



# 2024 ANNUAL REPORT

## LEYENDECKER PLANT SCIENCE CENTER

THE NMSU AGRICULTURAL EXPERIMENT  
STATION SUPPORTS RESEARCH THAT  
ADDRESSES REAL-WORLD PROBLEMS.  
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PEOPLE GLOBALLY.

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**College of Agricultural, Consumer  
and Environmental Sciences**  
Agricultural Experiment Station

Leyendecker Plant Science Center



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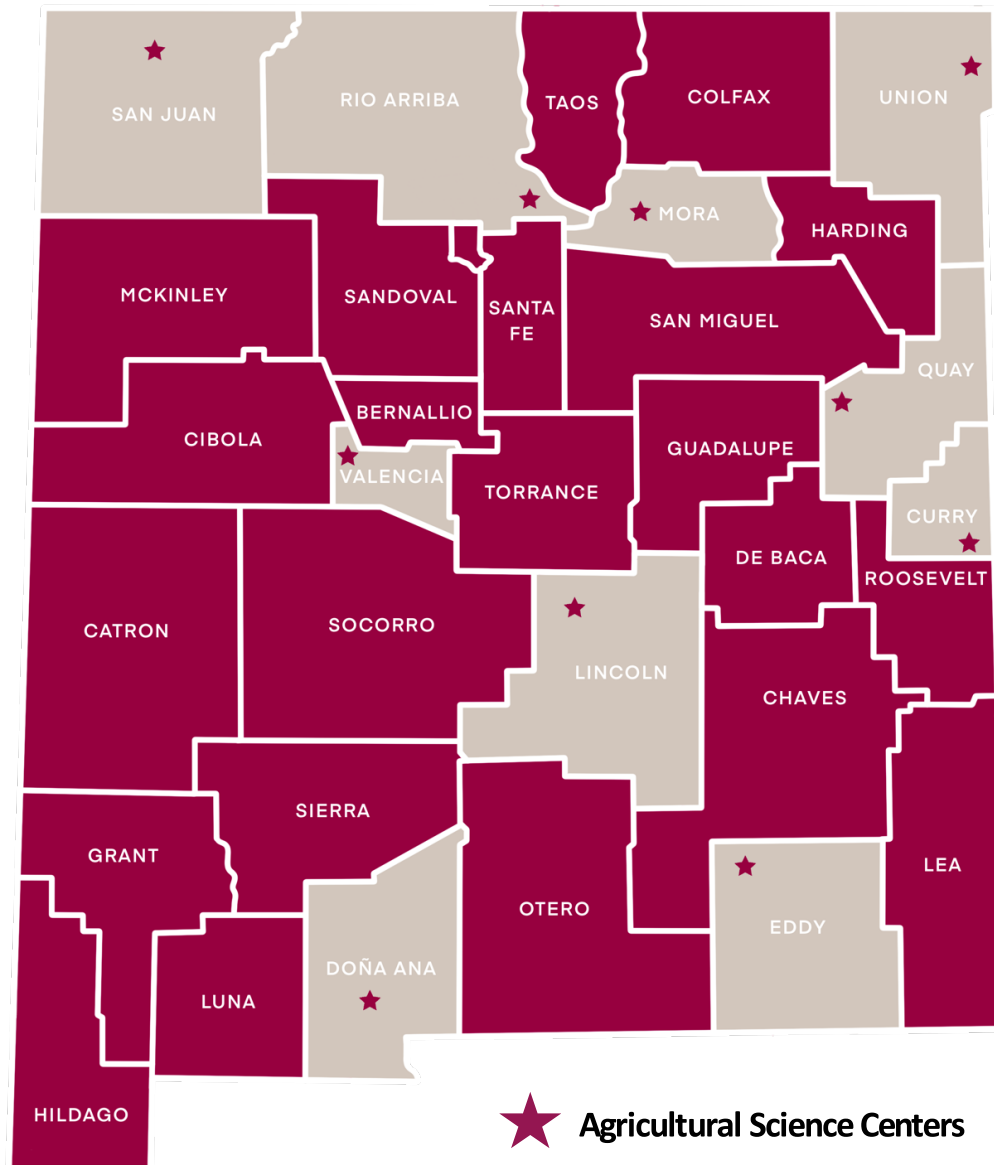
## Notice to Users of this Report

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.

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# Agricultural Science Center Locations Map



# Executive Summary

In 2024, the Leyendecker Plant Science Research Center (Leyendecker PSRC) addressed several research issues, including pest management, irrigation efficiency, crop improvement (chile, cotton, alfalfa, and pecan), agrivoltaics, alternative crops (guayule), soil health management and other research topics. Furthermore, the Leyendecker PSRC organized several community outreach events that informed stakeholders about the center’s cutting-edge research. One of the significant outreach events was the field day that took place in May 2024, which showcased multiple field trials at the center and had around 130 participants. Other outreach events included a Biochar and Soil Health workshop, ACES Open House, Agriculture Historic Society tour, and Science Exchange Program Fellows tour. The center also hosted multiple practical classes in which the center’s research and equipment were demonstrated for students’ learning and engagement. The center has started a new NSF-funded research project that focuses on the use of hydrogels extracted from seaweeds to enhance soil moisture. Scientists at the center submitted several proposals, and two USDA-NIFA Sustainable Agricultural Systems projects have been funded to start in 2025. The first project is focused on managing sustainable groundwater storage by improving farm-scale agricultural water efficiency and profitability, while the second project is focused on developing the potential of prickly pear cactus as an

alternative health-enhancing food crop. The equipment inventory of the center is now available to scientists working at the center. This will help researchers to understand the center’s capabilities when submitting proposals for grant funding.



# Research Highlights



## 2022-2025 Alfalfa Variety Trials at Las Cruces

**Investigators:** Christopher Pierce ([cpierce@nmsu.edu](mailto:cpierce@nmsu.edu)) and Dr. Ian Ray

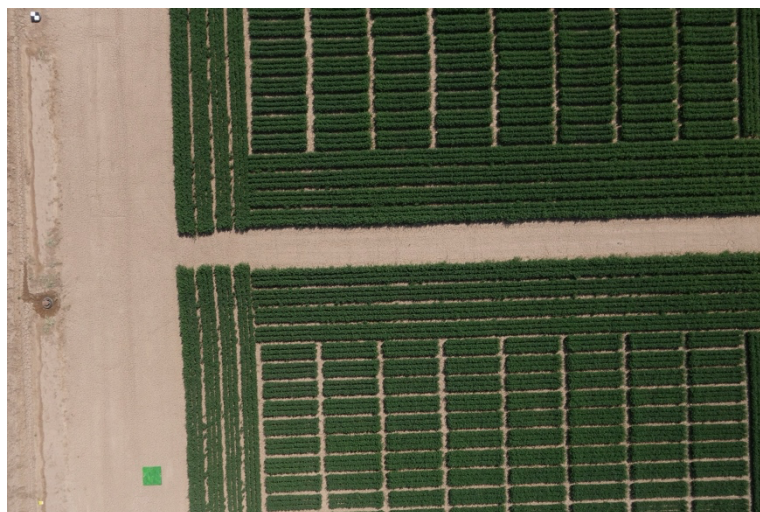
**Collaborating Agricultural Science Centers:** Los Lunas Agricultural Science Center and the Rex E. Kirksey Agricultural Science Center in Tucumcari

**Project Overview:** This study is being conducted to evaluate forage yield performance for 18 alfalfa varieties, 10 new advanced NMSU breeding lines, under standard irrigation management (trial 1) and deficit-irrigation management (trial 2) at Las Cruces, NM, from 2023 through 2025. Additionally, eight of these advanced NMSU breeding lines are also being evaluated at the Los Lunas ASC. The goal is to identify alfalfa varieties that perform well under variable irrigation management strategies within the Southwestern United States.

**Meeting the Needs of New Mexico:** Results from production years, 2023 and 2024, indicate that several NMSU alfalfa populations perform as well or better than regionally adapted commercial check cultivars. Four NMSU populations appear to exhibit good biomass performance under both standard irrigation water management and drought management strategies in multiple trials in New Mexico. Further data collection in 2025 will strengthen our knowledge of variety performance under both irrigation management strategies. These results indicate that several NMSU-derived alfalfa populations could be advanced as commercial varieties allowing for future utilization by New Mexico hay growers.

**Impacts:** Limited water resources threaten New Mexico's \$149 million alfalfa industry. The alfalfa variety trials conducted throughout New Mexico, are intended to help farmers identify currently available alfalfa varieties that they can grow, and which can be productive under highly variable soil moisture conditions. Additionally, these trials help to identify superior NMSU alfalfa varieties suitable for commercialization. Collectively, alfalfa variety evaluation and development benefits agricultural sustainability, yield stability, and water conservation in New Mexico and within the Southwestern United States.

**Funding Acknowledgement:** Hatch project 7001870-NMRAY22H, Genetic Improvement of Alfalfa Germplasm for New Mexico. Multiple Alfalfa Seed Companies. NM Hay Association.



# 2022-2024 NMSU Alfalfa Seed Increase Blocks at Las Cruces

**Investigators:** Christopher Pierce ([cpierce@nmsu.edu](mailto:cpierce@nmsu.edu)) and Dr. Ian Ray

**Collaborating Agricultural Science Center:** Los Lunas Agricultural Science Center

**Project Overview:** The Alfalfa Breeding Program has been conducting bee-pollinated alfalfa breeder seed production under cage isolation for 10 new elite NMSU alfalfa varieties, from 2022 through the fall of 2024. On average, 2.5 pounds of alfalfa seed was produced, per population, each year. These alfalfa populations are currently being evaluated for forage yield potential in trials at the Leyendecker Plants Science Research Center, and at the Los Lunas Agricultural Science Center, New Mexico. Alfalfa forage quality is also being evaluated at the Leyendecker Plant Science Research Center. Populations that perform well in regional trails will be advanced for commercial variety release.

**Meeting the Needs of New Mexico:** Alfalfa seed produced from ten populations will be used for testing at Leyendecker PSRC, Los Lunas ASC, and other locations in California and New Mexico. Yield data from current and future variety trials will identify superior NMSU alfalfa populations that perform well under variable irrigation management strategies and over multiple years and locations. Adapted NMSU varieties will be advanced for commercialization to benefit agricultural sustainability, yield stability, and water conservation in New Mexico and throughout the Southwest.

**Impacts:** The seed generated from this project will be used to determine the suitability of 10 advanced NMSU alfalfa breeding lines for commercial release. Superior NMSU varieties will be identified providing New Mexico hay growers with drought-resilient varieties that can help conserve water, ensure good farm profits, and meet New Mexico's livestock industry's feed demands.

**Funding Acknowledgement:** Hatch project 7001870-NMRAY22H, Genetic Improvement of Alfalfa Germplasm for New Mexico. Multiple Alfalfa Seed Companies. NM Hay Association.



# ThryvOn Cotton Research

**Investigator:** Scott Bundy ([cbundy@nmsu.edu](mailto:cbundy@nmsu.edu))

**Project Overview:** This research was sponsored by Bayer Crop Sciences to evaluate the impact of insect pests on different cotton varieties in southern New Mexico. The insects of focus were sucking pests, specifically thrips. Thrips populations, along with plant injury rating, were documented for the various varieties for the early growing season when thrips are a threat to cotton. Seasonal development of the plants was documented, and yield was taken at the end of the season.

**Meeting the Needs of New Mexico:** This research provides important information on how various varieties of cotton do in southern New Mexico. This is especially important for newly developed transgenic cotton lines used for sucking pest management. It further helps to determine the fit of these varieties for the unique environmental conditions of southern New Mexico and the state.

**Impacts:** Cotton is among the top agricultural commodities of New Mexico. Insect pests cause major economic losses to cotton in the state. Thrips are one of the most important early-season pests of cotton. They can greatly reduce cotton stand establishment and cause injury to terminal growth, which impacts yield, etc. Transgenic cotton varieties target sucking pests including thrips. This research evaluates the impact of thrips populations in southern New Mexico on these important varieties, thus providing valuable data for their efficacy against thrips under our unique growing conditions.

**Funding Acknowledgement:** Bayer Crop Sciences

## Jujube Cultivar Trials

**Investigators:** Shengrui Yao ([yoas@nmsu.edu](mailto:yoas@nmsu.edu)) and Robert Heyduck

**Collaborating Agricultural Science Centers:** Alcalde Sustainable Agricultural Science Center and Los Lunas Agricultural Science Center

**Project Overview:** We have collected and imported over 50 varieties to the New Mexico State University Alcalde Center and established cultivar trials at NMSU Alcalde Center (2015), Los Lunas Center (2015), and Leyendecker Center (2017). Plantings at Alcalde, Los Lunas, and Leyendecker are all growing and producing well especially Leyendecker and Los Lunas sites.

**Meeting the Needs of New Mexico:** Late frost is the most critical issue challenging fruit production in central and northern New Mexico. Most growers had five crops or fewer from 2010-2019. Good alternative crops with reliable yields are needed to diversify their operations and reduce risk. Jujube, also called Chinese date, adapts well to a wide range of soil and climate conditions. With its late-season start-up, same year flower bud initiation and bloom, and two month long blooming period, jujube produces a reliable crop in New Mexico.

**Impacts:** The limited choices of commercially available cultivars to the jujube industry will be greatly improved with the NMSU jujube project. There are currently only 5-6 jujube cultivars commercially available in the United States of which 'Li' is dominant. The New Mexico State University Alcalde Center jujube program has been evaluating more than 50 cultivars in the past eight years and has identified 8-10 fresh eating cultivars. Those cultivars will give growers nationwide more choices with extended maturation dates and achieve a \$1-2 premium per pound. The jujube acreage nationwide is expected to increase significantly.

**Funding Acknowledgement:** Specialty Crop Block Grant projects through the New Mexico Department of Agriculture



# Secure Water Future (Water Movement in Pecan Fields Under Different Irrigation Systems)

**Investigators:** Jorge Preciado ([preciado@nmsu.edu](mailto:preciado@nmsu.edu)), Alexander Fernald, and Richard Heerema

**Project Overview:** Secure Water Future is a collaboration of investigators across the semi-arid western US aiming to improve agricultural and environmental water resilience. To achieve climate change adaptation in Western agriculture and ecosystems, we need better information and flexible institutions for our most precious resource- water. This research is part of the Secure Water Future project, this project delivers novel tools and techniques for a water-stressed region, enabling thriving agriculture, healthy ecosystems, and community resilience in an uncertain climate future from the field to regional scales. The name of the research is “Comparison of Water Movement in Pecan Fields Under Different Irrigation Scenarios”. The project is going to evaluate the best irrigation scenario for the Mesilla Valley.

**Meeting the Needs of New Mexico:** This project is important because it is going to help Mesilla valley farmers to have the information to have better irrigation practices and grow pecans in an optimum way in the valley. In addition to it, communities are going to have information once it is ready to be presented to help them to make decisions that support their community and help them to conserve water.

**Impacts:** We are working on a water balance that will give us field data information on where the water is going and look for alternatives or actions that could be implemented to get the most benefit of the water that has been applied at the pecan fields and have better water management practices. The goals for the project are to make projections of the different irrigation methods to grow sustainable pecans in the Mesilla valley and know the implications of them to the water cycle. The transdisciplinary team works with growers, irrigation districts, and ecosystem managers to adopt and adapt climate resilience strategies, train the next generation of transdisciplinary practitioners, and produce online dashboard for data-driven decision-making.

**Funding Acknowledgement:** Agriculture and Food Research Initiative Competitive Grant no. 2021-69012-35916 from the USDA National Institute of Food and Agriculture



# Cost-Benefit Comparisons Between Cover Crop and Herbicide Methods for Controlling Early-Season Weeds in Chile Pepper

**Investigators:** Brian Schutte ([bschutte@nmsu.edu](mailto:bschutte@nmsu.edu)) and Ram Acharya

**Collaborating Agricultural Science Center:** Los Lunas Agricultural Science Center

**Project Overview:** Barley cover crops that are mowed and incorporated into the soil (herein “barley green manure”) suppress early-season weeds and reduce hand hoeing requirements in chile pepper. We conducted a field study and partial budget analysis to determine if barley green manure improves the profitability of conventional chile pepper production. Although further research is needed, first-year results suggest barley-induced reductions in hand hoeing expenditures may not offset barley-induced reductions in gross return caused by statistically insignificant reductions in yield.

**Meeting the Needs of New Mexico:** Chile pepper is central to the agricultural economy and heritage of New Mexico. However, chile pepper production in this state is threatened by high costs for hand hoeing caused by infestations of annual weeds. To address this threat, we are determining the benefits and limitations of an ecologically based method for reducing weeds and hand hoeing requirements in chile pepper. The results from this project will help farmers in New Mexico make informed decisions on a new weed management method that does not involve synthetic herbicides and promotes soil conservation.

**Impacts:** Through previous work in this project, we developed an ecological tactic for managing weeds and reducing reliance on both herbicides and hand hoeing in chile pepper production. This ecological tactic involves a cover crop that provides multiple ecological benefits in addition to weed suppression. The decision to adopt the new tactic for weed management requires knowledge of the tactic’s economic impact in the context of the local cropping system. Accordingly, this project generates the information needed for farmer decisions on the adoption of this ecological tactic for managing weeds. Adoption of the tactic is expected to reduce soil erosion on agricultural fields, reduce pesticide applications, and minimize labor expenditures in chile pepper production.

**Funding Acknowledgement:** US Department of Agriculture/National Institute of Food and Agriculture NIFA, Crop Protection and Pest Management Program



# Developing Region-Specific Guidelines for Selecting Cover Crop Species in New Mexico

**Investigators:** Brian Schutte ([bschutte@nmsu.edu](mailto:bschutte@nmsu.edu)), Mark Marsalis, Kevin Lombard, and Rajan Ghimire

**Collaborating Agricultural Science Center:** Clovis Agricultural Science Center, Farmington Agricultural Science Center, and the Los Lunas Agricultural Science Center

**Project Overview:** Cover crops provide multiple ecological benefits linked to agricultural productivity. To maximize benefits from cover crops, farmers must select cover crop species that consistently produce large amounts of biomass when grown under the environmental conditions that typify the farmer's region. This project is determining biomass production and growth characteristics of sixteen cover crop species across four regions of New Mexico. The results from this project will help New Mexico farmers select cover crop species that are best suited for their location.



**Meeting the Needs of New Mexico:** New Mexico has over two million acres of cropland that generate over \$800 million in agricultural product sales. Maintaining and enhancing this level of cropland productivity involves replacing external inputs with the management of biodiversity in crop production systems. Cover crops — crops grown between periods of cash crops — are means for diversifying crop production systems. This project is developing region-specific guidelines for selecting cover crop species in New Mexico. With knowledge of cover crop species best suited for their location, farmers in New Mexico can maximize benefits from cover crops that include, but are not limited to, soil conservation, pest suppression, and increased cash crop yield.

**Impacts:** This project has determined the suitability of summer cover crop species for the following four agricultural regions of New Mexico: Colorado Plateau, High Plains, Middle Rio Grande Valley, and Lower Rio Grande Valley. Research clarifying the suitability of winter cover crop species is ongoing. Based on the amounts of biomass produced in summer 2023 and summer 2024, sorghum-sudangrass (*Sorghum × drummondii*) is a well-adapted grass cover crop species for the Colorado Plateau, High Plains, Middle Rio Grande Valley of New Mexico. For the Lower Rio Grande Valley, sudangrass may be the best choice for a grass cover crop in summer. Best-choice legume cover crops for summer include cowpea (*Vigna unguiculata*) for the Colorado Plateau and Middle Rio Grande Valley, sunn hemp (*Crotalaria juncea*) for the High Plains, and sesbania (*Sesbania herbacea*) for the Lower Rio Grande Valley. These regional recommendations are expected to help farmers selection high performing cover crops for their specific locations.

**Funding Acknowledgement:** USDA Natural Resources Conservation Service

# Determining Costs and Benefits of Crop Rotations for Improved Weed Control in Chile

**Investigators:** Brian Schutte ([bschutte@nmsu.edu](mailto:bschutte@nmsu.edu)), Erik Lehnhoff, Mark Marsalis, John Idowu, and Madhav Regmi

**Collaborating Agricultural Science Center:** Los Lunas Agricultural Science Center

**Project Overview:** Weeds and hand hoeing in chile pepper are reduced by: 1) sorghum grown for forage the summer prior to chile, and 2) barley grown as green manure the winter prior to chile pepper. Although forage sorghum followed by barley green manure is a promising crop rotation for managing weeds in chile pepper, this crop sequence likely increases the fertilizer requirement for optimal growth of chile. Thus, before forage sorghum followed by barley green manure can be recommended to chile growers, we must first determine if sorghum-barley-induced reductions in hand hoeing expenses are greater than the increased costs for fertilizer associated with this crop rotation.

**Meeting the Needs of New Mexico:** High costs for hand hoeing are severe threats to chile production in New Mexico. To address this threat, we are clarifying the economic benefits of a crop rotation that is expected to reduce hand hoeing but increase fertilizer requirements for chile pepper production. The results from this project will help farmers make informed decisions on a crop rotation that is both well-suited to the climate and soil of southern New Mexico and a new strategy for managing weeds in chile pepper. In the near-term, adoption of the crop rotation addressed in this project is expected to increase profitability of chile pepper production. Long-term adoption of the crop rotation will conserve and improve soil supporting crop production.

**Impacts:** Chile production in New Mexico is reliant on hand hoeing for weed control. This reliance reduces profitability and threatens the sustainability of chile pepper production in New Mexico. In this project, we are determining the financial implications of a new crop rotation that reduces weeds and hand hoeing in chile pepper. Information on a novel tactic's economic impact can help farmers with adoption decisions, and thus, this field study is generating the facts that will be central to an education outreach program that presents new strategies for reducing hand hoeing in chile pepper production. With the knowledge gained from this study, farmers in New Mexico can better utilize a crop rotation that improves profitability by diminishing hand labor requirements in chile pepper production.

**Funding Acknowledgement:** New Mexico Chile Association



# Fostering Sustainable Organic Cotton Production in the US through Research and Outreach on Organic Regenerative Practices

**Investigator:** Brian Schutte ([bschutte@nmsu.edu](mailto:bschutte@nmsu.edu))

**Project Overview:** Weed management in organic cotton typically involves tillage. Excessive tillage degrades the soil that supports both high yields and profitable crop production. Thus, sustainable production of organic cotton requires weed management programs that allow growers to reduce frequency of tillage. This project is evaluating the efficacy of, and soil responses to, weed management programs for organic cotton that differ in the number of tillage events. In specific experimental programs, tillage events are replaced with cultural tactics including cover crops, and thermal tactics including flame weeding.

**Meeting the Needs of New Mexico:** In 2022, cotton was planted on 49,000 acres in New Mexico and provided approximately \$7 million cash receipts to growers. Although a fraction of the cotton acres in New Mexico is currently certified organic, organic production may be an opportunity for increased profits for cotton growers in New Mexico. Further, innovative tactics for managing weeds in organic cotton fields may enhance sustainability of conventional cotton production. Notably, some methods for managing weeds in organic cotton replace tillage with tactics such as rolled cover crops. By developing tactics for managing weeds in organic cotton — including tillage-replacement tactics — this project is establishing a knowledge base for growers considering transitions to organic production, as well as growers seeking to reduce tillage in cotton production.

**Impacts:** In New Mexico, tillage is an important tool for controlling weeds in organic and conventional cotton. However, excessive tillage degrades the soil that is foundational for many aspects of agroecosystem health. This project is identifying reduced-tillage methods for controlling weeds in cotton. Possible benefits of reduced tillage include, but are not limited to, reduced potential for soil erosion, improved soil structure, and increased water retention in soil. Thus, this project is developing techniques that can help preserve cotton yield potential in both the near- and long-term. Because weeds are often cited as a primary problem in organic crop production, enhanced techniques for weed control in organic cotton may promote adoption of organic crop production.

**Funding Acknowledgement:** USDA NIFA Organic Agriculture Research and Extension Initiative

## Biorational Management of Soilborne Diseases

**Investigators:** Soum Sanogo ([ssanogo@nmsu.edu](mailto:ssanogo@nmsu.edu)), Fechner, Dobey, Q., P. Lujan, and Jesus Barraza; K. Crosby (Texas AgriLife); and Vince Hernandez (Biad Chili, Co.)

**Project Overview:** The project has two components: 1) screening advanced varieties of chile pepper from Texas AgriLife breeding programs for resistance to soilborne pathogens; and 2) evaluation of biologicals (microbials and plant defense activators) for efficacy against chile wilt pathogens. Under field conditions, the advanced pepper varieties were evaluated in microplots artificially inoculated with three pathogens, *Phytophthora 17ahlia17*, *Rhizoctonia solani*, and *Verticillium 17ahlia*. All varieties were susceptible to the three pathogens. These results suggest that continuing breeding efforts are needed to identify lines and varieties that are resistant to chile wilt pathogens. Disease pressure was too low in experiments focused on the evaluation of biologicals, precluding any assessment of the efficacy of the tested biologicals.

**Meeting the Needs of New Mexico:** Soilborne pathogens are major constraints to the production of chile pepper in New Mexico and in the Southwest US. An integrated approach is fundamental to mitigating the effects of these pathogens on crop productivity. Components of this approach include disease resistance and management tools that reduce the activities of pathogens and boost the resistance of chile pepper. This project is specifically focusing on these two components, which have the potential to reduce the negative impact of chile wilt pathogens, and hence have relevance to meeting the needs of the NM chile industry and NM agriculture.

**Impacts:** This project focuses on the needs of the chile pepper industry and NM agriculture, especially the need to mitigate the activities of chile wilt pathogens. Results from the project provide information that will help producers make a decision on adopting tools that have the potential to reduce the negative impact of chile wilt pathogens on crop productivity.

**Funding Acknowledgement:** USDA-Agriculture Marketing Service, Specialty Crop Multi-State Program through Texas Department of Agriculture



*Presentation on Biorational Approaches for Management of Soilborne Diseases – Leyendecker Field Day (May 2024)*

# The Compatibility and Contribution of Natural Enemies in Western US Alfalfa Management

**Investigators:** Ricardo Ramirez ([ricarami@nmsu.edu](mailto:ricarami@nmsu.edu)), Ryan Larsen Ag Economist, Utah State University; Scott Bernhardt Entomologist, Utah State University; Ayman Mostafa Entomologist, University of Arizona

**Collaborating Agricultural Science Center:** Fabian Garcia Research Center

**Project Overview:** Through a multi-year project, a field survey of New Mexico alfalfa fields was conducted to evaluate the impact of varied management with and without insecticide applications on the natural enemy community. Moreover, field cage studies were conducted in alfalfa to evaluate how changes in natural enemy communities impact pest suppression.

**Meeting the Needs of New Mexico:** Broad-spectrum insecticides are traditionally used to suppress alfalfa insect pests but have unintended consequences on natural enemy populations like predatory insects that provide natural pest control. Increased natural enemy diversity has been shown to provide improved pest suppression and different species and their life stages contribute to pest suppression. Therefore, the conservation of natural enemies can provide a benefit to New Mexico alfalfa growers.

**Impacts:** Broad-spectrum insecticides are traditionally used to suppress alfalfa insect pests but have unintended consequences on natural enemy populations like predatory insects that provide natural pest control. Through a field survey across alfalfa fields in New Mexico we determined that insecticide treatments for alfalfa pests early in the season showed a decline in the abundance of natural enemies compared to untreated fields. These changes for some species altered the timing of nymphal life stages and their presence to contribute to pest suppression. A cage study in alfalfa also revealed that increasing natural enemy diversity can lead to improved pest suppression. Pairing adult and nymphal natural enemy life stages alone, however, may also contribute to improved pest control. Gaining a better understanding of the contribution of natural enemies on pest suppression and the impacts of crop management on the conservation of natural enemies provides a foundation for improved management strategies.

**Funding Acknowledgement:** USDA-NIFA Alfalfa Forage Research Program funded grant



# Soil Carbon Sequestration and Biological Health Under Pecan Orchards of Varying Ages

**Investigators:** Rajan Ghimire ([rghimire@nmsu.edu](mailto:rghimire@nmsu.edu)), John Idowu, Richard Heerema, and Atinderpal Singh

**Project Overview:** Farmers in the southwestern USA plant high-value crops, such as pecan (*Carya illinoensis*), to adapt with local conditions and climate change and variability. However, the effect of pecan crop production on soil health and their carbon © storage potential remains unknown. We studied the response of selected soil health indicators and profile C storage in pecan orchards of different ages (20, 40, 80 y) and a nearby cotton (*Gossypium hirsutum*) field as a control. Soil samples were collected from 0–90 cm depth and analyzed for potentially mineralizable carbon (PMC), soil organic carbon (SOC), total labile N (TLN), soil organic nitrogen (SON), and soil microbial community structure. Results showed that soil PMC and SOC content in 15–90 cm depth was greater in the 20-year-old pecan orchard. In addition, soil bacteria and fungi at 0-15 cm depth were enhanced in the 20-year-old pecan orchard. Pecan orchards can improve soil health and C sequestration, particularly in the first 20 years of establishment.

**Meeting the Needs of New Mexico:** The results from our study show that the increasing age of pecan orchards may influence soil C pools and soil microbial communities at various depths in southwestern New Mexico. The study suggests that the soil quality of land previously used for row cropping systems in southern New Mexico can be improved by establishing pecan orchards. However, pecan is a high water-demanding crop compared to many row crops grown in the region. Introducing orchard practices on farmlands can lead to significant carbon inputs in above and below-ground biomass and soil. These systems can provide an integrated approach to sustainable land use while contributing to the region’s climate change adaptation and mitigation.

**Impacts:** Climate change and variability have affected crop production and soil health in arid regions in the southwestern USA. Farmers have been planting crops with high market value and carbon © sequestration potential, like pecans, to cope with climate change. However, the soil health and C sequestration potential of these practices have not been quantified. We quantified the response of selected soil health indicators and profile C storage in pecan orchards of different ages (20, 40, 80 y) and a nearby cotton field as a control. We demonstrated that pecan orchards can enhance soil health and sequester carbon compared to annual crops like cotton, particularly in the first 20 years of establishment.

**Funding Acknowledgement:** USDA-Natural Resources Conservation Service, New Mexico GR0007378



# Development and Release of a New Cultivar: NuMex Enchantment Colored Serrano Chile Pepper (*Capsicum annuum* L.)

**Investigators:** Dennis N. Lozada ([dlozada@nmsu.edu](mailto:dlozada@nmsu.edu)), Seyed Shahabeddin Nourkakhsh, Ehtisham Khokhar, Muhammad Ibrar Khan, and Danise Coon

**Collaborating Agricultural Science Center:** Fabian Garcia Research Center

**Funding Acknowledgement:** Lozada, D.N. “Red and Green”: Multi-omics approaches to accelerate genetic improvement of chile peppers in New Mexico. Sponsor: Dr. Paul W. Bosland Endowed Chair in Chile Pepper Breeding and Genetics; Project Duration: 3 years; Project Dates: July 1, 2023-June 30, 2026

**Project Overview:** The NuMex Enchantment Serrano Chile Pepper is a newly developed, brightly colored, high-heat serrano pepper variety released by the NMSU Chile Pepper Breeding and Genetics Program. It was bred through crossbreeding Chimayo landrace and a serrano breeding line, followed by extensive field selections. This project evaluated its horticultural traits, yield performance, and heat level in replicated trials across multiple locations in New Mexico. With its vibrant orange color, high yield, and significantly increased pungency, NuMex Enchantment offers unique market opportunities for chile growers and processors interested in value-added serrano pepper products.

**Meeting the Needs of New Mexico:** The NuMex Enchantment Serrano Chile Pepper was developed to enhance the economic and agricultural landscape of New Mexico by providing growers with a high-value, marketable chile pepper variety. Its vibrant orange color and high heat appeal to specialty and value-added markets, increasing profitability for farmers and processors. Additionally, its development supports the state’s rich chile heritage and strengthens the chile pepper industry by offering a new variety suited for local growing conditions. This project aligns with NMSU’s commitment to agricultural innovation, ensuring that New Mexico remains a leader in chile pepper breeding and production.

**Impacts:** The development of NuMex Enchantment Serrano Chile Pepper represents a significant advancement in chile pepper breeding, offering New Mexico growers a high-yielding, high-heat, and visually distinct pepper variety. Its vibrant orange color and enhanced pungency cater to niche markets, increasing opportunities for value-added processing and specialty food production. Multi-location replicated field trials demonstrated its superior horticultural traits and its adaptability to local growing conditions while maintaining high yield potential. By expanding the genetic diversity of commercially available serrano peppers, this new variety strengthens New Mexico’s position as a leader in chile pepper production. Furthermore, its availability through the Chile Pepper Institute fosters continued research, breeding, and agricultural education. Ultimately, NuMex Enchantment benefits local farmers, food processors, and consumers, driving economic growth and sustainability in the state’s agricultural sector while preserving its rich chile-growing tradition.

**Funding Acknowledgement:** Lozada, D.N. “Red and Green”: Multi-omics approaches to accelerate genetic improvement of chile peppers in New Mexico. Sponsor: Dr. Paul W. Bosland Endowed Chair in Chile Pepper Breeding and Genetics; Project Duration: 3 years; Project Dates: July 1, 2023-June 30, 2026



*Fruits and plant habit of NuMex Enchantment serrano chile pepper (*Capsicum annuum* L.). The photographs were taken at the replicated trials at the Fabian Garcia Science Center, Las Cruces, NM, during the 2024 growing season.*

## Pecan Clonal Rootstock Field Trial

**Investigators:** Jennifer Randall ([jrandall@nmsu.edu](mailto:jrandall@nmsu.edu)) and Richard Heerema

**Project Overview:** Commercial pecan orchards have composite trees with scions grafted to rootstocks. Pecan rootstocks in current orchards are seed derived which leads to variability in the field. The development of micropropagation to clone pecan rootstocks will allow for consistency of traits. Different cloned genotypes are currently in field trials and being evaluated for growth and other phenotypic traits including water efficiency, salinity tolerance, zinc uptake, and microbiome analyses.

**Meeting the Needs of New Mexico:** There are numerous challenges that face NM agriculture including water availability, salinity tolerance for plants, nutrient acquisition (Zn) for plants in our soil conditions. These clonal pecan rootstocks are being tested in field trials in NM to see how they perform under our arid land conditions.

**Impacts:** Clonal rootstock will allow pecan growers to select consistent traits that they require in their orchard. We are working with a private company to commercialize clonal rootstock which will allow growers to specifically select the rootstock they will plant in their orchard. Clonal rootstock will reduce variability that leads to difficult/different management in an orchard system.

**Funding Acknowledgement:** San Simone Research Group, USDA NIFA 2022-51181-38332



# By the Numbers



## Research Publications

- Leonard Lauriault, Ian Ray, Chris Pierce, Koffi Djaman, Robert Flynn, Mark Marsalis, Charles Havlik, Abdullahi Liman, and Margaret West (2024). *The 2024 New Mexico Alfalfa Variety Test Report: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University*. [https://pubs.nmsu.edu/variety\\_trials/alfalfa\\_2024.pdf](https://pubs.nmsu.edu/variety_trials/alfalfa_2024.pdf).
- Yao, S. (2024). Register of jujube cultivar list. In David Karp and Ksenija Gasic (co-editors) , Register of New Fruit and Nut Cultivar list (52), *HortScience*, 59(8), 1220-1292, (1253-1256 for jujubes). <https://doi.org/10.21273/HORTSCI18040-24>
- Sapkota, D., Zhang, D., Park, S., Meinhardt, L., Lozada, D., Steiner, R. L., Yao, S. (2024). Genetic Diversity and Population Structure of Jujube Cultivars in the United States Revealed by Single Nucleotide Polymorphism Markers. *J. Amer. Soc. Hort. Sci.*, 149(2), 107-120. <https://doi.org/10.21273/JASHS05370-23>
- Toth, C.R., B.J. Schutte. 2024. Barley cover crops outperform brown mustard for early-season weed control in New Mexico chile pepper. *Weed Science*, 73(e8), 1-10. doi 10.1017/wsc.2024.81
- Toth, C.R, B. J. Schutte. 2024. Suitability of a barley crop to suppress weeds of chile pepper in southern New Mexico. *Proceedings of the 77th Annual Meeting of the Western Society of Weed Science* 77:133
- Schutte, B. J., A. Bajagain, A. Nagila, C. Toth. 2023. Cover crops for pest suppression in chile pepper. *Proceedings of the 76th Annual Meeting of the Western Society of Weed Science* 76:121
- Singh Insa, R., E. A. Lehnhoff, B. J. Schutte. 2024. Reducing hand hoeing in chile pepper by controlling weeds in a rotational sorghum crop. *Proceedings of the 77th Annual Meeting of the Western Society of Weed Science* 77:97
- Fechner, J., Dobey, Q., Hernandez, V., Crosby, K., and Sanogo, S. (2024). Screening Advanced Pepper Varieties from Texas AgriLife Breeding Programs for Resistance to Diseases and Other Disorders APS Pacific Division Meeting & Conference on Soilborne Plant Pathogens, Corvallis, OR, March 26-28, 2024.
- Lozada, D.N., Coon, D., Khokhar, E., Khan, M.I., Nourbakhsh, S.S., Bosland, P.W. NuMex Enchantment colored serrano chile pepper (*Capsicum annuum* L.). *HortScience* (accepted), in press, <https://doi.org/10.21273/HORTSCI18386-24>

## Grants and Contracts

- Allelopathic cover crops for pest suppression in chile pepper in the Southwest. USDA NIFA Crop Protection and Pest Management Program, September 2021-September 2024, \$191,173. B. Schutte (PI), E. Lehnhoff, S. Sanogo, R. Creamer, S. Bundy, R. Acharya
- Developing region-specific guidelines for selecting cover crop species in New Mexico and establishing a technological framework that allows remote monitoring of cover crop performance. Funded by the USDA Natural Resources Conservation Service, May 2023-December 2027, \$250,000.
- New Mexico Agricultural Experiment Station and the New Mexico Chile Association, July 2024-June 2026, \$74,583. B. Schutte (PI), E. Lehnhoff, M. Marsalis, J. Idowu, M. Regmi
- Fostering sustainable organic cotton production in the US through research and outreach on organic regenerative practices. USDA NIFA Organic Agriculture Research and Extension Initiative, September 2023-August 2027. \$3,000,000; NMSU subaward: \$249,073. M. Bagavathiannan (PI), N. Rajan, P. Dotray, J. Kever, K. Lewis, J. Mowrer, E. Kimura, N. Subramanian, B. Schutte, E. Rieke, A. Flanders, B. Kirksey, D. Constance, J. Choi, A. Sciligo, R. Ray, B. Whitney
- Enhancing Hot Pepper Production in the Southwest US Sanogo, S., Fedio, W., and Acharya, R. Subaward Amount: \$450,000. Funding Period: May 1, 2020-April 30, 2024.
- Lozada, D.N. “Red and Green”: Multi-omics approaches to accelerate genetic improvement of chile peppers in New Mexico. Sponsor: Dr. Paul W. Bosland Endowed Chair in Chile Pepper Breeding and Genetics; Project Duration: 3 years; Project Dates: July 1, 2023-June 30, 2026

## Outreach Activities

### ***International Pedometric Conference Tour (February 7, 2024)***

The international pedometric conference participants visited the soil health field at Leyendecker PSRC on February 7, 2024. This was a part of the field tours organized for the conference participants. Dr. John Idowu shared research results with the group on the influence of various practices on soil health. A large profile pit was dug at the edge of the soil health field to demonstrate to the participants the soil formation processes in Rio Grande Valley Basin. Seventy participants attended the tour.

### ***Leyendecker PSRC Annual Field Day (May 22, 2024)***

The Leyendecker annual field day was held on Wednesday, May 22, 2024. The field day featured presentations of several research trials hosted at the center. Research featured included agrivoltaics trials in chile, long-term soil health plots, the NMSU IR-4 program, biorational management of soil diseases, guayule growth and yield in southern New Mexico, crop rotation and cover crops for weed suppression in chile and chile breeding for mechanization. Results and breakthroughs on these research topics were discussed by scientists working on the projects. Participants had the opportunity to see different trials in the field and ask practical questions related to crop production and management.

The Associate Dean, Dr. Jay Lillywhite of ACES College gave welcome remarks while Dr. Lara Prihodko, the Associate Director of the Agricultural Experiment Station, also gave an opening address. During the brunch, different groups and agencies shared their updates with the audience.



### ***Biochar and Soil Health Field Day (April 24, 2024)***

The Biochar and Soil Health field day was held at the long-term soil health plots at Leyendecker PSRC on April 24, 2024. The field day featured how soil health practices affect crop production and soil productivity. Cover crop fields were showcased during the field day as participants had the opportunity to walk through the fields to examine cover crop species and ask specific questions on the management of cover crops. The field day also included a demonstration of how to prepare biochar from pecan wood waste. Participants observed all the stages involved in the production of biochar and were able to ask questions. A demonstration of different field instruments for assessing soil health measurements was also conducted. Presenters at the field day included Dave Lowry, Dr. Catherine Brewer, and Dr. John Idowu.



### ***Agricultural History Society Tour (June 7, 2024)***

The Agricultural History Society was founded in Washington, DC in 1919 "to promote the interest, study, and research in the history of agriculture". The current membership comprises agricultural

economists, anthropologists, economists, environmentalists, historians, historical geographers, rural sociologists, and various independent scholars. The Society delegation, about 85, visited the Leyendecker Plant Science Research Center to learn more about agriculture in the desert southwest. The group was very interested in irrigation practices, soil composition, crop growth portfolio, and general agricultural methods used in the Mesilla Valley. Members of the Society were from all over the country, many from eastern states, which made for healthy discussions and provided a much different view than they were used to.

***Foreign Agricultural Service Fellows Tour ( July 22, 2024)***

Leyendecker PSRC hosted scholars who were Foreign Agricultural Service Fellows through the Science Exchange Program (SEP). The visiting fellows had different agricultural expertise which included livestock nutrition, food-chain supply safety, and irrigation/water management, to name a few. This allowed for in-depth discussions at the science center given their scholarly backgrounds. The fellows came from Africa, and most were from countries with similar semi-arid to arid environments. Several topics discussed interested the fellows, and many of the research projects at Leyendecker PSRC related to issues they were facing in their home countries. Through the SEP program, we are in contact with the fellows, exchanging ideas and formulating new ones.

***Sustainable Crop Production Class (August 29, 2024)***

Some 400-level sustainable crop production class students visited Leyendecker to learn about agricultural implements and to discuss how they are used in farming operations. This opportunity provided students with a real-life learning experience and a hands-on assessment of the art of farming. During the tour, soil health and crop management in a semi-arid environment were discussed. Information on primary tillage, secondary tillage, carbon sequestration, irrigation management, and crop rotation was shared with the students. The economic implications of varying management practices were also discussed.

# People



## Cooperators and Collaborators

- University of California, Merced
- University of California, Berkley
- University of California, Davis
- Utah State University
- University of California Los, Angeles
- Bayer
- Crop Sciences
- USDA ARS Beltsville, MD
- Texas AgriLife
- Biad Chili, Co.
- Willie Villegas, Hillside Farms, Hatch, NM
- NM Hay Association
- Pratt Institute, Brooklyn, NY
- City College Manhattan, NY
- The University of Arizona, Tucson, AZ
- Bridgestone, Americas, Inc.

## Graduate Students

- Caroline Toth, PhD
- Lohith Siva Venkata Ramakrishna Koyya (Ram), PhD
- Ram Singh Insa, PhD
- Luis Ochoa-Cadena
- Evangelina Carabotta
- Mariam Sharma, PhD
- Ehtisham Khokhar
- Muhammad Ibrar Khar

## Post Doc.

- Atinderpal Singh

## ASC Personnel

- John Idowu, Research Coordinator
- Dave Lowry, Program Operations Director
- Autumn Martinez, Administrative Assistant
- Orlando Morales, Farm Supervisor
- Wade Robinson, Ag Science Center Laborer
- Pablo Holguin, Ag Science Center Laborer
- Isaac Medrano, Ag Science Center Laborer
- Curtis Anderson, Equipment Mechanic
- Zachary Coleman, Ag Science Center Laborer