Sustainable Agriculture Science Center at Alcalde

2019 Annual Progress Report

BE BOLD. Shape the Future. **New Mexico State University**
College of Agricultural, Consumer and Environmental Sciences
Agricultural Experiment Station

NOTICE TO USERS OF THIS REPORT

This report has been prepared to aid Science Center staff in analyzing results of the various research projects from the past year and to record data for future reference. These are not formal Agricultural Experiment Station Report research results.

Information in this report represents only one year's research. The reader is cautioned against drawing conclusions or making recommendations as a result of data in this report. In many instances, data represents only one of several years' results that will constitute the final formal report. It should be pointed out that 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.

Dr. Natalie P. Goldberg, Interim Associate Dean
and Director Agricultural Experiment Station

The College of Agricultural, Consumer and Environmental Sciences is an engine for economic and community development in New Mexico. ACES academic programs help students discover new knowledge and become leaders in environmental stewardship, food and fiber production, water use and conservation, and improving the health of all New Mexicans. The College's research and extension outreach arms reach every county in the state and provide research-based knowledge and programs to improve the lives of all New Mexicans.

2019 Annual Progress Report

Sustainable Agriculture Science Center at Alcalde

PO Box 159
Alcalde, NM 87511

(505) 852-4241
alcaldeasc.nmsu.edu

Robert Heyduck, Editor

Agricultural Experiment Station Staff

Full-time Staff

Steve Guldan
Superintendent and Professor

Shengrui Yao
Associate Professor, Ext. Fruit Specialist

Robert Heyduck
Research Scientist, Associate

Anna Trujillo
Administrative Assistant, General

Elena Arellano
Administrative Assistant, General

David Archuleta
Farm/Ranch Supervisor

David Salazar
Field & Shop Technician

Part-time and Seasonal Staff

Amy Larsen
Senior Research Assistant

Adrienne Rosenberg
Editor

Juan Lopez
Farm/Ranch Laborer

Diego Delgado
Farm/Ranch Laborer

Cooperative Extension Service
Rural Agricultural Improvement and Public Affairs Project (RAIPAP) Staff

Edmund Gomez
Director, RAIPAP, and Assistant Dept. Head

Augusta Archuleta
Administrative Assistant, Associate

Amanda Benavides
Administrative Assistant, Associate

Del Jimenez
Agricultural Specialist

Daniel Bird
Extension Outreach Agriculture Agent

Gabrielle Rodriguez
Extension Outreach Agriculture Agent

Graduate Students

Lily Conrad
MS Candidate

Cover Photo: David Archuleta, Steve Guldan, and Robert Heyduck use a no-till drill to seed cover crops for a soil health study (Photo by Amy Larsen).

Staff Appreciation

In 2019, the Sustainable Agriculture Science Center at Alcalde saw several long-time staff members retire. On the Experiment Station side, Anna Trujillo and David Salazar retired after 5 and 15 years of service, respectively. From RAIPAP, Administrative Assistant August Archuleta retired after serving for 22 years, Agriculture Agent Tori Hougland moved to an inspector position in the NMDA, and program Director Edmund Gomez retired after leading the program since 1994. We thank them for their commitment, service, and hard work in all our programs.

We also welcomed new staff to continue the research and extension work we do here at the Center. Elena Arellano and Amanda Benavides joined as Administrative Assistants, and Gabrielle Rodriguez and Daniel Bird join us as Extension Outreach Agriculture Agents to continue the RAIPAP mission.

Clockwise from top left: Anna Trujillo, Augusta Archuleta, David Salazar, Tory Hougland, and Edmund Gomez

Advisory Committee

Chris Bassett

Leonard Bird

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Table of Contents

Table of Figures

Table of Tables

Introduction

Mission

Working closely with Cooperative Extension Service specialists in the Rural Agricultural Improvement and Public Affairs Project (RAIPAP), the Sustainable Agriculture Science Center at Alcalde (SASC) serves the producers and consumers of north-central New Mexico. Most irrigated agricultural land in the region belongs to small scale farmers and ranchers with fewer than 20 acres, and since 1952, our research has focused on enhancing the productivity, profitability, and sustainability of a long farming tradition. In 2002, the first certified organic acres at NMSU were established at SASC to better address issues in organic agriculture.

History

New Mexico State University's Sustainable Agriculture Science Center at Alcalde is located approximately seven miles north of Española on the Taos Highway.
The Science center sits on 60 acres of property formerly known as the "San Gabriel Ranch," which had been part of a large land grant given to General Juan Andres Archuleta, an officer in the Spanish Army in the early 1700s, by the Spanish Crown. One of the buildings served as the seat of justice for an area that now encompasses three counties, which is where the name "Alcalde," meaning mayor or Justice of the Peace, comes from. The original building, which was used as the courthouse, still stands on the property.

In the early 1800s, Josefina, who was the daughter of General Juan Andres Archuleta, married a man named Joseph Clark. From this union came a son named Elias. In the early 1900s, Elias sold a small part of the original land grant to Caroline Stanley who later married Richard Pfaffle. With this land the Pfaffles established the San Gabriel Ranch, operating it as a 'dude ranch' that catered to wealthy families including the Rockefellers, who occasionally leased the entire pavilion for parties. Other elite personalities were Mary Cabot Wheelwright, who founded the Wheelwright Museum, and Georgia O'Keefe, a painter/writer who moved to Abiquiu, New Mexico, in 1929, only after visiting the San Gabriel Ranch. Ms. O'Keefe would return to the Ranch to paint scenic vistas from the third floor gazebo. In the early 1910s Richard Pfaffle mortgaged the ranch to Florence Bartlett, a philanthropist from Chicago. Ms. Bartlett had the present offices of the Alcalde Science Center built in 1923

Figure 1. Main office SASC Alcalde.

as well as the outbuilding in what is now called "Santa Maria El Mirador Home" which is located next door. A patron of folk art, Ms. Bartlett founded the International Folk Art Museum. Her first attempt to establish the Museum at Alcalde failed due to its remote location, but it remains successful at its current site on Museum Hill in Santa Fe, New Mexico.

In 1950, Ms. Bartlett deeded the ranch property to the State of New Mexico. The Museum of New Mexico received part of the property, but not knowing what to do with it, later sold it to New Mexico State University for $80,000. Since 1952, New Mexico State University has been using the site for agricultural research. The main office building had been Ms. Bartlett's house. It was obtained by NMSU in the late 1960s from the Welfare Department.

Research at the Science Center focuses on crops and cropping systems for north central New Mexico. Crop research includes various horticultural and agronomic crops. The Center is also cooperating on acequia hydrology research. Presently, the Science Center serves as a weather station for the U.S. National Weather Service providing climatological data since 1953. The Science Center has also supported youth development and education through Research/Extension Apprenticeship Programs as well as through hiring youth taking part in the New Mexico Department of Labor Summer Youth Program. The Science Center serves as the headquarters for the Cooperative Extension Service's Rural Agricultural Improvement and Public Affairs Project (RAIPAP), providing programs in sustainable agriculture, financial planning, and public policy skills in Bernalillo, Cibola, Guadalupe, McKinley, Mora, Rio Arriba, Sandoval, Santa Fe, San Miguel, Taos, Torrance and Valencia counties, as well as to the Jicarilla Apache Tribe.

Setting

Alcalde lies in the Upper Rio Grande Valley, between Española and Velarde, in Rio Arriba County. Geologically, it is within the bounds of the Española Basin, part of the larger Rio Grande Rift system. It is a structural basin of mostly sedimentary rocks that lies between the volcanic uplands of the Taos Plateau/Black Mesa to the north and the Caja del Rio Plateau to the south, the Pajarito Plateau/Valles Caldera to the west and the Sangre de Cristo mountains to the east. The elevation of the station is 5,680 ft. and natural vegetation in the area ranges from riparian bosque forest (cottonwood, New Mexican olive, various willows), to xeric grasslands and shrublands (blue grama,

Figure 2. Looking east over the Rio Grande, with the SASC grounds in the middle distance and Truchas Peak in the background. (Photo by Alec Richards).

fourwing saltbush, rabbitbrush, cholla), to xeric woodland (piñon, juniper). The Science Center itself stretches from the Acequia de Alcalde almost 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. Irrigated pasture and forages dominate these areas, but there are also numerous orchards and intensive, high-value fruit and vegetable producing operations. Outside of the irrigated valley areas, in the grass- and shrub-lands, grazing is the primary agricultural activity. These lands were once part of land grant commons (*ejido*) and are now managed largely by BLM (Bureau of Land Management) and the USFS (Forest Service).

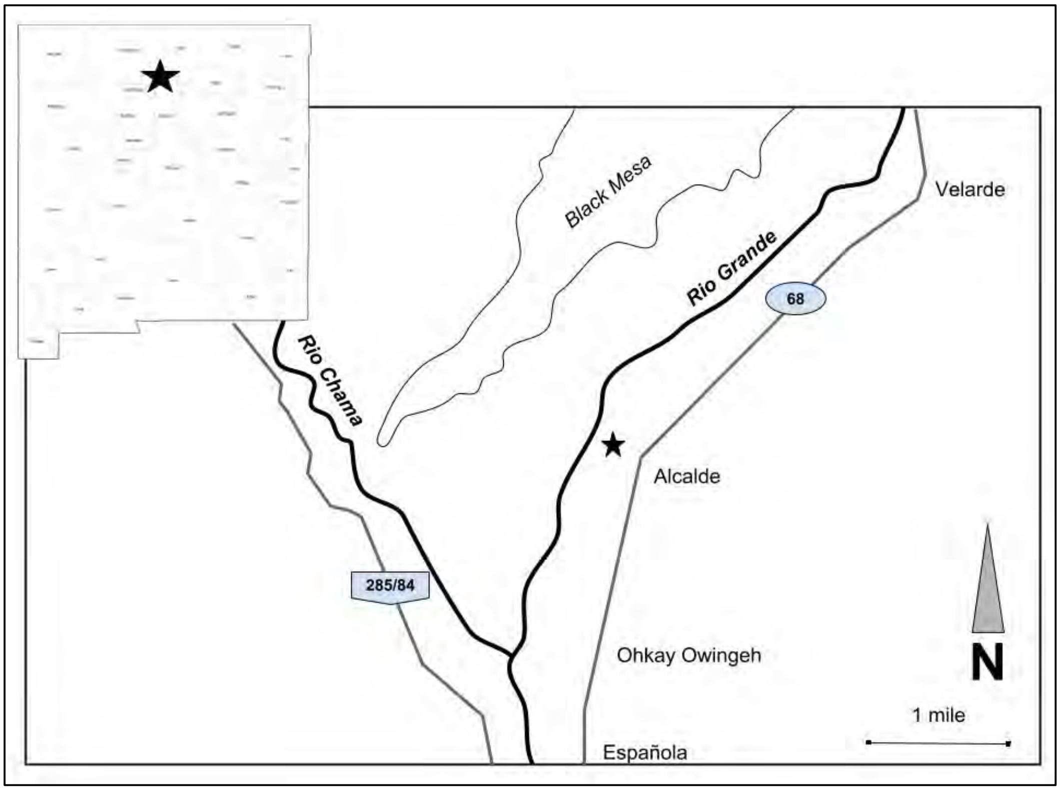

Figure 3. Alcalde's location within the Española Valley. Inset: Alcalde's location within NM.

Soils at the Alcalde Science Center are a mix of alluvial material derived from the surrounding sandstones, and clays derived from shale and igneous rocks upstream and to the north. The most common map unit on the Center is Fruitland sandy loam. Science Center soils are all classified as “not prime farmland” by the NRCS (Natural Resources Conservation Service), and can be sandy, excessively well drained, alkaline, and occasionally saline.

Flood and furrow irrigation are common in agricultural areas served by acequias. These methods are used at the Science Center for hay and forage crops, and for row crops such as maize, beans, and chile. We also have the capability to run sprinkler and drip irrigation from a well on-site or by running acequia water through a filtration system. The well provides supplemental water to limited crops in winter when the acequia is dry.

Figure 4. NRCS Web Soil Survey data superimposed on aerial view of SASC and vicinity. Red dotted lines define our property boundary and orange lines are soil map units referenced in Table 1.

Table 1. Coverage and characteristics of soil map units on SASC and vicinity.

Map Unit Symbol	Map Unit Name	Acres	Percent
11	Fruitland sandy loam, 0 to 3 percent slopes	68.6	43.9%
18	Abiquiu-Peralta complex, 0 to 3 percent slopes	15.9	10.2%
21	Werlog clay loam, 0 to 1 percent slopes	16.8	10.8%
34	Alcalde clay, 0 to 3 percent slopes	23.9	15.3%
151	Razito-Fruitland complex, 1 to 5 percent slopes	29.6	18.9%
W	Water	1.4	0.9%

Alcalde lies within the Arid/Steppe/Cold (BSk) climate zone according to the Köppen-Geiger Climate Classification System. This zone encompasses a large portion of North America including much of the Great Plains and the lower elevation Intermountain West. This zone is characterized by low rainfall, warm summers, and cold winters. However, highlands surrounding the valley and within the Science Center's service area reach into zones DFb and DFc, characterized by snowy winters, and CFb, and CFc, which are warm temperate, but semi-arid.

According to the USDA Hardiness Zone System, Alcalde lies within zone 6a with an average annual minimum temperature between -10 and -5 °F. Surrounding areas fall into zones 6b (-5 to 0 °F), and 7a (0-5 °F). Highlands within the service area fall within zones 5a (-20 to -10 °F) and 5b (-15 to -10 °F).

The record low between 1953 and the present (-35 °F) was recorded on January 7, 1971, in the middle of a four-day string of below-zero temperatures. The record high for the same time period of record is 102 °F recorded later the same year on July 14, 1971. In 2019, monthly mean temperatures were below average from January through June, above average from July through September, and below average for the remainder of the year. The extreme high was 95 °F recorded on August 27, and the low for the year was 1 °F recorded on January 1, 3, and 5. The lowest high temperature was 23 °F, recorded January 2, and the highest low was 63, recorded on August 2.

Table 2. Average daily maximum, minimum, and mean temperatures and extreme monthly maximum and minimum temperatures for 2019.

	Average High	Average Low	Mean	Extreme High	Extreme Low
Month	**Temperature °F**				
January	39.8	16.9	28.1	54.0	1.0
February	47.4	17.8	32.6	61.0	11.0
March	59.3	28.4	43.8	75.0	21.0
April	67.8	32.6	50.2	80.0	23.0
May	70.6	36.9	53.8	82.0	31.0
June	84.5	47.1	65.8	93.0	41.0
July	89.9	55.8	72.9	94.0	44.0
August	90.1	52.6	71.4	95.0	43.0
September	83.2	45.3	64.3	94.0	32.0
October	65.9	26.5	46.2	84.0	14.0
November	56.7	17.8	37.2	65.0	9.0
December	43.6	19.5	31.5	56.0	11.0

Between 1953 and 2019, Alcalde received an average of 10.8 inches of snow per year, and an average of 9.88 inches of rain per year. Total precipitation during 2019 was above average at 11.58 inches. Most of the rain occurs during the North American Monsoon from roughly July through October and average precipitation during these months is 5.56 inches. In 2019, only 4.31 inches of rain fell during these months. July had 2.55 in of precipitation, but August, September and October were far below average. We also experienced two extended dry spells: 34 days from August 13 through September 15 and 45 days from October 6 through November 19.

Freezing temperatures cut short the growing season for crops that are not cold-hardy, but late spring freezes are especially hazardous for fruit tree production in the northern valleys. At Alcalde, the average frost free period (32 °F) from 1953 to the present is 146 days from 11 May to 4 Oct. The average length of time with temperatures above 28 °F for the same period is 166 days from April 29 to October 13, and the average period with temperatures above 25 °F is 186 days from April 17 to October 20. Table 3 shows first and last dates of 32 °F as well as the season length. Out of the previous ten years, 2019 had both the latest and earliest 32 °F date making for a 122-day frost-free period, the shortest season since 2007.

Table 3. First and last freeze dates and growing season length, 2010-2019, Alcalde, NM.

Year	Last	First	Season length (days)
2019	5/24	9/23	122
2018	5/3	10/15	165
2017	5/20	10/8	141
2016	5/8	10/5	150
2015	5/11	10/25	167
2014	5/15	10/13	151
2013	5/4	9/29	148
2012	5/28	10/7	132
2011	5/3	10/10	160
2010	5/11	10/15	157
10-yr Mean	5/9	10/9	150
Long term Mean	5/11	10/4	146
Latest	6/8	10/25	
Earliest	4/15	9/9	

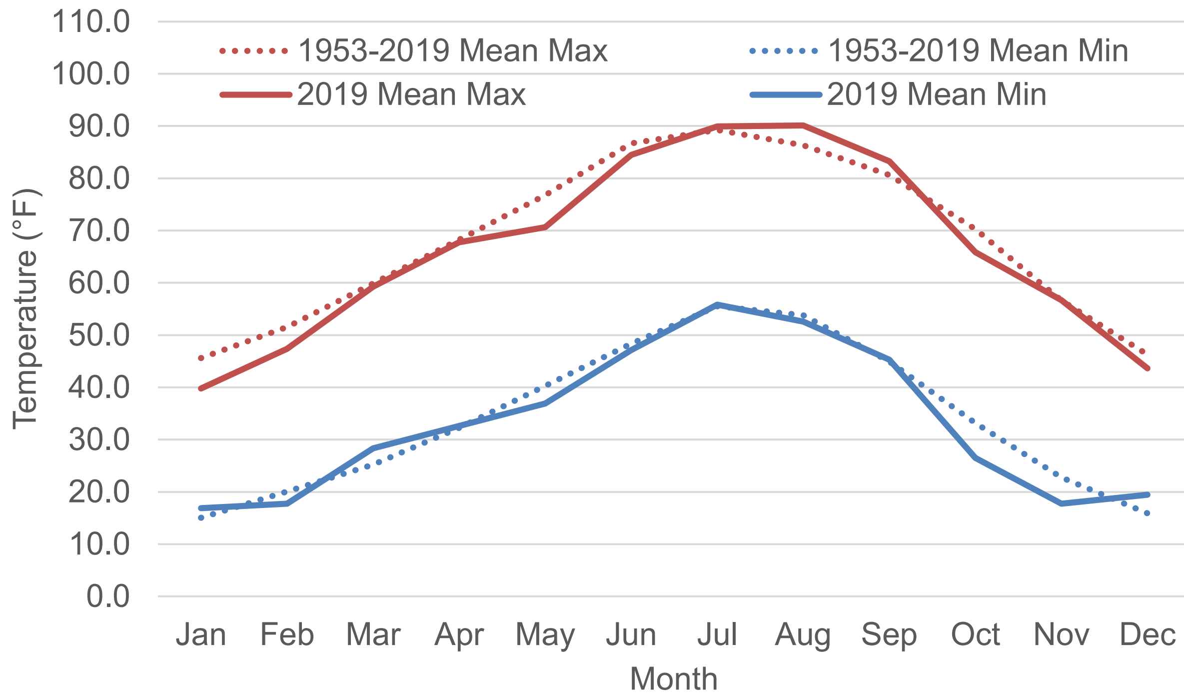

Figure 5. Average monthly maximum and minimum temperatures for 2019 compared with long term averages from 1953-2019.

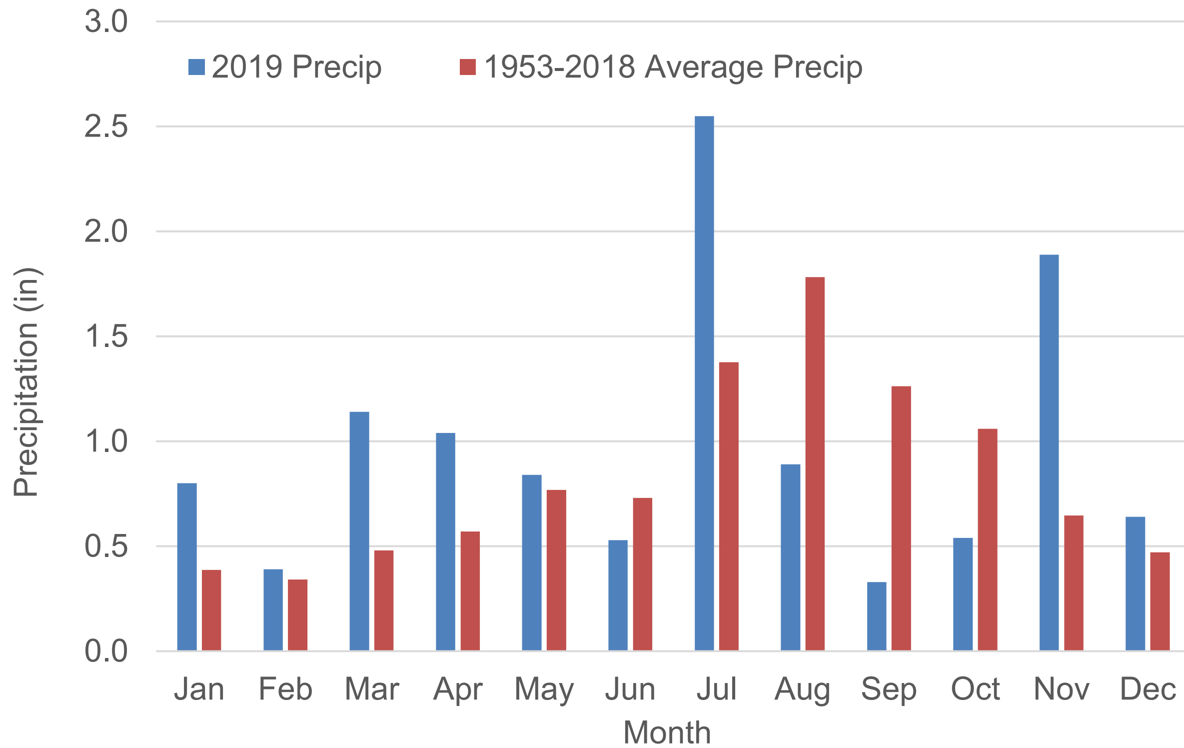

Figure 6. Monthly total precipitation for 2019 compared with long term average from 1953-2019.

Research Projects

Fruit Research

The history of tree fruit—apples, apricots, peaches, cherries, plums and pears—in the Española Valley stretches back to the early days of the Spanish in New Mexico in the 17th century. After 1821, when Mexico won its independence, trade with the United States to the east brought more settlers and new varieties of fruit. By the 1890s, investors such as James Hagerman, a Colorado mining baron, and the Missouri-based Stark Brothers nursery brought in planting stock in what would become the earliest move towards commercial fruit production. In the 1930s, improved roads and the advent of selling wholesale to out-of-state buyers provided a boost to commercial growers in the area. High apple prices during World War II increased planting further. By the 1950s, more than a third of apples produced in New Mexico came from Northern New Mexico and in 1953, the Española Valley Experiment Station (what is now the Science Center at Alcalde) established its first apple test orchard.

Numerous grower cooperatives formed and dissolved over the next several decades. Unfavorable weather conditions and lack of large-scale refrigerated storage hampered the stability and growth of the orchard industry. By the mid- and late- 1960s, however, several bumper crops, and federal funding through the Economic Opportunity Act of 1964 encouraged a number of community projects to improve economic conditions in the region. The Home Education Livelihood Program (HELP) encouraged the establishment of producer-run cooperatives throughout the state. In northern New Mexico, HELP was instrumental in the creation of the Chimayo Apple Growers' Cooperative in 1970.

In January 1971, however, temperatures reached -40 in some locations, killing up to 80% of the year's crop, and as many as 65,000 trees in the region. Another extreme winter in 1974 and the combination of bad weather, low yields, marketing struggles, and organizational strain led to the collapse of the Cooperative in 1978.

Today, fruit production continues, but is more geared toward direct marketing through community supported agriculture (CSA), farmers' markets, roadside stands, restaurant sales, and value-added products. The Alcalde Science Center still conducts research with popular tree fruit crops, but has also expanded to include less familiar crops such as jujube (Chinese date), brambles, strawberries, gooseberries, currants, honeyberries, and goji (wolfberry).

Reference

Carleton, W.R., 2017. Fruit, Fiber, and Fire: A Cultural History of Modern Agriculture in New Mexico. PhD Dissertation, University of New Mexico, Albuquerque, NM.

Jujube Cultivar Trial and Marketing

Shengrui Yao, Robert Heyduck, Steven Guldan, David Salazar, and David Archuleta,

Background information

Late frost is the most critical issue challenging fruit production in central and northern New Mexico. Most growers had 5 crops or less from 2010-2019. Good alternative crops with reliable yield are needed to diversify their operations and reduce risks. 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. We have collected and imported 50+ varieties to New Mexico State University's 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 also suffered from irrigation issues.

Potential impacts

The limited choices of commercially available cultivars to the jujube industry will be greatly improved with the NMSU jujube project. There are currently only 5-6 jujube cultivars commercially available in the United States with 'Li' as the dominant one. 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 $1-2 premium per pound. The jujube acreage nationwide will increase significantly on expectation.

Methods

The cultivar trial at NMSU Alcalde was established in April 2015 with 35+ cultivars as a randomized complete block design with two replicates.

The cultivars at Alcalde were: Chaoyang, Daguazao, Don Polenski, Dragon, Gaga, Honeyjar, Jinkuiwang, Jinsi2, Jinsi3, Jinsi4, Jixin, Junzao, Kongfucui, Lang, Maya, Mushroom, Pitless, Alcalde #1, Redland, Linyi Li, Li, GA866, Sherwood, Sihong, Liuyuexian, Jinchang, Shuimen, X38, So, Sugarcane, Teapot, Xiangzao, Xingguang, Zaocuiwang, Sandia, and Chico.

Results

A cool spring delayed flowering, fruit development and harvest. The fruit was about 20 days later than expected. But the early frost in the fall was on September 23 and hard freeze on October 8 which terminated the jujube season. The crop load was not bad from most cultivars (Table 4) but quite a few late cultivars did not have all their fruit fully mature before the hard freeze. 2019 had the shortest growing season in the past 10 years.

We published one peer reviewed paper in 2019 assessing the early performance of fresh eating cultivars.

2019 marked the fifth season after planting, but we do need a few more years to fully evaluate tree growth, yield and fruit qualities of all those cultivars tested.

Table 4. Alcalde jujube yields of different cultivars, average yield per tree, 2019.

Cultivar	Yield (g)	Yield (lb)
Alcalde #1	3787	8.3
Banzao	6393	14.1
Chaoyang	13402	29.5
Daguazao	12367	27.2
Don Polenski	5789	12.8
GA866	2669	5.9
Gagazao	9394	20.7
Honeyjar	9980	22.0
Jinchang #1	1479	3.3
Jinsi #2	3405	7.5
Jinsi #3	9049	19.9
jinsi #4	2615	5.8
Jixinzao	2243	4.9
JKW	9325	20.5
Junzao	4448	9.8
KFC	13364	29.4
Lang	6385	14.1
Li	6508	14.3
linyi Li	9193	20.2
Liuyuexian	8826	19.4
Mayazao	9669	21.3
Mu	3018	6.6
Pitless	9624	21.2
Redland	10620	23.4
Sandia	1494	3.3
Sherwood	2221	4.9
Shuimen	6472	14.3
Sihong	4386	9.7
Sugarcane	15128	33.3
Xiangzao	5417	11.9
Xingguang	4044	8.9
Zaocuiwang	2993	6.6

Peer-reviewed Publications

Yao, S., Heyduck, R., Guldan, S. J. (2019). Early performance of jujube fresh eating cultivars in the southwestern United States. HortScience, 54:1941-1946. https://doi.org/10.21273/HORTSCI14312-19

Jujube Fruit Processing and Value-added Products Research and Marketing

Shengrui Yao, Robert Heyduck, Steven Guldan, David Salazar, David Archuleta, and Margarito Hernandez

Background information

Jujube is a nutritional fruit that has historically been important to Traditional Chinese Medicine. It is high in vitamin C, cyclic adenosine monophosphate (cAMP), phenolic compounds, and antioxidants. Jujube has grown and fruited well in initial trials, but determining the best ways to store, process, and market these fruit will be the key to long term success of the crop. This project examines different drying methods, extraction and encapsulation methods for concentrated bioactive compounds, and pitting and slicing as methods of processing and preservation.

Potential impacts

We hope to develop shelf stable products that can extend beyond fresh fruit marketing.

Methods

Drying methods for jujube included traditional sun drying; oven drying in an industrial oven; and freeze drying.

Phenolic extraction methods were developed by graduate student Cristina Montero using ethanol and methanol. These methods concentrate the compounds of interest for encapsulation.

NMSU Alcalde also tested the pitter and slicer that arrived in 2018.

Results

Due to a cool spring, and early frost, many cultivars were not fully mature when harvested. We still managed to do some drying but we could clearly see the fruit quality was not high. Alcalde was worse than Los Lunas and fruit from Leyendecker station, Las Cruces, was not affected by the weather in 2019. Oven drying was more efficient and dependable. Most fruit could be ready within 36-48 hr at 60 °C, depending on fruit size.

The pitter and slicer both worked well, but the pitter was size limited due to its design. Fruit are held in place in holes which means fruit should have similar diameter or a little smaller than the holes, not too big or too small.

NC-140 Organic Apple Rootstock Trial at Alcalde

Shengrui Yao, Robert Heyduck, Steve Guldan, and David Salazar

Background information

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 NC-140 organic apple rootstock trial to test different rootstocks for organic planting with tall spindle system at NMSU Alcalde Center in 2015.

Potential impact

After another 5-7 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.

Methods and results

An organic apple rootstock trial with 11 rootstocks at 1.0 x 3.5 m planting density in tall spindle training system was established in 2015. The cultivar was Modi, a selection from Italy, and the eleven rootstocks are G.11, G.16, G.202, G.214, G.222, G.30, G.41, G890, G.935, G.969, and M9-337 (control). The cultivar Liberty on G.935 was used as a pollinizer. Trees were planted in a certified organic plot and were managed organically with drip irrigation. Organic chicken manure was applied twice per year at rate of 0.2 lb N/tree each year. The trees were trained to a tall spindle system following the protocols from the NC-140 group each year. The trees started to produce a light crop the second year after planting in 2016 but yield and quality varied by rootstock.

In 2019, G.890 still had the largest trunk circumference among the 11 rootstocks tested, while G.222 and G.16 had the smallest trunk circumference (Table 5). Rootstocks G.935 and G.890 had the highest yield among all rootstocks tested, followed by G.41, G.214 and G.30 which were also significantly higher than others while G.16 had the lowest yield. Some rootstocks (G.41, G.30, G.16, G.935 and G.214) had more severe leaf chlorosis in high pH soil than others. We lost two trees to fire blight in 2018 and another 3 trees during winter and early spring of 2019. Rootstocks G.222, G.935, G.890 and G.16 suckered more than others. We did not notice fire blight outbreak in 2019 and those dead trees were due to 2018 infection.

The main concept for a tall spindle system is using the early crop to slow down vegetative growth. When late frosts eliminate fruit set, it becomes harder to curb vegetative growth, especially for those vigorous rootstocks like G.890 and G.202 which had grown wider than its allowed spacing. This high density planting system trial has demonstrated that we must manage the late frost issue first.

In general, fruit production system and rootstock evaluations need 8-10 years. With the new over-canopy sprinkler system installation, we will strive to maintain reliable crops and then compare the rootstocks and the productivity of the tall spindle system.

Table 5. Apple tree average yield/tree (kg), fruit number per tree, tree circumference (mm), and sucker counts per tree.

Rootstock	Yield (kg)		Fruit #		Circum (mm)		Sucker #	
	2018	2019	2018	2019	2018	2019	2018	2019
G.11	5.6 cd	2.1	77.3 bcd	18.6	85.7 cd	96.1	0.7 cd	0.3
G.16	3.5 e	1.3	50.1 ef	12.4	70.8 f	81.7	3.6 a	1.9
G.30	7.9 b	2.9	92.0 b	25.0	103.8 b	117.3	2.9 ab	0.5
G.41	5.9 c	3.3	73.7 bcde	27.8	100.7 b	108.9	0.1 d	0.0
G.202	4.2 de	2.2	63.3 de	18.7	102.4 b	115.4	2.4 ab	1.1
G.214	6.0 c	3.0	76.1 bcd	25.8	79.9 de	92.3	1.5 bcd	0.6
G.222	2.8 e	1.4	36.8 f	12.4	74.0 ef	86.6	2.9 ab	3.6
G.890	12.7 a	4.6	147.5 a	40.4	126.9 a	140.5	2.4 ab	2.2
G.935	7.8 b	4.7	86.3 bc	44.6	101.9 b	111.2	2.3 abc	2.5
G.969	5.5 cd	1.4	72.3 cde	13.3	90.9 c	104.6	0.5 d	0.4
M.9-337	4.7 cde	1.7	66.1 cde	18.2	89.5 c	95.8	1.3 bcd	0.5

High Tunnel Stone Fruit Production in Northern New Mexico

Shengrui Yao, Robert Heyduck, Steve Guldan, David Archuleta, and David Salazar

Activities Performed

The objective of this study and demonstration is to assess the feasibility of using high tunnels for spring frost protection of peach and cherry in northern New Mexico.
The main structure of 30 x 72-ft FarmTek high tunnel was set up in March/April 2018, and the plastic cover and doors and end panels were added in March/April 2019.

Peach and cherry plants were planted in April 2017. Cherry plants were trained to an upright fruiting offshoot system (UFO) in the two border rows and a spindle system in the middle row. Cherry trees grew well. We did notice severe leaf chlorosis with the peach planting. Several of the young trees died. Peach trees on Lovell rootstock were not suitable in the high pH soil in New Mexico. We custom-ordered some almond hybrid rootstocks GF-677 from North America Plants Inc. We kept the west row of peach plants which performed better than the east row and central row and replanted with the GF-677 plugs. We could not get grafted cultivars from any nursery on GF-677. We had to grow the rootstocks and then grafted on site by Yao in the fall of 2018. All new planted trees were growing well in 2019.

The high tunnel cover was put on in March of 2019. Cropping on the trees was minimal due to late frosts.

Problems and Delays

The original peach plants were acquired from a nursery in Tennessee, but the Lovell rootstocks are not suitable for the high pH soil in New Mexico. Peach trees were yellow and stunted especially for the area of the old hoop house. To solve this problem, we asked a tissue culture nursery in Oregon to propagate the high pH tolerant peach rootstocks GF-677. These rootstocks arrived in May 2018 and were planted in the high tunnel. Peach tree scions were grafted in September 2018. We have also amended the soil in this area. Newly grafted peach trees were growing well in 2019.

Future Project Plans

Now that the high tunnel is completely constructed and the trees are established, We will put it in use in 2020 for late frost protection of those peach and cherry trees inside. Temperature sensors will be placed at several locations throughout to monitor temperature changes.

Other Tree Fruit and Berries at Alcalde

Other fruit planted at Alcalde Science Center include peaches, pears, tart cherries, sweet cherries, Japanese plums and European plums, blackberries, gooseberries, currants, bush cherries and honeyberries. Due to spotted wing *Drosophila* (fruit fly) concern, tart cherry trees were removed in 2017. In 2019, we had crops for all fruit crops except apricots.

Blackberries

Blackberries were planted in 2011 and produced good crops in high tunnels and reasonable crops in the field except in years with harsh winter like 2013, which greatly reduced the yield due to cane/bud damage. Spinach and kale were grown in the high tunnel with blackberries during the winters of 2016/17 and 2017/18. However, keeping the high tunnel closed to create the right environment for the greens caused cane and bud damage, and blackberry yield suffered. Total blackberry yield in the high tunnel from 2019 was 58 lb compared to 42 lb in 2017, the final year of the intercropping study. Blackberry plants responded somewhat to experiencing a full dormant season, and yield rebounded. But the yield for the blackberry in this high tunnel before the intercropping study was 250 lb and 213 lb for 2014 and 2015, respectively.

Gooseberries and currants

Gooseberries and currants were planted in 2010. In general, gooseberries performed better than currants. For currants, the dark colored clove currant, ‘Randal’, produced a reliable crop each year.

Bush cherries

Two cultivars were planted: ‘Carmine Jewel’ and ‘Romeo’. ‘Carmine Jewel’ had fruit in 2017. ‘Romeo’ was planted in 2016. Both ‘Camine Jewel’ and ‘Romeo’ fruited in 2019.

Honeyberries

Honeyberries were planted in 2014. They bloom early and are relatively cold tolerant. There was a small crop of 2-3 pounds per bush in 2018 and a smaller crop in 2019. The ‘blue’ berry of Honeyberry matures earlier than other tree fruit or berries in early to mid-June each year. Honeyberry plants are attractive ornamental bushes and make a good addition to an edible landscape.

Vegetable Research

High Tunnel (Hoop House) Research

Del Jimenez, Agriculture Specialist, began teaching how to build high tunnels (hoop houses) in the mid-1990s as a way to help local farmers extend the growing season with low-cost materials that could be found at nearby hardware stores. The structures are designed to be as low maintenance as possible.

In 2009, in a project funded by WSARE (Western Sustainable Agriculture Research and Education), a set of six high tunnels of three designs (single layer, double layer, and double layer plus thermal mass) were erected to study their effect on the temperature regime and growing environment of lettuce and spinach (Figure 7). These high tunnels have continued to be used to examine the effect of sowing date and harvest scheduling on spinach and kale.

Today, the Alcalde Science Center continues experiments with high tunnel structures by planting leafy greens for winter production, blackberries, fruit trees, and most recently cucumbers. During the summer months, the high tunnels are usually sown with cover crops in order to build soil organic matter and suppress summer annual weeds, but the station has recently begun trials with year-round rotational cropping systems inside the structures.

Figure 7. Spinach growing in a high tunnel at SASC Alcalde. (Photo by Robert Heyduck)

Organic Spinach Variety Trial in High Tunnel

Robert Heyduck, Steve Guldan

Activities Performed

In previous studies with spinach, the commonly available variety 'Bloomsdale Longstanding' was used. While total season-long yield of this variety ranged from 7.0 to 8.7 kg per 30 ft^2 harvest area, the results of these trials did not necessarily extend to other varieties of spinach or other leafy greens. We decided to test five varieties of early-maturing F1 hybrid spinach against 'Bloomsdale Longstanding' and its derivative 'Winter Bloomsdale'. These varieties were 'Palco', 'Yukon', 'Corvair', 'Renegade', and 'Escalade'. All seeds were sourced through Territorial seed, though these varieties are available through other suppliers.

In a 16 x 40-foot high tunnel, three beds approximately 2 feet wide and 36 feet long were rototilled with the addition of 30 pounds per bed composted organic dairy cattle manure and 3 pounds per bed of Farmer's Choice 4-2-2 organic chicken manure. Spinach plots were arranged in a randomized complete block design with six replicates. Spinach seeds were sown in 2-row, 2.5-foot long plots with a dripline running down the center (0.46 GPH, 6-inch emitter spacing). Regardless of variety, 2.5 grams of seed were sown per plot on October 17, 2017 and were watered by hand until germination. Spinach leaves were cut by hand once a month January through April, and the yield of each plot weighed separately. The Soil Plant Analysis Development (SPAD) meter measures absorbance of red and near-infrared light and calculates a numeric value proportional to the amount of chlorophyll in the leaf. These measurements can also be correlated with nutritional status of the plant and also with nutrient content for consumption. SPAD measurements were taken prior to each harvest on two plants in each plot and averaged.

Results

In the first year of the study, all hybrid spinach varieties outperformed 'Bloomsdale Longstanding' and 'Winter Bloomsdale'. 'Palco' (10.5 kg) was the most productive followed by 'Corvair' and 'Renegade' (both with 9.7 kg) (Figure 8). 'Bloomsdale Longstanding' yielded 6.5 kg and 'Winter Bloomsdale' the lowest at 5.1 kg. All yields are per total 30 ft^2 of each variety (six 5 ft^2 plots). 'Corvair' had the highest SPAD values overall with an average of 71.1 followed by 'Yukon' and 'Escalade' with 66.5. 'Palco' and 'Renegade' had the lowest SPAD readings with 55.8 and 53.0, respectively (Figure 9).

From first year results, 'Corvair' combines high yield with deep green leaves while 'Palco' and 'Renegade', though high yielders, had lighter colored leaves on average.

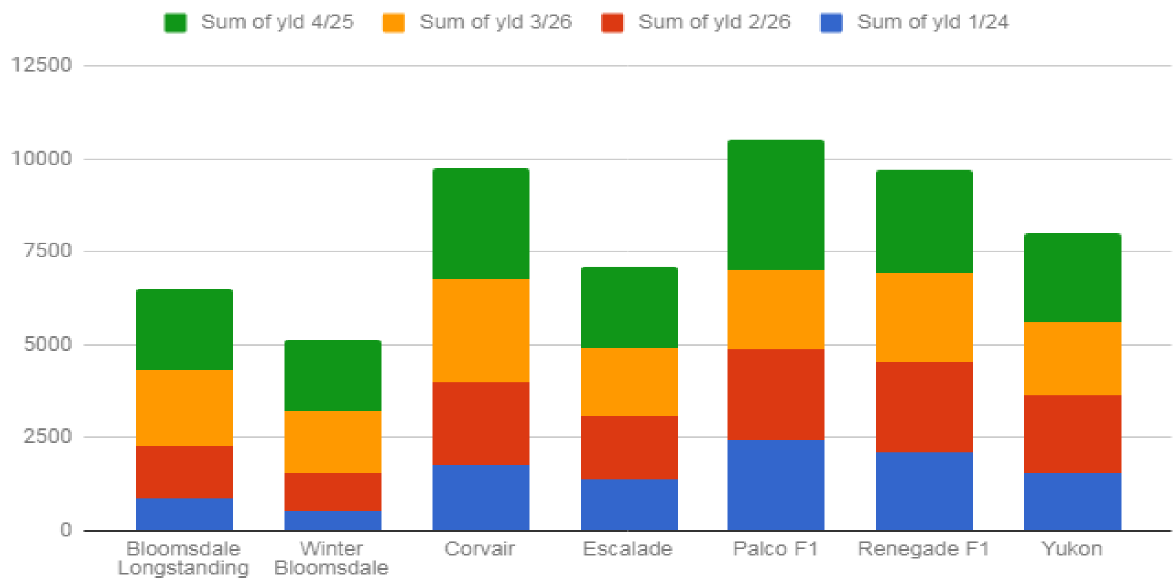

Figure 8. Total yield of four harvests of seven spinach varieties. Yield (g) is from 30 ft^2 area within 640 ft^2 hoop house.

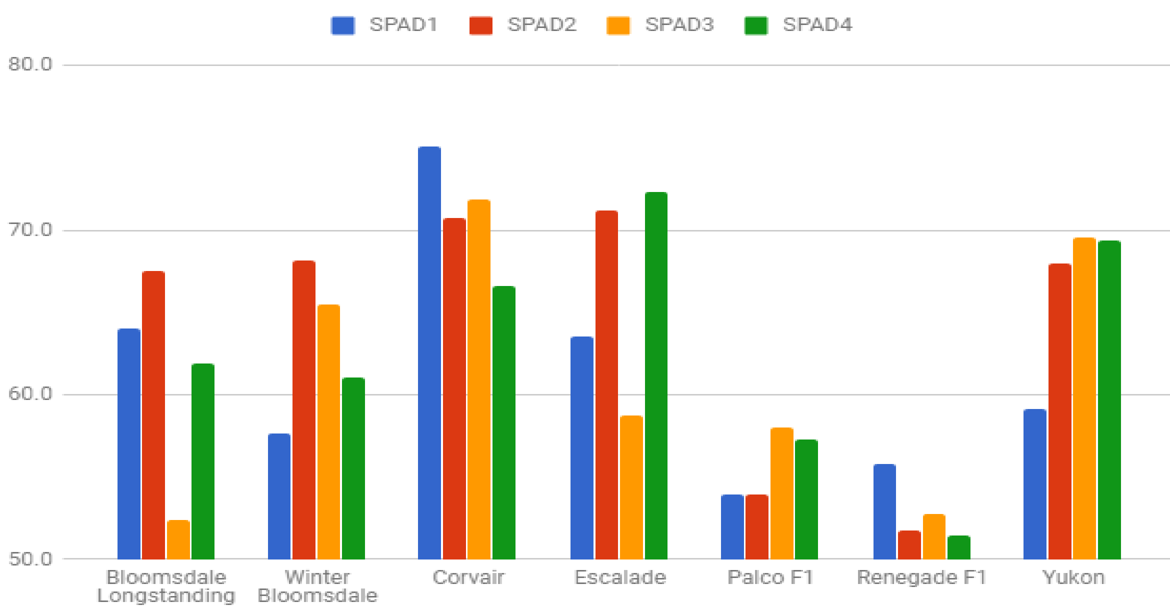

Figure 9. SPAD readings of seven spinach varieties.

Future Project Plans

The second season of this trial was sown on October 17, 2019. We plan to take leaf samples for nutritional analysis, and possibly correlate these values with SPAD values. Performance of varieties in the second season will allow us to make better recommendations to producers and home gardeners based on yield and quality information.

Agronomic and Agroecological Research

Implementing Soil Health Principles to Study Effects on the Soil Microbiome and Plant Health and Productivity in Organic Hoop House Tomato Systems

Amy Larsen, Steven Guldan, Robert Heyduck, David Archuleta, David Salazar

Background

NRCS defines soil health as the "continued capacity of a soil to function as a vital, living ecosystem that sustains plants, animals and humans." If soil health is to be understood as the capacity of an ecosystem to function, then measurable indicators like compaction, soil aggregation, filtration, soil organic matter, or soil microbial community composition should serve to assess the vitality of the below-ground ecosystem, and its ability to nourish the above-ground plant system. Improving soil health depends on implementing good management principles, including minimizing disturbance and maximizing soil cover, biodiversity, and the presence of living roots.

Due to disruptive crop management practices including intensive tillage, pesticide and fertilizer application, compaction, and bare fallow, many agricultural soils are less fertile and have poor microbial diversity compared to undisturbed grassland or forest systems. Compost that has been processed to maximize microbial diversity may serve to re-inoculate degraded soils and improve soil health and function. This study seeks to examine whether the combination of microbial re-inoculation and implementation of soil health principals in hoophouse soils can improve soil fertility, plant health, and plant production.

Methods

Phase I: Compost Production Spring 2018-Spring 2019

This project utilizes the method of composting designed by New Mexico State University research scientist Dr. David Johnson. His aerated, no-turn 'bioreactor' compost process allows for longer compost maturation, favoring the development of a diverse microbial community with higher fungal-to-bacterial ratios. When applied, it is hoped that this compost will inoculate the field or hoop house soil with a diverse suite of microorganisms, shifting the microbial community structure from a simple, bacterial-dominant soil to a more complex, fungal-dominant soil.

Phase II: Hoop house Trial Fall 2018 through 2019

The entire hoop house was planted with a cover crop mix (daikon radish, Austrian winter peas, hairy vetch, rye) November 8, 2018 (Figure 10). The cover crop continued to grow until May 3, 2019, when it was roller-crimped to terminate. The experimental design includes four replicates of three treatments: Till: cover crop was rototilled May 6; NT: no-till; and NT+C: no-till plus microbially diverse compost made onsite, which was added to the potting medium for the tomatoes. Tomatoes were transplanted May 21, 2019.

Figure 10. a) Cover crops prior to rolling on April 30, 2019; b) tomatoes harvested from hoophouse (Photos by Robert Heyduck).

Tomatoes were harvested twice weekly beginning August 5 and continuing through October 10, when we experienced a killing frost. Total and marketable fruit count and weight were recorded for each plot at each harvest (Figure 10).

The tilled treatment had the highest total tomato yield averaging 8.4 lb/plant. No-till with compost inoculant averaged 7.8 lb/plant, and no-till alone averaged only 5.3 lb/plant. However, when including only marketable tomatoes, tilled and no-till with compost were equal averaging 6.1 lb/plant while no-till alone averaged 4.2 lb/plant (Figure 11).

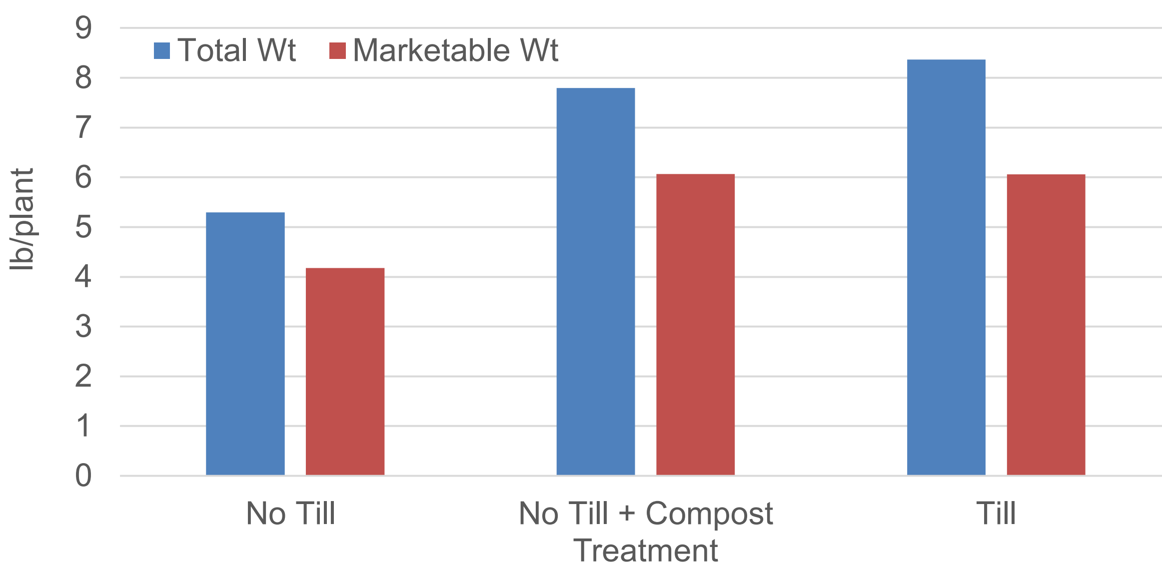

Figure 11. Total and marketable yield (lb/plant) for tomatoes grown in high tunnel under three soil treatments.

Future Project Plans

Tilled treatment plots were tilled and cover crops sown on all plots on October 31, 2019. Cover crops will grow until termination by rolling in the spring, and tilled plots will again be tilled. Instead of tomatoes, cucumbers will be grown during the summer of 2020.

A 'Soil Regeneration and Health' webpage was developed to house information pertinent to NM growers: https://alcaldesc.nmsu.edu/soil-regeneration-and-he.html

Streamlined Native Bee Monitoring Protocol for Assessing Pollinator Habitat and Bee Bowl Collection

Adrienne Rosenberg

Background
The purpose of this research project is to assess native bee populations by comparing a native wildflower field to a field of the more traditional cover crop alfalfa. The project is measuring diversity and collecting individual bees. The project will potentially aid in the conservation of acequia rights, create a demonstration site, establish easy planting methods, and invite native pollinators. According to professional entomologists, native bee data is extremely limited within New Mexico so this project may contribute to a wider understanding of the species present and habitat preferred in Northern New Mexico.

Activities Performed
The project established one native wildflower plot (44 ft x 103 ft) (Figure 12) and one alfalfa plot (44 ft x 103 ft) in Spring 2019. Plots were plowed, tilled, and broadcast planted. Watering was from the acequia and distributed through overhead sprinklers with a micro sprinkler head attachment. Weeding was conducted during the season to keep weed species from suppressing the wildflowers.

Figure 12. Wildflower plot measuring 44 x 103 ft (Photo by Adrienne Rosenberg).

A citizen science protocol written by the Xerces Society for Invertebrate Conservation, University of California Davis, Rutgers University, and Michigan State University called “Streamlined Native Bee Monitoring Protocol for Assessing Pollinator Habitat” was utilized to measure native bee diversity. Two transects per field (3 ft x 100 ft each) were established and used throughout the season. Each transect was walked within 7.5 minutes (totaling 15 minutes per plot) while counting native bees that landed on flowers within the transect. According to the protocol, bee abundance positively correlates with bee diversity. This count was performed four times throughout the season.

Figure 14. a) Bee bowl traps for pollinator collections and identification; b) pinned, sampled specimens; c) bumble bee (*Bombus* sp.) on blanketflower, *Gaillardia pullchella*.; d) Plains coreopsis, *Coreopsis tinctoria* (Photos by Adrienne Rosenberg except b) by Julieta Bettinelli).

In addition, eight bee bowls, or bee traps, in the colors of yellow, blue, and white were placed 13 ft apart on a 100 ft transect in the middle of the plot for several daylight hours. Bee samples were collected and placed into vials on the same days the monitoring protocol was administered (plus an additional day in October). The samples were then delivered to an entomologist to be pinned and identified. The plots were also photographed and audio recorded each time they were monitored.

In the fall, the Science Center with the Xerces Society hosted a workshop called "How to Support Pollinators in Northern New Mexico." Emily May, Xerces Society, and Adrienne Rosenberg, NMSU SASC Alcalde, presented information on pollinator observation, identification, ecology, habitat needs, environmental stressors, SASC's research, and community science opportunities. Don Martinez, NMSU CES Rio Arriba, facilitated the workshop. The workshop hosted around 40 attendees—government employees, master gardeners, private landowners, Native Plant Society members, NMSU faculty and staff, and other individuals from the general public.

Problems
The alfalfa plot did not establish well enough to measure. No data were gathered in 2019 on the alfalfa plot. It was replanted in the fall. Data will be gathered from this plot starting Spring 2020.

The wildflower plot was measured starting July 2019; in Spring 2020 both plots will be measured starting in May or June.

Results
The research is still in progress. No results yet. The bees from the 2019 season have been pinned and are being identified.

Acequia Hydrology

Acequias are the oldest water management institutions in the United States of European origin. These irrigation ditches, brought by the Spanish colonists, once supplied water to a large portion of the southwestern United States. Today, hundreds of acequias continue to feed the fields of northern New Mexico. Each acequia has a *mayordomo* (ditch boss) and a commission, which oversee the delivery of water, settle disputes, and maintain the ditch. Seepage from acequias and the fields they irrigate also help to recharge local aquifers, provide late-season groundwater return flow to the river, and enhance riparian areas. One of the few commons existing in the United States today, acequias are an essential part of identity and survival. The phrase, "Water is the lifeblood of the community", is often echoed throughout the high desert villages and towns in northern New Mexico. Acequias are, in short, the living history of New Mexican heritage and agriculture.

The Sustainable Agriculture Science Center at Alcalde is involved in research pertaining to acequias. One ongoing project characterizes the interactions between surface water and groundwater among acequias, irrigated fields, the source river, and the aquifer while asking, "To what extent do acequias and acequia-irrigated fields provide the benefits of aquifer recharge and delayed groundwater return flow to the river?" The Alcalde Science Center is also part of a study that analyzes and reports on how acequia water systems link culture and nature as well as provide resilience in the face of climate and land-use change. This multi-year, interdisciplinary, and inter-institutional project is based upon research that bridges the fields of social science and natural science. The intention of the project is to provide guidance for policy makers, academics, and the people who use these ditches. During 2018, Alcalde Science Center staff continued to assist with data collection as well as assisting to write up research results and develop new grant proposals. Recent results indicate that at three study sites, Alcalde, El Rito, and Rio Hondo, spring snowmelt runoff highly determines the amount of river and *acequia* flow available for irrigation. River flow in turn is the main driver for ditch flow and irrigation water available (Cruz et al., 2018). This is especially true for some *acequias* of El Rito where the irrigation season essentially ends when the snowmelt runoff that feeds the river and ditches ends. River flow typically peaks at the end of May or early June for the Alcalde and Rio Hondo sites and at the end of April or early May for the El Rito site.

Alcalde Science Center staff (Rosenberg and Guldan) are editors of a publication that will compile research results from this project in book form (planned completion in 2020).

Sustainable Farming Techniques in Northern New Mexico

Del Jimenez, Agricultural Specialist

Success in utilizing sustainable farming techniques in northern New Mexico is challenging due to many obstacles, including a short growing season. Greenhouse construction is very expensive and many small scale farmers cannot afford to invest due to these prohibitive costs. The use of hoop houses or high tunnels has been demonstrated to be cost effective for small scale farmers and can provide extended growing season for various high value cash crops. Cooperative Extension Service Rural Agricultural Improvement and Public Affairs Project (CES RAIPAP) specialists have assisted over 1,400 New Mexico producers in building high tunnel/hoop house units and by extending the growing season, thus improving annual income through additional crop production. High tunnel construction education projects continued during 2019.

Appendix

Cooperators/Collaborators

Local Farmers and Ranchers

New Mexico Department of Agriculture

Cooperative Extension Service Rural Agriculture Improvement and Public Affairs Project (CES RAIPAP)

Dr. Ivette Guzman, Assistant Professor, Department of Plant and Environmental Sciences, NMSU

Dr. Richard Pratt, Professor, Department of Plant and Environmental Sciences, NMSU

Dr. Lois Grant, Associate Research Professor, Agricultural Experiment Station, NMSU

Dr. Stephanie Walker, Professor, Department of Extension Plant Sciences, NMSU

Dr. Alexander Fernald, Professor, Department of Animal and Range Sciences and Director, Water Resources Research Institute, NMSU

Dr. Carlos Ochoa, Associate Professor, Watershed-Riparian Systems, Department of Animal and Rangeland Sciences, Oregon State University

Dr. Don Hyder, Department of Biology, San Juan College

Dr. Eric Smith, Department of Chemistry, San Juan College

Dr. Jay Evans, USDA-ARS Beltsville Bee Laboratory

Bee Informed Partnership

New Mexico Small Farm and Ranch Task Force

New Mexico Acequia Association

Institute of American Indian Arts

University of New Mexico

Texas A&M University

New Mexico Institute of Mining and Technology

Emerson College

USDA Natural Resources Conservation Service

New Mexico Farm and Livestock Bureau

New Mexico Cattle Growers Association

New Mexico Beef Council

Sangre de Cristo Livestock Growers Association

Los de Mora Growers' Cooperative, Inc.

Western Region Extension Risk Management Education Center at Washington State University

Alianza Agri-Cultura de Taos

Grants

Yao, S. (Principal), Sponsored Research, "Internal Award - 18/21 SCBGP Jujube Trials & Marketing", Sponsoring Organization Is: Other, Research Credit: $22,735.00, PI Total Award: $22,735.00, Current Status: Funded. (September 30, 2018 - September 29, 2021).

Yao, S. (Principal), Guldan, S. (Co-Principal), Flores, N. (Co-Principal), Delgado, E. (Co-Principal), Robinson, C. (Co-Principal), Sponsored Research, "Jujube Fruit Processing and Value-Added Products Research and Marketing." Sponsoring Organization: USDA/New Mexico Dept. of Agric. Total Award: $129,350, Current Status: Funded (October 1, 2017 – September 30, 2020).

Guldan, S. J. (Principal), Sponsored Research, "Health, Safety and Psychosocial Organic Farming Survey," Sponsoring Organization: NIH through the University of New Mexico/Health Sciences Center; Research Credit: $17,490.00, PI Total Award: $17,490.00, Current Status: Funded. (June 30, 2018 - June 29, 2021).

Publications

Cruz, J.J., A.G. Fernald, D.M. VanLeeuwen, S.J. Guldan, and C.G. Ochoa. 2019. River-ditch flow statistical relationships in a traditionally irrigated valley near Taos New Mexico. J. Contemporary Water Research & Education 168:49-65.

Heyduck, R.F., Guldan, S.J. and Guzmán, I., 2019. Effect of sowing date and harvest schedule on organic spinach grown during the winter in high tunnels. HortTechnology 29(3):320-329.

Larsen, A.L., S.J. Guldan, and R. Heyduck. 2019. Compost as microbial inoculant. Soil Science Society of America International Soils Meeting. https://scisoc.confex.com/scisoc/2019sssa/meetingapp.cgi/Paper/116041.

Yao, S., Guldan, S. J., Heyduck, R. (2019). High tunnel apricot production in frost-prone northern New Mexico. HortTechnology 29(4):457-460. https://doi.org/10.21273/HORTTECH04315-19

Yao, S., Heyduck, R., Guldan, S. J. (2019). Early performance of jujube fresh eating cultivars in the southwestern United States. HortScience 54:1941-1946. https://doi.org/10.21273/HORTSCI14312-19

Yao, S., Heyduck, R. (2019). Fresh eating jujube cultivars in the Southwestern United States (vol. 54(9S)), pp. S120. HortScience. (Abstract). https://journals.ashs.org/hortsci/view/journals/hortsci/54/9S/article-pS1.xml

Extension/Outreach Publications

Fernald, A., Boykin, K., Cibils, A., Gonzales, M., Guldan, S., Hurd, B., Ochoa, C., Rivera, J., Rodriguez, S., Tidwell, V., Wilson, J. Empoderando comunidades en zonas desérticas hechas para el cambio. 2019. Scientia https://www.scientia.global/wp-content/uploads/Acequias_Spanish.pdf

Yao, S. (2019). Guide H-337: Jujube training and pruning basics. https://aces.nmsu.edu/pubs/_h/H337.pdf

Yao, S. (2019). Guide H-307: Rootstocks for size controlling in apple trees. https://aces.nmsu.edu/pubs/_h/H307.pdf

Yao, S. (2019). Guide H-326: Minor small fruit crops for New Mexico Gardens. https://aces.nmsu.edu/pubs/_h/H326.pdf

Tours and Visiting Groups

Description: Gave tour of ASC-Alcalde Center projects to Western Risk Management group. (August 21, 2019).

Description: Gave tour of ASC-Alcalde Center and projects to Ayana Brown, NRCS. (July 12, 2019).

Description: Gave tour of ASC-Alcalde projects to water engineer group. (May 14, 2019).

Guest Lecture. Description: Gave lecture and tour of ASC-Alcalde to AXED Rural Development class (Carlos Rosencrans instructor). (March 25, 2019).

Heyduck, R. “Water Requirements & Irrigation Strategies for Hemp cultivation in northern New Mexico”, part of *Hemp Farming for CBD in New Mexico Part 2: Growing It!* at Juan I Gonzales Agricultural Bldg, Taos, NM. July 24, 2019.

Yao, S., Backyard Farming, summer through fall series, 2019, Gutierrez Hubbell House Alliance and Bernalillo County Open Space, at Gutierrez Hubbell House, Albuquerque, NM, "Introduction to the jujube plant: your new favorite fruit!", November 2, 2019.

Yao, S., Otero County Master Gardener Training, Alamogordo, NM, "Growing tree fruit and berries in New Mexico", October 15, 2019.

Yao, S., NMSU Los Lunas Field Day, NMSU Los Lunas Center, Los Lunas, NM, "Jujube fruit production", August 15, 2019.

Yao, S., "Cherry culture in New Mexico" for the Cherry Wine Making Workshop by Gill Giese, NMSU Viticulturist, Los Lunas, NM, July 19, 2019.

Yao, S., Taos County Master Gardener Training, Taos, NM, "Growing tree fruit and berries in New Mexico", April 3, 2019.

Yao, S., Santa Fe County Master Gardener Training, Santa Fe, NM, "Growing tree fruit and berries in New Mexico", April 2, 2019.

Yao, S., Santa Fe County Master Gardener Training, Santa Fe, NM, "Growing tree fruit and berries in New Mexico", April 1, 2019.

Yao, S., Colfax County Master Gardener Training, Raton, NM, "Growing tree fruit and berries in New Mexico", March 19, 2019.

Yao, S., Bernalillo County Master Gardener Training, Albuquerque, NM, "Growing tree fruit in New Mexico", February 26, 2019.

Yao, S., Valencia County Master Gardener Training, Los Lunas, NM, "Growing tree fruit and berries in northern New Mexico", February 25, 2019.

Rojas-Barboza, D. (Presenter), Delgado Licon, E. (Chair), Yao, S., Valles-Rosales, D. J. (Co-Chair), Rougas, S. (Co-Chair), Graduate Student Council, "Recovery and Microencapsulation of Jujube (*Ziziphus jujuba* Li) Bioactive Compounds using Cottonseed Meal Protein Isolate as carrier agent." April 5, 2019.

Workshops

New Mexico Fruit Growers Workshop (March 1, 2019).

Fruit tree pruning workshop (March 8, 2019).

Fruit tree grafting workshop (July 31, 2019).

How to Support Pollinators in Northern New Mexico (September 24, 2019)

Jujube flowering and fruiting habits and fruit tasting workshops at NMSU Alcalde Center (October 1, 2019).

Press and Press Releases

Documentary, FreshPlaza, October 17, 2019. New Mexico home for jujubes? by Astrid Van Den Broek. https://www.freshplaza.com/article/9154275/new-mexico-home-for-jujubes/

Documentary, NMSU Aggie Experts: Jujubes. September 16, 2019. It also appeared on NMSU Hotline Sept 17, 2019.
https://newscenter.nmsu.edu/stories/view/438/aggie-experts-jujubes

https://newscenter.nmsu.edu/Hotlines/view/1824/September17/2019

Documentary, The Furrow. May 10, 2019. Jiving with jujubes, a new old fruit ripe with potential by Martha Mintz. https://www.johndeerefurrow.com/2019/05/10/jiving-with-jujube/