Drs. Kip Balkcom and Ted Kornecki along with Mr. Jeffrey Walker and Mr. Carter Bonnell were invited to speak about cover crop management and equipment for small-scale growers at the Cover Crop Field Day in Headland, AL.

Drone conference attendees view a spray drone demonstration.

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