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### SUSTAINABLE AGRICULTURE SCIENCE CENTER AT ALCALDE

# 2023 ANNUAL REPORT

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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# **NOTICE TO USERS OF THIS REPORT**

These are not formal Agricultural Experiment Station research results. Readers are 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 for a project.

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 Sustainable Agriculture Science Center (SASC) at Alcalde is a sixty-acre research farm seven miles north of Española. The farm stretches from the Acequia de Alcalde to the Rio Grande and is representative of the irrigated farmland along the Rio Grande, Rio Chama, Rio Embudo and other smaller drainages in the area. Irrigated pastures and forages dominate, but there are also numerous orchards and intensive, high-value fruit and vegetable-producing operations.

The center research focuses on crops and cropping systems for north central New Mexico, including various horticultural and agronomic crops, organic and sustainable production methods, as well as acequia hydrology. Current research focuses on jujube variety development and testing (2 acres), pome and stone fruit production (2 acres), table grapes (1 acre), pollinator habitat and buffer strips (3 acres), saffron, and high tunnel fruit and vegetable production (five thousand square feet of covered growing space). The center also includes twelve acres of forage crops including alfalfa, red clover, western wheatgrass, Russian wildrye, smooth brome, tall fescue, and orchardgrass. Six acres of the station are certified organic, and certified crops in 2023 included apple, peach, and plum.



In 2023, the center welcomed new Research Director and Associate Professor Saeid Zehtab Salmasi, Farm Manager David Archuleta, and Assistant Farm Manager Gary Maestas. The SASC at Alcalde initiated a new research project on Saffron production in North Central New Mexico and a wide range of drought-tolerant medicinal herbs. We also initiated an intensive water quality sampling protocol on the Rio Hondo in Taos County to address concerns related to rapid ski area development. The center will participate in the Multistate Research Project, S1084, "Industrial Hemp Production, processing, and marketing in the U.S." and will host the annual meeting of the NC-140 multi-state Regional Rootstock Research Project in the coming year.

# **RESEARCH HIGHLIGHTS**







Investigators: Shengrui Yao (yaos@nmsu.edu) and Robert Heyduck

#### PROJECT OVERVIEW

An organic apple rootstock trial with 11 rootstocks at 1.0 x 3.5 m planting density in a tall spindle training system was established in 2015. The cultivar was Modi, a selection from Italy, and the eleven rootstocks were G.11, G.16, G.202, G.214, G.222, G.30, G.41, G.690, G.935, G.969, and M9-337 (control). The cultivar Liberty on G.935 was used as a pollinizer. Organic chicken manure was applied twice per year, beginning at 0.2 lb N/tree and increasing to 0.8 lb N/tree in 2021. The trees were trained to a tall spindle system following the protocols from the NC-140 group. The trees started to produce a light crop in 2016 but yield and quality varied by rootstock. Despite good bloom and fruit set, 2023 was a light crop year due to elk predation just before harvest.

#### MEETING THE NEEDS OF NEW MEXICO

Apple is the number one fruit species in New Mexico. States with big apple operations utilize high-density planting and dwarfing rootstocks to boost crop production, yet there is limited research on what growing methods are most suitable for New Mexico apple growers. Trees in high-density planting systems produce earlier crops with higher yields than conventional systems. The NC-140 program is a nationwide rootstock evaluation program for different temperate fruit tree species.

#### IMPACT

In 2025, this ten-year project will be complete. We will be able to recommend top-performing rootstocks for high-pH soils and the tall spindle production system for apple production.

#### FUNDING ACKNOWLEDGMENT:

USDA Specialty Crop Block Grant through NMDA



Investigators: Shengrui Yao (yaos@nmsu.edu) and Robert Heyduck

#### PROJECT OVERVIEW

This study and demonstration will assess the feasibility of using high tunnels for frost protection of peaches and cherries in northern New Mexico. We planted peach trees and cherry trees in April 2017. We built the main structure of a 30 x 72-ft FarmTek high tunnel in 2018, and the plastic cover, doors, and end panels were added in 2019. In 2023, the high tunnel peaches yielded well. Cherry buds were damaged by extreme cold in midwinter and did not produce.

#### MEETING THE NEEDS OF NEW MEXICO

Late spring frost is the most significant obstacle to tree fruit production throughout New Mexico. Growing trees under cover is one approach to mitigate this threat, and we used thermostat-controlled portable propane heaters and fans to provide additional heat in the system when needed. Simple automated systems may provide adequate protection at key points in tree and fruit development.

#### IMPACT

We are working to determine the infrastructure, labor, and energy inputs required to protect tree blooms and produce a more reliable crop. Determining best practices and the feasibility of different frost protection strategies can aid all fruit growers.

#### FUNDING ACKNOWLEDGMENT:

USDA Specialty Crop Block Grant through NMDA



# JUJUBE CULTIVAR SELECTION THROUGH OPEN POLLINATION PROGENIES

Investigator: Shengrui Yao (yaos@nmsu.edu)

#### PROJECT OVERVIEW

There are limited commercially available jujube cultivars and no formally released jujube cultivars in the U.S. Based on our cultivar trials and existing jujube trees, jujube grows and produces well across New Mexico. Jujube breeding and selection is non-existent in the U.S. Due to difficulties with jujube's crossbreeding—tiny flowers, difficulty of emasculation, late flowering/fruit interference, and low fruit set— NMSU Alcalde Center started the jujube cultivar selection through open-pollinated progeny in 2021. In the long run, we hope to select several US jujube cultivars. We have planted over 470 seedlings in 2021 and 2022 at Alcalde, and an additional 600 in Los Lunas in 2023.

#### MEETING THE NEEDS OF NEW MEXICO

Late frost challenges fruit production each year in central and northern New Mexico. We encourage growers to diversify their operations in order to minimize the revenue fluctuation for fruit growers. Since jujube blooms later and can avoid late frosts in most years and produce a reliable crop each year, it will be a perfect alternative crop for commercial growers and home gardeners in New Mexico. The jujube cultivars at three ASC locations have proven this over the past 8 years.

#### IMPACT

Like any perennial fruit species, jujube cultivar selection will be a long-term project which takes at least 8-15 years. Once jujube cultivar(s) is released, commercial growers nationwide can adopt them and generate more revenue with their operation. Home gardeners can also plant them in their yards and improve their food composition with jujube fruit.

#### FUNDING ACKNOWLEDGMENT:

USDA Specialty Crop Block Grant through NMDA

#### **COLLABORATING AGRICULTURAL SCIENCE CENTERS:**

Los Lunas Agricultural Science Center



# EXPANDING ORGANIC SYSTEMS TO REDUCE WATER DEMAND AND INCREASE AGRICULTURAL RESILIENCE IN THE SOUTHWEST

Investigators: Connie Maxwell (alamosa@nmsu.edu), Alexander Fernald, Kevin Lombard, Ivette Guzman, Jay Lillywhite, Rob Heyduck, Richard Davidson' Don Bustos

#### PROJECT OVERVIEW

This team's goal is to develop a protocol and toolkit for dryland and minimally irrigated organic system plans that provide effective targets and innovative pathways for adaptations to climate changes and water demand reductions through transitions to resilient organic crops and practices. In 2024, we will establish trials of low-water-use medicinal herbs and native fruit trees that we hope provide a marketable product as well as pollinator and wildlife habitat, erosion control, windbreaks, and other ecosystem services.

#### MEETING THE NEEDS OF NEW MEXICO

Climate change has resulted in less snowpack, earlier spring runoff, and sharp reductions in irrigated agriculture in some regions. However, keeping water in agricultural valleys is critical for the resilience of these working landscapes and communities. Expanding organic systems may be one of the few remaining viable options for reducing water demand and achieving resilience for agricultural communities in New Mexico's drylands, and arid and semi-arid regions.

#### IMPACT

The USDA-NIFA Organic Transitions Program supports research and extension that improves the competitiveness of organically raised crops and livestock. This project will address these priorities by using a systems approach to collaboratively develop improved strategies, models, and metrics to optimize productivity, sustainability, ecosystem services, and the climate variability adaptation ability of organic systems.

#### FUNDING ACKNOWLEDGMENT:

USDA-NIFA Organic Transitions Program

#### **COLLABORATING AGRICULTURAL SCIENCE CENTERS:**

Fabian Garcia Research Center and Farmington Agricultural Science Center



# SELECTING ADAPTED CULTIVARS OF LAVENDER FOR NORTHERN NEW MEXICO

Investigators: Robert Heyduck (rheyduck@nmsu.edu) and Kevin Lombard

#### PROJECT OVERVIEW

Building on work done from 2003 to 2011, we plan to select hardy lavender cultivars adapted to the growing conditions of northern New Mexico. We collected seeds in 2018 from elder lavender plants that have survived extremes of heat and cold, infrequent irrigation and weeding, suboptimal management conditions, and long-term soil-borne diseases. The 120 individual mother plants represent 22 lines and were likely open-pollinated by other remaining plants. Lavender germination can be low due to the quality of seed and dormancy, and we generated 112 individuals in one round of seeding in 2023. Another larger round is planned for 2024.

#### MEETING THE NEEDS OF NEW MEXICO

Lavender is a crop with a long history of use. The name reflects its connection to washing and its use in soaps and cleaning and freshening agents. It is also used as cut and dried flowers and is widely planted as an ornamental plant. While not native to New Mexico, it grows well in most parts of the state, does well on alkaline, sandy, and low-fertility soils, and is drought tolerant. Cold tolerance is an important trait for northern areas with colder, longer winters, and demand is increasing for cultivars that are both drought and cold-tolerant.

#### IMPACT

Lavender production and products play a part in several New Mexico businesses. Identifying and generating well-adapted and productive cultivars could help make existing businesses and farms more sustainable, promote the expansion of lavender production, and expand the offerings of small-scale growers as cut flowers or as value-added products.

#### FUNDING ACKNOWLEDGMENT:

New Mexico Department of Agriculture as part of the Specialty Crop Block Grant Program

#### **COLLABORATING AGRICULTURAL SCIENCE CENTERS:**

Farmington Agricultural Science Center



### JUJUBE CULTIVAR TRIALS

Investigators: Shengrui Yao (yoas@nmsu.edu) and Robert Heyduck

#### 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), Tucumcari Center (2016) and Leyendecker Center (2017). Plantings at Alcalde, Los Lunas, and Leyendecker are all growing and producing well, but Tucumcari had severe grasshopper damage in the planting year and suffered from irrigation issues.

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. Suitable 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, sameyear flower bud initiation and bloom, and two-month-long blooming period, jujube produces a reliable crop in New Mexico.

IMPACT

The limited choices of commercially available cultivars for the jujube industry will be 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 ACKNOWLEDGMENT:

Trials were established through Specialty Crop Block Grant projects through the New Mexico Department of Agriculture

#### **COLLABORATING AGRICULTURAL SCIENCE CENTERS:**

Los Lunas Agricultural Science Center and Leyendecker Plant Science Center



### TABLE GRAPE CULTIVAR TRIAL AT ALCALDE

Investigators: Shengrui Yao (yoas@nmsu.edu) and Kevin Lombard

#### PROJECT OVERVIEW

Due to severe late frosts in central and northern New Mexico, grapes can be an alternative crop for fruit growers. With high pH soils in New Mexico, not all grape cultivars are adapted in NM. Late frosts can also damage the new growth of grapes, but they can regenerate some new growth. The goal is to evaluate table grape cultivars to recommend top-performing cultivars to growers. We planted eight table grape cultivars in 2021 at Alcalde and are monitoring their growth and yield. Due to winter damage and personnel changes, the trellis system has not been set up yet at Alcalde.

#### MEETING THE NEEDS OF NEW MEXICO

Unlike most tree pome fruit and stone fruit species, grapes can regenerate some new growth if they are damaged by late frosts and still generate some income for growers even in years with severe late frosts. For table grapes, most growers can market their fruit directly to local markets which will increase their revenue. This table grape cultivar trial will be a demonstration for growers. Once we collect enough data, growers can adopt the recommended table grape cultivars in their operations.

#### IMPACT

Once we finalize this project and recommend top-performing table grape cultivars, local growers can plant them on their farms to minimize the late frost influence and increase revenue.

#### FUNDING ACKNOWLEDGMENT:

Specialty Crop Block Grant through the New Mexico Department of Agriculture

#### **COLLABORATING AGRICULTURAL SCIENCE CENTERS:**

Farmington Agricultural Science Center and Los Lunas Agricultural Science Center



Investigators: Saeid Zehtab Salmasi (saeidzs@nmsu.edu) and Robert Heyduck

#### PROJECT OVERVIEW

Saffron (*Crocus sativus L.*) holds a high economic value as the world's most expensive spice. It plays a crucial role in many small farm economies in countries such as Iran, India, Afghanistan, Greece, Morocco, Spain, and Italy. The net global production of saffron amounts to approximately 418 tons annually, produced on approximately 250,000 acres. The dehydrated stigma of saffron contains bioactive compounds with therapeutic properties in treating cancer cells, Alzheimer's disease, and cardiovascular disorders. In recent years saffron has also been cultivated in California and west Texas. In this project, the effects of three different Saffron corm sizes will be evaluated in high tunnel and open field conditions at Alcalde. About 2,000 Saffron corms were planted in September 2023. For the first year, we harvested flowers from October 18 until November 6. Saffron flower and stigma production will be evaluated for three years to test the feasibility of this high-value plant production in North Central New Mexico.

#### MEETING THE NEEDS OF NEW MEXICO

This project will demonstrate the benefits of integrating saffron into traditional small-scale vegetable production systems to enhance farm sustainability and profitability while improving overall soil health. We anticipate that this project will demonstrate a boost in farm profitability compared with current vegetable production systems, which will encourage the adoption of saffron as a new value-added, low-input cash crop. A major goal of this project is to test the feasibility of saffron production in North Central New Mexico and to generate educational resources, including planting, maintenance, harvesting, processing, and marketing. We believe the climate condition in Northern New Mexico should be conducive to producing high-yield saffron, but this requires local testing and trailing.

#### IMPACT

Studies showed that U.S.-grown saffron with an average price of \$30/g could generate >\$50,000 net revenue/acre. Diversification towards high-value crops can be a promising strategy to enhance farmers' economic welfare in the region. The project will produce new knowledge and promote high-value, low-input plants to the growers of Northern New Mexico, and the soil health and environmental benefits can improve overall on-farm resiliency, reduce off-farm inputs, and increase biodiversity.



### CHARACTERIZATION, GENOTYPING, AND USES OF JUJUBE CULTIVARS/GERMPLASM IN NEW MEXICO

Investigators: Shengrui Yao (yoas@nmsu.edu) and Dapeng Zhang

#### PROJECT OVERVIEW

There are 100+ jujube cultivars in the US with the majority imported and some selections across the country. But no cultivar was formally released with detailed information. Renaming, mislabeling, and synonyms are common. With single nucleotide polymorphism markers, we could get the majority of jujube cultivars genotyped/identified. Eliminated synonyms and mislabeled cultivars and got similar cultivars into groups. We also identified jujube germplasm in New Mexico and Tornillo/Fabens, TX, and confirmed a unique jujube population in Tornillo/Fabens area. Growers/researchers nationwide can use this information to identify their cultivars or guide their jujube cultivar selections.

#### MEETING THE NEEDS OF NEW MEXICO

This jujube genotyping project will directly benefit all jujube growers in New Mexico, nationwide, and internationally. This jujube genotyping project was the first of its kind in the US. It clarified the jujube cultivar confusion and will guide growers in their cultivar selection.

IMPACT

This jujube genotyping project will help growers in their cultivar identification and selection. The results from this project eliminate synonyms and mislabeling. Growers will know the relationship among cultivars and avoid fancy names/duplicates.

#### FUNDING ACKNOWLEDGMENT:

Specialty Crop Block Grant through NMDA

#### **COLLABORATING AGRICULTURAL SCIENCE CENTERS:**

Leyendecker Plant Science Center and Los Lunas Agricultural Science Center



For an enlarged picture, please see the last page of the report.

#### PROJECT OVERVIEW

With community input, we have selected 20 sampling points along the length of Rio Hondo, beginning at its source and ending where it joins the Rio Grande. We sample year-round for water quality parameters including total dissolved solids, salinity, pH, mineral content, fecal coliform, greases and oils, pharmaceutical residues, and isotopic composition.

MEETING THE NEEDS OF NEW MEXICO This two-year project aims to assess water quality during a phase of rapid development around Taos Ski Valley, addressing community concern over development impacts.

#### IMPACT

The project will run from September 2023 through September 2025, and this will allow us to gauge pollutant loads over the two water years as development intensifies and traffic and use increases.

#### FUNDING ACKNOWLEDGMENT:

Taos Soil and Water Conservation District



# **BY THE NUMBERS**







# **RESEARCH PUBLICATIONS**

- Bradshaw, T., Autio, W., Blatt, S., Clements, J., Einhorn, T., Elkins, R., Fallahi, E., Francescatto, J.L., Minas, L., Peck, G., Robinson, T., Yao, S. (2023). Performance of 'Modi®' apple trees on several Geneva rootstocks managed organically: Five-year results from the 2015 NC-140 Organic Apple Rootstock Trial. To appear in Journal of American Pomological Society, 77(1), 14-27.
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- Raei, Y., A. Jafari, S. Zehtab Salmasi and Y. Kheirizadeh Arough. (2024). Effect of biofertilizers and foliar application of iron and zinc on some morphological and biochemical traits of dill (*Anethum graveolens* L.). Journal of Agricultural Science and Sustainable Production. Doi: 10.22034/SAPS.2023.54937.2970.
- Rosero, D.V., Soto Mas, F., Nervi, L., Sebastian, R., Casanova, V., and Guldan, S. (2023). Impact of COVID-19 on USDA-certified organic producers: Exploring the role of sociodemographic and contextual factors. Organic Agriculture 13, 133-144. doi.org/10.1007/s13165-023-00430-9.
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- Sapkota, D., Zhang, D., Park, S., Meinhardt, L.W., Yao, S. (2023). Genotyping of Jujube (Ziziphus spp.) Germplasm in New Mexico and Southwestern Texas. MDPI Plants, 12, 2405 https://doi.org/10.3390/plants12132405
- Sapkota, D., Zhang, D., Park, S., Meinhardt, L.W., Lozada, D.N. Steiner, R. 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. (in press).
- Sapkota, G., Delgado, E., VanLeeuwen, D., Holguin, F. O., Flores, N., Yao, S. (2023). Preservation of Phenols, Antioxidant Activity, and Cyclic Adenosine Monophosphate in Jujube (Ziziphus Jujuba Mill.) Fruits with Different Drying Methods. MDPI – Plants, 12, 1804. https://doi.org/10.3390/plants12091804.
- Sapkota, G., Delgado, E., VanLeeuwen, D.F., Holguin, O., Flores, N., Heyduck, R., Yao, S. (2023). Dynamics of Nutrients in Jujube (Ziziphus Jujuba Mill.) at Different Maturity Stages, Cultivars, and Locations in Southwest United States. HortScience, 58(2), 155-163., https://doi.org/10.21273/HORTSCI16880-22.
- Zehtab Salmasi, S., R. Heyduck and C. Martin. (2023). Medicinal and high value native plants suitable for small farms and water deficit conditions of northern New Mexico. Journal of Medicinal Plants Studies. 11(5):26-28. https://doi.org/10.22271/plants.2023.v11.i5a.1582.

# **GRANTS AND CONTRACTS**

- USDA/NMDA Specialty Crop Block Grant Program. 2022-2025. \$39,225. Active.
- New Mexico Department of Agriculture as part of the Specialty Crop Block Grant Program. \$28,650. Active.
- USDA-NIFA Organic Transitions Program \$750,000 total, ~\$23,000 for Alcalde-based activities. 2022-2026. Active.
- Specialty Crop Block Grant through NMDA supported this project with a total of \$63,888 from 2022-2023. Active.
- Taos Soil and Water Conservation District \$18,008.55. Active

# **OUTREACH ACTIVITIES**

Yao, S., Fruit tree pruning workshop, February 23, 2023.

**Yao, S.,** 2022 NM Fruit Growers Workshop, "Fruit Tree Training Systems and Planting Density", March 3, 2023.

**Heyduck, R., Maxwell, C.** Field visit & workshop: Caring for Our Valleys to Improve Our Acequias & Farms. May 5th 2023.

# 2023 FIELD DAY AUGUST 9TH





# PEOPLE





# **COOPERATORS AND COLLABORATORS**

### NMSU SCIENCE CENTERS AND RESEARCHERS

- Dave Lowry Leyendecker ASC
- Dr. Kevin Lombard Farmington ASC
- Miranda Kersten Los Lunas ASC
- Dr. Chadelle Robinson Agricultural Economics and Agricultural Business
- Dr. Efren Delgado Family and Consumer Sciences
- Dr. Nancy Flores Food Technology
- Dr. Alexander Fernald Water Resources Research Institute

### OTHER UNIVERSITY, STATE, FEDERAL AND TRIBAL PARTNERS

- Dr. Dapeng Zhang USDA-ARS Beltsville, MD
- Dr. Calos Ochoa Oregon State University
- Ciara Cusack USDA-USFS Idaho City, ID

### **NC-140 COLLABORATORS**

- University of Kentucky
- University of Wisconsin
- University of Massachusetts
- Utah State University
- Agriculture and Agri-Food Canada
- University of Vermont
- University of Georgia
- University of Guelph
- Auburn University
- Pennsylvania State University
- Washington State University
- Michigan State University
- California Cooperative Extension

# **COOPERATORS AND COLLABORATORS**

### **NC-140 COLLABORATORS**

- University of Idaho
- University of Maryland
- USDA-ARS/Plant Genetic Resources Unit Purdue University
- University of Minnesota
- Cornell University
- University of Illinois
- Ohio State University
- Colorado State University
- University of Maine
- Rutgers University
- North Carolina State University
- Clemson University
- Virginia Polytechnic Institute and State University (VA Tech)
- USDA-ARS/Washington

### **INDUSTRY PARTNERS**

- La Montanita Co-op
- Taos Soil and Water Conservation District

# **ADVISORY COMMITTEE**

- Chris Bassett
- Don Bustos
- Donald Martinez
- Sage Faulkner
- Bob Lopez
- Craig Conley
- Joanie Quinn
- Leonard Bird

# **GRADUATE STUDENTS**

- Govinda Sapkota
- Dikshya Sapkota

## **ASC PERSONNEL**



### SAEID ZEHTAB SALMASI

Research Director and Associate Professor



### **SHENGRUI YAO**

Professor, Extension Fruit Specialist



### **ROBERT HEYDUCK**

Research Scientist, Associate



### **ELENA ARELLANO**

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### DAVID ARCHULETA

Farm/Ranch Manager



### **GARY MAESTAS**

Assistant Farm/ Ranch Manager



### JUAN LOPEZ

Farm/Ranch Laborer

### CHARACTERIZATION, GENOTYPING, AND USES OF JUJUBE CULTIVARS/GERMPLASM IN NEW MEXICO

Investigators: Shengrui Yao (yoas@nmsu.edu) and Dapeng Zhang

