

Highlights

Tillage System affects Nitrogen Requirements for Wheat after Corn

Corn generates large amounts of surface residue, which can require intensive surface tillage and increased N fertilizer rates to enhance subsequent wheat production. However, surface tillage degrades soil health benefits, while unnecessary N applications reduce profits and promote environmental pollution. Therefore, identifying the correct surface tillage level and N rate combination is critical to fine-tune wheat yields and profits following corn production.

We compared surface tillage levels and N fertilizer combinations for wheat following corn over four growing seasons (2016–17, 2017–18, 2019–20, 2020–21) in north Alabama. Surface tillage systems included conventional tillage (CT), mulch tillage (MT), light disk (LD), and no tillage (NT) systems. Tillage systems were designed to create different corn residue incorporation levels that ranged from complete residue burial in the CT system to no surface tillage in the NT system. Total N rates of 60, 90, and 120 lb N ac⁻¹ were applied as urea-ammonium nitrate 28% solution. Nitrogen treatments included each rate applied in the spring

Dynamically Speaking

As we begin Fall and the harvest season across the Southeast, the National Soil Dynamics Laboratory continues to move forward with agriculture research. I am happy to say the new NSDL state-of-the-art research buildings located at Auburn University's Research Park are underway with extensive site work and progress on foundations and walls. Also, I am happy to report an addition to our staff of Mr. Antonio (Tony) Hutchins, who joins us as a Biological Science Technician. I hope you enjoy reading about some of the research efforts we have included in this issue of NSDL Highlights. Please visit our web site for more information about our ongoing projects.



H. Allen Torbert
Research Leader

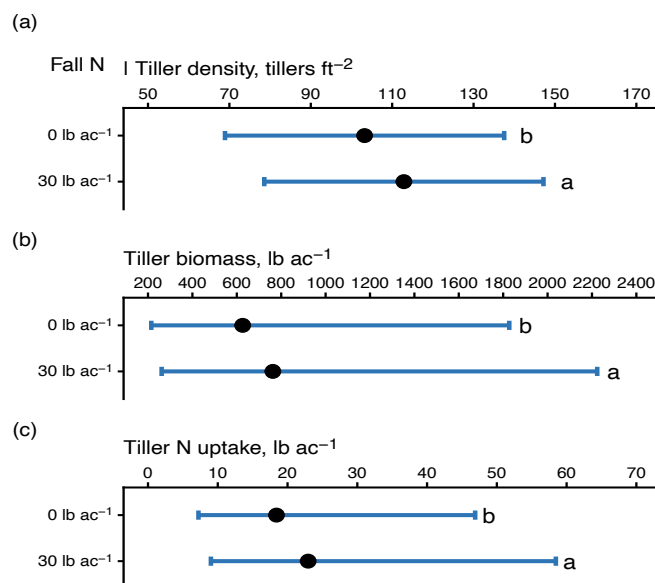


Fig. 1. Fall N effects on wheat tiller density (a), tiller biomass (b), and tiller N uptake (c) averaged over four growing seasons in north Alabama.

as a single application or 30 lb N ac⁻¹ applied in the fall with the remainder applied in the spring as a split treatment.

Fall N increased early season wheat growth parameters up to 25% (Fig. 1). The CT, MT, and LD systems yielded 23% greater than the NT system across N treatments and growing seasons. Average net returns, ranked in order, were US\$297 ac⁻¹ (MT), US\$260 ac⁻¹ (LD), US\$243 ac⁻¹ (CT), and US\$189 ac⁻¹ (NT).

Average 4-yr wheat yields following corn appeared more sensitive to N rate than N timing. Split N applications decreased wheat yields at the 60 lb N ac⁻¹ rate as surface tillage decreased in the LD and NT systems (Fig. 2a). Wheat productivity decreased the greatest in the NT system, but the other tillage systems indicated no profit advantage for N applied above the current wheat

... Wheat continued

recommendation of 90 lb N ac⁻¹ across either application time (Fig. 2b). Average net returns indicated some form of tillage was necessary to increase profits compared to NT for wheat following corn. The MT system was the most profitable and also indicated maximum incorporation of residue was not necessary.

Concerns NT systems can reduce wheat yields and net returns following corn were justified. Applying 120 lb N ac⁻¹ maximized wheat yields and net returns for NT, but 120 lb N ac⁻¹ also increased yields 10% and profits 19% compared with 90 lb N ac⁻¹ for the remaining tillage systems. These results indicate wheat N rates above 90 lb N ac⁻¹ may be justified, regardless of tillage system following corn.

Recent Selected Publications

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

Ahlersmeyer, A., Prior, S.A., Runion, G.B., Gamble, A., Mcelroy, S., Russell, D., Price, A.J., Maity, A. 2026. Shifts in weed diversity in response to management practices and elevated CO₂ in forage bermudagrass (*Cynodon dactylon*). *Weed Science*. 74(1):e43. <https://doi.org/10.1017/wsc.2026.10122>.

Balkcom, K.S. 2026. Tillage and N requirements for wheat planted into corn residue. *Field Crops Research*. 346:110615. <https://doi.org/10.1016/j.fcr.2026.110615>.

Celik, A., Way, T.R., Watts, D.B. 2026. Single-disk and double-disk openers: Soil forces and crop residue shearing performance. *Soil and Tillage Research*. 264:107326. <https://doi.org/10.1016/j.still.2026.107326>.

Cortes, J.A., Korzeniowska, A., Yakubova, G.N., Kavetskiy, A.G., Torbert III, H.A. 2026. Mathematical methods of soil gamma spectra analysis for carbon content determination. *Nuclear Instruments and Methods in Physics Research*. 581:166294. <https://doi.org/10.1016/j.nimb.2026.166294>.

Escalante, C., Reyes, A.M., Zhao, C., Balkcom, K.S., Jacobson, A.L., Strayer-Scherer, A., Martin, K.M., Koebnick, J., Huseh, A., Koziel, E., Small, I., Greene, J., Otulak-Koziel, K., Mulvaney, M.J., Price, P.P., Alcalá Briseño, R.I., Bag, S., Conner, K. 2026. Metatranscriptomics analysis reveals the cotton virome in the southern United States. *Scientific Reports*. (2026). <https://doi.org/10.1038/s41598-026-40828-5>.

Ghosh, R.K., Purohit, N.N., Prior, S.A., Maity, A. 2026. Physicochemical properties of biochar influence weed control efficiency of preemergence herbicide. *Weed Science*. 74(1):e54. <https://doi.org/10.1017/wsc.2026.10129>.

Islam, K.R., Rahman, A., Dick, W.A., Shedekar, V.S., Gonzalez, J.M., Watts, D.B., Fauser, N.R., Flanagan, D.C., Reeder, R.C., Vantoai, T.T., Batte, M.T. 2026. Minimum dataset with integrated scoring and indexing methods for soil quality assessment. *PLOS ONE*. 21(4):e0346136. <https://doi.org/10.1371/journal.pone.0346136>.

Kichler, C.M., Kornecki, T.S. 2026. Performance evaluation of improved small-scale vegetable transplanters in no-till tomatoes for two cropping systems. *Applied Engineering in Agriculture*. 42(4):425-437. <https://doi.org/10.13031/aea.16460>.

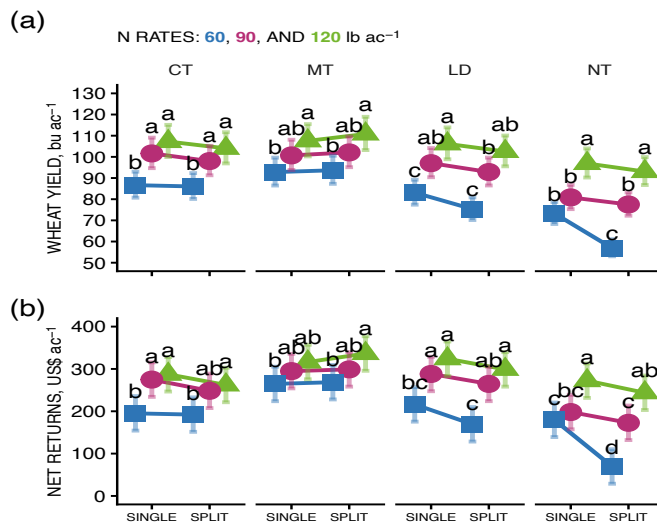


Fig. 2. Average wheat yields (a) and net returns (b) for single and split N applications of 60, 90, and 120 lb N ac⁻¹ across conventional (CT), mulch (MT), light disk (LD), and no-tillage (NT) systems over four growing seasons.

Kumari, A., Price, A.J., Singh, J., Balkcom, K.S., Russell, D. 2026. Impact of cover crop mixture and cereal rye on soybean critical period for weed control in a low-yield environment. *Weed Technology*. 2026:1-25. <https://doi.org/10.1017/wet.2025.10078>.

Pereira, L.I., Li, S., Langemeier, R., Mccaghren, J., Virk, S., Price, A.J. 2026. Evaluation of DJI AGRAS T30, airplane, and ground sprayer coverage and canopy penetration to simulate fungicide application on tassel stage corn. *Agronomy*. 16(4):446. <https://doi.org/10.3390/agronomy16040446>.

Prior, S.A., Runion, G.B., Torbert III, H.A., Kavetskiy, A.G., Yakubova, G.N. 2026. Assessing post-irradiation effects of neutron gamma analysis on soil microbial activity. *Communications in Soil Science and Plant Analysis*. 1-12. <https://doi.org/10.1080/00103624.2026.2735361>.

Rahman, A., Kumar, R., Brar, G., Lamba, J., Adhikari, S., Kasera, N.K., Torbert III, H.A., Watts, D.B., Way, T.R. 2026. Pinewood engineered biochar as a solution to nutrient leaching management: Mitigating phosphorus and nitrate from poultry litter under saturated porous conditions. *Journal of Environmental Management*. 416(2026):130641. <https://doi.org/10.1016/j.jenvman.2026.130641>.

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Satognon, F., Watts, D.B., Adesemoye, A.O., Torbert III, H.A., Prasad, R., Mullenix, K.M. 2026. Impacts of *Bacillus*-PGPR and poultry litter on the early growth of annual ryegrass and tall fescue under greenhouse conditions. *Journal of Crop Improvement*. 40(4):385-405. <https://doi.org/10.1080/15427528.2026.2659805>.

Sizemore, J., Virk, S., Li, S., Price, A.J. 2026. Application rate accuracy and distribution uniformity of cover crop seeding with an unmanned aerial system (UAS). *Journal of the ASABE*. 42(1):93-103. <https://doi.org/10.13031/aea.16548>.

Zhao, C., Owens, I., Jacobson, A.L., Escalante, C., Bansal, R., Martin, K.M., Balkcom, K.S. 2026. Novel iflavivirus species discovered through virome analysis of cotton field-collected aphids. *BMC Genomics*. 2026. <https://doi.org/10.1186/s12864-026-13132-9>.

Continued on p.3

Improved Small-Scale Vegetable Transplanters in No-Till Tomatoes

Farmers are finding it more difficult to hire people for intensive activities such as vegetable transplanting. Due to lower market shares, many equipment manufacturers overlook investing in new technologies, like vegetable transplanters and seed drills, that are affordable for smaller farm operations. This is especially true for equipment used in conservation cropping systems that needs specific adaptations to be effective in cover crop residue left on the soil surface.

A no-till vegetable transplanter was developed and tested at the NSDL using two versions: V1 (Fig. 3), a rigid mount operated by one person, and V2 (Fig. 3), an upgraded version with a pivoting hitch, seat, and lift assist wheels but requiring two operators. The transplant delivery system for both versions was controlled with a variable speed 12V electric motor with four seedling dispensing cups. Both versions were evaluated in cereal rye and crimson clover under roll/crimped and tilled conditions. Tomato seedlings were transplanted with V1 in 2023 and V2 in 2024 with both compared to hand planting.

Modification made to the transplanter improved productivity over both cover cropping systems. Although hand transplanting produced more consistent plant spacing than the electric transplanter, it was slower in the rolled system than in the tilled system for crimson clover. Average tomato yields were higher in the rolled rye system and in the tilled clover system across both seasons. Planting method did not influence yield in the clover system, but in the rye system, hand transplanting produced greater yields than the electric transplanter.

Upcoming Events 2026/2027		
Dates	Meeting	Location
Dec. 6 - 7	Alabama Farmers Federation Annual Meeting	Montgomery, AL
Jan. 5 - 7	Beltwide Cotton Conference	Fort Worth, TX
Jan. 21	Georgia Peanut Farm Show	Tifton, GA
Jan. 28	Alabama-Florida Peanut Trade Show	Dothan, AL
Feb. 18 - 19	30 th Annual National Conservation Systems Cotton & Rice Conference	Jonesboro, AR

The V2 transplanter offers the best option in terms of planting productivity, maneuverability, and planting capability into both no-till and conventional growing systems. Advancing the development of this no-till vegetable transplanter allows for improved small-farm efficiency and labor savings. Future research includes adapting the transplanter to other small vehicles along with improving the accuracy of plant spacing in no-till systems.



Fig. 3. Left: Version 1 (V1) seedling transplanter used in the first season. Right: Version 2 (V2) seedling transplanter used in the second season modified with (A) pivot point, (B) rear lift-assist wheels, (C) and seat for 2nd operator.

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Continued on p.4

Belowground Breakthroughs: Using Soil Microbes to Boost Forage Productivity

Responding to rising demands for food production, researchers at the NSDL are exploring strategies that enhance yield while reducing agriculture's dependence on fertilizer inputs. One promising avenue being investigated involves use of free-living root-colonizing microbes to stimulate plant growth through direct—such as improved nutrient uptake and hormone production—and indirect biological mechanisms, including reduced pathogen stress. Our studies over the last decade have effectively shown that these microbes—plant growth-promoting rhizobacteria (PGPR)—can improve yield and biomass production in row-crop systems. Building on these research findings our researchers are now investigating whether beneficial microbes can also strengthen forage production systems.

Grasses are the primary forage source for Alabama's cattle industry. With more than four million acres of land being devoted to forage production statewide, perennial species—especially bermudagrass, bahiagrass (Fig. 4), and fescuegrass—provide the core feed base supporting nutritional needs for Alabama-raised beef. Consequently, grazing and hay production systems serve as the backbone of cattle production in the state.

Integrating PGPR into management of Alabama's grazing and hayfield systems may offer a promising pathway for producers to lower fertilizer costs, reduce environmental risks associated with high nutrient inputs, and improve forage yield needed to support the thriving cattle industry. Early findings are showing that PGPR can enhance nutrient uptake, stimulate plant growth, including more tillers, and decrease fertilizer inputs—positioning PGPR to become a valuable tool for improving the sustainability and resilience of forage-based systems in Alabama.



Fig. 4. Harvest of bahiagrass research plots.

Happenings

Dr. Kip Balkcom was invited to present at the 2026 Wiregrass Annual Field Crops Day in Headland, AL. Dr. Balkcom spoke about cover crop management in southeast Alabama that included dates, seeding rates, N applications, and cultivars for cereal cover crops. Participants included growers, scientists, and industry representatives (~50 people).

Dr. Kip Balkcom was invited to present at the Cover Crop and Soil Health Field Day in Shorter, AL and the 2026 Wiregrass Cover Crop Field Day in Headland, AL. Dr. Balkcom spoke about cover crop management factors related to planting dates and N timing for cereal cover crops that growers should consider to maximize their success with cover crops. Participants included growers, scientists, and industry representative (~60 people).

Mr. Carter Bonnel, ARS-NSDL technician, showcased Agricultural UAS Research efforts and give a flight demo using our Hyllo spraying and spreading drone. The target audience was early education students, and the goal was to inspire thought and develop interest in agricultural careers. He was able to engage with the community and share the impact our research may have on the local area. Participants included ~175 people.

Additionally, an unanticipated finding showed that the growth medium used to culture PGPR can significantly influence seedling emergence (Fig. 5). Specifically, tryptic soy broth whether used alone or together with PGPR, suppresses emergence, whereas PGPR applied without growth medium performs comparably to the control. These results demonstrate that the medium—not the PGPR itself—is responsible for the reduced emergence observed. Moving forward, we are planning to evaluate alternative media that may improve emergence and determine whether such improvements translate into long-term yield benefits for forage grasses and row crops.

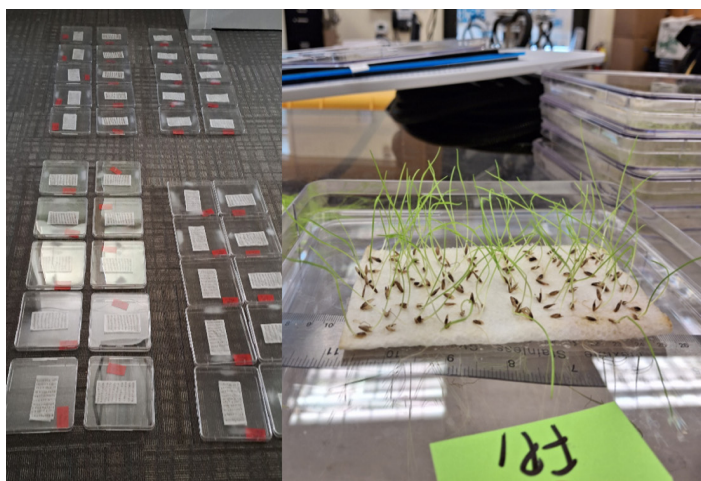


Fig. 5. Evaluating seedling emergence.