College of Agricultural, Consumer
and Environmental Sciences
Agricultural Experiment Station

Agricultural Science Center at Clovis

Clovis Agricultural Science Center Annual Report

Table of Contents

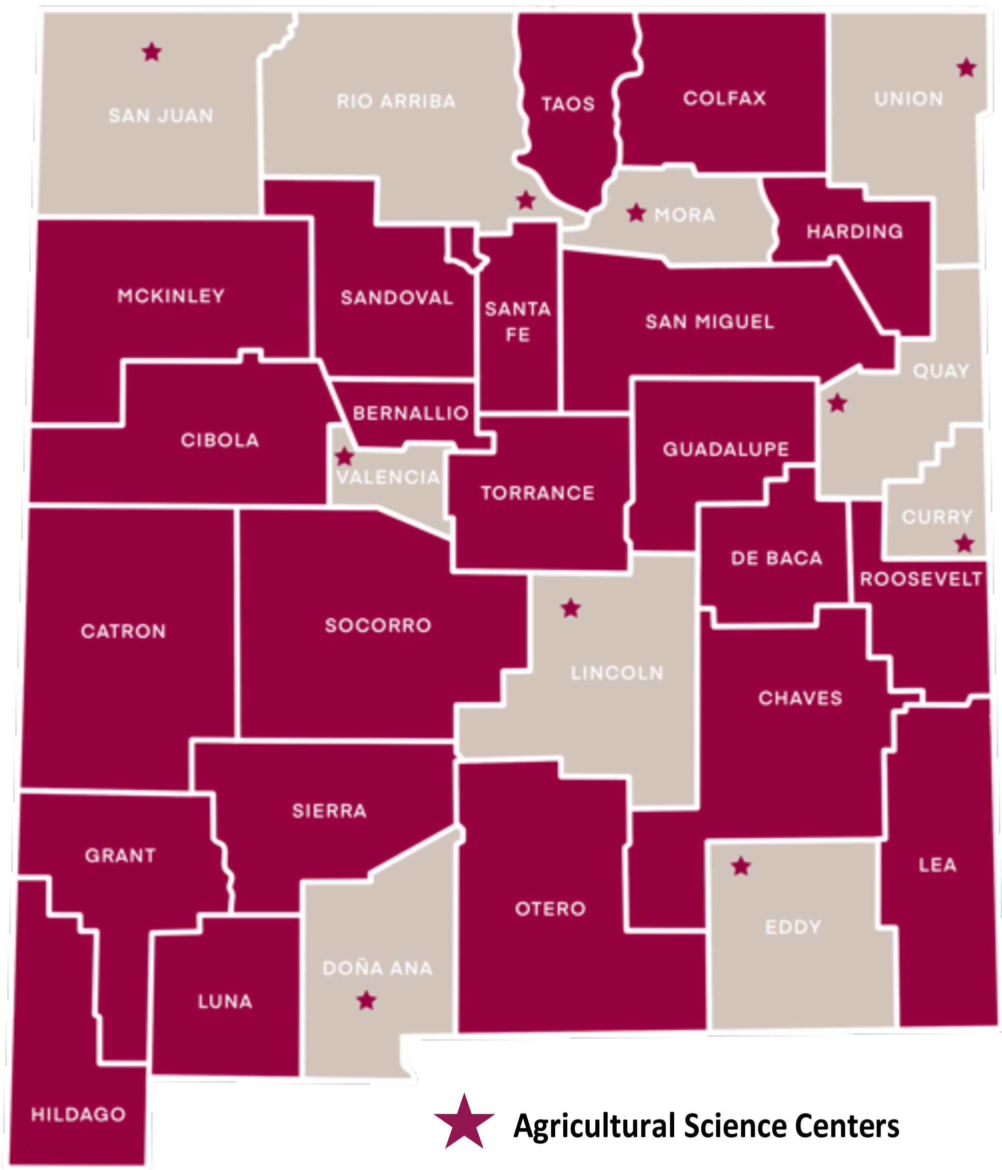
Notice to Users of this Report

These are not formal Agricultural Experiment Station Report research results. The reader is cautioned against drawing conclusions or making recommendations as a result of the summaries in this report. In many instances, data represents only one of several years' results that will ultimately constitute the final formal report.

None of the data are authorized for release or publication without the written prior approval of the New Mexico Agricultural Experiment Station.

Any reference in this report to any person, organization, activities, products, or services related to such person or organization is solely for informational purposes and does not constitute or imply the endorsement or recommendation of New Mexico State University or any of its employees or contractors. NMSU is dedicated to providing equal opportunities in areas of employment and academics without regard to any protected categories as outlined in federal and state anti-discrimination statutes. The College of Agricultural, Consumer, and Environmental Sciences is an engine for economic and community development in New Mexico. ACES academic programs help students discover new knowledge and become leaders in environmental stewardship, food and fiber production, water use and conservation, and improving the health of all New Mexicans. The College's research and extension outreach arms reach every county in the state and provide research-based knowledge and programs to improve the lives of all New Mexicans.

Agricultural Science Center Locations Map



Executive Summary

Last year, the Clovis Agricultural Science Center continued to advance research that supports the sustainability, profitability, and resilience of agricultural systems in eastern New Mexico and other semi-arid regions. The research summarized in this annual report highlights innovative approaches to addressing critical challenges related to water scarcity, soil degradation, climate variability, crop productivity, nutrient management, and environmental stewardship.

A major emphasis of this past year's research focused on improving soil health and resource conservation through regenerative agricultural practices. Multiple studies demonstrated the value of cover crops, compost, and biochar amendments in enhancing soil structure, increasing water infiltration, improving nutrient retention, and reducing greenhouse gas emissions in water-limited environments. Researchers also examined the long-term impacts of cover cropping and no-till systems on carbon sequestration, soil resilience, and crop productivity, providing science-based guidance for producers adapting to increasingly dry conditions and declining irrigation water supplies.

Water conservation and climate resilience remained central themes across many projects. Research evaluating transitions from irrigated to dryland production systems addressed the urgent need for sustainable forage and cropping strategies as groundwater resources continue to decline. Additional studies investigated the use of engineered biochars, compost, and occasional tillage practices to maintain soil productivity while minimizing environmental impacts.

Crop improvement research made progress in enhancing the productivity and resilience of peanut and cotton production systems in eastern New Mexico. Peanut breeding efforts focused on developing Valencia cultivars with improved yield potential, disease resistance, drought tolerance, and enhanced quality traits to strengthen producer profitability and competitiveness.

The center also expanded research supporting sustainable dairy and nutrient management systems. Investigations into microalgae-based dairy wastewater remediation demonstrated the potential for reducing nutrient loading, recovering valuable nutrients, and improving water management through circular agricultural systems. These efforts align with broader statewide priorities related to water conservation, nutrient recycling, and environmental protection.

Over the past year, the Clovis Agricultural Science Center continued to show commitment to developing practical, science-based solutions that enhance agricultural sustainability, strengthen rural economies, and improve environmental outcomes across New Mexico.

We would like to take a moment to thank Dr. Abdel Mesbah, who served as the research director for the Center for many years and retired in March 2026.

Research Highlights

Machine learning models reveal key drivers of carbon and nitrogen losses in semi-arid cover cropping systems

Investigator(s): Prakriti Bista (pbista@nmsu.edu), Sarbagya Ratna Shakya-Eastern New Mexico University, Pramod Acharya, and Rajan Ghimire

Project Overview: Land managers need a practical way to estimate carbon and nitrogen losses as greenhouse gas (GHG) emissions from the diversified cover crop system in semi-arid environments. Using simple, readily available soil, weather, and crop data, machine learning models predicted GHG emissions more accurately than traditional process-based models, which typically explain only 20-40% of the variation. The random forest model predicted 68% and 56% of the variation in daily CO_2 and N_2O emissions, respectively. Irrigation was the most important factor in predicting CO_2 emissions, and air temperature regulated N_2O emissions. Soil GHG emissions can be effectively estimated using simple inputs in machine learning models, helping farmers tailor management practices for agricultural sustainability.

Meeting the Needs of New Mexico: Improving soil health through cover cropping could mitigate soil fertility loss and the impacts of a changing climate in semi-arid farming systems in New Mexico. However, field monitoring and long-term observation of carbon and nitrogen dynamics under diversified cropping systems are labor- and cost-intensive, and traditional models are complex and less efficient. Our study showed that soil carbon and nitrogen losses can be accurately estimated using simple information via machine learning models. These new tools can help farmers adjust management practices to reduce nutrient losses and improve the soil health of their farm.

Impact: The study revealed that using data-driven machine learning models, which leverage readily available soil, weather, and crop data, can help predict carbon and nitrogen dynamics in a diversified cover cropping system in a semi-arid region. These new tools can support farm decision-making to minimize carbon and nitrogen losses, improve soil fertility, and help mitigate climate change impacts in semi-arid cover cropping systems. Details of the study are available at **https://doi.org/10.1002/saj2.70057**

Funding Acknowledgement: USDA National Institute for Food and Agriculture's Agriculture and Food Research Initiative project No. 2022-67019-36106 and the New Mexico Department of Agriculture

Field study depicting cover crop and no-cover crop plots at the Agricultural Science Center at Clovis, NM

Biochar and Compost as Sustainable Amendments for Soil Water Infiltration and soil health in the semi-arid region

Investigator(s): Prakriti Bista (pbista@nmsu.edu), Sangu Angadi, Rajan Ghimire and Sangam Panta

Project Overview: Organic amendments such as biochar and compost have shown potential to improve soil health; however, how they affect soil water infiltration in water-limited semi-arid regions remains unclear. In the summers of 2024 and 2025, soil infiltration and associated soil health properties in response to biochar, compost, a biochar-compost mixture, and control plots under no-tillage management were studied at the Agricultural Science Center in Clovis, NM. Soil water infiltration was measured using the SATURO dual infiltrometer, and soil physical and chemical properties at 0-15cm depth were analyzed. We found that biochar increased infiltration rate, lowered bulk density, and improved soil aggregation compared to the control plots. Compost with biochar also improved soil health, but infiltration response was variable. This study demonstrated that biochar under no-tillage can enhance soil health and resilience of semi-arid agroecosystems by improving soil water functions.

Meeting the Needs of New Mexico: In semi-arid New Mexico, declining water availability and high evapotranspiration losses make crop production challenging. Biochar and compost can be promising tools to improve water infiltration by enhancing soil health. This study focused on identifying soil properties that contributed to greater water infiltration when fields were amended with biochar and compost. Understanding these effects, New Mexico growers can better manage their soil amendments to improve soil structure and soil water movement. By strategically applying biochar and compost, farmers can enhance soil health, better use scarce water, and support long-term agricultural sustainability.

Impact: Biochar-amended plots had higher soil water infiltration, reduced bulk density, and enhanced soil aggregation compared to the no-biochar control. Similarly, compost application improved residue cover and soil organic carbon. This study highlighted the importance of biochar and compost as potential soil amendments for improving soil physical-chemical properties, such as soil structure, aggregation, porosity, and soil organic matter, combined with no-tillage management that reduces soil disturbance. Together, these practices support soil water conservation in arid and semi-arid regions. Details of the study are available at: **https://doi.org/10.3390/su18031369**

Funding Acknowledgement: National Science Foundation (2316278); United States Department of Agriculture (USDA) Natural Resources Conservation Service (GR0007378)

Biochar and compost study fields depicting Saturo Dula Head Infiltrometer measuring water infiltration (a), and soil sampling for soil properties analysis (b) at Agricultural Science Center, Clovis, NM.

Performance of advanced breeding lines of Valencia peanut

Investigator(s): Naveen Puppala (npuppala@nmsu.edu) and Yogesh D Naik

Project Overview: Valencia peanuts, which account for less than 1% of U.S. production, are primarily grown in eastern New Mexico and western Texas. This study aimed to develop Valencia cultivars with enhanced seed and pod traits, high oleic acid content for improved oil stability, elevated yield, and resistance to pod and stem rot—selection combined conventional phenotypic and biochemical evaluations with marker-assisted selection. Field trials were conducted across eastern New Mexico, western Texas, and Oklahoma using a randomized complete block design with three replications. The objectives were to evaluate genotypes for pod yield, quality, and economic return under diverse production environments.

Meeting the Needs of New Mexico: Peanut producers face challenges achieving high yields and market-quality traits, such as oil content and flavor, which can limit access to premium markets. The development of improved Valencia cultivars tailored to local conditions provides opportunities for improved productivity, enhanced disease resistance, and superior quality. These cultivars help reduce production costs, improve sustainability, and expand market opportunities, directly supporting the profitability and long-term success of New Mexico peanut farmers.

Impact: The newly developed Valencia cultivars exhibit enhanced productivity and profitability by demonstrating improved resistance to soil-borne pathogens, thereby reducing crop losses. These cultivars produce high-quality peanuts with a sweet taste, four seeds per pod, and larger seed size, enabling farmers to access premium markets and achieve higher prices. Adapted to the hot, dry conditions of eastern New Mexico and western Texas, these varieties provide growers with options optimized for local environments, supporting both yield stability and market competitiveness.

Funding Acknowledgement: New Mexico Peanut Research Board and National Peanut Research Board

Breeding plots at Richard Hardin Farm, Arch – New Mexico.

Screening of peanut lines for stem rot disease resistance

Investigator(s): Naveen Puppala (npuppala@nmsu.edu) and Madhu Janga, Texas Tech University

Project Overview: Stem rot, caused by the fungal pathogen *Agroathelia rolfsii*, is a devastating disease of peanut (Arachis hypogaea L.) that results in substantial global agricultural losses. This study employed RNA sequencing to unravel the molecular mechanisms of resistance by analysing the gene expression profiles of a resistant peanut genotype (Georgia-03 L) and a susceptible genotype (Valencia C) under normal and infected conditions. In the resistant genotype, key defense-related genes were strongly induced upon infection in G03L. Weighted Gene Co-expression Network Analysis (WGCNA) identified a co-expression gene module that was associated with resistance and enriched for genes involved in oxidative stress response, secondary metabolism, and cell wall reinforcement. In contrast, the susceptible genotype showed limited activation of these defense pathways, underscoring its vulnerability to *A. rolfsii*. Functional annotation highlighted critical pathways, such as oxidoreductase activity, glutathione metabolism, and peroxidase-mediated responses, as pivotal to the resistance mechanisms. These findings provide valuable insights into the molecular basis of stem rot resistance in peanuts, offering a foundation for breeding or genetic engineering approaches to enhance disease resistance in susceptible cultivars.

Meeting the Needs of New Mexico: Soil-borne diseases are a major constraint to peanut production. Developing disease-resistant cultivars mitigates the need for chemical fungicides, reducing production costs, minimizing environmental contamination, and promoting soil health. Growers benefit from fewer fungicide applications and reduced reliance on additional disease management interventions, thereby enhancing profitability. Resistant cultivars are less susceptible to stem rot, resulting in higher and more stable yields.

Impact: The current study identifies key genes and pathways involved in resistance to *Agroathelia rolfsii* in the resistant cultivar Georgia-03 L and the susceptible cultivar Valencia C. Our analysis highlighted the significant role of pathogen recognition, oxidative stress management, secondary metabolism, and cell wall reinforcement in Georgia-03 L's defense responses. Key upregulated genes included receptor-like kinases, NBS-LRR resistance genes, and transcription factors like MYB and zinc finger proteins. Co-expression analysis identified the salmon module as central to resistance, with enriched pathways related to L-serine metabolism and primary and secondary metabolism. In contrast, Valencia C showed limited activation of defense mechanisms, underscoring its susceptibility. Thus, our study offers valuable insights into the molecular basis of stem rot resistance and identifies potential targets for improving resistance in vulnerable cultivars such as Valencia C through breeding and biotechnological approaches.

Funding Acknowledgement: New Mexico Peanut Research Board and National Peanut Research Board


Gene expression study from a susceptible peanut variety (left) and a resistant variety (far right) after artificial inoculation of the stem rot fungus (Athelia rofsii).

Assessment of Drought Tolerance in Peanut Genotypes

Investigator(s): Naveen Puppala (npuppala@nmsu.edu) and Yogesh D Naik

Project Overview: Prolonged drought poses significant threats to food and fiber production in the U.S. Southwest. New Mexico, with the lowest water-to-land ratio of any state, faces particularly severe challenges. Peanut farmers in the state, especially in the eastern region around Portales, experience severe drought stress, which reduces water availability for irrigation, lowers yields, and increases the need for drought-tolerant varieties. Identifying peanut lines that perform well under such conditions is therefore essential. Peanut plants respond to drought through changes in morpho-physiological and agronomic traits, which breeders can leverage to enhance crop resilience. These responses include rapid physiological adjustments, such as stomatal closure to conserve water, even at the cost of reduced photosynthesis. Evaluating peanut lines for both physiological and yield-associated traits is a critical first step in identifying stable genotypes suitable for breeding. The objective of this research was to screen peanut genotypes at three growth stages for physiological and yield traits under both drought and well-watered conditions.

Meeting the Needs of New Mexico: Agriculture in New Mexico, particularly peanut production, is highly vulnerable to drought and posing risks to both economic stability and food security. Developing drought-tolerant peanut varieties can help farmers sustain yields while lowering irrigation costs, conserving water and improving profitability. Developing drought-tolerant peanut varieties not only helps farmers maintain yields but also builds their confidence and satisfaction in their crops.

Impact: This study demonstrates the effect of drought on peanuts at three stages (vegetative, flowering, and pod-filling), showing significant reductions in physiological and yield-related traits. Low stomatal conductance was observed to help reduce water loss under drought stress. The results provide breeders with valuable physiological and yield-related information to develop improved varieties, supporting sustainable agriculture in New Mexico and other arid regions. Additionally, this study will help identify drought-tolerant peanut genotypes, enabling farmers to maintain yields under water-limited conditions.

Funding Acknowledgement: New Mexico Peanut Research Board and National Peanut Research Board

Peanut field under drought stress at USDA-ARS- Cropping System Research Laboratory, Lubbock-Texas

Organic Seed Treatment Study in Valencia Peanut

Investigator(s): Naveen Puppala (npuppala@nmsu.edu) and Yogesh D Naik

Project Overview: The demand for organic peanuts is the fastest-growing segment of the U.S. peanut industry. Growers are increasingly adopting organic peanut production because certified organic peanuts command higher prices than conventional varieties. Organic peanut cultivation is primarily concentrated in the southwestern United States, with eastern New Mexico and West Texas being the largest production regions. Despite strong market interest, organic peanut production is constrained by a wide array of biotic and abiotic stresses. Key challenges include weed management, control of soil-borne pathogens, and mitigation of insect infestations. The objective of this study is to evaluate the efficacy of the bio-fungicide Convergence in controlling pod rot in peanuts and to assess its impact on pod yield and grade.

Meeting the Needs of New Mexico: Soil-borne diseases pose significant challenges to peanut production. The use of organic fungicides as seed treatments protects seeds from soil-borne pathogens, improving germination and enhancing early-season disease resistance. Moreover, this approach reduces reliance on chemical pesticides, thereby lowering pest management input costs and contributing to more sustainable production practices.

Impact: This study demonstrated that seed treatment with organic biofungicides enhances seedling establishment by protecting seeds from soil-borne pathogens. Treated plants exhibited improved early-season disease resistance, resulting in higher pod yield, better quality, and higher net returns. Among the soil-applied microbial fungicides, Convergence showed the greatest effect, increasing pod yield by 21% and net return by $298 compared with the untreated control. These findings highlight the potential of organic biofungicide applications to improve peanut production both agronomically and economically. However, it is important to acknowledge the study's limitations. Future research should investigate long-term effects and performance under diverse environmental conditions, and conduct a comprehensive economic analysis to better assess the practical and financial feasibility of incorporating soil-applied fungicides into peanut cultivation.

Funding Acknowledgement: CERTIS Biologicals


In furrow application of Convergence at 30 days after planting

Evaluating the Impact of Digging Dates on Peanut Yield

Investigator(s): Naveen Puppala (npuppala@nmsu.edu) and Yogesh D Naik

Project Overview: Yearly variations in weather patterns influence the length of the growing season, flowering time and pod development. Determining the optimal planting and digging dates for different cultivars to maximize yield, value, and grade is a complex management decision. The timing of harvest significantly influences peanut yield and quality. Early harvesting can result in reduced pod development, lower kernel grade, and decreased overall yield. In contrast, delayed harvesting may lead to over-mature pods, deterioration in seed quality, and increased susceptibility to environmental stresses and post-harvest losses. As new cultivars are developed, it is essential to establish the number of days each cultivar requires to reach maximum yield, grade, and market value. The objective of this research was to determine the impact of digging dates and to identify the specific dates at which optimum yield, grade, and market value could be achieved for four peanut market types. The findings of this study provide critical guidance for growers, enabling informed management decisions that can maximize peanut yield, improve seed quality, and enhance market value, even under variable seasonal conditions.

Meeting the Needs of New Mexico: Variations in climate, soil types and water availability create unique challenges for crop production, making informed management decisions critical for farmers. By identifying optimal practices, such as the best planting and harvesting dates for different market types, research can help growers maximize yield, quality and market value. This approach not only enhances the profitability of local agriculture but also ensures the state's food systems remain resilient amid seasonal and environmental variability.

Impact: This study demonstrates that optimal digging dates vary across peanut market types, reflecting differences in physiological maturity. Digging earlier resulted in significant yield losses, highlighting the importance of timing harvest according to each market type. By determining optimal digging dates for different market types, growers can achieve higher yields, improved crop quality, and greater market value. Additionally, efficient management practices can reduce resource waste, improve sustainability, and help farmers adapt to seasonal climate variations.

Funding Acknowledgement: New Mexico Peanut Research Board and National Peanut Research Board

First digging date of peanut at Richard Hardin Farm, Arch – New Mexico in 2025 September

Cotton Variety Trial

Investigator(s): Naveen Puppala (npuppala@nmsu.edu) and Yogesh D Naik

Project Overview: The depletion of the Ogallala Aquifer has led to declining water levels, reducing the availability of irrigation water for farmers. Consequently, growers are increasingly favoring crops with low water requirements. Cotton, a drought-tolerant crop, is gaining popularity in Curry, Lea, and Roosevelt counties. This research aimed to evaluate commercially available cotton varieties from seed companies and provide unbiased data on yield, lint quality, and net return for the 2025 growing season. The findings will assist cotton producers in selecting varieties that combine high yield potential, desirable fiber properties and earlier maturity. Specifically, this study evaluated 35 commercial cotton varieties adapted to the agro-climatic conditions of eastern New Mexico.

Meeting the Needs of New Mexico: This research enables farmers to identify cotton varieties that perform best under high temperatures and limited water, thereby enhancing crop productivity, improving sustainability, and increasing profitability.

Impact: This research enables farmers to identify cotton varieties that are most resilient under high-temperature, water-limited conditions, thereby enhancing crop productivity, promoting sustainable practices, and increasing profitability. Statistical differences were observed in lint yield, loan value and net return among the varieties. The average seed cotton yield across the trial was 2898 lb/ac, with PHY 1126F263-04 (3414 lb/ac) being the highest-yielding variety. Lint yield for 35 varieties in the trial ranged from 837 to 1676 lb/ac with a trial average of 1354 lb/ac. The highest lint yield was 1676 lb/ac for PHY 1126F263-04, followed by PHY 1120H277-04 at 1665 lb/ac. The estimated net return was higher for PHY 1126F263-04 (USD 594), followed by PHY 1120H277-04 (USD 589.5). The average net return of an experimental trial was USD 464.

Funding Acknowledgement: BASF, Bayer, Brownfield Seed & Delinting and Phytogen.

Overview of the cotton research plots at harvest

Advancing manure and nutrient management through microalgae-based dairy wastewater remediation

Investigator(s): Joyce Marumo (jlm13@nmsu.edu), Robert Hagevoort, and Alina A. Corcoran

Project Overview: Dairy wastewater is typically rich in organic matter, nitrogen (N), phosphorus (P), suspended solids, and other nutrients that require effective management to reduce environmental risks and support sustainable dairy production. In New Mexico (NM), where dairy production is important, but water availability and nutrient management are major concerns, practical dairy wastewater treatment options are needed. Microalgae-based treatment has emerged as an economical and environmentally sustainable approach because algae can use nutrients in dairy wastewater for growth while reducing N, P, and organic loading to produce feedstocks that can be used for biofertilizers, biofuels, or animal feed. Microalgae can reduce chemical oxygen demand (COD) up to 90% and remove macronutrients (N up to 99.26%, P up to 92%) and pathogenic bacteria (up to 98%) from waste streams.

This project includes two complementary components. The first component synthesized published research on microalgae-based dairy wastewater treatment to evaluate nutrient removal, organic matter reduction, and biomass production, and identify key operational factors affecting treatment performance. The second component, which is currently ongoing, will build from these findings by evaluating attached-growth algal treatment systems, including rotating algal biofilm and algal turf scrubber systems (Figure 1), as practical strategies for improving dairy manure wastewater management in NM. This study will assess how indigenous algal consortia can remove nutrients and organic matter from non-sterile dairy wastewater (Figure 2) while producing recoverable biomass with potential value as a bio-based product. The work will focus on conditions relevant to NM dairies, including non-sterile wastewater, variable wastewater strength, greenhouse or outdoor conditions, and low-resource operational approaches that could be scaled for producer use.

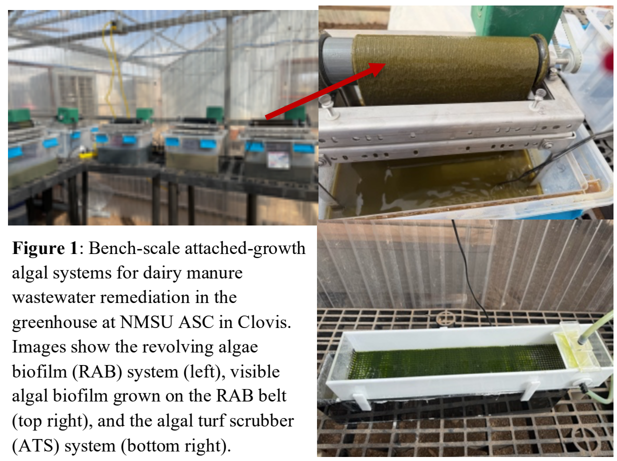


Figure 1: Bench-scale attached-growth algal systems for dairy manure wastewater remediation in the greenhouse at NMSU ASC in Clovis. Images show the revolving algae biofilm (RAB) system (left), visible algal biofilm grown on the RAB belt (top right), and the algal turf scrubber (ATS) system (bottom right).

Meeting the Needs of New Mexico: New Mexico has a major dairy sector, with the USDA reporting about 230,000 milk cows and approximately 5.86 billion pounds of milk production valued at over $1.15 billion in 2025. At the same time, dairy production in the state operates under serious water and nutrient-management constraints. New Mexico's 50-Year Water Action Plan projects a future water shortfall of 750,000 acre-feet with up to 25% less water available in rivers and aquifers. This emphasizes the urgent need for water conservation, wastewater modernization, groundwater protection, and agricultural water resilience. Practical technologies are needed to reduce N, P, organic matter, and solids in dairy wastewater while creating opportunities for nutrient recycling. Microalgae-based systems may provide a useful treatment option for NM dairies by improving wastewater polishing, recovering manure nutrients, and generating biomass that could potentially be used as animal feed, fertilizer, or soil amendment after proper safety and quality evaluation.

Impact: Results from the evidence synthesis (first research component) showed that microalgae-based dairy wastewater treatment can remove substantial amounts of nutrients, indicating ~78.7% total N, 81.5% total P, and 82.2% PO_4^--P removal, depending on wastewater characteristics, culture type, reactor design, light, temperature, CO_2 availability, and operating conditions. These findings demonstrate that microalgae systems have the potential to reduce nutrient loading while recovering N and P as algal biomass. The project also supports the development of a circular manure management approach by linking wastewater treatment with biomass recovery. Harvested algal biomass may provide value as a potential animal feed ingredient, biofertilizer, or soil amendment, although additional evaluation is needed to confirm nutrient composition, digestibility, pathogen safety, heavy metals, and other quality indicators.

The second component of the project will generate science-based information on whether microalgae systems can help reduce N, P, solids, and organic loading in dairy wastewater under NM-relevant conditions. Overall, this work will provide science-based guidance for future greenhouse and pilot-scale studies in NM. In the longer term, this work may contribute to more sustainable dairy production in arid regions by linking wastewater treatment, nutrient recycling, biomass production, and environmental stewardship.

Funding Acknowledgement: Waste-to-Jet Consortium, Los Alamos National Laboratory, funded by U.S. Department of Energy (DOE)

Dairy wastewater collection from the local dairy farm for the ongoing greenhouse algal-based nutrient management evaluation study.

Soil Health and Carbon Sequestration Potential of Long-Term Cover Cropping in Semi-Arid New Mexico

Investigator(s): Rajan Ghimire (rghimire@nmsu.edu), Dotun Arije, Olufemi Adebayo, Prakriti Bista, and Caitriana Steele

Project Overview: Soils in semi-arid regions are highly vulnerable to organic carbon and nutrient losses due to low plant productivity, long fallow periods between crops, and increasing drought and heat stresses. We studied soil health and the resilience of cropping systems in semi-arid areas by integrating multi-species cover crops into a wheat-sorghum-fallow rotation. Soil organic carbon, total nitrogen, and selected other soil health indicators, along with winter wheat and sorghum yields, were quantified from 2016 to 2024. Using these data, a DayCent biogeochemical model has been used to assess the future potential of cover cropping under current climatic conditions for the next few decades, as well as under extreme drought and heat. Results showed that multi-species cover crops can increase long-term soil carbon storage, while yield benefits depend on regional water availability.

Meeting the Needs of New Mexico: Agricultural production in New Mexico is constrained by limited rainfall, declining irrigation water availability, and increasing climate variability. Maintaining soil health while sustaining crop productivity is therefore a major challenge for producers in the region. This project addresses these challenges by evaluating whether replacing fallow periods with multi-species cover crops can enhance soil health, long-term soil carbon storage, and crop yield in semi-arid cropping systems. By integrating field observations with process-based modeling, the study provides region-specific insights into the long-term soil health benefits and yield trade-offs associated with cover cropping in NM. The findings will help farmers in informed decision-making and policymakers in supporting climate-resilient soil management strategies for water-limited environments across NM.

Impact: This project demonstrates that multi-species cover crops can substantially improve soil health and long-term soil organic carbon storage in semi-arid wheat–sorghum-fallow rotation, both in the current climate and under a future high-emissions scenario. Model simulations suggest that soil carbon gains under cover cropping may take 15 to 20 years to become evident, underscoring the importance of long-term management commitments. Although cover crops did not consistently increase wheat or sorghum yields, the results emphasize soil carbon storage as a critical ecosystem service that supports long-term soil health and resilience. These findings help producers set realistic yield goals while showing potential for earning carbon credit benefits by adopting regenerative management practices, such as multi-species cover cropping, in NM.

Funding Acknowledgement: USDA/Western Sustainable Agriculture Research and Education Grant
USDA/NIFA Foundational Program Grant


Graduate students harvesting sorghum in the long-term cover crop research plots (Photo: Rajan Ghimire).

Enhancing Soil Health in Lands Transitioning from Irrigated to Dryland Production

Investigator(s): Rajan Ghimire (rghimire@nmsu.edu), Pratima Poudel, Barsha Sharma, Prakriti Bista, John Idowu

Project Overview: Eastern New Mexico relies primarily on irrigated forage crops to support dairy and beef production. Nonetheless, declining water levels in the Ogalla Aquifer are forcing farmers to transition from irrigated to dryland systems. This change can reduce soil quality and increase greenhouse gas emissions. Management strategies such as cover crops and perennial crops can help mitigate these losses by improving carbon sequestration and soil health. This study is evaluating the effects of winter cover crops on soil health, carbon sequestration, and forage productivity in fields under irrigation and in those transitioning from irrigated to dryland production. The treatments include: (1) no-cover crops control, (2) grass only, (3) grasses, brassica, and legumes mixture (residue retained), and (4) mixtures of grasses, brassica, and legumes (residue removed).

Meeting the Needs of New Mexico: Agriculture in eastern New Mexico is facing growing challenges as irrigation water becomes increasingly scarce. Many farmers are being forced to switch from irrigated to dryland farming, which can reduce yields and increase risk. This project explores how different cover crops can help farmers during this transition by improving soil condition, conserving moisture, and supporting reliable forage production. The study showed that cover cropping and retaining residue on the ground improve soil carbon storage and enhance forage yield under irrigation. As the farm transitions to dryland production, the fraction of organic matter that is susceptible to loss increases, indicating the soil's vulnerability to degradation. These findings urge farmers to continue adopting conservation practices on lands transitioning to dryland production and will help them choose cover crop options that work in both irrigated and dryland systems. By helping farms to stay productive with less water, this project supports local agriculture, rural communities, and long-term economic stability across New Mexico.

Impact: This study is currently ongoing, and we are collecting valuable information regarding sustainable land management options for forage producers and dairy farmers in New Mexico. The outputs from this study will help farmers make better management decisions to improve forage yield and quality while dealing with limited water for crop and livestock production. The project will also highlight the added benefits, such as healthier soils and reduced wind and water erosion. Overall, this work aims to support more productive, sustainable, and resilient forage systems that benefit farmers, livestock, and the environment.

Funding Acknowledgement: NMDA Healthy Soil Program Research/Demonstration Grant and USDA NIFA (Sub-award of Colorado State University Project)

Researchers are installing soil moisture sensors on the long-term soil health research site.

Engineered Biochar for Reducing Greenhouse Gas Emissions and Improving Soil Functions

Investigator(s): Rajan Ghimire, rghimire@nmsu.edu, Jinfa Zhang, Shannon Norris-Paris, Sundar Sapkota, Piumi Yaddehi, Angila Devkota, Jasmeet Lamba (Auburn University), Sushil Adhikari (Auburn University), and Neha Pontis (Auburn University)

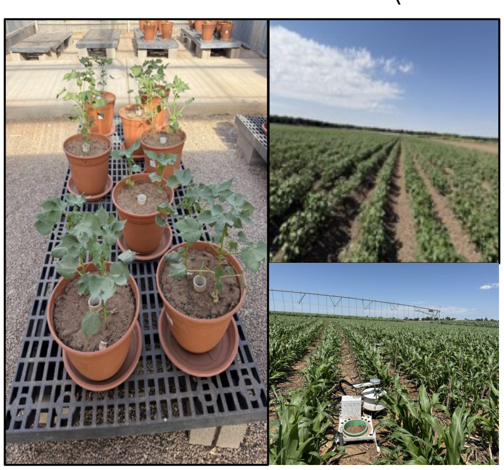
Project Overview: This project evaluates how soil type and moisture affect the effectiveness of engineered biochar amendments in reducing greenhouse gas emissions, improving soil nitrogen dynamics, and enhancing crop performance across various cropping systems. We conducted field and greenhouse experiments with sorghum and cotton as test crops. In a greenhouse study, clay loam and loamy sand soils amended with pristine and engineered biochars (S- and CO_2-modified) were evaluated. Measurements included soil N_2O and CO_2 emissions, crop yield metrics, and soil health. Soil samples are being analyzed for nitrogen-cycling gene abundance to explore microbial mechanisms controlling N_2O emissions. Laboratory incubation studies further examined how soil texture and moisture regulate these outcomes. Field trials at Leyendecker and demonstration plots in Clovis are ongoing to evaluate biochar under real-world farming conditions.

Meeting the Needs of New Mexico: New Mexico soils are low in organic matter, vary in texture, and are often dry. These conditions create challenges, including higher greenhouse gas emissions, reduced nutrient-use efficiency, and limited crop production. This project evaluated engineered biochars under NM-representative soil and moisture conditions to identify strategies to reduce emissions while maintaining crop productivity. By studying biochar effects on N_2O emissions, nitrogen retention, and microbial nitrogen-cycling processes, the research aims to provide insights into nitrogen losses in NM agriculture. Understanding how biochar performs across soil types and moisture levels gives practical guidance for site-specific application, helping producers minimize nitrogen loss, optimize nutrient use, improve soil function, and reduce environmental impacts.

Impact: Engineered biochar shows promise as a climate-smart strategy to improve soil function, reduce greenhouse gas emissions, and enhance nutrient retention in semi-arid cropping systems. Preliminary results indicate that engineered biochars, particularly S-modified biochar, numerically reduce cumulative soil N_2O in clay loam and CO_2-C emissions in loamy sand soils. Soil texture influenced labile carbon and nitrogen, with clay loam supporting higher total labile nitrogen, potentially mineralizable carbon, and microbial biomass carbon than loamy sand. Across both soils, biochar amendments increased labile nitrogen and carbon, suggesting improved nutrient retention. Ongoing analyses, including microbial gene abundance and leaching assessments, will clarify mechanisms behind improvements in soil response after biochar application.

Collaborating Agricultural Science Center: Leyendecker Plant Science Center

Funding Acknowledgement: National Science Foundation (2316278)



Engineered Biochar for Soil Phosphorus Management in Sustainable Crop Production.

Investigator(s): Rajan Ghimire and Juan P. Frene

Project Overview: This project aims to improve the effective use of a carbon-rich agricultural waste product by developing a modified biochar that enhances phosphorus utilization in agricultural production. The project will assess the capacity of modified biochar to absorb phosphorus and slowly release it, facilitating more efficient crop utilization. This project is conducted simultaneously across three countries on two continents: Ireland, the UK, and the USA. The engineered biochar can mitigate some adverse effects of agriculture, including environmental pollution, while helping farmers improve farm productivity and enhance the cost-effectiveness of nutrient fertilizers. This project involves laboratory, greenhouse, and field experiments to adapt the use of biochar to typical agricultural management in eastern New Mexico, such as compost addition or cover crops.

Meeting the Needs of New Mexico: This study strengthens and sustains the agriculture sector, one of New Mexico's primary economic activities, making it more resilient and more self-integrated. This project uses novel technology, such as modified biochar, to improve nutrient use efficiency. The project will develop a soil amendment that enables producers to maximize profits by using fewer resources to achieve equivalent yields. It also provides other benefits, including improved water infiltration, increased soil organic carbon, and enhanced soil biological activities.

Impact: The primary goal of this project is to improve our understanding of biochar's effectiveness as a soil amendment and modify it as a biofertilizer to absorb and slowly release phosphorus to crops when they require it, thereby improving the phosphorus utilization in the soil. By increasing phosphorus use efficiency, the environmental impact of agriculture will be reduced, crop production costs will be lower, and agricultural systems will be more resilient to climate change. Tailoring biochar to meet local farmers' needs can improve their efficiency and profitability.

Funding Acknowledgement: USDA National Institute of Food and Agriculture (2023-69016-39062)

Occasional Tillage in Long-Term No-Till Systems: Soil Health, Water, and Greenhouse Gas Responses

Investigator(s): Rajan Ghimire, Prakriti Bista, Abdel Mesbah, and Hamza Badrari

Project Overview: Long-term no-till systems enhance soil health and water conservation in semi-arid drylands but may develop surface compaction and nutrient stratification over time. This study evaluated how the frequency and intensity of occasional tillage within long-term NT: stubble mulch tillage (SMT; applied in 2019 and in 2025) and chisel plow tillage (CPT, applied in 2022 and in 2025) influence soil health, soil water and temperature dynamics, and greenhouse gas emissions relative to NT (established since 2013) and continuous conventional tillage (CT). Across repeated sampling at 0-10 cm and 10-30 cm, and relative to NT, SMT reduced surface soil total carbon (STC) and total nitrogen (TN) by 22% and 21%, respectively, while CPT showed smaller reductions (12% STC, 10% TN). In contrast, CT (36% lower STC and 35% lower TN). Soil inorganic nitrogen was 35% lower under SMT, whereas CPT and CT treatments generated higher short-term N than NT. Microbial biomass carbon declined least under CPT (7%) and SMT (22%) and most under CT (37%).

Meeting the Needs of New Mexico: Dryland agriculture in eastern New Mexico faces increasing challenges from limited rainfall, high temperatures, and declining soil productivity. Producers frequently ask whether occasional tillage can relieve surface compaction in long-term no-till systems without degrading soil health or increasing environmental losses. This project directly addresses these concerns by evaluating occasional tillage practices that differ in disturbance intensity and frequency. The study provides science-based guidance on when and how to integrate occasional tillage into no-till systems to improve soil physical condition, conserve soil water, and maintain soil carbon and nitrogen. These findings support sustainable, resilient dryland crop production in the semi-arid regions of New Mexico.

Impact: Preliminary results demonstrate that the frequency and intensity of occasional tillage strongly influence short-term soil health responses in semi-arid dryland systems. Continuous CT resulted in the greatest depletion of surface soil carbon and nitrogen, with STC and TN approximately 36% and 35% lower than in NT. In contrast, occasional tillage within long-term NT, including SMT and CPT, retained much of the surface carbon and nitrogen benefit while temporarily alleviating surface compaction. Compared with CT and CPT, SMT showed more moderate inorganic nitrogen mineralization and less disruption of microbial biomass. Overall, these findings indicate that low-intensity, infrequent, occasional tillage within long-term NT can alter short-term soil physical and biological responses without large losses of surface soil carbon and nitrogen. Additional analyses of soil water storage, soil temperature regulation, and cumulative greenhouse gas emissions are underway to assess the impact of occasional tillage.


Conventional Tillage


No-Till


Stubble mulch tillage


Chisel plow Tillage

Research Publications, Sponsored Projects, and Presentations

Publications

1. Sapkota, S., B. Sharma, and **R. Ghimire****. 2025. Enhancing carbon stability in biochar-amended arid soils: insights from a long-term soil incubation study. Carbon Management. https://doi.org/10.1080/17583004.2025.2602999.
2. Frene, J.P., N. Kasera, D. Jaisi, S. Sapkota, D. O'Connell, S. Higgins, S. Adhikari, and **R. Ghimire****. 2025. Enhancing soil health and phosphorus use efficiency with modified biochar amendment. Science of the Total Environments, 180794, https://doi.org/10.1016/j.scitotenv.2025.180794
3. Noble Strohm*, T., S. Fonte, **R. Ghimire**, M. Mikha, O. Adebayo, P. Bista, V. Acosta-Martinez, S. Angadi, M. Schipanski. 2025. Soil health indicators for water-limited regions: Evaluating relative sensitivity to compost and cropping intensification. Journal of Soil and Water Conservation. https://doi.org/10.1080/00224561.2025.2477320
4. Acharya, P., A. Ogunleye, M. Marsalis, J. Bell and **R. Ghimire****. 2025. Enhancing forage production and quality under resource-limited conditions by alfalfa-bermudagrass interseeding. Agronomy Journal. https://doi.org/10.1002/agj2.70174.
5. Adebayo, O.*, V.R. Thapa, A. Ulery, and M. Schipanski, **R. Ghimire****. 2025. Optimizing the inorganic nitrogen extraction method to evaluate alternative cropping strategies. Agronomy Journal. https://doi.org/10.1002/agj2.70120.
6. Morales-Ruiz, D.E., G. Villanueva-López, F. Casanova-Lugo, J.A. Venegas-Venegas, R. Pinto-Ruiz, F. Guevara-Hernández, M. Reyes-Sosa, P. Martínez-Zurimendi, **R. Ghimire**, D.R. Aryal. 2025. Silvopastoral systems reduce soil CO_2 emissions, enhance carbon stocks, and regulate the micro-environment in tropical grazing lands, Agriculture, Ecosystems & Environment, 393, 109844. https://doi.org/10.1016/j.agee.2025.109844.
7. Sharma, B*., **R. Ghimire****, S. Sapkota, P. Shrestha, C. Brewer, and S. Adhikari. 2025. Nitrous oxide mitigation potential of biochar derived from agricultural and forest biomass: effects of feedstock composition and pyrolysis temperature. Journal of Environmental Quality. https://doi.org/10.1002/jeq2.70054.
8. Singh, A., D.R. Aryal, M. Omer, A.D. Adhikari, O.J. Idowu, R. Herema, **R. Ghimire****. 2025. Soil carbon sequestration and biological health under pecan orchards of varying ages. Soil Science Society of America Journal. https://doi.org/10.1002/saj2.70089.
9. Bista, P., S. Shakya, P. Acharya, and **R. Ghimire**. 2025. Evaluating machine learning models for greenhouse gas emissions prediction in diversified semi-arid cropping systems. Soil Science Society of America Journal. https://doi.org/10.1002/saj2.70057.
10. Adebayo, O.*, A. Singh, P. Bista, S. Angadi, and **R. Ghimire****. 2025. Compost addition improves soil water storage and crop water productivity in a cover crop-integrated sorghum production system under limited irrigation management. Irrigation Science. https://doi.org/10.1007/s00271-025-01011-2.
11. Sapkota, S.*, **R. Ghimire****, C Brewer, S. Fernando. 2025. Contrasting effects of plant and animal residue biochars on soil health, carbon stability, and crop yield. Journal of Soils and Sediments. https://doi.org/10.1007/s11368-025-03968-1.
12. Liu, R., U.M. Sainju, R. Ghimire, H. Cheng, F. Guan, Y. Liu, C. Yang, F. Zhao, and J. Wang. 2025. Mechanisms of cover crop-derived carbon sequestration in winter wheat fields: Insights from 13C labeling. Soil and Tillage Research, 248, 106462. https://doi.org/10.1016/j.still.2025.106462.
13. Singh, A., P. Bista, S.K. Deb, and **R. Ghimire**. 2025. Simulating cover crops' impacts on soil water and nitrogen dynamics and silage yield in the semi-arid Southwestern United States. Agricultural Water Management. https://doi.org/10.1016/j.agwat.2024.109246.
14. Frene, J.P., **R. Ghimire**, S. Sapkota, and S. Angadi. 2025. Evaluating the potential of circular grass buffer strips to promote fungal community and soil health in water-limited agroecosystems. Soil Ecology Letters. https://doi.org/10.1007/s42832-024-0265-z.
15. Adireddy, G. Rajanna, Saseendran S. Anapalli, Manisha Ojha, **Naveen Puppala** and Krishna N. Reddy**.** 2025. Photosynthetic responses to light levels in drought-tolerant novel peanut (*Arachis hypogaea* L) genotypes. Scientific Reports 15:25032. https://doi.org/10.1038/s41598-025-10978-z

16. Adireddy, G. Rajanna, Saseendran S. Anapalli, **Naveen Puppala** and Krishna N. Reddy**.** 2025**.** Investigating photosynthetic and chlorophyll fluorescence responses to light in peanut acclimated to elevated CO2 and temperature. Photosynthesis Research 163:29. https://doi.org/10.1007/s11120-025-01151-8

17. Krishna Kumar Jangid, Anuja Gangurde, Shweta Shinde, Rohit Babar, Basavaraj PS, Amarnatha Reddy V, **Naveen Puppala** and Ratnakumar Pasala. 2025. Advances in Plant Phenotyping for Climate-Resilient Oilseeds Breeding. In: Breeding Climate Resilient and Future Ready Oilseed Crops. Pp 215-234. DOI: 10.1007/978-981-97-7744-0_8

18. Khadgi. A., Lekkala, S., Verma, P.K., _**NP**., & Janga, M.R. 2025. Emerging Strategies for Aflatoxin Resistance in Peanuts via Precision Breeding. Toxins, 17(8), 394. http://doi.org/10.3390/toxins17080394

19. Strohm, T. N. S. Fonte, R. Ghimire, V. Acosta-Martinez, M. Mikha, O. Adebayo, **P. Bista**, S. Angadi, M. Schipanski. 2025. Soil health indicators for water-limited regions: Evaluating relative sensitivity to compost and cropping intensification. J. Soils Water Conservation pp.1-21.

20. **Bista, P**., S. Shakya, and R. Ghimire. 2025. Evaluating machine learning models for greenhouse gas emissions prediction in diversified semi-arid cropping systems. Soil Sci. Soc. Am. J. 89(2). P.e70057

21. Adebayo. O, A. A. Singh, **P. Bista**, S. Angadi, and R. Ghimire. 2025. Compost addition improves soil water storage and crop water productivity in cover crop integrated sorghum production system under limited irrigation management. Irrigation Science, pp.1-15.

22. Singh, A., P. **Bista,** S.K. Deb, and R. Ghimire, 2025. Simulating cover crops impacts on soil water and nitrogen dynamics and silage yield in the semi-arid Southwestern United States. Agricultural Water Management, 307, p.109246.

23. Pruitt, D., Idowu, O. J., **Angadi, S**., Steiner, R. L., Sanogo, S., Omer, M., Darapuneni, M. K. (2025). Guar growth and yield as affected by nitrogen and phosphorus fertilizer. Journal of Plant Nutrition, 48(14). https://doi.org/10.1080/01904167.2025.2482094

24. Singh, P., **Angadi, S.**, Begna, S., Stamm, M. J., Schutte, B. J., VanLeeuwen, D. (2025). Winter canola water use response under dormant and growth stage based irrigation strategies. Agricultural Water Management, 319, 109807. https://doi.org/10.1016/j.agwat.2025.109807

25. Liman, A., Darapuneni, M. K., **Angadi, S.**, Idowu, O. J., Steiner, R. L., Lauriault, L. M. (2025). Impacts of biochar application on winter canola early growth, biomass, and mineral composition under controlled environmental conditions. Communications in Soil Science and Plant Analysis, 2025, 1-17. https://doi.org/10.1080/00103624.2025.2561034

26. Liman, A., Darapuneni, M. K., **Angadi, S**., Idowu, O. J., Steiner, R. L., Lauriault, L. M. (2025). Soil physical, chemical, and biological properties as influenced by biochar application rates under winter canola production. Communications in Soil Science and Plant Analysis. 56(22), 3187–3200. https://doi.org/10.1080/00103624.2025.2557389

27. Noble Strohm, T., Fonte, S., Ghimire, R., Mikha, M., Bista, P., **Angadi, S**., Schipanski, M. 2024. Soil health indicators for water-limited regions: sensitivity to compost and cropping intensification. J. Soil Wat Cons. 80(4):1-21. https://doi.org/10.1080/00224561.2025.2477320.

28. Adebayo, O., Singh, A., Bista, P., Angadi, S., and Ghimire, R. (2025). Compost addition improves soil water storage and crop water productivity in cover crop integrated sorghum production system under a limited irrigation management. Irrigation Science. https://doi.org/10.1007/s00271-025-01011-23

29. Panta, S., Bista, P., Angadi, S. and Ghimire, R., 2026. Biochar and Compost as Sustainable Amendments for Soil Health and Water Functions in Semi-Arid Agroecosystems. *Sustainability*, *18*(3), p.1369.

Grants

1. **Ghimire, R. (Principal)**, P. Bista, and O.J. Idowu. Establishing soil health and carbon farming demonstration plots in lands transitioning from irrigated to dryland production –Year 4, **PI Total Award: $47,379,** July 2025- June 2026.
2. **Ghimire, R. (Principal)**. Preparing for the future: Evaluating cover crops and compost application through a field assessment and DayCent modeling. USDA Western SARE. **PI Total Award: $29,464**. July 2025- December 2026.
3. Kehlet C. (Principal), H. Takai (Pratt Institute), John Idowu (NMSU, PI), **S.V. Angadi** and others (Multi-state), AquaSteady, an Alginate-based Hydrogel for Sustainable Agriculture in a Changing Climate, Sponsored by NSF Program (through Pratt Institute), Research Credit: **$133,904** (Additional funds for me to added SOW (January 2025 - November 2026).
4. Thomas V. (Ginkgo Bioworks-PI)... O. Holguin, **S.V. Angadi** (NMSU, Co-PI), S. Negi, S. Sevanto (LANL-Co-PI) (Multi-state), CARBON-CAB: Cultivating Agriculture with Revolutionary Bio-Optimized Naturals - Cyanobacteria and Algae for a Brighter future, Sponsored by DOE-MACRO Program (through Ginkgo Bioworks), **$309,159** ($2,991,022) March 1, 2025 - February 01, 2029).
5. **Puppala, N.** 2025. "Valencia Peanut Breeding for High Yield, High Oleic Oil Content, Early Maturity with Favorable Amino Acid Profile. Organization: New Mexico Peanut Growers, Sponsoring Organization Is: Hampton Farms Inc. Total Award: **$ 54,218.85** (September 1, 2024 to August 31, 2025).
6. **Puppala, N.** 2025. Malawi Early Generation Seed Production. Sponsoring Organization Is: Organization: UDAID, Peanut Innovation Lab. Through University of Georgia. Total Award: **$ 320,000** (January 1, 2025 to December 2029).
7. **Puppala, N.** 2025. "Valencia Peanut Breeding For Drought Tolerance-2025 Organization: National Peanut Board, Sponsoring Organization Is: Other, Research Credit: **$9,913**, PI Total Award: $9,913, Current Status: **Funded**. (November 1, 2024 - October 30, 2025).
8. **Puppala, N.** 2025. "Fungicide Studies on Peanut Yield and Grade", Sponsoring Organization: Certis. Total Award: **$5,000**. (January 1, 2025 – December 31, 2025).
9. **Puppala, N.** 2025. "Evaluating Corteva Breeding Lines for Yield and Fiber Quality", Sponsoring Organization: Corteva Agriscience, Total Award: **$12,510**, (January 1, 2025 - December 30, 2025).
10. **Puppala, N.** 2025. "Production of Peanut F1 for use in the development of future publicly available African breeding and research population", Sponsoring Organization: CIMMYT, Total Award: **$7,000** (January 1, 2025 - June 30, 2025).
11. **Puppala, N.** 2025. "Peanut Population Development- Phase-1", Sponsoring Organization: CIMMYT, Total Award: **$7,000** (July 1, 2025 - December 31, 2025).

Presentations

1. Shekawat, Sonu, Justus Chintu, **N. Puppala**. 2025. Adaptability and Stability Analysis of Peanuts in Malawi Across Different Agro-Ecological Zones. 16th edition of the International Symposium of Plant Virus Epidemiology – 16th ISPVE-São Paulo 2025.
2. Pankaj Kumar Verma, Arindam Das, Manisha Ojha, Koushik Ghose, Gunvant B. Patil, Venkateswara R. Sripathi, **Naveen Puppala***, Madhusudhana R. Janga*. 2025. Dissecting Resistance Mechanisms to *Sclerotium rolfsii* in Peanut (*Arachis hypogaea* L.) Through Comparative RNA-Seq Profiling of Resistant and Susceptible Genotypes. AAGB conference in Goa, India March 23-25, 2025.
3. Rajanna G Adireddy, Saseendran S Anapalli, Manisha Ojha, **Naveen Puppala** and Krishna N Reddy. 2025. Evaluation of drought-tolerant novel peanut (*Arachis hypogaea* L) genotypes to photosynthetic rates and yield. American Peanut Research and Education Society. July 15-17, 2025 – Richmond, Virginia. Omni Richmond Hotel.

4. Muhammad Ahmad Yahaya, Regina Ofure Usiomon, Mounirou sow, **Naveen Puppala**, Monique Chan-Huot, Abdoul Kader Yonli. 2025. Experimental Trials for High Nutritional Groundnut Varieties In Nigeria. Nigerian Plant Breeders Association Annual meeting, Victoria Falls, Zimbabwe. October 6-9, 2025.
5. Adebayo, O., T. N. Strohm, V. Acosta-Martinez, S.J. Fonte, M.E. Schipanski, M.M Mikha, **P. Bista**, **S.V. Angadi, and R. Ghimire**, 2025. Optimizing Soil Health Assessment and Management for Water-Limited Agroecosystems. CANVAS 2025.
6. Panta, S., **P. Bista**, **S.V. Angadi, and R. Ghimire**, 2025. Organic Amendments: Strategy to Improve Water Infiltration. CANVAS 2025.
7. De Santiago, C., **S.V. Angadi**, B. Schutte, **R. Ghimire**, **P. Bista**, and S. Panta, 2025. Effect of Circular Buffer Strips on Seasonal Soil Moisture Dynamics Cotton (Gossypium hirsutum L.) in the Southern Great Plains. CANVAS 2025.
8. Panta, S., **P. Bista**, **S. V. Angadi, and R. Ghimire**. Soil water infiltration under various regenerative farming practices in semi-arid regions: the role of soil properties. ACES Open House 2025- Poster competition
9. De Santiago, C., **Angadi, S**., Schutte, B. J., **Ghimire, R., Bista, P**., Panta, S., CANVAS 2025, Salt Lake City, UT, "Effect of circular buffer strips on seasonal soil moisture dynamics of cotton (Gossypium hirsutum L.) in the Southern Great Plains", Scope: International, (November 2025). (Second Prize in graduate student competition)
10. Adebayo, O., Noble Strohm, T., Acosta-Martinez, V., Fonte, S., Schipanski, M., Mikha, M., **Bista, P., Angadi, S., Ghimire, R**., CANVAS 2025, Salt Lake City, UT, "Optimizing soil health assessment and management for water-limited agroecosystems", Scope: International. (November 2025).
11. Panta, S., **Bista, P., Angadi, S., Ghimire, R**., CANVAS 2025, Salt Lake City, UT, "Soil water infiltration and its relationship with soil properties in biochar-compost amended soil in semi-arid regions", Scope: International. (November 2025).
12. Darapuneni, M. K., Idowu, O. J., Pruitt, D. J., **Angadi, S**., Steiner, R., Sanogo, S., Omer, M., CANVAS 2025, Salt Lake City, UT, "Guar Growth and Yield as Affected by Nitrogen and Phosphorus Fertilizers", Scope: International. (November 12, 2025).
13. **Angadi, S**., Patel, T., Rasheed, R. A., Panwar, G., Idowu, O. J., Kehlet, C., De Santiago, C. M., CANVAS 2025, Salt Lake City, UT, "Developing Automated Scanning Technology to Assess Hydrogel Effect on Root Functioning", Scope: International. (November 11, 2025).
14. Tetteh, R., Ojekanmi, A., Okunkenu, A., Fademi, I., **Angadi, S**., Chorover, J., Kehlet, C., John, G., Idowu, O. J., Canvas 2025, ASA-CSSA-SSSA, Salt Lake City, UT, "Effects of Aquasteady Hydrogel Types, Application Rates, and Placement Methods on the Saturated Hydraulic Conductivity of Arid Soils", Scope: International. (November 11, 2025).
15. Okunkenu, A., Ojekanmi, A., Fademi, I., Tetteh, R., Kehlet, C., John, G., **Angadi, S**., Darapuneni, M. K., Idowu, O. J., Canvas 2025, ASA-CSSA-SSSA, Salt Lake City, UT, "Effects of Organic Amendments on Soil Moisture Retention in Arid Soils", Scope: International. (November 11, 2025).
16. Joukhadar, I., Idowu, O. J., Ojekanmi, A., Tetteh, R., Walker, S., **Angadi, S**., Darapuneni, M. K., Kehlet, C., Canvas 2025, ASA-CSSA-SSSA, Salt Lake City, UT, "Growth and Yield of Bell Peppers in Aquasteady Hydrogel-Amended Soil", Scope: International. (November 11, 2025).
17. Rasheed, R. A., **Angadi, S**., Idowu, O. J., Schutte, B. J., Kehlet, C., CANVAS 2025, Salt Lake City, UT, "Split ROOT Method to Analyse the Effect of Hydrogel on ROOT Development, Physiology and Water Use Efficiency in Pepper (Capsicum annuum L.) Seedlings", Scope: International. (November 11, 2025).
18. **Angadi, S**., Yadahalli, G., Kumar, D., Stamm, M., Panta, S., Intermediate Oilseed Crops Conference (IOCC) and Advancement of Industrial Crops (AAIC), "Role of leaves, flowers, pods, and populations on seasonal pattern of radiation dynamics in winter canola genotypes", Scope: International, Invited or Accepted? Accepted. (September 1, 2025).
19. Panta, S., **Bista, P., Angadi, S., Ghimire, R**., ACES Open House, College of ACES, Las Cruces, "Soil water infiltration under various regenerative farming practices in a semi-arid region: the role of soil properties", Scope: State, Accepted. (April 2025).

20. Adebayo, O., **Ghimire, R., Bista, P., Angadi, S.**, New Mexico Crop Production Association Annual Meeting 2025, Ruidoso, NM, "Improving soil health and soil water storage using cover crops and compost in semi-arid agroecosystems", Scope: State, Invited or Accepted? Invited. (January 2025).
21. Marumo, J.L., A.A. Corcoran, **R. Hagevoort**. 2025. Beyond Waste: Microalgae-based Remediation Systems for Dairy Wastewater – Meta-Analytic Approach. Algal Biomass Organization Summit in Tempe, Arizona. Oct 19-21, 2025
22. **Ghimire, R.,** S. Sapkota, A. Singh, J.P. Frene, P. Bista, and P. Acharya. 2025. More carbon per drop: decoding soil carbon for climate resilience in water-limited areas. American Geophysical Union Annual Meeting, New Orleans, LA.
23. Vitsa, S., D. O'Connell, C. Van Midden, S. Higgins, D.P. Jaisi, S. Adhikari, and **R. Ghimire**. 2025. Effectiveness of Mg-modified willow-based biochar on phosphorus sorption, leachate, and perennial ryegrass growth. CANVAS 2025, Salt Lake City, UT.
24. Frene, J.P., B. Sharma, V. Acosta-Martinez, X. Li, and **R. Ghimire**. 2025. Microbial community responses to alternative management regulate soil organic carbon storage in agroecosystems experiencing irrigation retirement. CANVAS 2025, Salt Lake City, UT.
25. Adebayo, O., V.R. Thapa, A. Ulery, M. Schipanski, and **R. Ghimire**. 2025. Optimizing the inorganic nitrogen extraction method to evaluate alternative cropping strategies. CANVAS 2025, Salt Lake City, UT.
26. Sharma, R., I. Santos, J. Ortega-Carranza, B. Hunter, D. Coon, I. Guzman, J. Idowu, R. Ghimire, S. Walker, A.L. Ulery, and X. Li. Effects of soil amendments on nutrient dynamics and chile pepper yield. CANVAS 2025, Salt Lake City, UT.
27. Fademi, I., K. Djaman, **R. Ghimire**, C. Gard, and O.J. Idowu. 2025. Soil moisture and temperature assessment in a compost-biochar amended arid soil. CANVAS 2025, Salt Lake City, UT.
28. Fademi, I., M.N. Omer, K. Djaman, **R. Ghimire**, C. Gard, and O.J. Idowu. 2025. Assessment of soil health in an irrigated arid cropping system. CANVAS 2025, Salt Lake City, UT.
29. Acharya, P., A. Ogunleye, M.A. Marsalis, J.M. Bell, and **R. Ghimire**. 2025. Interseeding alfalfa in bermudagrass improved forage production and nutritional composition under resource-limited conditions. CANVAS 2025, Salt Lake City, UT.
30. Sapkota, S. and **R. Ghimire**. 2025. Understanding the dynamics and drivers of greenhouse gas emissions in cropland and natural rangeland systems. CANVAS 2025, Salt Lake City, UT.
31. Madhuwanthi, P., **R. Ghimire**, and S. Sapkota. 2025. High-frequency monitoring reveals the impacts of organic amendments on greenhouse gas emissions in dry agroecosystems. CANVAS 2025, Salt Lake City, UT.
32. Badrari, H., **R. Ghimire**, J.P. Frene, and O. Adebayo. 2025. Impact of cover crop functional diversity and compost application on soil organic carbon and nitrogen allocation in semi-arid regions. CANVAS 2025, Salt Lake City, UT.
33. Arije, D.N., **R. Ghimire**, P. Bista, S. Gautam, C. Steele, and U. Mishra. 2025. Multi-species cover crops for enhancing soil carbon storage in water-limited environments: a DAYCENT model simulation. CANVAS 2025, Salt Lake City, UT.
34. Devkota, A., P. Madhuwanthi, S. Sapkota, and **R. Ghimire**. 2025. Modified biochar amendments and moisture levels affected CO_2 emission, soil health, and cotton growth: a laboratory and greenhouse study. CANVAS 2025, Salt Lake City, UT (Third place in ASA Biochar Community Student Poster Competition).
35. Singh, A. and R. Ghimire. 2025. Evaluating winter crop effects on greenhouse gas emissions and soil water dynamics in forage corn production under semi-arid regions. CANVAS 2025, Salt Lake City, UT.
36. Awasthi, H., S. Sapkota, J.P. Frene, P. Bista, S.V. Angadi, and **R. Ghimire**. 2025. Assessing Soil Health and Organic Carbon in Circular Grass Buffer Systems Under Semi-Arid Conditions. CANVAS 2025, Salt Lake City, UT.
37. Hafford, L., M. Schipanski, **R. Ghimire**, and M. Mikha. 2025. Supporting regenerative farmers with responsive on-farm testing. Regenerate: Cultivating Adaptability Conference, Santa Fe, NM.

38. Frene, J.P., N. Kasera, D.P. Jaisi, S. Sapkota, S. Adhikari, and **R. Ghimire**. 2025. Modified biochar improves sorghum growth by increasing phosphorus use efficiency in semi-arid environments. Ecological Society of America Annual Meeting, Baltimore, MD.
39. Madhuwanthi, P., S. Sapkota, and **R. Ghimire**. 2025. Exploring diurnal and seasonal variation in greenhouse gas emissions with biochar and compost amendments. Li-COR Connect 2025, Tucson, AZ.
40. Sapkota, S., J.P. Frene, and **R. Ghimire**. 2025. Understanding greenhouse gas emissions associated with exogenous carbon additions in semi-arid cropping systems. Li-COR Connect 2025, Tucson, AZ.

Invited Speaker

1. USDEC-US Indonesia Central Java Dairy Partnership Lecture Series Q1. January 6-7-8, IPB University, Bogor, Indonesia.
2. AgTrust Farm Credit: Board of Directors *"Dairy Industry Update"*. January 30, 2025. Fort Worth, TX.
3. 2025 Dairy Cattle Reproduction Council Webinar Series: *"Employee Training & Retention"*. February 3, 2025. https://www.dcrcouncil.org/webinars/
4. 2025 Scowcroft Institute Pandemic Policy Summit: A Year of H5N1 and How to Move Forward. Panel presentation: *"The Policy to Move Forward"*. March 18, 2025. Bush School of Government and Public Service, Washington, D.C. (Pandora Report).
5. 2025 IFCN Dairy Conference: "Employee Training & Retention, the Achilles Heel of the Dairy Industry". May 22, 2025. Dairy Campus, Leeuwarden, the Netherlands (https://ifcndairy.org/ifcn-dairy-conference-2025-public/).
6. Cattle AgriBusiness Course 2026. *"Dairy Challenges (vulnerabilities) & Opportunities"*. June 4, 2025, West Texas A&M University, Canyon, TX.
7. USDEC-US Indonesia East Java Dairy Partnership Lecture Series Q2. July 22-23-24, Brawijaya University, Malang, Indonesia.
8. NCBA 2025 Stockmanship & Stewardship Event. *"Challenges & Opportunities with Workforce Development"*. August 14, 2025. WATMU, Canyon, TX.
9. Guest lecture at TTU Vet School. "*Industry Lecture: Dairy Industry*". September 9, 2025. TTU School of Veterinary Medicine, Amarillo, TX.
10. USDEC Regulatory Workshop Central America & Dominican Republic. "Overview of U.S. and Southwest Dairy Industry". September 22-25, 2025. Amarillo, TX.
11. USIDP Webinar for Indonesian Veterinary Medical Association (IVMA). "*Designing for Impact: How to Create More Effective Extension Programs*". September 27, 2025.
12. USIDP Webinar for Indonesian Veterinary Medical Association (IVMA). "*Dairy Cow Nutrition and the Role of Volatile Fatty Acids in Milk Formation*". October 25, 2025.
13. USIDP Webinar for Indonesian Veterinary Medical Association (IVMA). "*Dairy Nutrition, Feed Types, and the Ruminant GHG Formation Process*". November 22, 2025.
14. Dairy West/IDA 2025 Annual Meeting. Moderator for panel discussion on Beef on Dairy. Boise, ID. November 6, 2025.
15. USDEC-US Indonesia Sumatra Dairy Partnership Lecture Series Q4. December 4-11, 2025. Bandung, and Sriwijaya University, Palembang, Indonesia.