

2022

ANNUAL REPORT

SUSTAINABLE AGRICULTURAL
SCIENCE CENTER AT ALCALDE

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Notice to Users of this Report

This report has been prepared to aid Science Center staff in analyzing the results of various research projects from the past year and to record data for future reference. 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 data in this report. In many instances, data represents only one of several years' results that will ultimately constitute the final formal report. Although staff members have made every effort to check the accuracy of the data presented, this report was not prepared as a formal release.

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

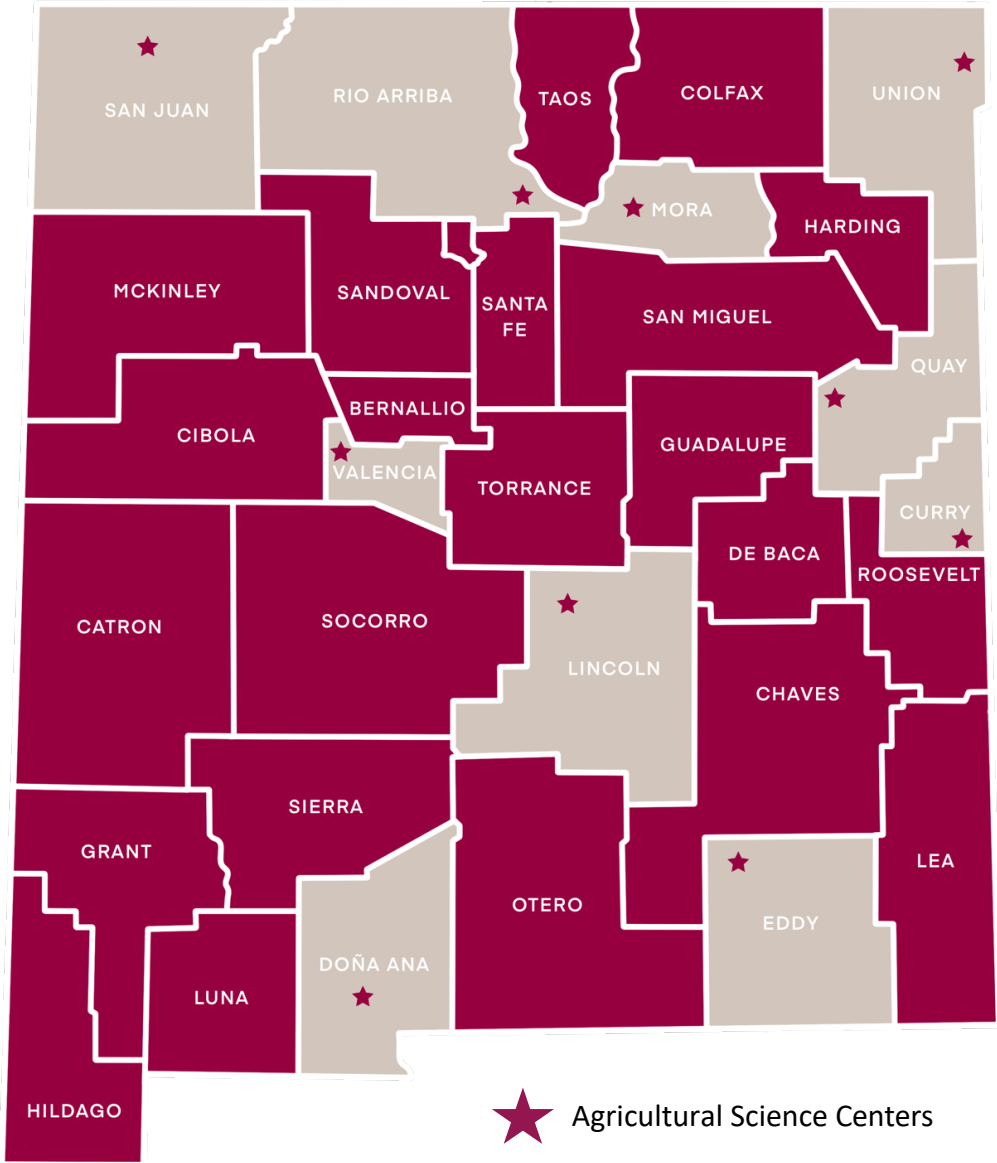


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Executive Summary

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 along the lowest terrace and floodplain 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 in this region, but there are also numerous orchards and intensive, high-value fruit and vegetable-producing operations.

Research at the Science Center focuses on crops and cropping systems for north-central New Mexico, including various horticultural and agronomic crops 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), soil health and cover crops (3 acres), pollinator habitat and buffer strips (3 acres), 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 2022 included apple, peach, plum, and sweet corn.

We look forward to the innovative ideas and skills that our new staff will bring as we continue to seek solutions for the producers of northern New Mexico amidst changing climate and economic pressures.

Research Projects:

Soil health benefits of diverse cover crop mix – Investigators: Robert Heyduck and Amy Larsen

Jujube cultivar trial and marketing – Investigators: Shengrui Yao and Robert Heyduck

Selecting adapted cultivars of lavender for northern New Mexico – Investigators: Robert Heyduck and Kevin Lombard

NC-140 Organic apple rootstock trial at Alcalde – Investigators: Shengrui Yao, Robert Heyduck, and Steve Guldan

High tunnel stone fruit production in northern New Mexico – Investigators: Shengrui Yao, Robert Heyduck, Steve Guldan

Jujube cultivar selection through open pollination progenies – Investigator: Shengrui Yao

Table grape cultivar trial at Alcalde – Investigators: Gill Giese, Shengrui Yao, and Kevin Lombard

Expanding organic systems to reduce water demand and increase agricultural resilience in the Southwest – Investigators: Alexander Fernald, Connie Maxwell, Kevin Lombard, Ivette Guzman, Jay Lillywhite, Rob Heyduck, and Richard Davidson' Don Bustos

Initial hemp variety trials across NM environments (A) – Investigators: Hanah Rheay, Catherine Brewer, and Rebecca Creamer

Initial hemp variety trials across New Mexico environments (B) – Investigators: Catherine Brewer and Rebecca Creamer

Soil health benefits of diverse cover crop mix

Investigators: Robert Heyduck (rheyduck@nmsu.edu) and Amy Larsen

Project Overview: We seek to understand the soil building capacity of a cover crop mix (forage radish, winter pea, and oats) when combined with 1) a microbially rich compost inoculant 2) a legume inoculant, and 3) no inoculant at all. Cover crops sown in the fall of 2021 germinated and grew well initially but were grazed and trampled by elk in early 2022. The resulting cover was thin and patchy. We sowed the field to sorghum-sudangrass in June of 2022, and this stand grew well but was chlorotic. We mowed the cover crop and collected soil samples in September and in October, sowed the same cool season cover crop blend.

Meeting the Needs of New Mexico: Cover crops provide numerous benefits including reducing erosion and compaction, fixing nitrogen, and increasing soil organic matter. They can improve soil aggregation and tilth by providing soil cover and a living root in the ground year-round. This can reduce soil loss, fertilizer costs, and weed pressure while increasing water infiltration, crop yield, and quality.

Impact: A better understanding of cover cropping management and dynamics will lead to a more effective application of practices. In this trial, it appears that the system was nitrogen-poor, resulting in slow decomposition of previous cover crop residue and reduced vigor of current crops. Further analysis will shed light on soil changes over time-related to inoculation treatments.



Jujube cultivar trial and marketing

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

Project Overview: We have collected and imported over 50 varieties to the Sustainable Agricultural Science Center in Alcalde and established cultivar trials at NMSU's Alcalde (2015), Los Lunas (2015), Tucumcari (2016), and Leyendecker (2017) Agricultural Science Centers. 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. 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.

Impact: 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.

Collaborating Agricultural Science Centers: Los Lunas Agricultural Science Center, Tucumcari Agricultural Science Center, and Leyendecker Plant Science Center

Funding Acknowledgement: Trials were established through funding from the New Mexico Department of Agriculture



Selecting adapted cultivars of lavender for northern New Mexico

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

Project Overview: Building on work done between 2003 and 2011, we plan to select hardy lavender cultivars adapted to the growing conditions of northern New Mexico. We have collected seed 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. This seed was collected in late summer 2018 from the 120 or so surviving plants out of roughly 1,440 planted in 2010 and 2011. These 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 the seed and dormancy; therefore, we plan to sow 3000-5000 seeds to generate as many individuals with as much genetic variation as possible.

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 soap, cleaning, and freshening agents. It is also used as cut and dried flowers and is widely planted as an ornamental. 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.

Collaborating Agricultural Science Centers: Farmington Agricultural Science Center

Funding Acknowledgement: \$28,650 from the New Mexico Department of Agriculture as part of the Specialty Crop Block Grant Program



NC-140 Organic apple rootstock trial at Alcalde

Investigators: Shengrui Yao (yaos@nmsu.edu), Robert Heyduck, Steve Guldán

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. While 2021 produced a larger crop than 2020, 2022 was a very light crop year for the trial. Late frost and elk predation of buds reduced the crop significantly.

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 the conventional systems; higher yields timed for better market pricing could generate more revenue for growers. The NC-140 program is a nationwide rootstock evaluation program for different temperate fruit species (apple, cherry, pear, etc.). We set up our first NC140 organic apple rootstock trial to test different rootstocks for organic planting with the tall spindle system at NMSU Alcalde Center in 2015.

Impact: After another four years, when this project is complete, growers can adopt the top-performing rootstocks for high pH soils and the tall spindle production system to increase their revenue.

Funding Acknowledgement: USDA Specialty Crop Block Grant through NMDA 2014-2017. The trial continues until 2025.



High tunnel stone fruit production in northern New Mexico

Investigators: Shengrui Yao (yaos@nmsu.edu), Robert Heyduck, Steve Guldán

Project Overview: The objective of this study and demonstration is to assess the feasibility of using high tunnels for spring frost protection of peach and cherry trees in northern New Mexico. We planted peach and cherry trees in April 2017. We trained the cherry to an upright fruiting offshoot system (UFO) in the two border rows and a spindle system in the middle row. We erected the main structure of the 30 x 72-ft FarmTek high tunnel in 2018, and the plastic cover and doors, and end panels were added in 2019. In 2022, the high tunnel peaches yielded well. Cherry buds were damaged by extreme cold in midwinter and produced a very sparse crop.

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 Acknowledgement: USDA Specialty Crop Block Grant through NMDA 2018-2020



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 cultivar in the U.S. Based on our cultivar trials and existing jujube trees, jujubes grow and produce well across New Mexico. Jujube breeding and selection are non-existing in the U.S. Due to difficulties with jujube's crossbreeding—tiny flowers, the difficulty of emasculation, late flowering/fruit interference, and low fruit set— the 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.

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 to minimize revenue fluctuation. 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. Our jujube cultivars at three locations have proven it in 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) are 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.

Collaborating Agricultural Science Centers: Los Lunas Agricultural Science Center

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

Table grape cultivar trial at Alcalde

Investigators: Gill Giese, Shengrui Yao (yaos@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. The new growth of grapes can also be damaged by late frosts, but they can regenerate some new growth. The goal of this project is to evaluate table grape cultivars in order 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(s): 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.

Collaborating Agricultural Science Centers: Los Lunas Agricultural Science Center and Farmington Agricultural Science Center

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



Expanding organic systems to reduce water demand and increase agricultural resilience in the Southwest

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

Project Overview: This team's goal is to develop a protocol and toolkit for dryland organic system plans that provide effective targets and innovative pathways for adaptations to climate change and water demand reductions through transitions to resilient organic crops and practices.

Meeting the Needs of New Mexico: Climate change has resulted in less snowpack, earlier spring runoff, and sharp reductions of irrigated agriculture in some regions, yet 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 that can also achieve resilience for agricultural communities in New Mexico's drylands, arid and semi-arid regions.

Impact: The USDA-NIFA Organic Transitions Program supports research and extension that improve 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.

Collaborating Agricultural Science Centers: Fabian Garcia Science Center, Farmington Agricultural Science Center, Water Resources Research Institute

Funding Acknowledgement: USDA-NIFA Organic Transitions Program \$750,000 total, ~\$23,000 for Alcalde-based activities. 2022-2026.

Initial hemp variety trials across NM environments (A)

Investigators: Hanah Rheay (handsr@nmsu.edu), Catherine Brewer, Rebecca Creamer

Project Overview: The project is led by the Department of Chemical and Materials Engineering and the Department of Entomology, Pathology, and Weed Science. The project involved the cultivation of CBD ('Sweetened' and 'Wife') and grain ('Anka' and 'Altair') hemp varieties at three NMSU Agricultural Science Centers: Leyendecker, Los Lunas, and Alcalde. The trials evaluated the suitability of different varieties to the unique climatic areas throughout the state and provided initial scouting opportunities for pests and diseases. Other extension agents that contributed to the planning and implementation of this project are Kevin Lombard (Farmington) and Jeff Anderson (Doña Ana County). Additional collaborating partners include Rich Global Hemp (located in Las Cruces, NM), who provided hemp seeds and guidance for best management practices of CBD hemp.

Meeting the Needs of New Mexico: The NM hemp industry is faced with challenges entering this new industry and expanding hemp production, as farmers grapple with limited options for biomass utilization and potential detrimental interactions due to pests/diseases shared with other major crops. This work aims to address this problem by finding industrial varieties that are suitable for production in the state, evaluating the potential for establishing hemp market use outside of CBD, and identifying pests that are common to hemp fields.

Impact: The potential impacts of this project include developing recommendations for hemp farmers based on their location within the state, identifying the most relevant downstream uses for the biomass that is produced in NM, and establishing pest management guidelines for the region. This work primarily addresses one ACES Pillar: Food and Fiber Production and Marketing.

Collaborating Agricultural Science Centers: Los Lunas Agricultural Science Center

Funding Acknowledgement: \$10,000 from the College of Engineering (COE), \$20,000 from the Agriculture Experiment Station (AES), and \$25,000 of seed grant funding was awarded from the NMSU Center of Excellence in Sustainable Food and Agricultural Systems



Initial hemp variety trials across New Mexico environments (B)

Investigators: Catherine Brewer (cbrewer@nmsu.edu) and Rebecca Creamer

Project Overview: This project established a two-year variety trial at three NMSU ASC locations to study the cultivation of different hemp types throughout the state. The primary goal of the project was to investigate the suitability of cannabidiol (CBD), grain, and fiber hemp types for NM production. Data was collected to compare how the yields and chemical profiles of the hemp varieties change when grown under conditions different than those of the locations where the varieties were bred to perform.

Meeting the Needs of New Mexico: The main purpose of this project is to strengthen the NM hemp industry, which experienced financial losses and difficulties entering the market during the first two years of legal hemp production in NM. Challenges plaguing stakeholders across the supply chain have included instability of variety genetics, risk of crops exceeding legal tetrahydrocannabinol (THC) limits, issues with manufacturing quality control, and a lack of infrastructure. NM producers have described an overwhelming need for understanding how local environments interact with hemp genetics to identify varieties that are successful in the region.

Impact: The underlying impact across all investigations has been to develop hemp variety recommendations for NM hemp farmers based on their location. Other impacts generated by this project include the establishment of procedures for university researchers to receive state licensure for hemp production, dissemination of treatments of interest to increase crop yields, and identification of crop residues with potential for value-added products. This work further generated educational impacts by expanding the experience and knowledge of university faculty and staff that can be used to create university courses and training materials.

Collaborating Agricultural Science Centers: Leyendecker Plant Science Center and Agricultural Science Center at Los Lunas

Funding Acknowledgement: USDA-NIFA



Grants and Contracts

- Jujube cultivar selection through open pollinated progenies \$39,225 USDA/NMDA Specialty Crop Block Grant Program. 2022-2025. Recommended for funding.
- Selecting adapted cultivars of lavender for northern New Mexico \$28, 650 USDA/NMDA Specialty Crop Block Grant Program. 2022-2023.
- The Future of Agriculture in New Mexico: Building Resilience through Organic and Traditional Approaches \$750,000 total, ~\$23,000 for Alcalde activities. USDA-NIFA Organic Transitions program 2022-2026.

Research Publications

- Conrad, L.M., Fernald, A.G., Guldán, S.J. and Ochoa, C.G., 2022. A Water Balancing Act: Water Balances Highlight the Benefits of Community-Based Adaptive Management in Northern New Mexico, USA. *Hydrology*, 9(4):64.
- Cusack, C.J., Fernald, A.G., VanLeeuwen, D.M., Guldán, S.J., Baker, T.T. and Heyduck, R.F., 2022. Supporting Riparian Habitat with Traditional Irrigation Systems of the Northern Rio Grande Region. *The Southwestern Naturalist*, 66(4):280-289.
- Lauriault, L.M., Guldán, S.J., Popiel-Powers, F.G., Steiner, R.L., Martin, C.A., Falk, C.L., Petersen, M.K. and May, T., 2022. Relay Intercropping Winter Cover Crop Effects on Spring Forage Potential of Sweet Maize Stover and Yearling Cattle Beef Performance. *Animals*, 12(15):1923.
- Soto Mas, F., L. Nervi, D.V. Rosero*, R. Sebastian, S.J. Guldán, and V. Casanova. 2022. COVID-19 and essential workers: Healthcare delays among organic farmers. *J. Healthcare Quality Research* 37:283-290. DOI: 10.1016/j.jhqr.2022.02.001
- Yao, S., 2022. Low Temperature Is Critical for Jujube Grafting Success in Frost-prone Northern New Mexico. *HortTechnology*, 32(1):28-31.
- Yao S. and Heyduck, R., 2022. Early performance of jujube cultivars in the southwestern United States. *Acta Hort.* 1350, 7-14. DOI: 10.17660/ActaHortic.2022.1350.2
<https://doi.org/10.17660/ActaHortic.2022.1350.2>

Cooperators and Collaborators

NMSU

- Dr. Gil Giese—Los Lunas ASC
- 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. John Idowu—Extension Plant Sciences
- Dr. Robert Flynn—Artesia ASC
- Leonard Lauriault—Tucumcari ASC
- Dr. Alexander Fernald—Water Resources Research Institute
- Dr. Rebecca Creamer— Entomology, Plant Pathology, and Weed Science (EPPWS)
- Dr. Catherine Brewer—Chemical Engineering

Other University, State, Federal, and Tribal Partners

- Dr. Dapeng Zhang—USDA-ARS Beltsville, MD
- Dr. Carlos 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 Massachusetts
- University of Guelph
- Auburn University
- Pennsylvania State University
- Washington State University
- Michigan State University
- California Cooperative Extension
- University of Idaho
- University of Maryland
- USDA-ARS/Plant Genetic Resources Unit Purdue University
- University of Minnesota
- Cornell University
- University of Illinois
- Michigan State University
- 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
- Rich Global Hemp

Outreach Activities

- Heyduck, R., Building Capacity for Agriculture: Small-scale Drip Irrigation February 9, 2022, with San Juan County Extension (online).
- Yao, S., Fruit tree pruning workshop, February 24, 2022.
- Yao, S., 2022 NM Fruit Growers Workshop, "Fruit Tree Training Systems and Planting Density", March 2, 2022. (online).
- Heyduck, R., Extended Season Production Workshop Series: Hoophouse Management and Maintenance March 16, 2022, with Southern Pueblo Extension Agriculture and Flower Hill Institute (online).
- Yao, S., Fruit tree grafting workshop, August 10, 2022.



Advisory Committee

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

Personnel

- Lara Prihodko, Interim Superintendent
- Shengrui Yao-Professor, Extension Fruit Specialist
- Robert Heyduck-Research Scientist, Associate
- Elena Arellano, Administrative Assistant