# NORTH MISSISSIPPI RESEARCH & EXTENSION CENTER

2025

ANNUAL REPORT

MISSISSIPPI STATE UNIVERSITY™
MS AGRICULTURAL AND
FORESTRY EXPERIMENT STATION

MISSISSIPPI STATE UNIVERSITY™
EXTENSION


**FACULTY AND STAFF IN THE NORTH MISSISSIPPI RESEARCH AND EXTENSION CENTER (NMREC)** listen to your concerns. Our scientists conduct research and implement solutions to the everyday challenges Mississippians face. This annual report highlights some of the many research projects and extension programs conducted by faculty and staff in 2025. Research sponsors, stakeholders, and volunteers made valuable contributions and are appreciated for their continued input and support.

As part of the Mississippi State University Division of Agriculture, Forestry, and Veterinary Medicine, NMREC supports the missions of the Mississippi Agricultural and Forestry Experiment Station (MAFES) and the MSU Extension Service. NMREC works to improve your life by responding to your needs: collaborating to conduct and share innovative agricultural research; offering practical education for everyone; and serving communities and businesses. As one of four Research and Extension Centers strategically located in the state, NMREC brings Mississippi State to north Mississippi, facilitating research in different soil types and climates, and providing local education and technical assistance to our communities.

Researchers based in North Mississippi conduct programs in agronomy, horticulture, animal science, and forestry. NMREC includes four MAFES research locations:

- **Northeast Mississippi Branch (Verona)**
  - *Agronomy Unit*
  - *Horticulture Research and Education Unit*
- **Prairie Research Unit (Prairie)**
- **Pontotoc Ridge-Flatwoods Branch (Pontotoc)**
- **North Mississippi Branch (Holly Springs)**

Please visit https://www.mafes.msstate.edu/branches/north.php to contact NMREC or any of its research locations.

# Developing and applying science-based solutions through research and extension programs from the North Mississippi Research and Extension Center

JANE PARISH

**IN 2025,** the faculty and staff of the North Mississippi Research and Extension Center (NMREC) focused our efforts on crop production, horticulture, beef cattle, forestry, plant pathology, and agricultural engineering research to address important needs in north Mississippi and beyond. Mississippi Agricultural and Forestry Experiment Station (MAFES) scientists and staff engaged in research projects and outreach programs targeted at providing relevant technical assistance to our clientele. Extension specialists developed and shared research-based information in a variety of ways including hosting field days, providing individualized technical guidance, and expanding online educational resources. The overall emphasis remains in matching our expertise and efforts to the needs of north Mississippi in order to develop science-based solutions that can be applied in the lives and livelihoods of our stakeholders.

In May of 2025, NMREC added a new faculty member, Dr. Lucas Borges Ferreira. Dr. Ferreira is an agricultural and biological engineer and a MAFES scientist, with research efforts dedicated to leveraging digital twins, artificial intelligence, and robotics for the quick development of sensing and automation solutions in specialty crops important to the region. This report highlights agricultural engineering studies that advance agriculture through artificial intelligence, sensing, and automation as well as delineation of agricultural field boundaries from the sky.

Sweetpotato research and extension programs remained nationally recognized with implementation of the Mississippi State University led multi-state CleanSEED project. Funded through a competitive grant from the U.S. Department of Agriculture's National Institute of Food and Agriculture, this project addresses virus, pest, and disease problems and improves the sustainability of U.S. sweetpotato seed programs. This work added to the diverse portfolio of sweetpotato and row crop research that covered topics including the effects of greenhouse hardening of sweetpotato transplants for stronger slips and improved yields, as well as weed control options for enhancing sweetpotato production. Plant pathology work in sweetpotato included a survey to identify pathogens causing postharvest diseases on sweetpotato in Mississippi and locations throughout their distribution. Frequent interactions with growers and industry collaborators helped direct and inform future sweetpotato research efforts. Callie Morris, a research associate and agronomy doctoral student at the MAFES Pontotoc Ridge-Flatwoods Branch, focuses on sweetpotato research. An exceptional researcher, Morris was awarded the MAFES Outstanding Professional Staff award as well as the Mississippi Agricultural Industry Council Outstanding Graduate Student award in 2025.

Research highlights at the MAFES Northeast Mississippi Branch in Verona included agronomic research that covered important topics such as soil nutrient management, cover crop use, and soybean iron deficiency chlorosis. One study highlighted in this report discusses the effects of potassium fertilizer on cotton when soil potassium is below what is commonly considered the critical level. The Northeast Mississippi and Pontotoc stations were both contributors to the MAFES Official Variety Trails programs for major row crops in the region including corn, soybean, cotton, peanuts, and wheat. Additionally, Mississippi youth were offered

the opportunity to participate in agronomy science projects through experiential learning in statewide 4-H plant science projects led by NMREC team members.

The MAFES Northeast Mississippi Branch was also very involved in horticulture and plant pathology research. Horticulture research in 2025 included applied studies to answer questions about fungicide options for white mold management in field tomato production, tomato productivity as affected by nitrogen application rates in high tunnels, ornamental proven winner herbaceous flower comparisons, and the American Rose Trail for Sustainability (A.R.T.S). A feature plant pathology project addressed potential phytotoxicity of fungicides for the control of powdery mildew in lettuce in a greenhouse hydroponic production system.

Forestry projects were another key focus in 2025. This report presents a Mississippi log trucking business owner workforce and profitability evaluation. At the Verona station, a research trial to evaluate different Christmas tree species native to the area as well as different tree management practices entered its sixth year of implementation. New information developed on nitrogen rate influences on southern Christmas tree production was an exciting addition to the ongoing project. To celebrate the success of our forestry programs, we harvested our first mature Christmas trees from this project.

Beef cattle research at the MAFES Prairie

Research Unit investigated various management approaches to improving reproductive and other performance outcomes in cow-calf and stocker cattle production. Researchers studied the impact of an ultra-high stocking density grazing system on cattle behavior and productivity. Nutritional management research projects included a study evaluating how a post-weaning stair-step nutritional regimen in beef heifers influences their reproductive development and productivity as first-calf cows. Another project assessed trace mineral consumption strategies for beef cattle during preconditioning and feedlot receiving. The MAFES Prairie Research Unit also hosted youth education events such as the 4-H Youth Stockmanship training.

The annual North Mississippi Producer Advisory Council was hosted in February 2025 to engage with stakeholders and gain insights into current and emerging research and education needs for a wide range of agricultural commodities. Throughout the year, Extension specialists and MAFES scientists shared up-to-date agricultural science with stakeholders on a regular basis. Several field days and workshops were held at north Mississippi MAFES stations in 2025 to showcase current information on agricultural production systems in the region. This provided growers, producers, allied industry members, and community members the opportunity to see research in progress firsthand and to learn the results of completed research trials. It also offered practical guidance on how to apply these findings to make more informed management decisions for their farms, businesses, and homes.

A signature Extension focus during the year was the statewide Mississippi Master Gardener training program based out of the NMREC which offered self-paced online training options to expand program accessibility and reach. Notably, the program team including Dr. Jeff Wilson and Susan McGukin, was honored with the 2025 MSU Extension Customer Outreach Award. The program was available to anyone with an interest in improving horticultural knowledge and offered opportunities for volunteer service in local communities. In 2025, active program participation continued to be vibrant with 890 Mississippi Master Gardeners across the state contributing 76,500 volunteer hours valued at $1.94 million. Horticulture education at the NMREC included hands-on workshops such as pruning training in the demonstration orchard at the MAFES Northeast Mississippi Branch and the inaugural Greenhouse Vegetable Short Course. Educational events were routinely held in the Magnolia Botanical Garden at the MAFES Northeast Mississippi Branch. Public access to self-guided tours in the Magnolia Botanical Garden are available year-round.

The North Mississippi Research and Extension Center continued collaborations with the Mississippi Department of Transportation through active participation in the Adopt-a-Highway program as part of our service portfolio to help our local community. NMREC implemented quarterly litter pick-ups for a one-mile stretch of Mississippi Highway 145 South in Lee County. The team, led by Dr. James Shannon, sorted and weighed the litter after each pick-up and then recycled any scrap metal, aluminum, #1 plastic, and intact glass collected. This report describes the results of those litter collections and how much recyclable materials were acquired and then moved into proper recycling channels. The team provided data to the Mississippi Department of Transportation after each litter pick-up event that included recycling totals to help inform educational efforts. This report further details the overall recycling efforts of the North Mississippi Research and Extension Center coordinated by Shannon.

Research projects, Extension programs, and service efforts that matter and put into action by the faculty and staff in the MSU North Mississippi Research and Extension Center were made possible by the financial support of numerous funding agencies and organizations and by the university's Mississippi Agricultural and Forestry Experiment Station and the Extension Service. This annual report is intended to provide an overview of some of these efforts. Additional research projects and extension programs are ongoing and under development with continued programming focused on real-world impacts planned for 2026. Faculty and staff are available throughout the year to share further details of projects and programs upon request. These experts also help agricultural producers and the public including youth with technical expertise in agronomy, horticulture, plant pathology, agricultural engineering, animal science, and forestry. Thank you for taking time to learn more about our 2025 discoveries and educational resources.

NMREC

# AGRONOMY

**RESEARCHERS:**

AMEE BUMGUARDNER

DILLON HORN

DOUG MESSER

VAUGHN REED

ELIZABETH WORLEY

# The effects of potassium fertilizer on cotton when soil potassium is below the Mississippi lancaster critical level

AMEE BUMGUARDNER, DILLON HORN, DOUG MESSER

Cotton requires potassium (K) in large amounts for crop growth and development compared to other agronomic crops due to increased yield potential of modern cultivars. In the Blackland Prairie region of Mississippi there are heavy clay soils, which have a potential to fix K within the clay particles making it unavailable for cotton uptake. This project seeks to determine the agronomic effects of K on cotton production by providing information specific to practices and soils found in the Black Prairie region of Mississippi. The proposed study evaluates the effectiveness of K application rates in cotton production systems in the Black Prairie region. The objectives of this research were to first evaluate whether K fertilizer application increases yields in fields with different fertility levels, then evaluate the effects of K fertilizer on leaf tissue K and petiole K. This project was conducted at the MAFES Northeast Mississippi Branch in Verona during 2024 and 2025. The cotton variety Deltapine 2333 B3XF was planted on June 21, 2024, due to heavy rains in late May and early June at 46,000 seed $ac^{-1}$ and the variety Deltapine 2328 B3TXF was planted on June 6, 2025, at 42,000 seed $ac^{-1}$ on 38-in row spacing. The experimental design was a randomized complete block design with four replications for a total of 40 plots. The treatments were five rates of K fertilizer (0, 50, 100, 150 and 200 lb K $ac^{-1}$) as dry potassium chloride (KCl; 0-0-60) broadcast applied on June 24, 2024, and June 10, 2025. Soil samples were collected prior to fertilizer application and analysis was conducted at Waters Agricultural labs in Vicksburg, MS and Vaughn Reed's lab at MSU.

In 2024, the difference between the low K field 14 and medium K field 15 was approximately 20 ppm K. The low K field had a lower $R^2$ ($R^2$=0.42), comparing the soil analysis methods of Lancaster and Mehlich III than the high K field, which had a relatively strong relationship between the two analysis ($R^2$= 0.79) (Fig. 1). In 2025, the Lancaster analysis method classified field 14 as medium and field 15 as high according to the MSU Extension Service. The difference in K between the two fields was approximately 30 ppm. With the limited difference in K between the two fields in 2024, there was still a significant increase in yield between fields. A positive response to added K fertilizer was observed in the lower K field (Fig. 2) and a significant yield increase was observed with the addition of 200 lb K $ac^{-1}$ compared to the 0, 50, and 100 lb K $ac^{-1}$. However, it was not different than the 150 lb K $ac^{-1}$. There was no difference in cotton lint yield with the addition of K in the medium K field. Cotton yield was numerically greater in field 15 when 50 lb K $ac^{-1}$ was applied and then decreased in yield with the greater K application rates. In 2025, leaf petiole concentration was greater with the 200 lb K $ac^{-1}$ application than the 100 and 150 lb K $ac^{-1}$. However, there was no difference between the 0 and 50 lb K $ac^{-1}$ (Fig. 3). There were no differences in seed cotton in 2025 for either field. Potassium deficiency was observed early in the 2024 season on field 14, which decreased yields due to not having enough K in the soil for reproductive growth. The late planting in 2024 negatively impacted yields for both fields. The results of this study determined that when you are below the soil critical level for K, it is important to add the recommended amount to reach that level.

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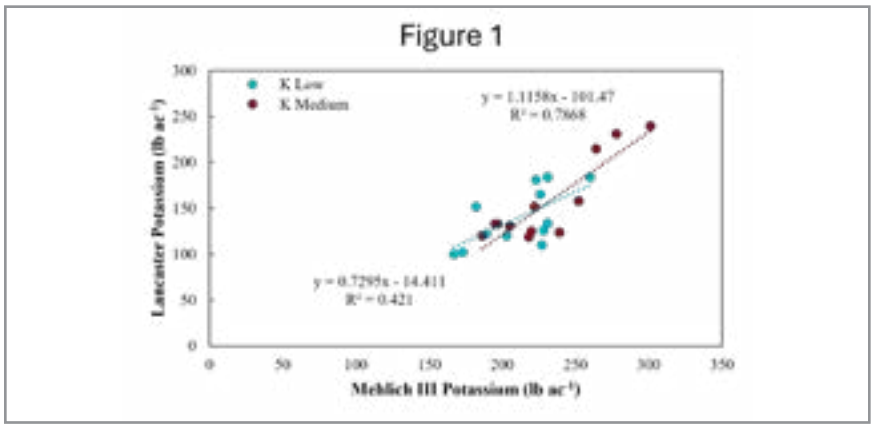


**FIGURE 1.** Regression analysis between soil analysis methods Lancaster and Mehlich III in 2024.

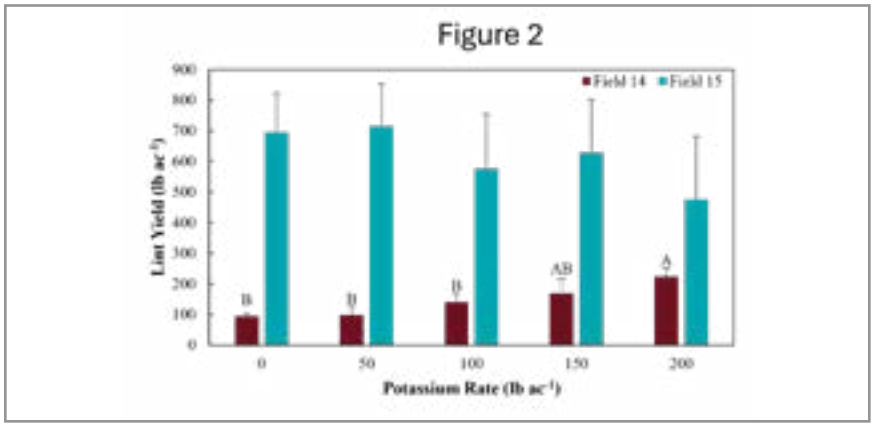


**FIGURE 2.** Cotton lint yield determined in 2024 with low K and medium K fields. The same letter within field 14 means is not different at P < 0.05 by Fisher's protected LSD. The vertical bars represent the standard error of the mean.

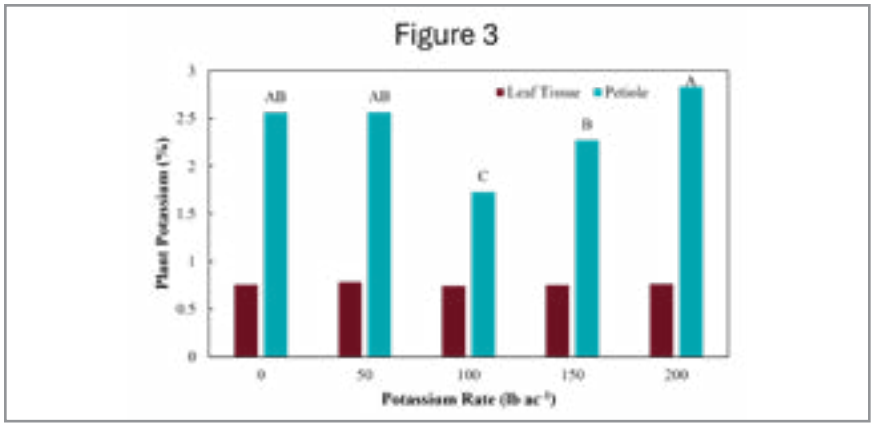


**FIGURE 3.** Leaf tissue and petiole K determined in 2025. The same letter within the petiole K is not different at P < 0.05 by Fisher's protected LSD.

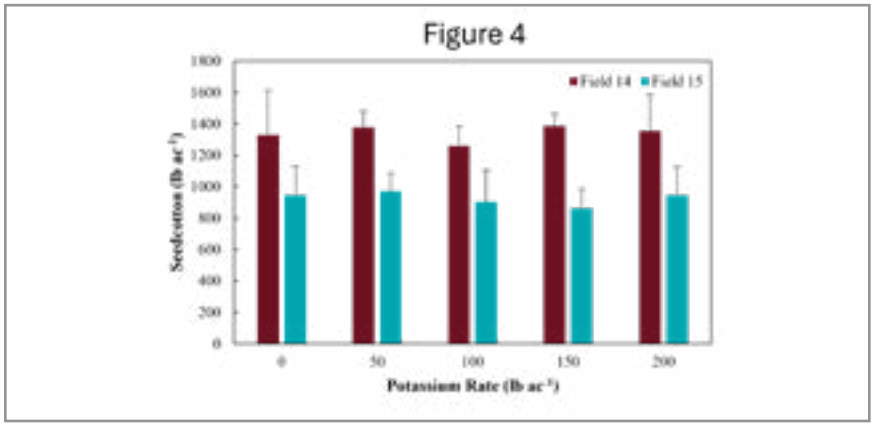


**FIGURE 4.** Seed cotton determined in 2025 with low K and medium K fields. The vertical bars represent the standard error of the mean.

# Finding the limits of late nitrogen applications

VAUGHN REED, ELIZABETH WORLEY, AMEE BUMGUARDNER

**THE SPRING IS AN EXTREMELY BUSY SEASON** for corn producers across the state. Planting is often the first event to happen in fields, followed by fertilizer applications shortly after. Weather is an important variable that can prohibit producers from following this operable timeline. In the spring of 2025, the effects of a rainy spring caused many producers in northeast Mississippi to forego applying nitrogen (N) fertilizer. This led to a less than desirable V6-V10 corn crop.

Current recommendations suggest that a split nitrogen application is the most effective way to maximize yield while maintaining efficiencies, however, there are currently no recommendations for timing of the applications. The objective of this study was to determine how late into a season the first and second nitrogen applications could be applied and still maintain yield.

This study used two experimental structures. The first examined how late the initial nitrogen application could be made while keeping the second application fixed at V10. The second evaluated how late the second application could occur without reducing yields, using a fixed preplant application as the first. In both structures, nitrogen was applied at specific growth stages ranging from V2 to V18/VT.

In 2025, no decrease in yield from delaying N application up to V8 was observed, compared to the all preplant application (Figure 1). Though applying all N at the V10 timing did not maintain yield, as expected. As for the second application, if application was made by V12, yield was maintained, and proofed more efficient than applying all at planting or at V10. This suggests that in this environment, the latest first application could be applied as late as V8, and second application at V12.

Although conditions vary from year to year, continued analysis of the 2024–2026 datasets will help identify environmental indicators, such as rainfall and growing degree days, that can refine and better predict optimal late-application windows. Future research will build on these findings by exploring additional nitrogen-timing strategies, including two-way versus three-way splits and varying application rates at each timing.

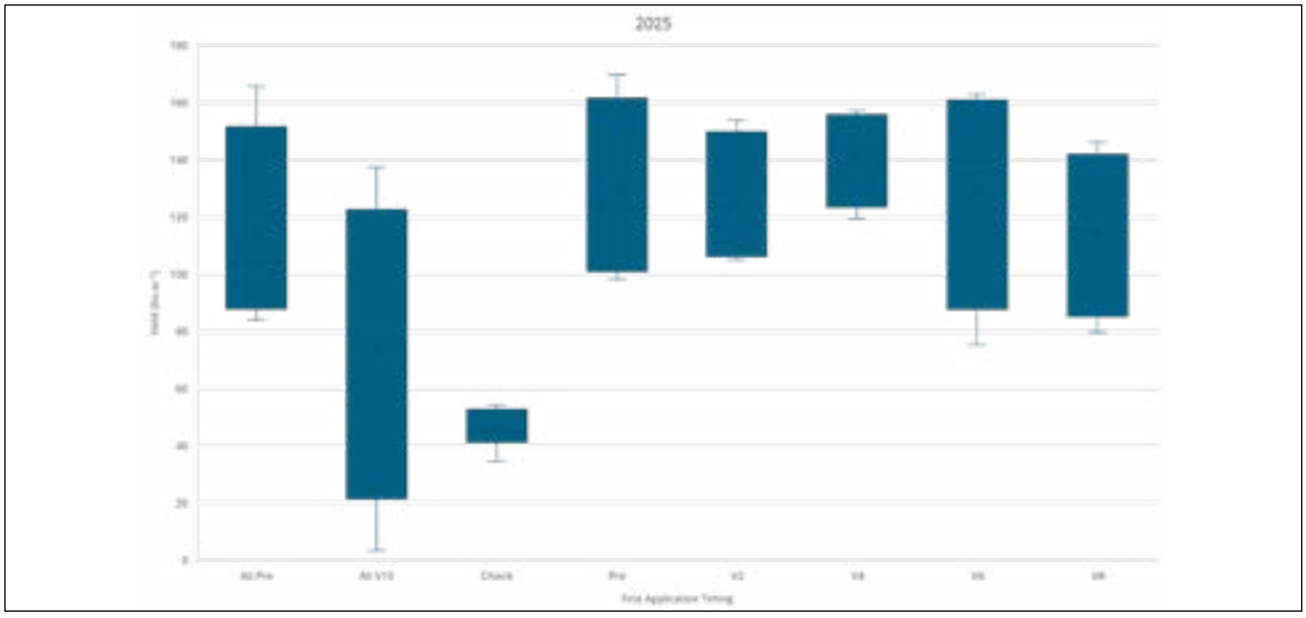


**FIGURE 1.** Yield effects from the first application of nitrogen during crop development.

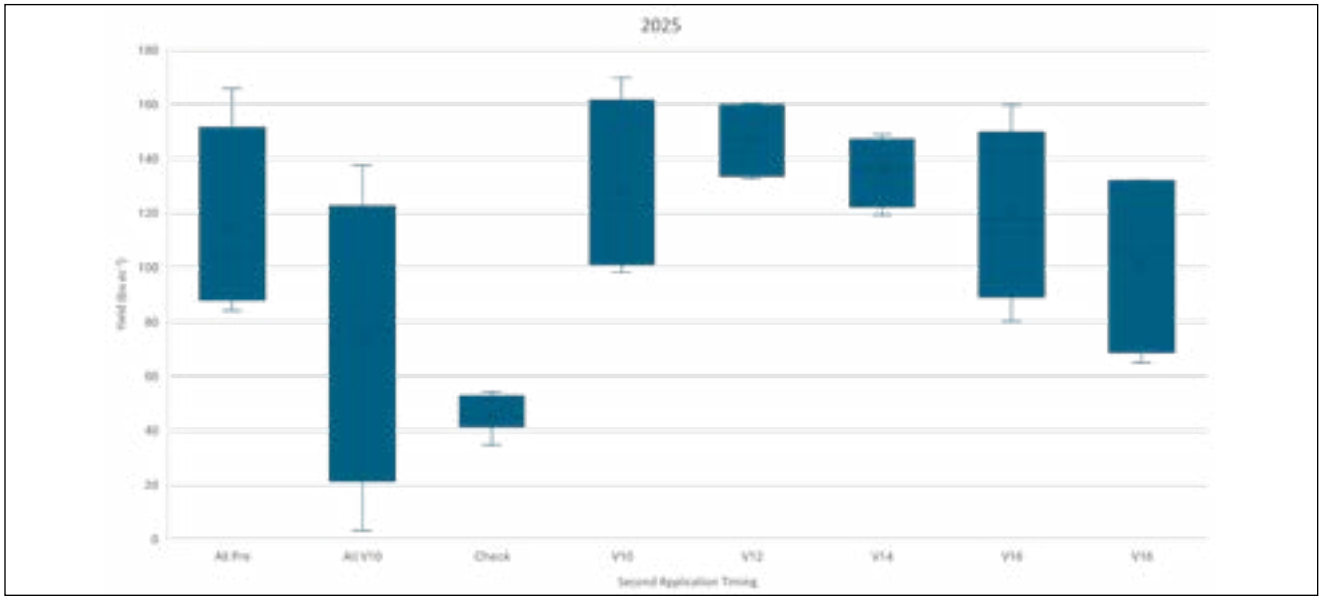


**FIGURE 2.** Yield effects from the second application of nitrogen during crop development.

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# SWEET POTATOES


**RESEARCHERS:**

LORIN HARVEY

PINKKY KANABAR

ALYSSA MILLER

CALLIE MORRIS

PAUL TSENG


# Stronger slips, better yields: Greenhouse hardening of sweetpotato transplants

PINKKY KANABAR, LORIN HARVEY, CALLIE MORRIS

**SWEETPOTATO (*IPOMOEA BATATAS*) PRO-**ducers often face high slip mortality and poor stand establishment during transplanting, which leads to yield losses and economic challenges. Ensuring early slip survival is crucial for successful cultivation. Greenhouse hardening, which exposes slips to controlled stress, can enhance resilience to transplant shock and environmental stressors. This study investigates the effects of hardening treatments on post-transplant performance and storage root yield under field conditions.

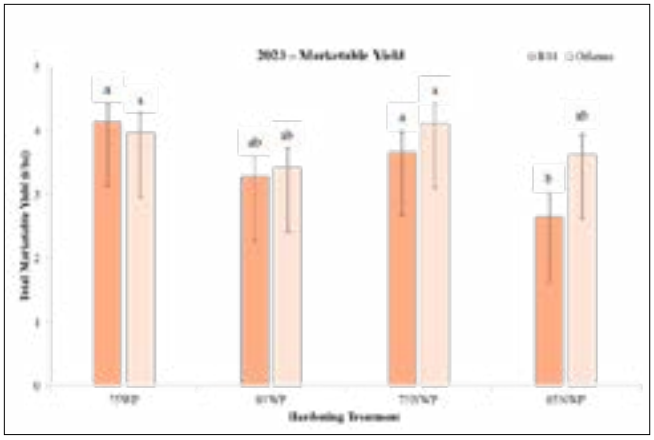
The study included two phases: greenhouse slip production and field transplanting. Both took place at the MAFES Pontotoc Ridge–Flatwoods Branch (34.13789° N, 89.00506° W). Two-node cuttings of cultivars B14 and Orleans were grown for six weeks in 72-cell trays with a peat–perlite–vermiculite mix under natural light in polyethylene greenhouses at 75°F or 85°F and fertilized three times per week with 20N–10P–20K. Slips then received one of two hardening treatments. They were either watered until planting, indicated by WP, or had water withheld for one week, indicated by NWP.

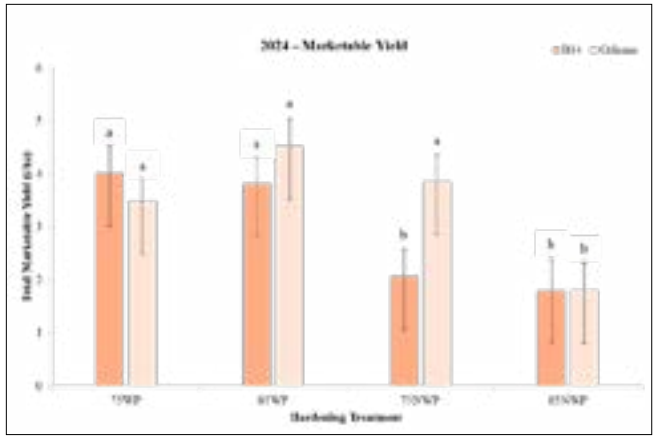
Next, the slips were replanted, outside, in silty loam soil (pH 5.92, 1.28% organic matter) using a mechanical transplanter. The field had eight 30-foot rows spaced 3.33 feet apart, with plants spaced 12 inches within each row, covering about 65 $m^2$. For the field study hardening, cultivar and temperature were all measured. In both the greenhouse and the field, a randomized complete block design was utilized with a 2 x 2 and a 2 x 2 x 2 grid design implemented respectively, and each treatment was replicated four times. Finally, the sweetpotatoes were harvested 111–115 days after transplanting, and graded into either Canner, US No. 1 or Jumbo, and the total marketable yield (kg/ha) was computed.

Slip survival was very strong in both 2023 and 2025, staying above 94% regardless of the applied treatment. Overall, the B14 variety tended to survive better than the Orleans variety. In 2023, Orleans dropped slightly lower with the 85WP treatment (around 93%) but withholding water didn't make much of a difference that year. In 2025, B14 approached 100% survival under 85WP conditions, and Orleans still stayed above 94% even without water. 2024 was a very different story, with survival dropping sharply when water was withheld. 75NWP and 85NWP showed only ~55% and ~20-30% survival, respectively. The watered treatments that year still maintained survival rates above 85%.

Reductions in the 2024 growing season can likely be attributed to delayed transplanting and temperature variability, which potentially exposed slips to variable field conditions and increasing stress. For marketable yield, watered treatments consistently produced the highest yields across all years. In 2023 and 2024, slips that hardened at 75°F yielded about 4 t/ha, while yields declined under 85NWP (<3 t/ha in 2023 and <2 t/ha in 2024). In 2025, the highest yield occurred under 85WP for B14 (~5 t/ha), contrasting with previous years, while Orleans remained lower (~4 t/ha). Water withholding consistently reduced yield, with Orleans generally more sensitive to stress than B14.

These findings emphasize the critical role of effective water management during greenhouse hardening to maintain slip vigor and ensure high transplant survival. Consistent irrigation, along with stable greenhouse conditions and timely transplanting, is essential for producing high-quality slips and optimizing sweetpotato establishment in the field.



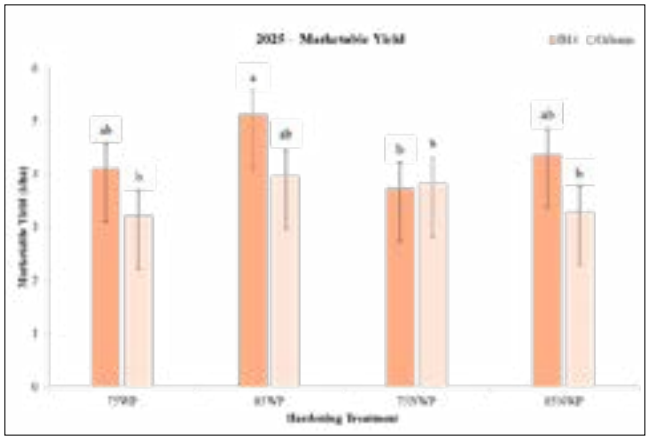
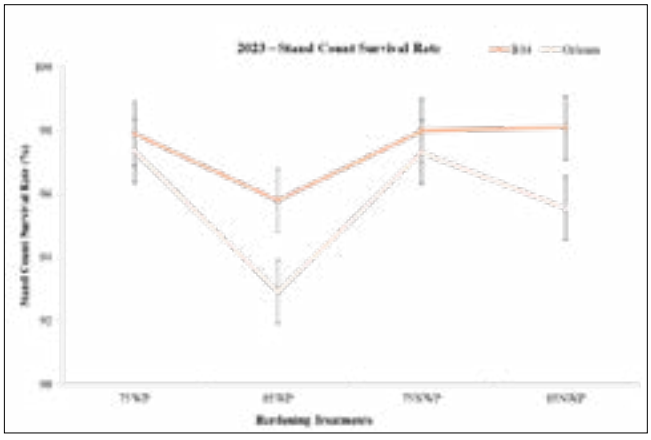
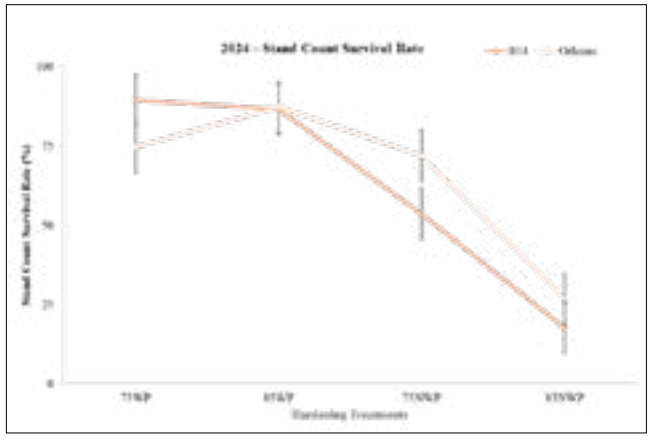




**FIGURE 1.** Marketable sweetpotato yield (t/ha) as affected by greenhouse hardening temperature (75°F and 85°F), watering regime (WP = watered until planting; NWP = water withheld for one week), and cultivar (B14 and Orleans) across three growing seasons.



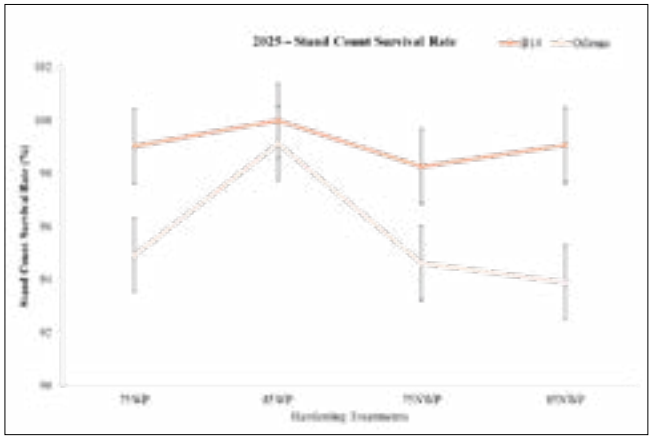




**FIGURE 2.** Slip survival rate (%) as affected by greenhouse hardening temperature (75°F and 85°F), watering regime (WP = watered until planting; NWP = water withheld for one week), and cultivar (B14 and Orleans) across three growing seasons.

# Where weeds fall, food rises: Protecting sweetpotatoes for a hungry world

ALYSSA MILLER, PAUL TSENG, AND LORIN HARVEY

**SWEETPOTATOES *(IPOMOEA BATATAS)*** are the sixth most important food crop globally, and a high-value commodity in the state of Mississippi and across the U.S. Despite its adaptability to low-input systems, sweetpotato cultivation faces significant challenges from weed competition, particularly due to the limited number of herbicides currently labeled for use in the crop. Effective weed management is critical to maintaining yield and market quality, yet many broadleaf and sedge species, such as Palmer amaranth *(Amaranthus palmeri)*, ivyleaf morning glory *(Ipomoea hederacea)*, and yellow nutsedge *(Cyperus esculentus)* are not adequately controlled by tested and available chemical options.

This field study was conducted at the MAFES Pontotoc Ridge-Flatwoods Branch in 2024 and 2025 to evaluate the tolerance for the 'Beauregard' sweetpotato variety to a range of herbicides including pre-emergence applications of fluridone, linuron, metribuzin, sulfentrazone, diclosulam, and imazethapyr; post-transplant applications of metribuzin, linuron, acifluorfen, tolpyralate, and bentazon; and a weed-free control treatment. Visual injury ratings were taken at 7, 14, 21, and 28 days after treatment (DAT), and yield data was collected and categorized into either jumbo, U.S. No. 1, canner or cull grades, and then the overall yield was also computed.

Results indicated that bentazon, fluridone, metribuzin (PRE), sulfentrazone, and tolpyralate caused higher levels of foliar injury compared to diclosulam and imazethapyr. Post applications of linuron and metribuzin caused moderate injury at first, but decreased over time. Both treatments significantly increased marketable yield compared to the untreated control. Over the 28-day period, diclosulam (PRE) caused the highest crop injury at 7%. Metribuzin applied post-transplant produced 2072.12 kg $ha^{-1}$ more marketable yield than the weed-free control. Linuron applied post-transplant produced 3390.64 kg $ha^{-1}$ more total marketable yield and 2771.8 kg $ha^{-1}$ more U.S. No. 1 yield compared to the weed-free control.

These findings support the inclusion of linuron and metribuzin in sweetpotato weed management programs in the future. Both herbicides provide residual control of broadleaf weeds and grasses and may serve as valuable tools to diversify the Mississippi sweetpotato growers' herbicide toolbox, reduce resistance development, and maintain crop productivity. Future studies will focus on herbicide residue analysis to ensure food safety and support registration efforts for expanded use in sweetpotato production.

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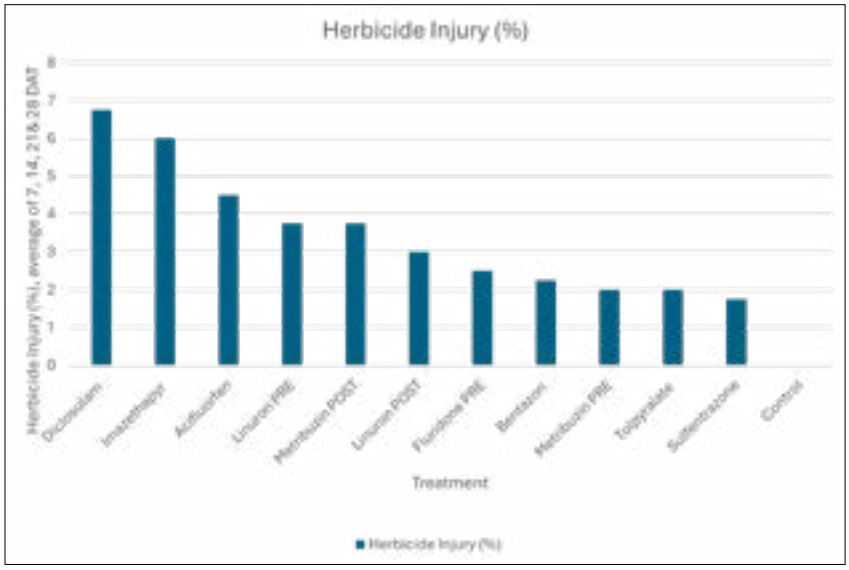


**FIGURE 1:** Average visual herbicide injury in percentage over the periods of 7, 14, 21, and 28 DAT. Note: no injury was seen from any plants in any treatment after 21 DAT.

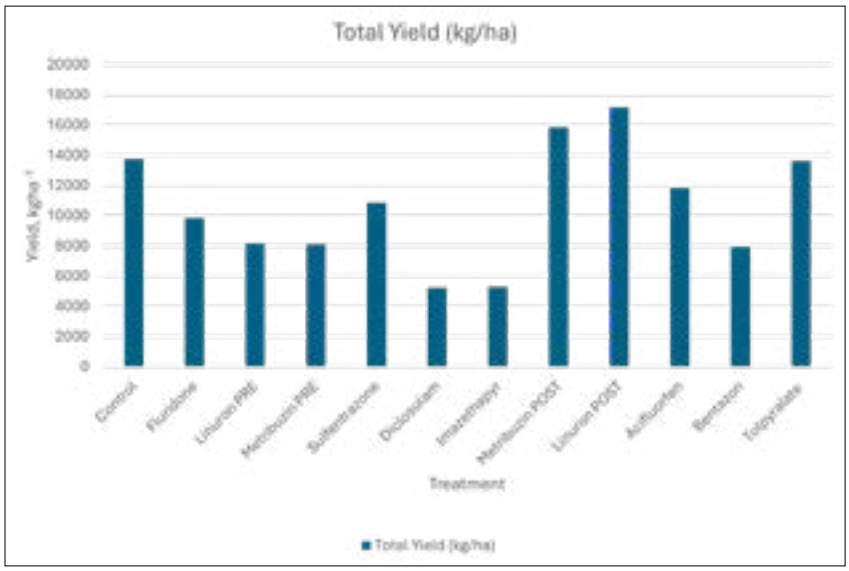


**FIGURE 2:** Average total yield in kg/ha among all four replications of each treatment.


**FIGURE 3:** Average U.S. No. 1 yield in kg/ha among all four replications of each treatment.

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# FORESTRY

**RESEARCHERS:**

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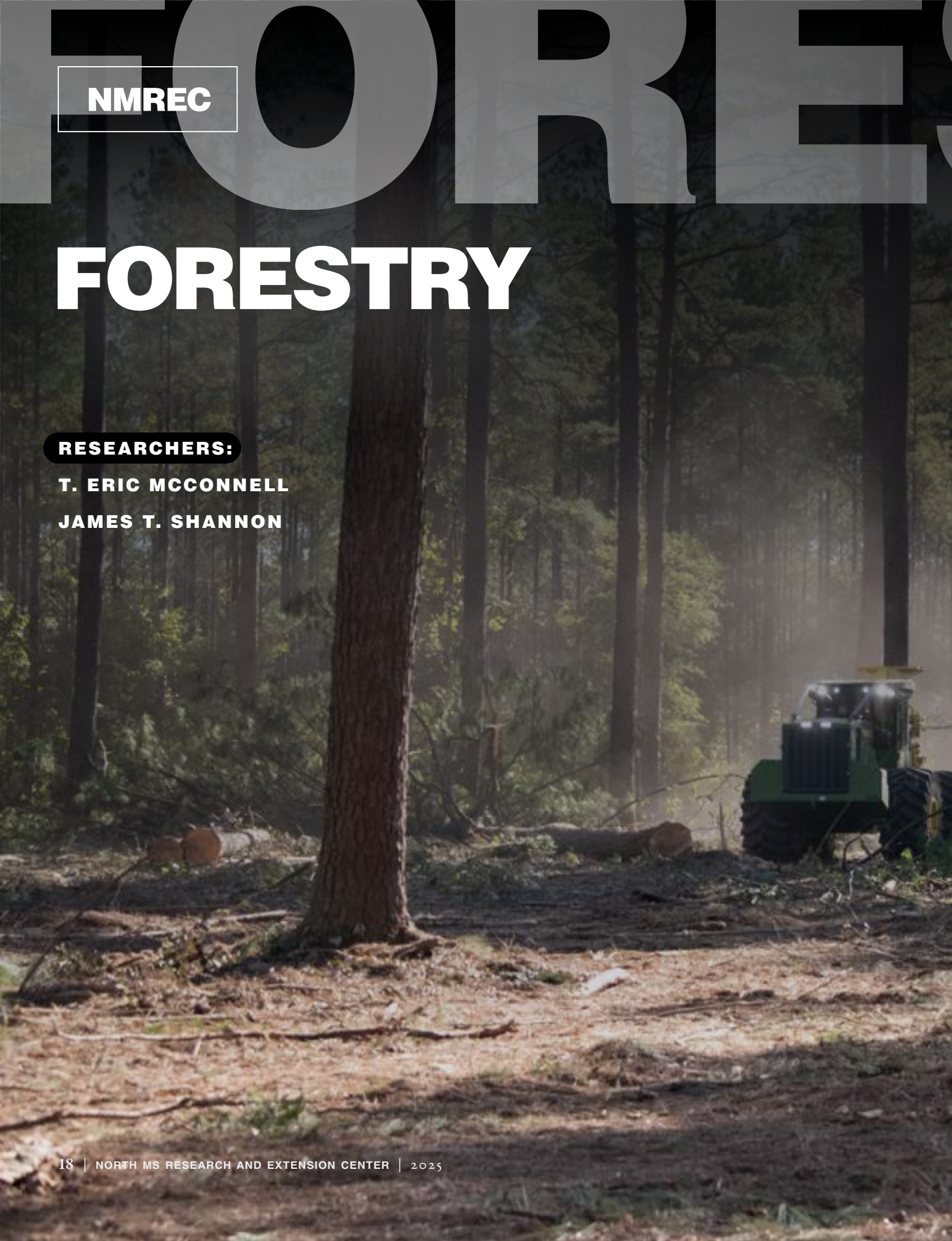
**JAMES T. SHANNON**



# Mississippi log trucking business owner workforce and profitability evaluation

JAMES T. SHANNON AND T. ERIC MCCONNELL

**LOG TRUCKING** has commonly been labeled as an obstacle in maximizing efficiency and performance in the southeastern United States wood supply system. Log trucking challenges include difficulty hiring drivers, rising costs, increasing liability insurance premiums, and resulting profitability concerns.

This study sought to document Mississippi log trucking business owner perceptions regarding increased challenges in hiring qualified truck drivers and in profitability. A state-wide mixed-mode survey was conducted in late 2022 and early 2023 using in-person Mississippi Loggers Association district meetings, an e-mail survey, and an online QR code survey. A total of 98 mixed-mode surveys were collected, yielding a response rate of 9.3%.

Eighty-four percent of Mississippi log trucking companies said hiring qualified drivers in 2021 was harder than in 2019; no respondents said it was easier (Figure 1). Survey participant ratings of factors that had important or very important impacts on hiring drivers included: lack of qualified drivers (88%), failed drug tests (75%), uncompetitive pay (64%), and lack of employee benefits (56%) (Figure 2). More emphasis was placed on driver shortages than on the lack of pay and employee benefits.

Seventy-three percent of Mississippi log trucking companies stated that profits were worse or slightly worse in 2021 compared to 2019 (Figure 3). Survey participant ratings for important and very important factors that impact business profitability included insurance premiums (95%), fuel prices (94%), hiring qualified drivers (92%), trucking rates (89%), accident lawsuits (85%), one-way haul distance (84%), and mill turnaround times (82%). There was less agreement regarding the importance of in-woods turnaround times (71%), road weight limits (70%), and one-way haul distance (67%) (Figure 4). Rising expenses appeared to prompt business owners to place greater emphasis on direct costs rather than on litigation, policy, or operational management.

Group comparisons indicated that Mississippi log trucking business owners were generally in agreement about reduced driver availability, profits, and their contributing factors. Overall, sound business management, cooperation with wood-consuming mills, and workforce development and recruitment could improve results.

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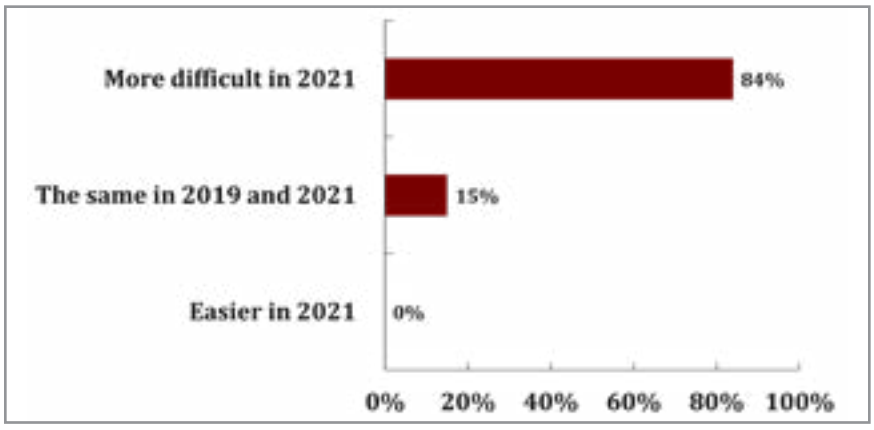


**FIGURE 1.** Mississippi log trucking business survey responses comparing ability to hire drivers in 2019 and 2021. Data were collected using a 5-point Likert scale in a mixed-mode survey conducted during 2022-2023 (more difficult 4,5; same 3; easier 1,2). Summing may not equal 100 due to rounding.

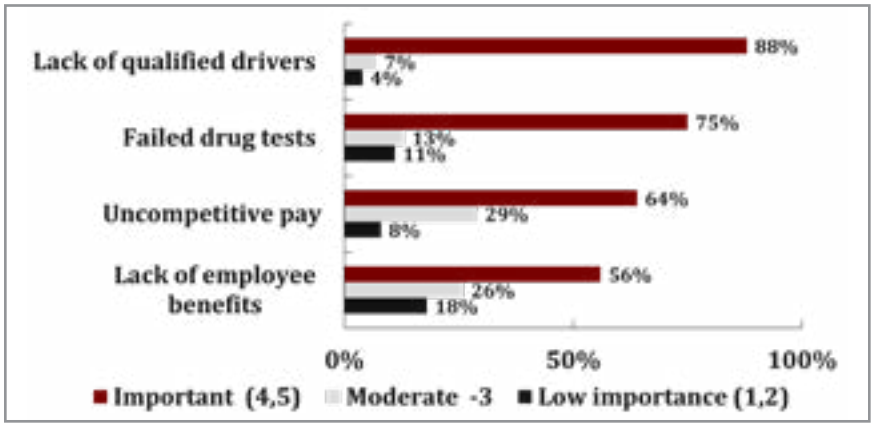


**FIGURE 2.** Percentage of Mississippi log trucking business owner survey responses rating the impact of four variables on hiring qualified drivers. Data were collected using a 5-point Likert scale in a mixed-mode survey conducted during 2022-2023. Summing may not equal 100 due to rounding.

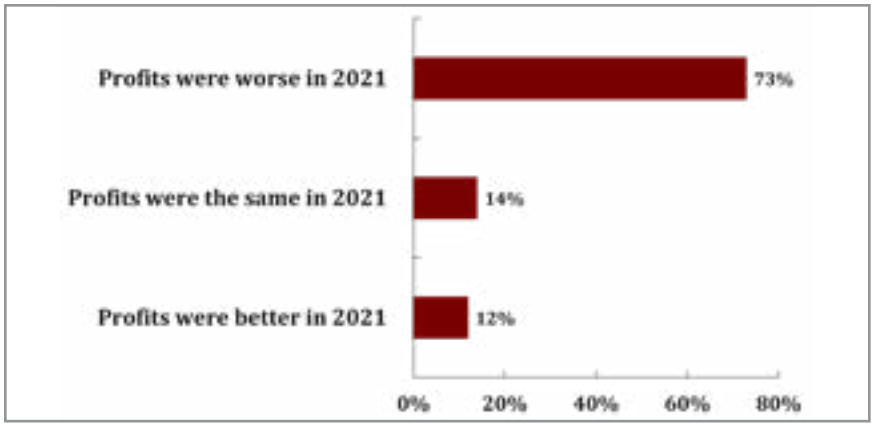


**FIGURE 3.** Mississippi log trucking business survey responses comparing profitability in 2019 and 2021. Data were collected using a 5-point Likert scale in a mixed-mode survey conducted during 2022-2023 (profits worse 4,5; same 3; profits better 1,2). Summing may not equal 100 due to rounding.

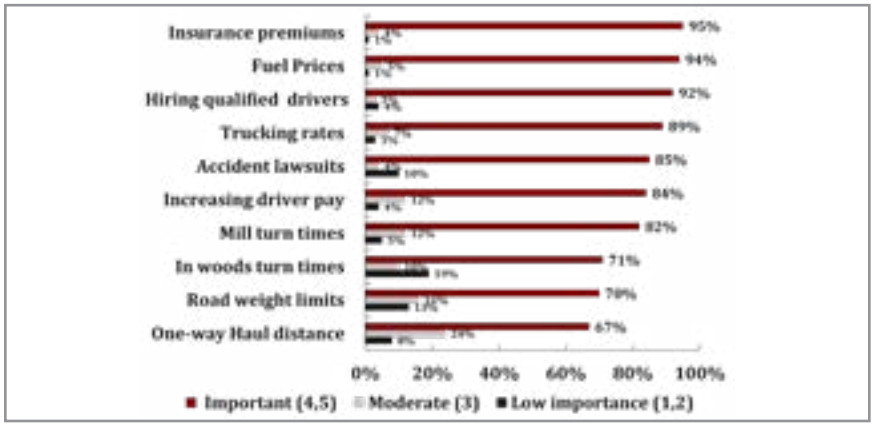


**FIGURE 4.** Percentage of Mississippi log trucking business owner survey responses rating the impact of various variables on profitability. Data were collected using a 5-point Likert scale in a mixed-mode survey conducted during 2022-2023. Summing may not equal 100 due to rounding.

# North Mississippi Research and Extension Center recycling program

JAMES T. SHANNON

**THE NORTH MISSISSIPPI RESEARCH** and Extension Center (NMREC) began its recycling program in 2023 with the goals of preventing recyclable materials from reaching landfills, demonstrating how a business, school or government building can serve as a sorting, collection, and storage site for recyclables.

Collection bins were placed in three areas of the NMREC main office building to collect and sort paper, cardboard, #1 and #2 plastic bottles, plastic grocery bags, and aluminum cans. Larger bins were placed in a laboratory and shop areas across the NMREC campus to store other recyclables, like larger pieces of cardboard. Employees are encouraged to contribute to the effort at work, but can also utilize this resource personally, bringing items from home. The program has been a great success, with 4,975 pounds of materials collected and recycled as of December 2025 (Table 1). The following actions have been taken to recycle materials collected at the NMREC.

Glass has been sorted by color and delivered to four recycling events sponsored by the MSU Campus Services Office of Sustainability. Paper and cardboard have been collected and taken to a local recycling center on four occasions. Aluminum has been delivered to a local recycling center three times, while plastic #1 and #2 bottles have been delivered twice. In addition, plastic bags have been taken to a local retail center on two occasions.

The second part of NMREC's recycling program is public outreach. This is being done in partnership with the Mississippi Department of Transportation's Adopt a Highway Program, focused on maintaining roadsides. NMREC employees are excited for the initiative, having volunteered over 60 man-hours since 2024 during three collection events held on the one-mile stretch of Highway 145. A total of 689 pounds of litter has been removed from the adopted stretch of highway, of which 27% has been recycled (Table 2).


The NMREC recycling program has successfully achieved its initial goals of promoting recycling to its employees and community members. It will continue to beautify Lee County and serve to encourage sustainability for years to come. Future goals include delivering recyclables to local collection sites, hosting events on MSU's Starkville campus twice a year and completing quarterly Adopt-A-Highway cleanup days.

**TABLE 1.** Total weights of all products delivered for recycling. All weights are in pounds.

| Product | Total |
|---|---|
| #1 Plastic | 367.7 |
| #2 Plastic | 480.2 |
| Aluminum Cans | 269.9 |
| Cardboard | 2,689.1 |
| Glass | 1,090.6 |
| Plastic Bags | 77.5 |
| Total | 4,975 |

**TABLE 2.** North Mississippi Research and Extension Center Adopt-A-Highway total weights for each pickup date. All weights are in pounds, glass is not broken, and plastic is in #1 bottles.

| Date | Volunteers | Trash | Scrap metal | Aluminum | Plastic #1 | Glass | Tires | Cardboard | Total |
|---|---|---|---|---|---|---|---|---|---|
| 11/4/2024 | 14 | 206.0 | 33.2 | 6.6 | 4.9 | 27.1 | 46.0 | 0.0 | 323.8 |
| 3/27/2025 | 10 | 137.2 | 27.8 | 3.6 | 2.1 | 12.4 | 18.6 | 0.0 | 201.7 |
| 9/8/2025 | 10 | 97.2 | 26.5 | 10.9 | 7.1 | 13.3 | 0.0 | 8.5 | 163.5 |
| Total | | 440.4 | 87.5 | 21.1 | 14.1 | 52.8 | 64.6 | 8.5 | 689.0 |

NMREC

# BEEF CATTLE


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CATTLE

# Impact of ultra-high stocking density grazing system on cattle behavior and productivity

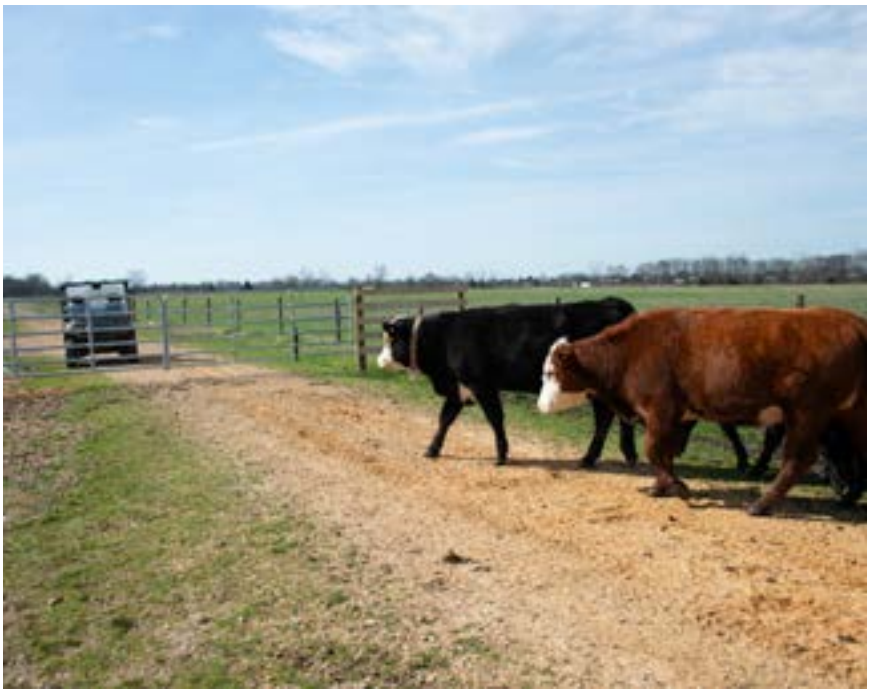
KELSEY HARVEY, AARON NORRIS, AMEE BUMGUARDNER, ANNA MCGEHEE, BROOKLYN LAUBINGER, MADELINE MCKNIGHT, JULES RIMMER, COLE MILES, AND BRANDI KARISCH

**ULTRA-HIGH STOCKING** density (UHSD) grazing—where cattle are rotated strategically through small paddocks at high densities—has been promoted for its potential soil and pasture benefits. However, its effects on cattle behavior and productivity remain less understood. This study evaluated how UHSD grazing influences cattle physiology, growth, and activity patterns.

Fifty Angus crossbred calves were sorted by sex and initial body weight and assigned to 10 paddocks, each two hectares. Each paddock contained five calves (three steers and two heifers) and was assigned to one of two treatments: UHSD grazing (stocking density of 55,000 kg of liveweight/ha) or continuous grazing (CON) (stocking density of 625 kg of liveweight/ha). Grazing occurred on predominant forage species for 28 days.

The UHSD paddocks used a combination of permanent and temporary fencing to achieve required stocking densities and plot sizes. Calves were moved to new paddocks once forage height reached a 7 centimeter residual height. Soil bulk density and penetrometer resistance were measured on day 0 and day 28, while forage biomass was recorded weekly.

Calves were fitted with ear tags on day 0 to monitor behavior. Calf body weight and exit velocity were collected weekly. Data was averaged by the week and analyzed for treatment, week, and treatment per week effects with differences evaluated using the least squared means method, which is a mathematical approach to finding the best-fit line of a given set of data-points.



Soil bulk density did not differ between treatments, whereas penetrometer resistance was greater in UHSD paddocks, suggesting increased soil compaction. Forage biomass did not differ between treatments.

Exit velocity also did not differ between UHSD and CON calves. Weekly average proportion of time spent eating and classified as not active was reduced ($P < 0.01$) during the experiment for UHSD vs. CON calves. A treatment × week interaction was detected ($P < 0.01$) for weekly average proportion of time spent ruminating, which was greater ($P < 0.01$) during week 1 and tended ($P = 0.08$) to be greater during week 2 for CON vs. UHSD. A treatment × week interaction was detected ($P < 0.01$) for weekly average proportion of time spent highly active which was greater ($P = 0.02$) during week 4 in UHSD vs. CON calves. Overall calf average daily gain was greater ($P < 0.01$) in CON vs. UHSD calves (0.58 and 0.14 kg/d, respectively, SEM = 0.06), accordingly final BW tended ($P = 0.07$) to be greater in CON vs. UHSD calves.

Collectively, results from this experiment suggest that UHSD grazing increases soil compaction and compromises short-term cattle growth performance. Further research is warranted to investigate UHSD strategies with mature cattle.

# Impact of post-weaning stair-step nutritional regimen in beef heifers on the reproductive development and productivity as primiparous cows

BROOKLYN S. LAUBINGER, KELSEY M. HARVEY, MASON E. DREWERY, ANNA E. MCGEHEE, JULES RIMMER, T. COLE MILES, MADELINE G. MCKNIGHT, TORIANN S. WINTON, REINALDO F. COOKE, CALEB O. LEMLEY, JESSICA HALFEN, AND BRANDI B. KARISCH

Replacement beef heifers represent a substantial investment for cattle producers and require appropriate management to achieve puberty, conceive, and calve efficiently. This study evaluated the impact of post-weaning body weight (BW) gain on reproductive development and subsequent productivity in primiparous cows.

Sixty Angus crossbred heifers were stratified by age and BW (237 ± 6 d; 226 ± 6 kg) at 28 d post-weaning (d -3) and randomly assigned to one of three supplementation strategies from d 0 to 168—a forage-based diet designed to restrict BW gain (low control; LC), concentrate supplementation to promote accelerated BW gain (high control; HC), or a stair-step regimen consisting of HC for 2 months, followed by LC for 2 months, followed by HC for the final 2 months (SS).

Heifers were maintained in a single pasture with ad libitum access to grass hay and individually fed supplement treatments six days weekly. Shrunk BW was recorded on d -3 and 169 to calculate average daily gain (ADG). Blood samples were collected weekly from d 0 to 168 to assess pubertal status via plasma progesterone. From d 169 to 222, heifers were subjected to a fixed-time artificial insemination protocol combined with natural service.

As designed, overall ADG from d 0 to 168 was greater ($P < 0.01$) in HC versus SS and LC (0.76, 0.68, and 0.48 kg/d, respectively; SEM = 0.02), and greater ($P < 0.01$) in SS versus LC heifers. Puberty attainment was delayed (treatment × day; $P < 0.01$) in LC heifers compared to HC and SS. No treatment differences were detected ($P = 0.69$) for pregnancy rate. No treatment differences were detected ($P \geq 0.11$) for heifer BW or body condition score at calving, or calf birth BW. Calving rate was greater (treatment × day; $P < 0.01$) in SS and LC heifers compared to HC. Heifers were assessed for milk production via weigh-suckle-weigh at 51.3 ± 1.4 d postpartum followed by milk sample collection and mammary artery hemodynamic assessment via Doppler ultrasonography 24 h later. No treatment differences were detected ($P \geq 0.50$) for milk yield or composition. Average resistance index was greater ($P = 0.03$) in SS versus LC, and average pulsatility index was greater ($P \leq 0.05$) in SS versus LC and HC, indicating reduced mammary blood flow in SS versus LC. No treatment differences were detected ($P \geq 0.11$) for offspring age or BW at weaning.

Collectively, results from this experiment indicate that HC and SS hastened the reproductive development of replacement heifers, without negatively affecting their milk productivity as primiparous cows. Exposure to a stair-step nutritional regimen may be an opportunity to hasten puberty attainment in replacement beef heifers, while reducing feed input.

# Trace mineral supplementation strategies for beef cattle during preconditioning and feedlot receiving

MADELINE G. MCKNIGHT, KELSEY M. HARVEY, W. ISAAC JUMPER, JULIANA RANCHES, BRANDI B. KARISCH

**BEEF CATTLE ROUTINELY EXPERIENCE A** variety of stressors during the preconditioning and feedlot receiving phases, such as weaning, transportation, and pathogen exposure. These challenges can trigger physiological responses that impair metabolism and suppress immune function, ultimately compromising animal performance. To help offset these effects, producers often turn to targeted nutritional strategies such as trace mineral supplementation.

Trace minerals—including copper (Cu), cobalt (Co), manganese (Mn), selenium (Se), and zinc (Zn)—play key roles in antioxidant defense, energy metabolism, and immune system activity. These functions are particularly important during periods of increased stress. However, supplementation strategies differ in form, bioavailability, and route of administration, which can influence their effectiveness in stressed cattle.

Inorganic trace minerals (INR), typically bound to sulfate or oxide molecules, are widely used due to their relatively low cost. However, their absorption can be limited by antagonistic interactions in the gastrointestinal tract. Organic trace minerals (OTM)—those bound to amino acids or other organic ligands—generally exhibit improved bioavailability compared to inorganic sources. Injectable trace mineral (ITM) solutions provide an alternative route by delivering minerals directly into circulation for rapid availability.

Despite these options, research evaluating the effectiveness of different trace mineral sources has produced variable results, with no clear consensus of best practices for cattle entering preconditioning or feedlot receiving phases. To address this, two systematic reviews and meta-analyses were conducted to evaluate the effects of organic (OTM) versus inorganic (INR) oral trace mineral supplementation, and the effects of injectable trace mineral (ITM) products on average daily gain (ADG) and morbidity. Across 20 studies, OTM supplementation increased ADG ($P = 0.01$) by 0.04 kg/d compared to INR but did not influence morbidity ($P = 0.92$). In a separate analysis of 16 studies examining ITM administration, no overall effects were observed on ADG ($P = 0.21$) or morbidity ($P = 0.20$). However, when studies were categorized by risk classification, ITM use improved ADG ($P = 0.03$) by 0.12 kg/d in high-risk cattle—those with unknown management or vaccination histories—while no effect was detected in low-risk cattle ($P – 0.93$) compared to saline controls.

Taken together, these results indicate that although trace mineral supplementation may not reduce morbidity, strategic trace mineral selection can support growth performance during stress. Organic trace minerals offer a consistent advantage over inorganic sources, and injectable products may be particularly beneficial for high-risk cattle entering preconditioning or feedlot systems.

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NMREC

# AGRICULTURAL ENGINEERING


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LUCAS B. FERREIRA

VITOR S. MARTINS



FPS: 112
NVIDIA GeForce RTX 5090: 10.1 GiB
Process Memory: 16.1 GiB

# Advancing agriculture through artificial intelligence, sensing, and automation

LUCAS B. FERREIRA

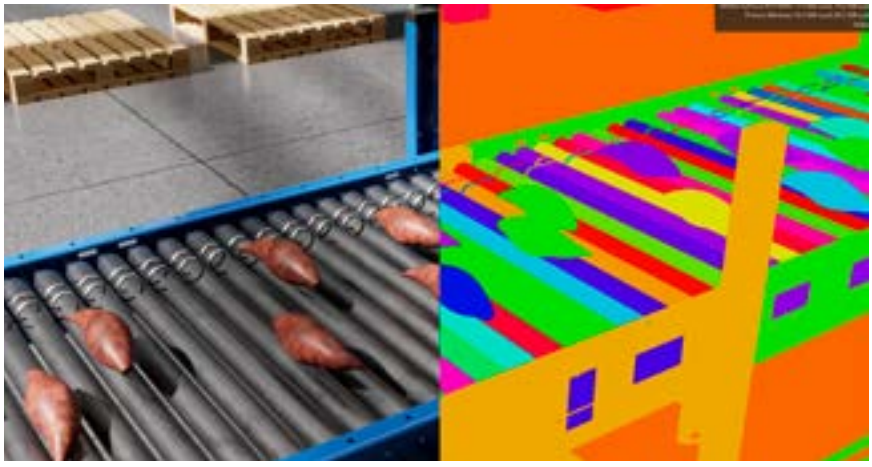

**FIGURE 1.** Digital twin of a sweet potato packing line. Each object inside the simulation can be tracked, allowing for automatic creation of datasets to train artificial intelligence models.

**DIGITAL AGRICULTURE** and modern technologies, including artificial intelligence (AI), sensors, and automation play an increasingly important role in improving agricultural efficiency and productivity. Recent advances in AI and computing power have allowed for the development of new tools for crop monitoring, disease detection, irrigation scheduling, and automated agricultural systems.

To support these efforts and contribute to regional and national agriculture, a new research group focused on sensing and automation technologies is being established at the North Mississippi Research and Extension Center. The group is led by Dr. Lucas B. Ferreira, an assistant professor in agricultural and biological engineering, with expertise in artificial intelligence and digital agriculture.

One of the primary challenges in developing AI-based solutions for agriculture is the need for large, high-quality datasets, particularly image data. After images are collected, a major bottleneck is the manual annotation process required to train AI models. For example, developing an AI system to detect poor-quality sweet potatoes on a packing line requires collecting numerous images of the system and manually labeling the location of defective sweet potatoes within each image.

To reduce reliance on manually prepared datasets, current research is exploring the use of a technology called "digital twins" combined with generative AI. Digital twins are virtual replicas of real-world systems that allow researchers to simulate agricultural environments in detail (Figure 1). Within these virtual environments, researchers can automatically generate variations in lighting, shadows, object placement, and operational scenarios. This approach allows datasets to be created more efficiently and with greater diversity, reducing the time and labor required to develop robust AI models. Similar techniques have shown strong potential in other industries, and this research aims to extend those benefits to agricultural applications.

# Delineating agricultural field boundaries from the sky

LUCAS B. FERREIRA AND VITOR S. MARTINS

**FIGURE 1.** Demonstration of agricultural field boundaries extracted using satellite images (Sentinel-2) and an artificial intelligence model (Segment Anything Model).

**IN DIGITAL AGRICULTURE,** accurate field boundary information is essential for research and commercial applications. Field boundaries are commonly defined using GPS data or manually drawn from satellite imagery, but these approaches can be time-consuming when working across many fields. Automated methods offer a more efficient alternative.

Recent research, from a team led by Drs. Lucas Ferreira and Vitor Martins, assistant professors in agricultural and biological engineering, demonstrates that artificial intelligence (AI) models combined with freely available satellite imagery can successfully automate field boundary delineation (Figure 1). Satellite platforms such as Sentinel-2 provide free, broad coverage and frequent updates, making them valuable tools for agricultural monitoring. However, their relatively low spatial resolution can limit performance when identifying small fields, such as those around one acre in size.

To address this limitation, the team's research applies AI-based image enhancement techniques before extracting field boundaries . Specifically, a method known as "super resolution" is used to improve image quality by increasing visual detail and clarity (Figure 2). Preliminary results indicate that enhancing satellite imagery in this way improves the accuracy of boundary extraction for smaller fields.

In addition, the study is evaluating new AI models designed to further refine boundary detection. Together, these advancements improve the ability to automatically delineate agricultural fields with diverse sizes and characteristics, supporting the growing demand for high-quality spatial data in digital agriculture.

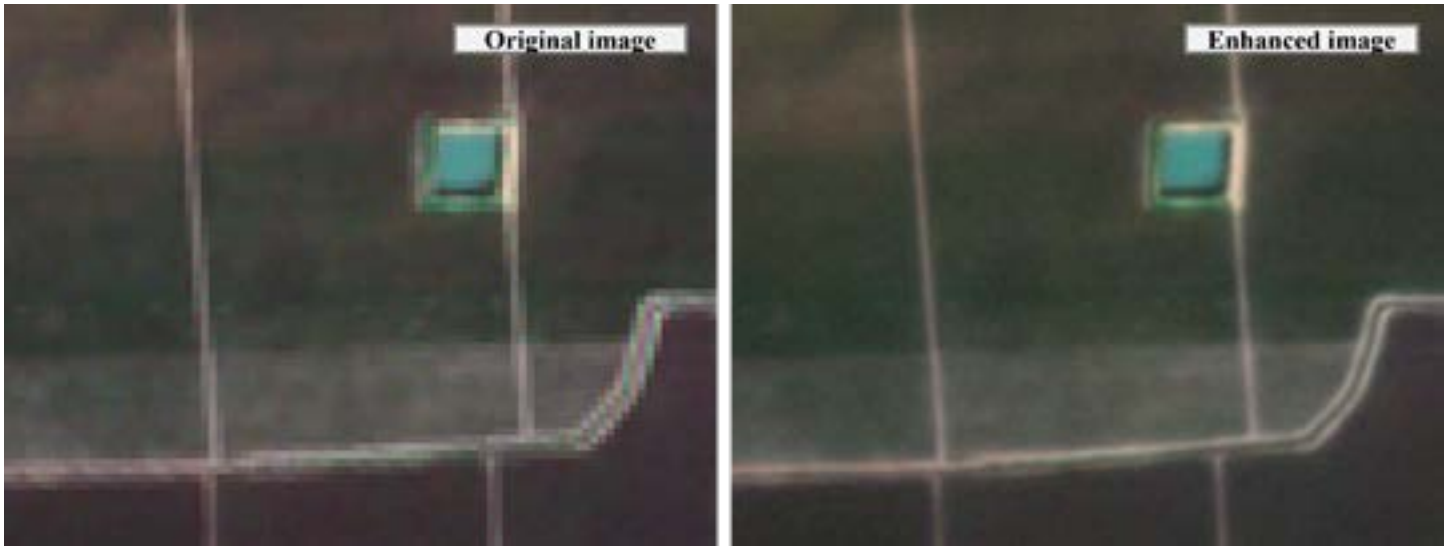


**FIGURE 2.** Demonstration of the use of AI-based super-resolution to enhance the quality of satellite images.

NMREC

# PLANT PATHOLOGY


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LORN HARVEY

MISBAKHUL MUNIR

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# Identification and distribution of pathogens causing postharvest diseases on sweetpotato in Mississippi: A pathogen survey

BY MISBAKHUL MUNIR AND LORIN HARVEY

**POSTHARVEST DISEASES** pose major challenges for sweetpotato (*Ipomoea batatas*) production. They reduce not only the economic value but also the nutritional quality of the crops. In sweetpotato production, 20 to 25% of total crop losses occur during curing and storage where postharvest diseases account for the greatest loss. While diseases can be caused by different organisms (fungi, bacteria, nematodes, or viruses), fungal diseases are the most common postharvest diseases of sweetpotato. To determine the identity and distribution of fungal pathogens associated with postharvest diseases on sweetpotato in Mississippi, diseased sweetpotato storage roots were sampled from nine packing facilities across major producing counties in Mississippi and from the storage at the MAFES Pontotoc Ridge-Flatwoods Branch (10 sites total). Fungal pathogens were then isolated from the diseased sweetpotato samples and grown as pure cultures on potato dextrose agar (PDA, fungal growth media) in Petri dishes in the lab. The fungal isolates were grouped and identified based on their morphological features and characteristics.

Approximately 274 fungal isolates were recovered from diseased sweetpotato samples in 2025. The preliminary results of the pathogen identification study indicated that multiple fungal pathogens were affecting sweetpotato postharvest in Mississippi. *Fusarium*, *Aspergillus*, *Lasiodiplodia*, *Ceratocystis*, *Rhizopus*, and *Macrophomina* were the most commonly recovered genera from the samples. These genera are associated with *Fusarium* root rot/surface rot, *Aspergillus* rot, java black rot, black rot, soft rot, and charcoal rot, respectively. Among these fungal genera, *Fusarium* was the most frequently recovered from the samples, with 58% of the total isolates belonging to this genus (Figure 1). In addition, *Fusarium* was the most widely distributed genus, having been found at all ten sample sites (Table 1).

Effective disease management depends on correctly identifying the causal agent(s) of the disease. The fungal isolates collected in this study provide an important resource for future applied research. They can be used to evaluate improved management strategies—such as testing alternative fungicides to Botran® and assessing cultivar resistance—and to support the development of pathogen detection systems. Leveraging the isolate collection from this study, these potential future studies will help producers make accurate and effective decisions in managing the diseases. In turn, it will result in reduced losses due to postharvest diseases.

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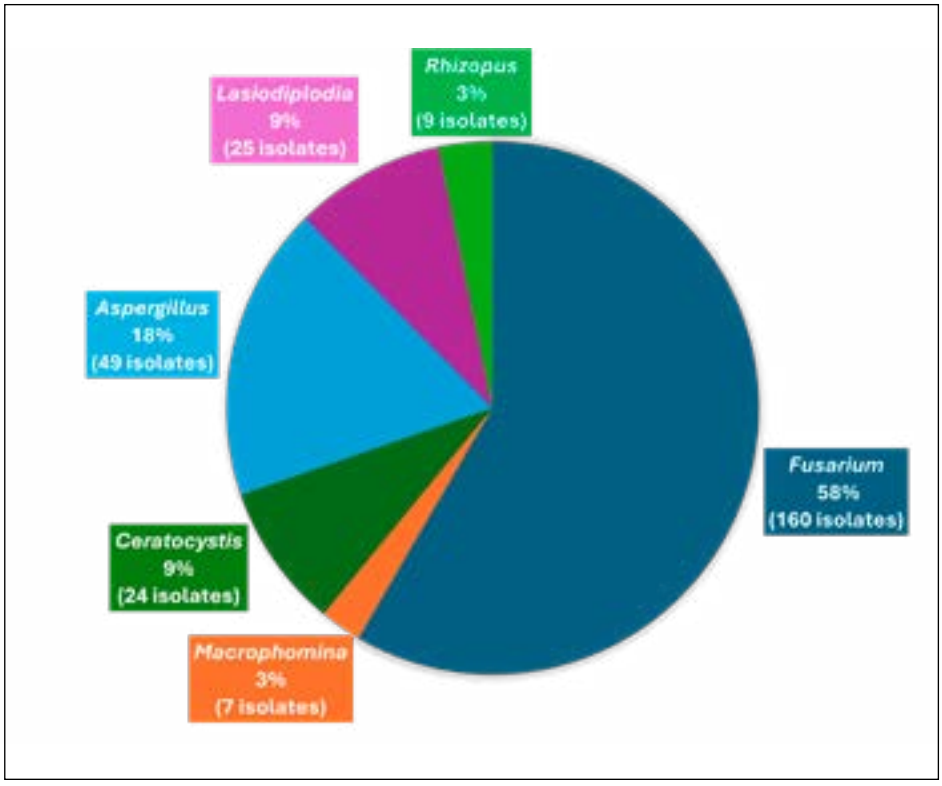


**FIGURE 1.** Prevalence of fungal pathogens associated with post- harvest diseases on sweetpotato collected from 10 sweetpotato packing facilities/ storages in Mississippi (total fungal isolates recovered from samples was 274 isolates).

**TABLE 1.** Widespread distribution of fungal pathogens associated with postharvest diseases on sweetpotato collected from 10 sweetpotato packing facilities/storages in Mississippi.

| Genus | Disease | Widespread Distribution |
|---|---|---|
| *Fusarium* | *Fusarium* root rot, surface rot | 10 out of 10 sites |
| *Ceratocystis* | Black rot | 8 out of 10 sites |
| *Aspergillus* | *Aspergillus* rot | 7 out of 10 sites |
| *Rhizopus* | Soft rot | 6 out of 10 sites |
| *Lasiodiplodia* | Java black rot | 5 out of 10 sites |
| *Macrophomina* | Charcoal rot | 2 out of 10 sites |

# Evaluation of potential phytotoxicity of fungicides for the control of powdery mildew in lettuce in a greenhouse hydroponic production system

BY TIMOTHY AYANKOJO, MISBAKHUL MUNIR AND JAIMIN PATEL

**POWDERY MILDEW** (*Erysiphaceae*) is one of the most significant fungal diseases in greenhouse production of romaine lettuce (*Lactuca sativa* 'Green Forest'). Symptoms include a white powdery coating, and chlorotic and deformed leaves. Severely infected leaves can turn yellow or brown, become dry and brittle and in severe cases die. The importance of fungicide in disease management is demonstrated by an increasing number of newly registered fungicides available for use against powdery mildew. While the availability of new fungicides may provide growers with more options for integrated pest management strategies, it also creates the need for evaluation of potential impacts to crop safety including evaluating the risk of fungicide in causing phytotoxicity causing plant injury or adverse effects on plant growth, physiology, or metabolism.

In this study the potential phytotoxicity of two different application rates of Avelyo (active ingredient: mefentrifluconazole) were evaluated for its ability to control powdery mildew. The trial was conducted in 2025 in Veronaon lettuce in a greenhouse hydroponic production system with a nutrient film technique (NFT) system. The study used four treatments: a water-spray control, Procure at 8 fl oz/acre (triflumizole)(the highest recommended rate of standard fungicide for powdery mildew management), and Avelyo applied at either 5 or 10 fl oz/acre. All treatment applications were started 10 days after lettuce transplanting (DAT) to ensure the plants were fully established and prevent potential variability among treatments due to variation in plant growth. The water spray and both Avelyo treatments were applied at 7-day intervals, while Procure was applied at 14-day intervals. Phytotoxicity rating was then conducted weekly starting from 7 days after the first

treatment application until harvest. During this process, each plant in each treatment plot was carefully examined and rated for signs of toxicity. Finally, plant growth data including leaf number, leaf or head area, and plant height, were collected and reported weekly after the first treatment application from all plants in each treatment plot, and plant weight data (yield) was collected at harvest.

No visible injury from fungicide applications was observed at any point during the trial. The number of leaves did not differ significantly among treatments on any observation date. For plant height, significant differences were detected only at the earliest observation (16 DAT). At 30 and 37 DAT, plants treated with Procure had significantly lower leaf area than the untreated control, while leaf area under both Avelyo rates did not differ significantly from the control. Fresh weight was significantly higher under the low-rate Avelyo treatment compared to the Procure treatment (Table 1).

The plant growth data collected in this trial suggest that the highest recommended rate of Procure posed a relatively higher adverse effect on plant growth than both Avelyo regimes. Results from this trial can help advise greenhouse lettuce growers in minimizing phytotoxicity while managing powdery mildew using fungicides through rate adjustment.

**Completed research may be found at:**

Ayankojo, I. T., M. Munir, J. Patel. 2025. Evaluation of potential phytotoxicity of Avelyo for the control of powdery mildew in lettuce in a greenhouse hydroponic production system in Mississippi, 2025. Plant Health Progress. https://doi.org/10.1094/PHP-04-25-0125-PDMR

**TABLE 1.** Evaluation of potential phytotoxicity of Avelyo for the control of powdery mildew in lettuce (*Lactuca sativa* – 'Green Forest') in a greenhouse hydroponic production system[w].

| Treatment and amount/A | Appl. Timing[x] | Mean number of leaves (NL), leaf area (LA) ($cm^2$), and plant height (PH) (cm) at 16 dat | | | Mean number of leaves (NL), leaf area (LA) ($cm^2$), and plant height (PH) (cm) at 24 dat | | | Mean number of leaves (NL), leaf area (LA) ($cm^2$), and plant height (PH) (cm) at 30 dat | | | Mean number of leaves (NL), leaf area (LA) ($cm^2$), and plant height (PH) (cm) at 37 dat | | | Mean fresh weight (g/plant) at harvest[y,z] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NL | LA | PH[z] | NL | LA | PH | NL | LA[z] | PH | NL | LA[z] | PH | |
| Untreated | A,B,C | 7 | 401.3 | 9.2 ab | 9 | 796.4 | 15.1 | 10 | 982.0 a | 24.0 | 15 | 1245.4 a | 33.9 | 344.3 ab |
| Procure 8 fl oz | A,C | 7 | 275.0 | 7.3 b | 8 | 650.7 | 13.1 | 10 | 779.6 b | 19.7 | 15 | 1005.5 b | 33.4 | 326.9 b |
| Avelyo 5 fl oz | A,B,C | 7 | 448.8 | 9.9 a | 9 | 846.8 | 18.5 | 10 | 1006.6 a | 24.5 | 15 | 1221.9 a | 36.5 | 403.9 a |
| Avelyo 10 fl oz | A,B,C | 7 | 374.0 | 8.6 ab | 9 | 784.4 | 13.8 | 10 | 966.1 a | 21.4 | 15 | 1100.2 ab | 34.1 | 354.5 ab |
| *P-value* | | *0.665* | *0.134* | *0.050* | *0.873* | *0.157* | *0.143* | *0.955* | *0.006* | *0.060* | *0.863* | *0.011* | *0.132* | *0.046* |

[w]No visible injury (e.g., plant damage, burn, dead tissue, yellowing, or leaf distortion) was observed on the plants (phytotoxicity scale = 0) at the four observation dates (10 days after transplanting [dat], 16 dat, and 24 dat), thus statistical analysis was not conducted for phytotoxicity rating and data were not shown.
[x]Application code representing intervals for treatment applications: A – 10 dat, B – 16 dat, and C – 24 dat.
[y]Fresh weight was collected at harvest which was at 39 dat.
[z]Means within columns followed by the same letter are not significantly different according to Tukey HSD test ($a < 0.05$).

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# HORTICULTURE


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# Assessing fungicide options for white mold management in field tomato production

TIMOTHY AYANKOJO, ALAN HENN AND JAIMIN PATEL

**WHITE MOLD, OR TIMBER** rot, is a destructive fungal disease in field-grown tomatoes caused by the soilborne pathogen *Sclerotinia sclerotiorum*. The disease can lead to significant yield losses in vegetable crops. Early symptoms typically appear as water-soaked lesions at the stem base or on lower branch axils under cool, moist conditions. As infection progresses, affected tissues become necrotic, drying and splitting until they ultimately collapse. Due to the disease's destructive nature and persistence in soil, fungicides remain one of the most important management tools available to tomato growers.

This study was conducted at the MAFES Northeast Mississippi Branch in Verona, to evaluate the efficacy of several fungicides for white mold control in field tomatoes (*Solanum lycopersicum*). Tomato seedlings were transplanted on August 1, 2024, into raised beds covered with black plastic mulch, equipped with drip irrigation. The experimental design was a randomized complete block with five replications per treatment. Seven fungicide treatments were evaluated: Control, Priaxor (standard control), Tessaris, Miravis, Omega, Quash, and Switch. All fungicides were applied through the drip system beginning two days after transplanting. To ensure adequate disease pressure, all plants were inoculated with *S. sclerotiorum*.

Most treatments received three applications before inoculation (August 3, 16, and 30) and three applications after inoculation (September 13, 27, and October 11). Switch and Miravis Prime received only two post-inoculation applications. To assess phytotoxicity, disease ratings were recorded seven days after each application and plant height measurements were taken at 7 and 11 weeks after transplanting. Harvests were conducted on October 16 and November 17 using eight representative plants from each plot.

Environmental conditions experienced during the study were largely unfavorable for white mold development. No rainfall occurred during the first 28 days after transplanting, temperatures remained high (30°C max; 17°C min) and relative humidity averaged only 49%. The crop faced only minimal disease pressure. Despite this, notable differences among treatments were still observed. Disease incidence was highest in the Control and Quash treatments. Conversely, Miravis and Omega consistently showed the lowest disease levels, indicating strong protective activity even under suboptimal conditions for pathogen development. Phytotoxicity was only observed in the Quash treatment. Symptoms included stunted plant growth; dark-green, curled leaves; reduced shoot development; and significantly shorter plant height relative to other treatments. No phytotoxic effects were observed in any other fungicide treatment, and fruit yield did not differ among treatments (Table 1).

Overall, the study suggests that Miravis and Omega are the most effective and least phytotoxic options for white mold management when delivered through drip irrigation. Additional multi-year trials under conditions more favorable for disease development are needed to further validate these results and refine recommendations for commercial tomato growers.

**TABLE 1.** Assessing fungicide options for white mold management in field tomato production.

| Treatment[u] | Active ingredients | Treatment application rate/A | Application timing[v] | Disease rating (%)[w] | Plant height 7 WAT (cm)[x] | Plant height 11 WAT (cm)[y] | Yield (Mg/ha)[z] |
|---|---|---|---|---|---|---|---|
| Control | N/A | N/A | N/A | 1.54 a | 84.86 a | 84.97 a | 49,068 |
| Priaxor | Fluxapyroxad and pyraclostrobin | 8.0 fl. oz | 0, 1, 2, 3, 4, 5 | 0.86 ab | 88.13 a | 87.78 a | 51,244 |
| Tesaris | Fluxapyroxad | 4.6 fl. oz | 0, 1, 2, 3, 4, 5 | 1.15 ab | 86.51 a | 88.63 a | 50,431 |
| Omega 500 F | Fluazinam | 24.0 fl. oz | 0, 1, 2, 3, 4, 5 | 0.38 b | 86.54 a | 86.52 a | 49,831 |
| Switch | Cyprodinil and Fludioxonil | 14.0 oz | 0, 1, 2, 3, 4 | 0.67 ab | 74.91 b | 71.92 b | 43,392 |
| Miravis Prime | Fludioxonil and Pydiflumetofen | 15.4 fl. oz | 0, 1, 2, 3, 4 | 0.38 b | 86.81 a | 87.54 a | 50,675 |
| Quash | Metaconazole | 4.0 oz | 0, 1, 2, 3, 4, 5 | 1.35 a | 86.83 a | 87.65 a | 43,596 |
| P-value | - | - | - | 0.025 | <0.0001 | <0.0001 | 0.14 |

[u]Priaxor was used as the standard registered control

[v]Indicates the number of applications per treatment. 0 = 3 August, 1 = 16 August, 2 = 30 August, 3 = 13 September, 4 = 27 September, and 5 = 11 October

[w]Disease rating was measured as the percentage of plants with at least a rating of 2 (*S. sclerotiorum* growth present on tomato stem)

[x]First toxicity (plant height) assessment conducted on 7 September 2024

[y]Second toxicity (plant height) assessment conducted on 10 October 2024

[z]Yield were determined as the sum of the total marketable fresh fruit weight from the two harvest events conducted on 16 October and 17 November 2024.

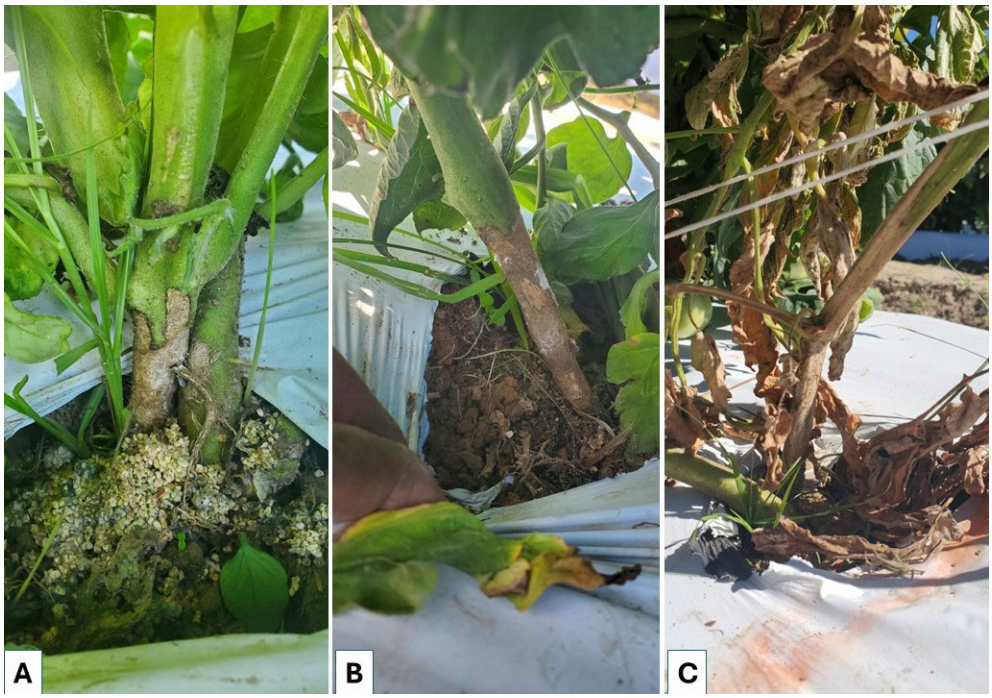


**FIGURE 1.** Early (A), mid (B), and late (C) stages of white mold disease progression in field tomato.

# Tomato nitrogen requirements in high tunnel

TIMOTHY AYANKOJO, PRAKASH KHANAL, THOMAS HORGAN AND WESTIN PHILLIPS

**NITROGEN IS AN ESSENTIAL NUTRIENT** and one of the most critical production inputs for vegetable crops. It directly influences plant growth, yield, and fruit quality. Adequate nitrogen supports vigorous growth and can help reduce plant susceptibility to diseases. However, excessive nitrogen application can have the opposite effect, reducing crop productivity and negatively impacting fruit quality. It can even increase the risk of groundwater and surface water contamination. This study was conducted to determine the optimal nitrogen application rate for tomato (*Solanum lycopersicum*) production under high tunnel conditions.

Tomatoes of the Red Deuce variety were transplanted on April 2, 2025, after six weeks of growth in the greenhouse. These seedlings were transplanted to raised beds with white plastic mulch and drip tape in a single row spaced 2 feet apart. The study evaluated six nitrogen application rates. Each rate was applied as a split: 25% pre-plant and 75% through weekly fertigation using ammonium nitrate (33-0-0), beginning five weeks after transplanting. Potassium and phosphorus were both applied entirely pre-plant, using 0-46-0 and 0-0-60 fertilizers, respectively. Each plant was also sprayed every 7 to 10 days with the insecticides Mustang Maxx

(zetacypermethrin) and Entrust (spinosad), mixed with either Bravo WS (chlorothalonil) or Kocide (copper hydroxide) fungicides. Beginning on June 17 and ending on July 24 four harvest events took place. Finally, all harvested fruits were graded according to the USDA standards of extra-large, large, and medium. The preliminary results indicate no increase in total or marketable yield at nitrogen rates above 120 lb. per acre. Additionally, nitrogen application rates were found to have only influenced the extra-large fruit category, with no significant effects on other size classes.

These results support the claim that the moderate nitrogen rates should be utilized to optimize yield, maintain fruit quality and reduce production costs and environmental risk. Further seasonal evaluations will help refine recommendations for commercial tomato growers.

**TABLE 1.** Effects of nitrogen application rate on average tomato yield by fruit category, total marketable, and total yield (lb. per plant) under high tunnel production.

| Nitrogen application rate | Extra Large | Large | Medium | Unmarketable Fruit | Total Marketable | Total Yield |
|---|---|---|---|---|---|---|
| lb/acre | lb/plant | | | | | |
| 0 | 15.23 c | 0.99 a | 0.27 a | 1.28 a | 16.50 c | 17.78 b |
| 60 | 17.05 bc | 1.10 a | 0.40 a | 1.76 a | 18.57 bc | 20.33 b |
| 90 | 19.91 ab | 1.07 a | 0.30 a | 1.75 a | 21.30 abc | 23.05 ab |
| 120 | 22.38 a | 1.07 a | 0.29 a | 2.75 a | 23.75 a | 26.50 a |
| 180 | 19.05 abc | 1.20 a | 0.47 a | 1.76 a | 2.72 abc | 22.48 ab |
| 240 | 19.57 abc | 1.391a | 0.52 a | 1.10 a | 21.48 abc | 22.59 ab |
| *P value* | *0.002* | *0.67* | *0.34* | *0.12* | *0.003* | *0.006* |

# Nitrogen rates effect on southern Christmas trees

JEFF WILSON, SUSAN WORTHEY, AMEE BUMGUARDNER AND JAMES SHANNON

**FIGURE 1.** Native Christmas Trees Year 3.

**CHRISTMAS TREES** were grown to determine optimal production methods for Mississippi producers. Varying nitrogen rates for initial and final growth were studied on three tree species: Leyland Cypress 'Ovensii', Arizona Cypress 'Blue Ice', and Eastern Red Cedar 'Burkii' (Figure 1).

Leyland Cypress final stem height data ($p < .0001$) and stem diameter data ($p < .0003$) showed the 1.0x treatment rate to be significantly greater than all other treatments (Figure 2). Data showed all growth measurements to be lowest with the 2.0x treatment rate.

Arizona Cypress final stem height data and stem diameter both showed the 1.0x treatment rate to be greater than all other treatments, but not significantly different ($p = 0.35$) and ($p = 0.08$) (Figure 3). Data again showed all growth measurements to be lowest with the 2.0x treatment rate.

Eastern Red Cedar final stem height data showed no significant differences between treatments ($p = 0.15$). Final stem diameter data showed the 0.25x treatment rate to be significantly greater than other treatments ($p < .05$) (Figure 4). Data showed final stem height and final stem caliper to be lowest with the 0.5x treatment rate, different from the other varieties.

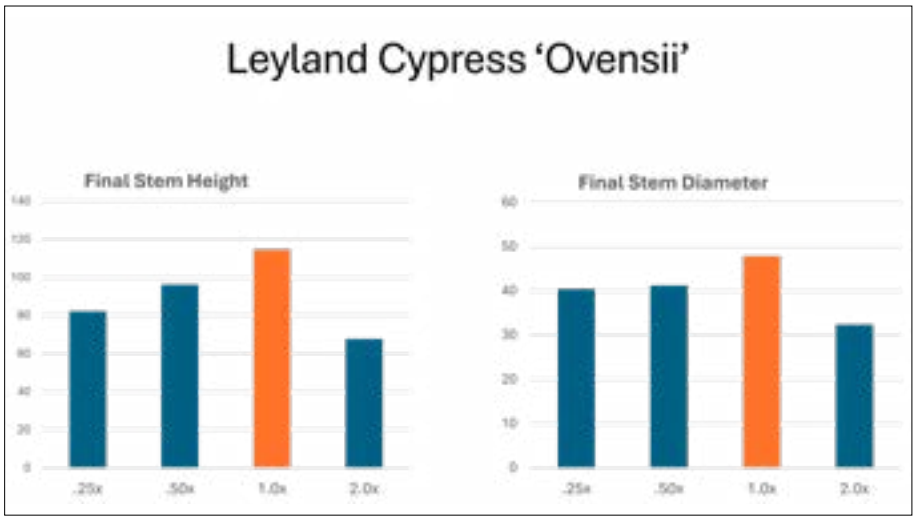


**FIGURE 2.** Leyland Cypress 'Ovensii' Christmas tree final stem height and stem caliper.

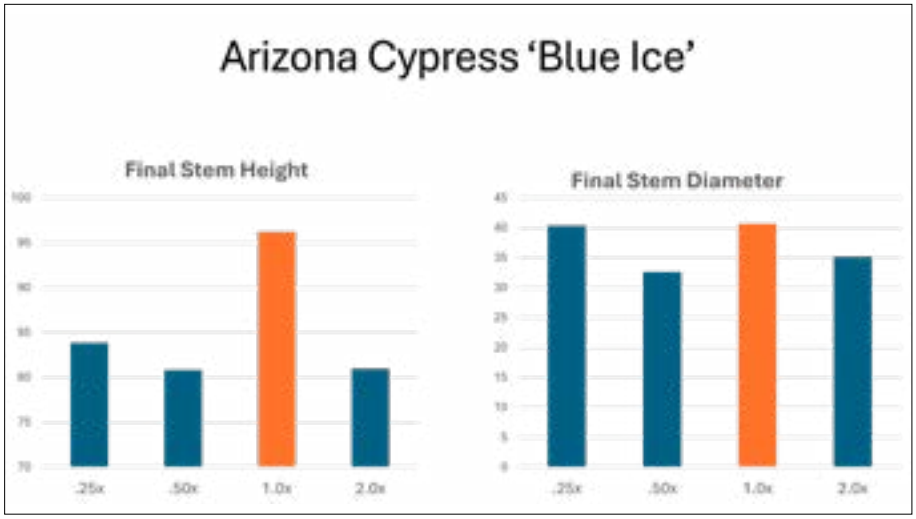


**FIGURE 3.** Arizona Cypress 'Blue Ice' Christmas tree final stem height and stem caliper.

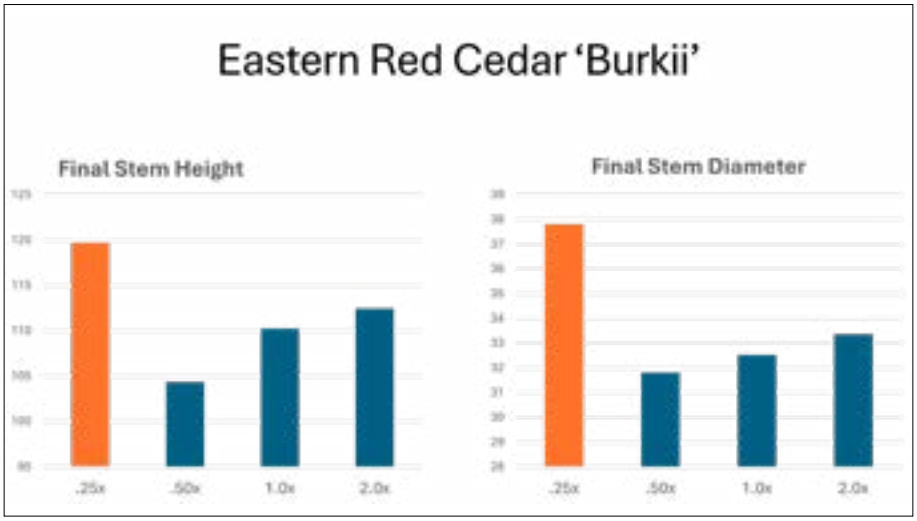


**FIGURE 4.** Eastern Red Cedar 'Burkii' Christmas tree final stem height and stem caliper.

# Magnolia Botanical Garden

JEFF WILSON AND SUSAN WORTHEY

**THE MAGNOLIA BOTANICAL GARDEN** serves north Mississippi as a demonstration and educational resource for consumers, green industry professionals, and horticulture educators. The garden provides a public green space for visitors while supporting plant evaluations, outreach efforts, and hands-on learning opportunities.

**FIGURE 5.** M.B.G. Educational Program Proven Winners Herbaceous Flower Trial

# Proven Winners® herbaceous flower trial

JEFF WILSON, SUSAN WORTHEY, AND SHAUN BRODERICK

**PROVEN WINNERS®,** a renowned gardening brand, partnered with Mississippi State University to provide annual and perennial plants for a summer evaluation trial focusing on flower coverage, leaf health, and landscape impact. Species included angelonia, begonia, coleus, cuphea, dahlia, helianthus, heliotrope (Figure 1), impatiens, lantana (Figure 2), petunia, portulaca, salvia, and scaevola.

The MSU trial manager recorded plant performance data throughout the season, including overall health, bloom stage, insect pressure, and landscape value. Beyond research value, the trial enhanced the Magnolia Botanical Garden's annual display beds and offered visitors an early look at new ornamental selections entering the market.

**FIGURE 7.** Aromagica® Purple Heliotrope

**FIGURE 8.** Luscious® Basket Tangeglow™ Lantana

# American rose trial for sustainability

JEFF WILSON, SUSAN WORTHEY, AND SUSAN MCGUKIN

**THE AMERICAN ROSE TRIAL FOR** Sustainability (A.R.T.S.) was conducted from 2022–2025, with each trial lasting two years. Unknown rose cultivars were grown under low-input conditions, receiving only sufficient irrigation. Plants were installed in raised beds and mulched with shredded pine bark.

A completely randomized block design consisting of three blocks with one replication per block was used. Plants were evaluated twice a month for a span of eight months by two Master Gardener teams using a standardized rating system: 45% flowering, 45% foliage health, and 10% plant form. All evaluations were submitted electronically to the trial manager. Magnolia Botanical Garden was one of 13 national trial locations. Winning regional and national selections are announced each May.

Regional winners ("Master Roses") from the 2023-2024 trials were **Bee Sweet® Dessert First™, Blushing Drift®, Ruby Red™** (Figure 1), and **Elizabeth®** (Figure 2).

**FIGURE 1.** Regional winner Elizabeth®.

**FIGURE 2.** Regional winner Ruby Red™.

# Mississippi Master Gardener volunteer program 2025

JEFF WILSON AND SUSAN MCGUKIN

**NOW IN ITS' 34TH YEAR,** the Mississippi Master Gardener program includes more than 1,500 active volunteers across 60 counties. Master Gardener's assist MSU Extension in meeting consumer horticulture needs by supporting agents and specialists statewide and delivering research-based educational programs that strengthen the economic, social, and cultural well-being of all Mississippians.

Master Gardener trainees complete 40 hours of online instruction covering botany, soils, weeds, honeybees, propagation, urban trees, ornamentals, turfs, entomology, plant diseases, fruits and nuts, vegetables, pesticide safety, and volunteerism. After passing a final exam, trainees volunteer for a total of 40 hours to become certified. Active volunteers maintain certification by completing a minimum of 20 service hours and 12 continuing education hours annually.

In 2025, 231 gardeners enrolled in the online Master Gardener training and 206 completed the course, resulting in an 89% completion rate. Across the state, 890 Master Gardeners reported 76,500 volunteer hours, with participation from 57 of Mississippi's 82 counties. Their service equated to 37 full-time employees and provided an estimated $1.94 million in value to Mississippi.

Master Gardeners play a vital role in communities statewide. They provide practical horticulture education, demonstrate safe and efficient gardening practices; support the Mississippi green industry; and promote active, healthy lifestyles through gardening. Mississippi Master Gardeners continue to make a meaningful impact for MSU Extension and for residents across the state.

Master Gardeners celebrating completing the online course.



Master Gardeners receiving continuing education hours.

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