



# 2024 ANNUAL REPORT

**AGRICULTURAL SCIENCE  
CENTER AT FARMINGTON**

THE NMSU AGRICULTURAL EXPERIMENT  
STATION SUPPORTS RESEARCH THAT  
ADDRESSES REAL-WORLD PROBLEMS.  
RESEARCH IS AT THE CORE OF NMSU'S  
MISSION TO IMPROVE THE LIVES OF  
PEOPLE GLOBALLY.

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

Agricultural Science Center at Farmington



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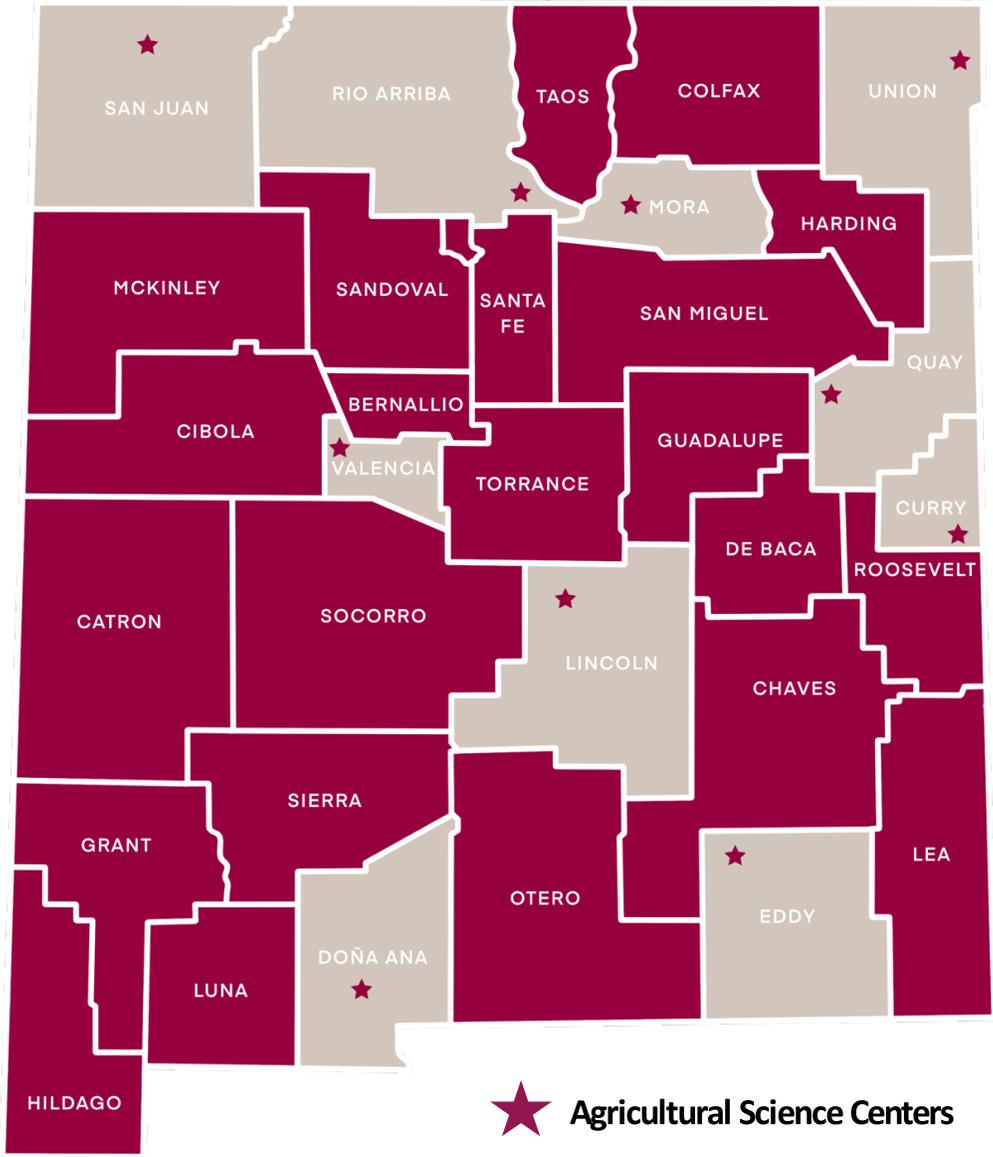
## Notice to Users of this Report

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

The mission of the New Mexico State University Agricultural Science Center at Farmington is to conduct research, demonstration, and educational programs that will best fill the needs of the agricultural community of San Juan County and the Navajo Nation in particular, and the State of New Mexico, Four Corners Region, and Nation in general.

Core research activities are focused on traditional agronomic and horticultural variety trial testing (including alfalfa, forage corn, winter malted barley, beans, viticulture, fruit trees, and medicinal herbs), integrated projects spanning cover cropping, chili pepper and cucurbits, agricultural photovoltaic (solar power), controlled environment agriculture (e.g. greenhouses) and human dimensional studies (e.g. Indigenous farmer’s needs assessment, translating science through animations, and public health interventions involving school gardens). While the ASC Farmington is a physical location located about 10 miles south of Farmington, its research, educational, and outreach impact extends well beyond into the surrounding Four Corners Region.

These projects are not possible without the hard work and dedication of several collaborating faculty, staff, graduate students, and interns working across the Agricultural Experiment Station system, allied departments like Plant and Environmental Sciences, and cooperating institutions with industry and community partners. Funding for these projects is supported through the USDA National Institutes of Food and Agriculture, National Science Foundation, Department of Energy, New Mexico Attorney General’s Office, and National Institutes of Health through a competitive process. Operational and salary support is partially funded through the Hatch Act of 1887, which established funding to “conduct agricultural research programs at State Agricultural Experiment Stations in the 50 states, the District of Columbia, and the U.S. insular areas”.

We appreciate the continued support of the New Mexico Legislature, which made possible additional salary supports and capital improvements that in 2024, included additions of field research equipment and visiting scientist housing to enable the conduct of high-quality agricultural research. We want to thank the Navajo Nation for their continued support of a unique land lease agreement and acknowledge the Navajo Nation for the land on which the ASC at Farmington resides and the irrigation water provided through the Navajo Indian Irrigation Project (NIIP).

*Vision: Building agricultural and community resilience with innovative science that respects regional cultural values in the Four Corners Region (Navajo Nation and Beyond)*

# Research Highlights



## Specialty crops (grapes, fruit trees, medicinal herbs)

**Investigator:** Kevin A. Lombard ([klombard@nmsu.edu](mailto:klombard@nmsu.edu)), William Giese, Bernd Maier, Ciro Velasco-Cruz, Connie Maxwell, Ivette Guzman, Saied Salmasi, Rob Heyduck, Jay Lillywhite, Shengrui Yao, and Gasper Martinez

**Collaborating Agricultural Science Centers:** Sustainable Agricultural Science Center at Alcalde, Fabian Garcia Science Center, and Agricultural Science Center at Los Lunas

**Project Overview:** Specialty crop evaluations include grapes (viticulture), fruit trees (cherry and jujube), and medicinal herbs. A few wineries exist in Northwest NM and Southwest Colorado in a region with extensive agritourism potential (Durango Herald, 2019). While hot days and cool nights benefit fruit ripening during the growing season, Northwest NM grape growers at a high elevation (>5,600 ft) are challenged with extremely low winter temperatures and killing spring frosts. Calcareous, high-pH soils also present challenges for micronutrient management in sensitive crops.

**Meeting the Needs of New Mexico:** The objectives of this research is to evaluate grape, cherry, and jujube performance in several trials: *Grapes:* 1) *Vitis* sp. hybrids, which typically have higher cold tolerance, 2) grafted and non-grafted *Vitis vinifera* varietals, which typically have higher market potential than hybrids but less cold tolerance, and 3) table grapes for fresh markets. Results indicate that at the ASC Farmington location, once established, some varietals produce high-quality juice conducive to fine winemaking and fresh table markets. *Cherry trials* include six cultivars grafted onto two rootstocks planted in 2014. Cherries produced fruit in 2019, 2021, and 2024, but have not produced fruit in the remaining previous years due to killing spring frost damage at the time of flowering. *Jujube:* Jujube trees flower in May, typically after the last danger of frost, and have consistently produced fruit since their planting in 2020. Marketing jujube fruit, however, is new to San Juan County consumers. Medicinal herbs include several perennial species like lavender, sumac, golden currant, service berry, yarrow, and others. Some of these plots are being monitored for water usage under three irrigation rates.

Growers are cautioned to apply risk management principles before planting grapes and fruit trees: 1) select sites carefully to avoid low-lying topography, which are prone to frost pockets, 2) understand site-specific weather conditions by investing in a simple minimum/maximum thermometer or inexpensive weather station, 3) match grape and fruit cultivars with specific sites (e.g. hybrid grape varieties better tolerate extreme winter cold temperatures and spring frost events than *Vitis vinifera* (European grape species), and 4) avoid monocultures by diversify perennial fruit crop plantings. Medicinal herbs should also be monitored for invasive potential.

**Impacts:** In 2022, the New Mexico wine industry had an estimated \$1.12 billion total impact, which included 7,918 jobs in direct viticulture/wine production and auxiliary service industry jobs through 86,434 tourism visits and \$80.81 million in total local, state, and federal taxes. While table grapes, cherries, and jujubes have less of an economic impact, their potential remains high for fresh market consumption through fruit stands and farmers' markets. Herbs have a long tradition in New Mexico as both medicinal and food crops.



## Weather data monitoring

**Investigators:** David Dubois ([dwdubois@nmsu.edu](mailto:dwdubois@nmsu.edu)), Margaret West, Gasper Martinez, Jonah Joe, and Dallen Begay

**Project Overview:** NMSU's Agricultural Science Center at Farmington (ASCF) has recorded and monitored weather data from 1969 to the present from two weather stations 1) National Weather Service (WS-1) and 2) ZiaMet system (W2), which is part of a state-wide network that monitors surface weather conditions and sub-surface soil conditions. The daily and historical weather is electronically disseminated for use by interested stakeholders. The NWS Cooperative Weather Observer Network can be accessed here: [https://www.weather.gov/abq/coop\\_program](https://www.weather.gov/abq/coop_program). The ZiaMet Weather Station Network website can be accessed at [weather.nmsu.edu](http://weather.nmsu.edu), once on the page, click on Farmington ASC to see specific data. Several ZiaMet weather stations are located across the Four Corners Region including Aztec, Bloomfield and Navajo Nation Chapter Houses.

**Meeting the Needs of New Mexico:** Weather data are used by the U.S. Department of Agriculture Natural Resources Conservation Service (USDA–NRCS) San Juan District, large and small acreage agricultural producers, and municipalities for water demand planning and monitoring flood events, by private end-users for irrigation scheduling and used in agricultural research. This varying and ongoing need for weather data demonstrates the importance of long-term weather monitoring for the Four Corners Upper Colorado Plateau region.

**Impacts:** In the New Mexico Four Corners region, local industries and municipalities rely on surface water from the San Juan, Animas, and La Plata Rivers, which converge in Farmington, NM, and then flow into the Colorado River at Lake Powell in Utah. This water use is regulated for natural resources, agricultural, industrial, municipal, and residential use. Weather data collection and subsequent monitoring across San Juan County includes several stations across multiple jurisdictions, of which the NMSU's ASC Farmington's National Weather Service – Weather Station – 1 (WS-1) and the New Mexico Climate Center – Weather Station - 2 (WS-2) contribute data for decision making across the Four Corners Region and beyond.

**Funding Acknowledgement:** National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) – Albuquerque, NM and New Mexico Climate Center for maintenance and equipment housed at the NMSU's Agricultural Science Center at Farmington. Agricultural Experiment Station for salary support.



National Weather Service (WS-1) NMSU ASC at Farmington

## Yéego! Healthy eating and gardening intervention trial: COVID-19 and process evaluation results

**Investigators:** Kevin Lombard ([klombard@nmsu.edu](mailto:klombard@nmsu.edu)) (Co-PI), Shirley A.A. Beresford (Co-PI), India J. Ornelas, Geraldine Garrity, Mark C. Bauer, Sonia K. Bishop, Annie Vreeke, Linda Garcia, Brandon Francis, and Eileen Rillamas

**Project Overview:** The Yéego! Healthy eating and gardening intervention trial involved school gardens and a healthy eating and gardening curriculum. Six elementary schools on the Navajo Nation in Arizona or New Mexico were randomized to an intervention or comparison group. One adult family member for each 3<sup>rd</sup> and 4<sup>th</sup>-grade student completed surveys at baseline, nine-month, and 21-month follow-up. Adult outcomes were fruit and vegetable (F&V) intake, obesogenic dietary index, and gardening frequency. COVID-related measures were collected at a 21-month follow-up. Differential changes and interactions were examined using repeated measures of linear mixed models. As part of a group randomized trial of a school-based intervention promoting gardening and healthy eating, health behaviors of adult family members were evaluated. The COVID-19 pandemic hit the Navajo Nation in March 2020, and the ongoing Yéego! collaborative study allowed the description of adult response to COVID as an ancillary objective. Process measures following the intervention allowed for recommendations to sustain the intervention.

**Meeting the Needs of New Mexico:** Navajo families are at increased risk for obesity, type-2 diabetes, and cancer in part due to low fruit and vegetable consumption. Engaging Navajo Elementary Schools in a Randomized Controlled Trial of Yéego! Healthy Eating and Gardening trial (NRR 19.333) aimed to increase fruit and vegetable consumption among Navajo families through a school-based intervention focused on gardening and healthy eating.

**Impacts:** The child-focused school-based intervention significantly increased their F&V intake among school children and adult family members and suggested the reach of school-based intervention involving a healthy eating and gardening curriculum extended to students' families. The impact on adult F&V intake persisted during the COVID-19 pandemic, especially among those reporting COVID concerns. Gardening interest increased across the U.S. during the COVID-19 shutdowns. Findings have important implications for augmenting healthy eating interventions involving gardens. Process measures indicate that further refinement of the approach is needed to sustain such interventions.

**Funding Acknowledgement:** Partnership for the Advancement of Cancer Research, supported in part by National Cancer Institute grants U54 CA132383 (NMSU) and U54 CA132381 (Fred Hutch). \$824,945 (completed)



## Northwest New Mexico agriculture restoration project

**Investigators:** Kevin Lombard ([klombard@nmsu.edu](mailto:klombard@nmsu.edu)) and Bonnie Hopkins

**Project Overview:** The Gold King Mine Spill (GKMS) negatively impacted New Mexican communities along the Animas and San Juan Rivers. New Mexico State University's response to the GKM spill was vested in its commitment to collecting and disseminating data through its long-standing cooperative extension and agricultural research presence in San Juan County. While assurances may have been received from federal, state, and tribal agencies regarding the recovery of the rivers and surrounding landscapes, assurances alone are often insufficient to overcome deeply ingrained worries and public perceptions. Some negative perceptions still exist today. Some of the concerns can, however, be addressed by continued education and training. Specifically, by training local community members, students, and agricultural practitioners who have a vested interest in the agricultural resiliency of the region. Work includes building capacity for soil health measures, building pilot demonstrations including hoop houses and agricultural photovoltaics, and creating digital storytelling to raise awareness of farming along the San Juan River.

**Meeting the Needs of New Mexico:** This project is addressing continued farmer, consumer, and community education, research, and training that will contribute to greater economic development in the agricultural sector of San Juan County and Four Corners in general. Key areas for agricultural restoration in Northwest New Mexico include: 1) integrated greenhouse and field production utilizing off-grid/micro-grid agricultural photovoltaics at the food energy water nexus and innovative research/training and season extension system development around energy and water conservation, enhancing existing high-value perennial vineyard, orchard, and ornamental crops, and best production practices for soil health/conservation/reforestation. 2) New Farmer Training program and farm business incubator to increase land linkages and access, hands-on training programs with available land, and increased market access (food hub). 3) training in skills through agriculture, landscape skills for entrepreneurship, and agricultural production, and 4) infrastructure enhancements for research, demonstration, community development, and outreach.

**Impacts:** Enhanced training opportunities and agricultural skill-building could result in greater individual and organizational profitability, not at the expense of the environment. Engendering infrastructure enhancements at both AES and CES facilities that will serve to demonstrate best management practices and increased capacity to produce transplants that could be distributed across the county (environmental enhancements to farms). Educated workforce from laborers to students interested in science, technology, engineering, the arts, and mathematics (STEAM) careers. Increased awareness of agricultural resiliency throughout the San Juan River watershed, emphasizing regional cultural values.



**Funding Acknowledgement:** New Mexico Office of the Attorney General

# Transformation Network: Four Corners Indigenous farm assessment (4CIFA)

**Investigators:** Kevin Lombard ([klombard@nmsu.edu](mailto:klombard@nmsu.edu)), Brandon Francis, Emiliano McLane, Ruth Pannil, and Karletta Chief

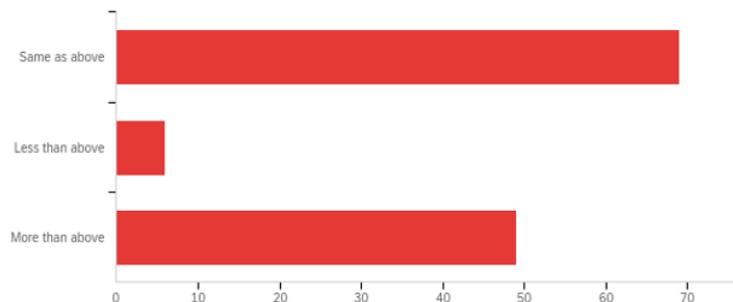
**Project Overview:** The Transformation Network (TN) is comprised of 7 universities across the Intermountain Western U.S., including the ASC Farmington. This study explored the interest in controlled environment agriculture (CEA) and agricultural impacts on farming practices among Diné farmers in the San Juan River Valley, stemming from the COVID-19 pandemic. The survey instrument, developed by NMSU and the University of Arizona was approved by the Navajo Nation Human Research Review Board through passed resolutions from Shiprock, Nenahnezad Upper Fruitland, Gadahi, San Juan, and Tse Dikaan Chapter Houses. A total of 126 farmers participated in the survey.

**Meeting the Needs of New Mexico:** This study aimed to understand the farmers’ needs who are adopting CEA systems, both successes and failures. Results will provide information for future training and research opportunities related to CEA. In addition, understanding the needs of Indigenous farmers related to current land and water use practices and perceptions of cooperative extension and technology transfer methods best tailored to these farmers. The survey provided insight into the challenges Navajo farmers are facing and future research and outreach directions.

**Impacts:** The results of the study showed the resiliency of indigenous farmers in the San Juan River Valley, as well as some barriers these farmers are facing. Events like the COVID-19 pandemic are unplanned, and Navajo farmers utilized this time to increase farming. 40% of the participants currently in production stated they would likely increase the number of farmed acres in the next 5-10 years. Despite the adversity confronted by the COVID-19 pandemic, Diné farmers demonstrated resiliency through their long, rich agricultural history and the connection they have with the land. Responses show that agriculture will be practiced in the San Juan River Valley for years to come and highlight areas for focused research and outreach to address their current needs.



*Planned increase in acreage in future by Navajo farmers (n=124)*



**Funding Acknowledgement:** National Science Foundation’s Sustainable Regional Systems Program Transformation Network (NSF Grant# 2115169) New Mexico Office of Attorney General (GR0007668) through the Northwest New Mexico Agriculture Restoration Project

## Heritage grain trial

**Investigators:** Kevin Lombard ([klombard@nmsu.edu](mailto:klombard@nmsu.edu)), Gasper Martinez, Dallen Begay, and Franklin J. Thomas

**Project Overview:** Ancient grains have been feeding people since the beginning of civilization. Finding varieties with solid agronomic characteristics that are well adapted to regional growing conditions is a crucial first step toward a profitable cropping season. To explore the potential for heritage grain production in New Mexico, ASC Farmington obtained several heritage grains (wheat, rye, einkorn, emmer, and barley) from the Southwestern Colorado Research Center. The heritage grain trial seeks to identify, seed increase, and trial heritage and ancient grain varieties in high desert San Juan County and northern New Mexico. Due to the mild winters in New Mexico; heritage grains can be planted in the fall (Sept-Oct), similar to winter barley. Heritage grains can also give the same benefits of soil cover and erosion control and tend to be harvested just a week or two after winter barley. Twenty heritage grain varieties were planted on September 18<sup>th</sup>, 2024; these plots are to be harvested in July 2025.

**Meeting the Needs of New Mexico:** Heritage grain varieties are older varieties that have been grown in the past and are experiencing a resurgence in consumer interest. In New Mexico, there is certainly potential for these ancient grain varieties with their nutritional and flavor profiles to be integrated into local value-added food and beverage markets. These ancient grains also provide more opportunities for NM growers to diversify existing cropping systems already in practice.

**Impacts:** What is “old” is “new” again with consumers. A report by TechSci predicts economic growth in ancient and heritage grains to \$142.3 million by 2028 from \$90.4 million in 2022 as consumers seek authentic culinary flavors and healthier diets. Many ancient crops are also drought-tolerant and more efficient at scavenging soil nutrients and may be well adapted to Northwest New Mexico’s high-elevation climate.



**Funding Acknowledgement:** Northwest NM Ag Restoration Project, NM Office of Attorney General

# Using cover crops in transitioning from traditional agriculture to climate-adaptive organic farming in the southwestern U.S.

**Investigators:** Richard C. Pratt ([ricpratt@nmsu.edu](mailto:ricpratt@nmsu.edu)), Koffi Djaman, Brian Schutte, Kevin Lombard, and Michael Patrick

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

**Project Overview:** To identify summer cover crop species suitable for limited irrigation under semi-arid conditions, four grasses and four legumes cover crops, and two-way mixtures were evaluated at the ASC Farmington. The above-ground cover crop and weed biomass were collected 60 and 90 days after planting to calculate the Cover Crop Weed Index. Soil moisture content was monitored in each plot of the third replication. Results showed that good cover crop biomass could be achieved with limited irrigation. The two varieties of Sorghum-Sudangrass and Pearl millet and mixtures produced more aboveground dry biomass than the other cover crops. Moreover, Pearl millet and Sorghum-sudangrass varieties showed an outstanding weed control followed by Sunn hemp with an excellent weed control. Crop biomass is sent to the laboratory for forage quality analysis and the soil samples are also sent to the lab to see the impact of two-year cover cropping on soil characteristics.

**Meeting the Needs of New Mexico:** Identifying summer cover crops that could use a limited amount of irrigation water, suppress weeds, and improve soil health will contribute to reduced irrigation water use and increased ecosystem services on New Mexico farms. These findings may help make farming more sustainable for New Mexico farmers who would like to transition their farms to climate-adaptive organic farming. During the transition process, farmers in New Mexico may use the selected summer cover crops to improve ecosystem services on their farms and reduce the costs of irrigation and weed management.

**Impacts:** This project will lead to reduced irrigation water use for summer cover crop production and reduce the cost of weed management in organic farming while enhancing ecosystem services. In addition, it provides the availability of summer forage crops for livestock in the southwestern U.S. It offers market opportunities as some organic farmers may become organic seed producers and private organic seed sellers. With the assistance of Rodale Institute, New Mexico organic farmers can certify their farms and transform their organic transition into certified organic farmers and organic seed producers. Overall, there will be an increase in organic farms across the southwest U.S.

**Funding Acknowledgement:** National Institute of Food and Agriculture 'Organic Transitions Program



## Alfalfa variety performance evaluation: 2024 planted alfalfa trial

**Investigators:** Koffi Djaman (kdjaman@nmsu.edu), Margaret West, Gasper Martinez, Dallen Begay, and Franklin J. Thomas

**Primary ASC Hosting this Project:** Leyendecker Plant Science Center and Rex E. Kirksey Agricultural Science Center Tukumcari

**Project Overview:** The Fall 2024 Planted Alfalfa Variety Trial is part of a statewide testing program to help determine which alfalfa (*Medicago sativa*) fall dormancy ratings will perform best in the different geographic areas across the State of New Mexico. This study is coordinated through the NMSU Plant and Environmental Sciences Department. The 2024 trials consist of 5 cultivars from public varieties and 3 cultivars from a private seed company. Alfalfa is planted on September 05, 2024, and is irrigated using ET-based irrigation scheduling. Since this is Fall 2024 planting, alfalfa was not harvested in 2024, and the first harvest will be in June 2025 at 10% blooming. The alfalfa research plot will be kept weed-free by pursuit application in spring at the recommended rate. Overall, alfalfa is harvested four times a season.

**Meeting the Needs of New Mexico:** Alfalfa is a major hay crop in New Mexico and in San Juan County, and has long been studied at ASC Farmington, with performance results shared annually with the public. This research helps the New Mexico alfalfa hay grower with guidelines on alfalfa fall dormancy rating selection in relation to their geographic location for maximizing hay yield and profitability.

**Impacts:** Alfalfa is a major hay crop in the Four Corners region. It is important to know which fall dormancy ratings or varieties have the best long-term yields and pest tolerance under local conditions. This information is helpful for alfalfa growers who wish to maximize yields, considering fall dormancy ratings, yield index, winter hardiness, and water constraints.



## Weed suppression capability and grain yield of five edible dry beans under two planting patterns and densities

**Investigators:** Koffi Djaman ([kdjaman@nmsu.edu](mailto:kdjaman@nmsu.edu)), Gasper Martinez, Dallen Begay, and Franklin J. Thomas

**Project Overview:** Five different dry bean varieties were planted in late June 2024 under two different planting patterns and two densities to evaluate their capability to suppress weeds and yield potential. The black bean showed the highest weed suppression, followed by small red, great northern, pinto, and red kidney. The great northern yielded the highest, followed by the small red, pinto, the black bean, and the red kidney. The red kidney was the earliest bean to mature, with losses greater than 40%, and the black was the latest. The 15-inch row spacing is more effective than the 30-inch row spacing for weed suppression. The increase in plant population does not always translate into an increase in grain yield. All dry bean varieties except the red kidney are good candidates with double objectives, such as weed suppression and grain yield for crop diversification in northwest New Mexico.

**Meeting the Needs of New Mexico:** Successful identification of dry bean varieties in New Mexico to replace fallow periods common in semi-arid cropping systems will assist local producers to achieve higher water-use efficiency and productivity. It could also promote the state-level infrastructure and broader marketing opportunities in New Mexico.

**Impacts:** Introduction of efficient resource use crop selection will result in broader diversity in the existing cropping systems. Understanding the water-use efficiency dynamics of dry beans and increasing the diversity in the cropping systems may reduce the seasonal risk of crop failures due to water scarcity and increase the farm-level income security.



# Irrigation management in Chile Peppers and pumpkins and plant susceptibility to *Phytophthora capsici* and development of *Phytophthora* blight

**Investigators:** Koffi Djaman ([kdjaman@nmsu.edu](mailto:kdjaman@nmsu.edu)), Margaret West, Gasper Martinez, Dallen Begay, Chad Begay, Franklin J. Thomas, and Jonah Joe

**Collaborating Agricultural Science Centers:** Leyendecker Plant Science Center

**Project Overview:** The 2024 chile and pumpkin research consisted of 6 chile pepper varieties and 3 pumpkin varieties tested under 3 irrigation regimes (full irrigation and two water saving strategies). The experiment is organized under a split-split plot design with three replications. Chile seedlings were transplanted in May 2024, and the pumpkin seeds were planted in June 2024. The plots are sprinkler irrigation based on crop ET irrigation scheduling and were uniformly managed in terms of weed, pest, and fertilizer, and other practices. Chile peppers were harvested 4 times, sorted and the total and marketable yield were determined. Chile pods were checked for external and internal defects. Chile and pumpkin plants and fruits were carefully checked periodically for *Phytophthora Capsici* throughout the growing season. No *Phytophthora* was detected; however, powdery mildew was observed starting from the lowest irrigation regime and one pumpkin variety to the other varieties and other irrigation regimes.

**Meeting the Needs of New Mexico:** The State of New Mexico is well known for chile pepper production. The project is using holistic integrated management practices to improve crop production and profitability. With a set of sensitive and resistant chile pepper cultivars to phytophthora blight, this research will provide chile and pumpkin growers with a well-designed water-saving strategy to increase water use efficiency in these crops while maintaining or increasing crop yield and reducing the impact of phytophthora on plant growth and marketable yield. This will improve the profitability of chile and or pumpkin production systems, and the breeding component of the project will develop some *Phytophthora*-resistant chile and cucurbits cultivars for the New Mexico chile growers.

**Impacts:** The objective of the chile peppers and cucurbits research is to develop multi-barrier management strategies of phytophthora blight in peppers and cucurbits. This will systematically reduce the impact of the disease on plant growth and the marketable yield while saving irrigation water. This project will improve the farm revenue of the chile and cucurbits production systems by reducing the cost of management of phytophthora blight and other costs associated with irrigation management, providing the farmers with phytophthora-resistant germplasms, climate-smart crop management and production package, ready to use for the New Mexico growers.

## Funding

**Acknowledgement:** USDA-NIFA



## Forage hybrid corn performance evaluation

**Investigators:** Koffi Djaman ([kdjaman@nmsu.edu](mailto:kdjaman@nmsu.edu)), Margaret West, Gasper Martinez, Dallen Begay, Chad Begay, Franklin J. Thomas, and Jonah Joe

**Collaborating Agricultural Science Centers:** Leyendecker Plant Science Center

**Project Overview:** The 2024 Forage Corn Variety Trial consisted of four forage hybrid corns from Bayer Company-DeKalb brand forage corn seeds. The trial was planted on May 16, 2024, in four replications. All plots were managed uniformly regarding irrigation management, fertilizer application rate, weed control, pest management, and other management practices. Data collection includes plant populations and morphological data such as silk dates, plant and ear heights. At harvest, green (fresh) forage yields and dry are estimated for the forage. Samples from a variety of tests were dried in a forced-air oven for the determination of moisture content. Sub-samples of the dried material from all plots were submitted to the Ward forage testing laboratory for nutrient composition analysis, and the mild production estimates were calculated.

**Meeting the Needs of New Mexico:** Forage corn is a major hay crop in addition to alfalfa in New Mexico and the southwestern US, with performance results shared annually with the public. This statewide research helps the New Mexico hay grower with guidelines on forage hybrid corn selection in relation to their geographic location for maximizing hay yield and profitability. Variability in climate, soil, water, and local production practices contributes to the need for crop performance tests throughout the state. Growers use this project to make cropping decisions, and they should rely primarily on results from tests near their location or in comparable climate zones.

**Impacts:** The dairy industry is expanding in New Mexico. The average New Mexico dairy produces over 58 million pounds of milk per year. The economic value of this raw milk alone contributes over \$1.4 billion to the economy of New Mexico, and the total economic impact exceeds \$4.45 billion annually. There is a need to produce more good-quality forage to meet the needs of the dairy farms across the State of New Mexico. The present project offers the possibility to select locally adapted, high-yielding and good-quality forage hybrid corn which will be adopted by forage corn growers in the region and helps increase their forage production and profitability and farm revenue improvement.

**Funding Acknowledgement:** USDA-NIFA



# Expanding market opportunities for United States potatoes and potato products

**Investigators:** Koffi Djaman ([kdjaman@nmsu.edu](mailto:kdjaman@nmsu.edu)), Margaret West, Gasper Martinez, Dallen Begay, Chad Begay, Franklin J. Thomas, and Jonah Joe

**Project Overview:** The 2024 Potato trial consisted of 17 chip potato cultivars planted in combination with the Navajo Mesa Farms (NMF) field with the ideal management practices in terms of water management, pesticide and fertilizer applications, and other practices. At harvest, the tuber yield was determined after tuber size sorting the internal and external defects monitoring, and the specific gravity. Potatoes were harvested and processed at Navajo Mesa Farms (NMF) laboratory. Plants were systematically checked for potato psyllids (*Bactericera cockerelli*) and other pests. After harvest, the tubers are stored in cold storage at NMF, and periodically sugar content, defects, and chip color were monitored regularly during the post-harvest nine-month storage season to determine long-term storage quality. The yield and quality data are entered into the Potatoes USA database for use by all growers, processors, and plant breeders.

**Meeting the Needs of New Mexico:** The Four Corners region has a very favorable climate and sandy to Sandy loam soils for potato production. Navajo Agricultural Products Industry (NAPI) and Navajo Mesa Farms (NMF) are large-acreage potato producers in the region and the present study selects the high-yielding and adapted potato cultivars with great post-harvest quality to the growers to improve their production system profitability while minimizing the environmental pollution by nitrates.

**Impacts:** The objective of the chip potato varietal research is to evaluate several potato germplasms developed across the United States and to determine the locally adapted and high-yielding potato cultivars with good storage quality. The best chip potato cultivars are recommended to potato growers of the Four Corners region for profitability and increased system revenue.

**Funding Acknowledgement:** Potatoes USA



## Agrivoltaics farmer needs assessment and demonstration study

**Investigators:** Emiliano McLane ([emilmcla@nmsu.edu](mailto:emilmcla@nmsu.edu)), Kevin Lombard, Ciro Velasco-Cruz, Olga Lavrova, Shannon Norris-Parish, and Donald Edgar

**Primary ASC Hosting this Project:** Chihuahuan Desert Rangeland Research Center, Leyendecker Plant Science Center, and Agricultural Science Center at Los Lunas

**Project Overview:** To address the knowledge gap regarding the perception of agrivoltaics in the Four Corners region, questions on agrivoltaics perceptions were incorporated into a regional farmer needs assessment survey. The survey included questions to assess farmers' awareness, interest, and training needs related to agrivoltaics. In conjunction with the survey, a pilot field study utilizing agrivoltaics grow boxes equipped with four different types of photovoltaic panels was conducted. The study aimed to evaluate the impact of agrivoltaics on the microclimate and the growth performance of radishes in the Four Corners region.

**Meeting the Needs of New Mexico:** The survey section of the project benefits New Mexico agriculture by exploring community perceptions of agrivoltaics, helping to identify the needs of Navajo farmers in the Four Corners region. The agrivoltaic grow box pilot site serves as a demonstration plot, allowing farmers and gardeners in Northwest New Mexico to become familiar with agrivoltaic systems and support early adoption of an innovative agricultural system that is gaining interest across the globe.

**Impacts:** The survey results will support extension efforts in addressing community needs by providing valuable insights into local perceptions, awareness, and interest in agrivoltaics. This will help ensure that interventions are tailored, purposeful, and aligned with the priorities of Navajo farmers and other agricultural stakeholders in the region. The anticipated impact of the agrivoltaics grow box pilot study and demonstration site is to offer community members a hands-on opportunity to engage with and observe the system in action. By experiencing the benefits and challenges of agrivoltaics firsthand, farmers and gardeners can make more informed decisions about its potential applications in their own agricultural practices. Additionally, the data and feedback gathered from this pilot study will help refine extension strategies, guide future research, and enhance the effectiveness of service providers working to promote sustainable farming solutions in the region.

**Funding Acknowledgement:** New Beginnings for Navajo Students through Dine' College (USDA Grant # 2022-70411-38313) (salary support)  
National Science Foundation's Sustainable Regional Systems Program Transformation Network (NSF Grant# 2115169) (salary support)  
New Mexico Office of Attorney General (GR0007668) through the Northwest New Mexico Agriculture Restoration Project (material support)



## New Beginnings for Navajo Students: An integrative approach to expanding agricultural opportunity

**Investigators:** Kevin Lombard ([klombard@nmsu.edu](mailto:klombard@nmsu.edu)), Benita Litson, and William Norris

**Project Overview:** Diné College Agriculture Degree Program will increase Tribal student retention and graduation rates by instituting a plant/growing-focused dual credit program at six area high schools. The dual credit program will establish a pipeline from high school to undergraduate degree completion with a pathway to graduate studies at New Mexico State University. The program will involve training and professional development for high school teachers, as well as peer mentoring at the high school, undergraduate, and graduate levels.

**Meeting the Needs of New Mexico:** Diné College, a 1994 land grant institution, is partnering with New Mexico State University (NMSU), an 1862 land grant institution, to provide educational pathways that promote recruitment, retention, and degree attainment for students on the Navajo Nation. This program is addressing the challenge of providing educational opportunities to Navajo students that are: (i) close to home, (ii) support and sustain cultural values; and (iii) lead to a rewarding career and financial security.

**Impacts:** Many students on the Navajo Nation are interested in futures that involve traditional lifeways, and agriculture affords that opportunity. Researchers anticipate that the impacts of having more Navajo students graduate from the Diné College and NMSU land grant institutions will be that more Navajo students can pursue higher education close to home, uphold cultural values, and succeed in the agriculture industry. Additional impacts from this program include, establishing a dual credit program for agriculture in area high schools, enrolling students in that dual credit program, increasing enrollment to Diné College as a result of students participating in the dual enrollment program, improving retention rates at Diné College through mentorship opportunities, and providing a seamless pathway for students from high school dual credit to Diné College, to NMSU.

**Funding Acknowledgement:** New Beginnings for Navajo Students through Dine' College (USDA Grant # 2022-70411-38313)



## Winter malt barley trial

**Investigators:** Kevin Lombard ([klombard@nmsu.edu](mailto:klombard@nmsu.edu)), Gasper Martinez, Dallen Begay, Franklin J. Thomas, and Leonard Lauriault

**Primary ASC Hosting this Project:** Rex E. Kirksey Agricultural Science Center at Tucumcari

**Project Overview:** The University of Minnesota Barley Breeding program organizes the Winter Malting Barley Trial (WMBT), which is a collaboration between Public and Private Breeders and Agricultural Science Centers spanning the entire United States. Two goals of the WMBT are to identify winter barley lines that meet malt industry standards and to expand winter barley acreage. Thirty winter malt barley entries were planted on September 18th, 2024. These plots are to be harvested for grain in June 2025. Entries in the WMBT are screened for winter survival, vigor, lodging, disease, yield, moisture, and protein. Selecting the right variety is very important for producing high yields of winter malt barley.

**Meeting the Needs of New Mexico:** With considerable increases in recent years in the craft brewing industry in the state; brewers are also looking to source locally available grain. Winter barley also allows for an earlier harvest (early June) which would give NM growers the opportunity to plant a second crop in the same year, resulting in a more robust and diverse cropping system. In certain portions of the state, soil erosion due to high winds is common for growers who may want to plant a spring crop. Planting barley in the fall can mitigate soil erosion and reduce the risk of spring planting delays due to inclement weather events.

**Impacts:** In 2023, New Mexico Craft Breweries had an economic impact of 361 million dollars with 109 craft breweries operating in the state. The state also ranked 31st in the nation in terms of production with 159,807 barrels of craft beer produced within that same year. Differences in grain yield among winter malted barley varieties at ASC Farmington ranged from 53 to 93 bu/ac with a study average of 77 bu/ac. As of November 2024, the farm price of winter malt barley is \$6.25/bu, this would return from \$331.25 to \$581.25/ac.



# Numbers



## Research Publications

- Beresford, S. A.A., Ornelas, I., Garrity, G. A., Bauer, M. C., Bishop, S. K., Vreeke, A., Garcia, L. V., Francis, B., Rillamus-Sun, E., Lombard, K. A. (2024). Impact of a school-based intervention and the COVID-19 pandemic on healthy eating in Navajo families: Results from the Yéego! Healthy Eating and Gardening Intervention Trial. *Preventative Medicine Reports*, 46(102858) <https://doi.org/10.1016/j.pmedr.2024.102858>
- Wilcox, H., Bishop, S. K., Francis, B., Lombard, K. A., Beresford, S. A.A., Ornelas, I. (2024). Process Evaluation of the Yéego! Program to Increase Healthy Eating and Gardening among American Indian Elementary School Children. *BMC Public Health*, 24(232), 11.
- Lauriault L.M., M.K. Darapuneni, K. Djaman, M.A. Marsalis. 2025. Winter and season only irrigation with late summer irrigation termination influences alfalfa dry matter yield and applied water use efficiency. *Agriculture* 2025, 15, 146.
- Darapuneni M., L. Lauriault, G. Martinez, K. Djaman, K.A. Lombard, S. Dodla. 2024. Potassium and Sulfur Fertilizer Sources Influence Alfalfa Yield and Nutritive Value and Residual Soil Characteristics in an Arid, Moderately Low-Potassium. *Agronomy*, 14(1) 117.
- Djaman K, Djaman D.S, Puppala N, Darapuneni M. 2024. Plant nutrient removal and soil residual chemical properties as impacted by maize planting date and density. *PLoS ONE* 19(3): e0299193. <https://doi.org/10.1371/journal.pone.0299193>
- Djaman. K., Koudahe, S. Essah, U.K. Shanwad. 2025. Critical Nitrogen Dilution Curves for Nitrogen Management in Potato (*Solanum tuberosum* L.): A Minireview. *American Journal of Potato Research*. (in press).
- Shrestha B., B.L. Stringam, M. Darapuneni, K. Lombard, S. Sanogo, C. Higgins, K. Djaman. 2024. Effect of Irrigation and Nitrogen Management on Potato Growth, Yield, and Water and Nitrogen Use Efficiencies. *Agronomy* 2024, 14, 560.

## Grants and Contracts

- Lombard, K. A., "NMSU Agricultural Science Center at Farmington Agricultural Support for Viticulture in Northwest New Mexico Research", New Mexico Legislative Special Appropriations Projects, 56th Legislative Session, Funded, \$160,000.00. (July 1, 2024 - June 30, 2026). Status: Funded, Effective Start Date: July 1, 2024, Effective End Date: June 30, 2026.
- Fernald, Alexander (Principal), Connie Maxwell (Co-Principal), Kevin Lombard (Co-Principal), Ivette Guzman (Co-Principal), Jay Lillywhite (Co-Principal), and Robert Heyduck (Co-Principal). "Expanding Organic Systems to Reduce Water Demand and Increase Agricultural Resilience in the Southwest," USDA/National Institute of Food and Agriculture NIFA, \$750,000.00. Current Status: Active. (September 1, 2022 - August 31, 2026).
- Heyduck, Robert (Principal), Kevin Lombard (Co-Principal). "Selecting adapted cultivars of lavender for northern New Mexico," New Mexico Department of Agriculture Specialty Crop Block Award. Total Award: \$24,000. Current Status: Active. (September 1, 2022 - August 31, 2024).
- Lombard, Kevin, (Principal), Bonnie Hopkins (Principal). "Northwest New Mexico Agriculture Restoration Project," New Mexico Office of the Attorney General, \$930,402.00. Research Credit: \$416,006, Total Award: \$930,402, Current Status: Active. (July 1, 2023 – June 30, 2025).
- Lombard, K. A. (Co-Principal), Sponsored Research, "SRS RN: Transforming Rural-Urban Systems: Trajectories for Sustainability in the Intermountain West", Sponsoring Organization: University of New Mexico, Sponsoring Organization Is: Other, Research Credit: \$280,181.00, PI Total Award (UNM): \$15,000,000, Current Status: Active. (September 1, 2021 - August 31, 2026).
- Wang, J. (Principal), Lombard, K. A. (Co-Principal), Stanford, M. L. (Co-Principal), Gomez, S. (Co-Principal), Jarchow, M. (Co-Principal), Keith, J. (Co-Principal), Lin, Y. (Co-Principal), Hanson, D. (Co-Principal), Guadagno, C., "Collaborative Research: RII FEC: Harnessing Controlled Environment Agriculture to Secure Sustainability and Economic Growth", NSF EPSCoR RII Track-2 FEC under subcontract w/ UNM, Total Award \$6,424,444.00. Current Status: Awarded in 2024 and Active, (September 1, 2024 - August 31, 2028). NSF Award# 2418348
- Pratt, R.C. et al (2022 – 2026) "Bridging Traditional Agriculture and Climate-Adaptive Organic Agriculture in the Southwest," USDA/National Institute of Food and Agriculture NIFA. PI Total Award: \$744,971.00.
- Pratt, R.C. and T. Vos. (2023 -2024) Cropping Systems Research Program – Southwest Grain Collaborative Initiative. Various private foundations support (anonymous) \$75,000.
- Litson, Benita (Principal), Demetra Skaltsas (Co-Principal), P. Abertan (Co-Principal), S. Bender (Co-Principal), Kevin Lombard (Co-Principal), William Norris (Co-Principal), Koffi-Djaman (Supporting). "New Beginnings for Navajo Nation Students," Sponsoring Organization: USDA/National Institute of Food and Agriculture NIFA, Research Credit (to NMSU): \$140,088, PI Total Award: \$550,000. Current Status: Active. (September 1, 2022 - August 31, 2025).
- Prihodko, L. (Principal), Hanan, N. P. (Co-Principal), Lavrova, O. A. (Co-Principal), Lombard, K. A. (Co-Principal), Thompson, M. Y. (Co-Principal), Walker, S. (Co-Principal), Prime Grant, "New Mexico State University Agrivoltaics Research Program", Sponsoring Organization: US Department of Energy, Current Status: Active. (February 1, 2024 - February 28, 2026).

## Outreach Activities

- March 6, 2024: Villanova University, 8 undergraduate students, mainly civil engineers, visited the center and conducted a service learning project. They are working out of WindowRock.
- March 14, 2024: New and Beginning Farmer Talk, CES San Juan County Office.
- May 14, 2024: Fort Lewis College/Colorado School of Mines ASC Farmington farm tour and service project (about 15 undergrad and graduate students). Grad student Emiliano McLane provided a tour and service-learning project (Recruitment opportunity)
- May 17, 2024: 2nd annual ASC Farmington Plant Sale and Open House
- May 29, 2024 Dine College Seed Planting Workshop, Monument Valley, AZ Invited
- June 10, 2024: San Juan College Youth Conservation Corps (9 students). Staff, Jason Thomas and Brandon Francis and grad students Emiliano McLane provided a tour and service-learning project. Recruitment opportunity.
- July 8-9, 2024 Diné College Summer Convoy Project, Plants, Soils and Nutrients, and Agrivoltatic assembly of small boxes. Planting Workshop, Tuba City, AZ
- July 15, 2024. Summer Ag Tour. Nine students from Tampa Florida traveled to the ASC Farmington as part of a 10 ½ day Summer Ag Tour program.
- July 22-23, 2024 ASC Farmington Hosts Diné College “Ag 101” class of 11 students.
- September 20, 2024 Food Energy Systems An Introduction to Agrivoltaics Workshop
- October 6, 2024, ASC Farmington Advisory committee meeting
- November 18, 2024: New Mexico Agricultural Leadership Tour ASC Farmington
- June 12, 2024: Career Day AgTivity Camp, CES San Juan Branch, Aztec, NM (high school student career fair). Dr. Koffi Djaman interacted with 4H kids to provide an overview of plant science career paths and recruitment.
- September 26, 2024: 2<sup>nd</sup> Annual Farm Day and Pumpkin Giveaway, K-5 elementary students (about 110 students and their teachers participated). A corn maze was created with support from Basin Coop (Durango, CO). The goal of the event was to raise awareness among elementary kids about farming activities and to give something back to the community, in this case a pumpkin to each visiting kid.



July 5 2024, Monument Valley AZ

People



## Cooperators and Collaborators

### **NMSU**

- Agricultural Experiment Station (AES) and Science Centers (Statewide)
- College of Agricultural, Consumer, and Environmental Sciences (ACES), Las Cruces, NM
- College of Engineering, Las Cruces, NM
- Department of Plant and Environmental Sciences
- Department of Agriculture and Extension Education
- McKinley County Cooperative Extension Service, Gallup, NM
- San Juan County Cooperative Extension Service, Aztec, NM

### **Other Colleges and Universities**

- Colorado State University, San Luis Valley Research Center, Center, CO
- Colorado State University, Southwestern Colorado Research Center
- Diné College, Shiprock, NM/Tsaile, AZ
- Fort Lewis College, Durango, CO
- Land Institute, Salina, KS
- Northern Arizona University, Center for Ecosystem Science and Society
- University of Arizona, Native FEWS Alliance
- University of Illinois
- University of Minnesota Department of Agronomy and Plant Genetics
- University of New Mexico, Intermountain Transformation Network
- University of New Mexico, TriCEA, Albuquerque, NM (includes University of South Dakota, University of Wyoming, Santa Fe Community College)
- University of Washington School of Public Health/Fred Hutchinson Cancer Research Center,
- Utah State University, San Juan County Cooperative Extension Service
- Washington State University

### **State, Federal, and Tribal**

- Navajo Nation Human Research Review Board, Window Rock, AZ
- New Mexico Department of Agriculture, Las Cruces, NM
- San Juan Soil and Water Conservation District, Aztec, NM
- USDA Agricultural Research Service, U.S. Potato Genebank, Sturgeon Bay, WI
- USDA NRCS, New Mexico, San Juan County Soil and Water Conservation District 1, Aztec, NM

### **Industry**

- Basin Cooperative, Durango, CO
- Navajo Agricultural Products Industry (NAPI), Farmington, NM
- Navajo Mesa Farms, Farmington, NM
- Potatoes USA, Denver, CO
- Quality Irrigation Solutions, Cortez, CO
- Valley Irrigation (Valmont Industries), Valley, NE

### **Community**

- Dream Diné Charter School, Shiprock, NM
- Navajo Ethno-Agriculture, Nenahnezad, NM
- San Juan River Farm Board, San Juan County, NM
- Shiprock Area Food Access Coalition, Shiprock, NM

- Northern Navajo Agency and regional Chapter Houses

## Advisory Committee

- Dave Arnold (Turley Manzanarez ditch; Wines of the San Juan, Blanco NM)
- Zach Ben, Bididi Baby Foods
- Carol Cloer (Hammond Ditch; Cloer Hay)
- Gary Hathorn (Farm Bureau)
- Bonnie Hopkins (NMSU San Juan County Cooperative Extension)
- Dineh John (Navajo Agricultural Products Industry; NIIP canal)
- Gloria Lane (Navajo Ethno Agriculture, Fruitland Canal)
- Bud Lopez (NMSU McKinnley County Cooperative Extension)
- Renae Pablo (Navajo Agricultural Products Industry; NIIP canal)
- Tracey Raymond (President, San Juan River Irrigation Board, Nenahnezad Chapter)
- Reagan Wyslucy (Utah State University San Juan County Cooperative Extension)
- Dave Zeller (Navajo Agricultural Products Industry; NIIP canal)

## Graduate & Undergraduate Students and Interns

- Brandon Francis, MS
- Emiliano McLane, MS
- Aminou Saibou, PhD
- Melvin Cooley, San Juan College
- Gabbi Henderson, Diné College
- Korbin Nakai, Navajo Technical University
- Devaugn Tapaha, San Juan College
- Daveishena Redhouse, MS
- Cayden Manuelito
- Elora Roberts
- Saugat Karki
- Adedapo Oyenuga
- Rafiqul Islam
- Yusuf O. Anifowoshe
- Heather Wilcox
- Dale Etsity



## ASC Personnel

- Dallen Begay, Farm Manager
- Chad Begay, Agricultural Experiment Station Laborer
- Corey Benally, Admin Associate
- Koffi Djaman, Associate Professor, Agronomy
- Jonah Joe, Agricultural Experiment Station Laborer
- Kevin Lombard, Professor of Horticulture and Research Director
- Gasper Martinez, Associate Research Scientist
- Franklin Jason Thomas, Farm and Ranch Supervisor
- Margaret West, Associate Research Scientist

