
SUSTAINABLE AGRICULTURE SCIENCE CENTER AT ALCALDE
NM
STATE

Notice to Users of This Report

This report has been prepared to aid Science Center staff in analyzing the 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 the data in this report. In many instances, data represents only one of several years' results that will 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 is authorized for release or publication, without the written prior approval of the New Mexico Agricultural Experiment Station.

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Conversion Table for English and Metric (SI) Units

The following conversion table is provided as an aid for those who may wish to convert data appearing in this report from English (U.S.) units to Metric (SI) units, or vice versa. (Calculations are approximations only.)

To convert English to Metric, multiply by	English (U.S.) units	Metric (SI) units	To convert Metric to English, multiply by
2.540	inches (in)	centimeters (cm)	0.394
0.305	feet (ft)	meters (m)	3.281
1.609	miles (miles)	kilometers (km)	0.621
0.093	square feet (ft2)	square meters (m2)	10.764
2.590	square miles (mile2)	square kilometers (km2)	0.386
0.405	acres (ac)	hectares (ha)	2.471
28.350	ounces (oz)	grams (g)	0.035
29.574	fluid ounces (fl oz)	milliliters (mL)	0.034
3.785	gallons (gal)	liters (L)	0.264
0.454	pounds (lbs)	kilograms (kg)	2.205
907.185	ton (2000 lbs) (t)	kilograms (kg)	0.001
0.907	ton (2000 lbs) (t)	metric tonnes (t) or Megagrams (Mg)	1.102
1.000	parts per million (ppm)	ppm (mg/kg)	1.000
1.121	pounds/acre (lbs/ac)	kilograms/hectare (kg/ha)	0.892
2.240	tons/acre (t/ac)	Megagrams/hectare (Mg/ha)	0.446
16.018	pounds per cubic feet (lbs/ft3)	kilograms per cubic meter (kg/m3)	0.062
0.070	cubic feet/acre (ft3/ac)	cubic meters/hectare (m3/ha)	14.291
73.078	ounces/acre (oz/ac)	milliliters/hectare (mL/ha)	0.014
62.710	bushels/acre (corn: 56# bu)	kilograms/hectare (kg/ha)	0.016
67.190	bushels/acre (wheat: 60# bu)	kilograms/hectare (kg/ha)	0.015
125.535	Cwt/acre (100 wt)	kilograms/hectare (kg/ha)	0.008
0.042	Langleys (Ly)	Megajoules (MJ)/m2	23.900
(°F-32)÷1.8	Fahrenheit (°F)	Celsius (°C)	(°C x 1.8) + 32

For additional helpful English-Metric conversions, see: https://www.extension.iastate.edu/agdm/wholefarm/html/c6-80.html and https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/null/?cid=stelprdb1043619

Executive Summary

The Sustainable Agriculture Science Center (SASC) at Alcalde is located approximately seven miles north of Española and 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. The farm 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 in the area. Irrigated pasture and forages dominate these areas, 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. Crop research includes various horticultural and agronomic crops as well as acequia hydrology and climate-related research. The Science Center has served as a weather station for the National Weather Service providing climatological data since 1953. Current research focuses on jujube variety development and testing (1 acre), pome and stone fruit production (2 acres), table grapes (1 acre), soil health and cover crops (3 acres), pollinator habitat, and buffer strip (3 acres), and high tunnel fruit and vegetable production (5000 square feet of covered growing space).

The center also includes roughly 12 acres of forage crops including alfalfa, red clover, western wheatgrass, Russian wildrye, smooth brome, tall fescue, and orchardgrass, and 3 acres of fallow land. Six acres of the station are certified organic, and certified crops in 2019 include apple, peach, pear, sweet and sour cherry, tomatoes, and spinach.

The Science Center also 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.

Meeting The Needs Of New Mexico

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 is cultivated by 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 small-farming tradition. In 2002, the first certified organic acres at NMSU were established at SASC to better address issues in organic agriculture.

Mission

The mission of the Alcalde Sustainable Agriculture Science Center (SASC) is to conduct agricultural and natural resource research to benefit small-scale family farms and ranches of north-central New Mexico. Through testing of different crops, varieties, and production techniques, the goal is to provide new information that producers can adapt to their operations for greater productivity and profitability. SASC serves as the headquarters for the Cooperative Extension Service's Rural Agricultural Improvement and Public Affairs Project (RAIPAP). CES RAIPAP provides programs in sustainable agriculture to the 13 northern counties that comprise the Small Farm and Ranch Task Force.

Agriculture Science Center At Alcalde

Comprised of 60 acres in north-central New Mexico the Sustainable Agriculture Science Center at Alcalde (SASC) was founded in 1952 with a mission to conduct agricultural and natural resource research to benefit small family farms and ranches.

North-central New Mexico is home to many small-scale, independent farmers and ranchers who rely on direct marketing of agricultural products. Being in New Mexico's semiarid climate with increasing water challenges threatens the local economy. Research at the SASC is vital to the continuance of the agricultural industry in this area.

The SASC at Alcalde has a history of innovative research, responding to changing times and continual developments in technology.

Agricultural Experiment Station

What Is the Agricultural Experiment Station?

NMSU's Agricultural Experiment Station is the principal research unit of the College of Agricultural, Consumer and Environmental Sciences. All research faculty in the college have appointments in the Agricultural Experiment Station.

Mission

The Agricultural Experiment Station is not a physical site, but rather a system of scientists who work on facilities on the main campus in Las Cruces and at 12 agricultural science and research centers located throughout the state. The Agricultural Experiment Station system also interacts with other university research units and various state and federal agencies to provide opportunities for research that will benefit the citizens of New Mexico.

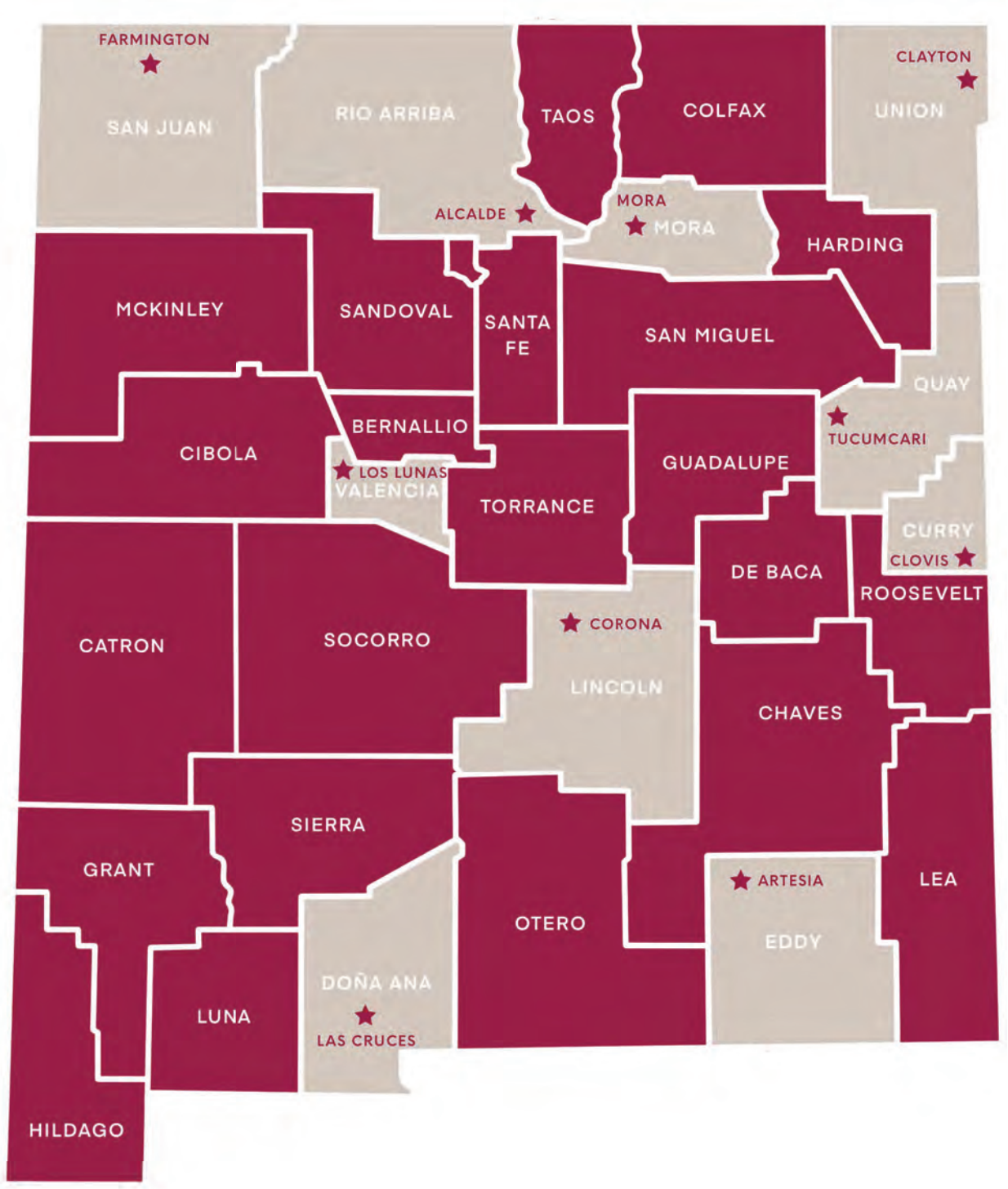
The Agricultural Experiment Station supports research designed to:

- Enhance agricultural profitability.
- Stimulate economic development using natural resources.
- Improve the quality, safety and reliability of food and fiber products.
- Sustain and protect the environment with ecologically sound practices.
- Manage and protect natural resources.
- Improve the quality of life for the people of New Mexico.

AES Research Focus includes, but is not limited to:

Agricultural water use efficiency, endangered/ sensitive species management, cattle genetics to improve grazing, improve forage quality, range management improved crop selection, soil-borne disease prevention, food safety and nutrition, product development and value-added agricultural products, medicinal plant uses, and water quality and treatment.

NMSU Agricultural Experiment Station



Agricultural Science Center Alcalde

Fiscal Year: **2020**

Fiscal Period: **30-Jun-20**

Department	Acct Type	Account Index Desc	Revenue YTD	Expense Budget	Expense YTD	Budget Balance Available YTD	Fund Balance Dr/(Cr)
Ag Science Ctr at Alcalde	HATCH FEDERAL APPROPRIATIONS FY 20	SUSTAINABLE AGRICULTURE IN NCNM SAL		$54,392.00	$39,130.60	$15,261.40	
Ag Science Ctr at Alcalde	HATCH FEDERAL APPROPRIATIONS FY 20	SUSTAINABLE AGRICULTURE IN NCNM OPS		$20,000.00	$4,812.61	$15,187.39	
Ag Science Ctr at Alcalde	NM 2018 SPECIALTY CROP BLOCK GRANT	18/21 SCBGP JUJUBE TRIALS & MKTNG		$22,340.07	$503.16	$21,836.91	
Ag Science Ctr at Alcalde	NM FY 17 SPECIALTY CROP BLOCK GRANT	17/20 SCBGP-VALUE ADDED JUJUBE		$70,692.47	$37,073.77	$33,618.70	
		Total Restricted Funds		**$167,424.54**	**$81,520.14**	**$85,904.40**	
Ag Science Ctr at Alcalde	APPLIED CHARGES	ASC ALCALDE VEHICLE	$0.00	($1,000.00)	($656.32)	($343.68)	($3,536.62)
Ag Science Ctr at Alcalde	OVERHEAD TRANSFERS	01344745N01010045OVHD ASC AL	$0.00	$0.00	$0.00	$0.00	($266.62)
Ag Science Ctr at Alcalde	SALES & SERVICE	ALCADE ASC SALES	$4,070.50	$500.00	$3,900.00	($3,400.00)	($28,146.35)
Ag Science Ctr at Alcalde	SALES & SERVICE	ALCALDE WORKSHOPS	$560.00	$0.00	$0.00	$0.00	($560.00)
		Total Sales and Service Funds	**$4,630.50**	**($500.00)**	**$3,243.68**	**($3,743.68)**	**($32,509.59)**
							* See note
Ag Science Ctr at Alcalde	STATE APPROPRIATIONS	ASC ALCALDE SALARY		$189,774.69	$160,448.86	$29,325.83	
Ag Science Ctr at Alcalde	STATE APPROPRIATIONS	ALCALDE TEMP SALARY SAVINGS		$8,571.69	$7,478.04	$1,093.65	
Ag Science Ctr at Alcalde	STATE APPROPRIATIONS	SUSTAINABLE AG IN NORTH-CENTRAL NM		$59,663.86	$60,540.07	($876.21)	
Ag Science Ctr at Alcalde	STATE APPROPRIATIONS	ALCALDE ADMIN		$55,745.00	$54,501.52	$1,243.48	
Ag Science Ctr at Alcalde	STATE APPROPRIATIONS	SUSTAINABLE AG IN NORTH-CENTRAL NM		$10,000.00	$7,411.02	$2,588.98	
		Total State Appropirated Funds		**$323,755.24**	**$290,379.51**	**$33,375.73**	

Note: " ( ) " In the Fund Balance column indicates a positive number

AES RESEARCH

NMSU's Agricultural Experiment Station research publications provide information to help improve production techniques and efficiencies for farmers, ranchers, dairies, and other agricultural producers.

Forestry

Agronomy

Dairy

Weather and Climate

Horticulture

Task Force Reports

Livestock and Range

Water

Economics

JUJUBE CULTIVAR TRIAL AND MARKETING

Investigators: Shengrui Yao, Robert Heyduck, Steven Guldan, and David Archuleta

BACKGROUND INFORMATION

Late frost is the most critical issue challenging fruit production in central and northern New Mexico. Most growers had five crops or less from 2010-2019. Good alternative crops with reliable yields 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 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 a $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

In general, jujube trees grew and produced well in 2020. With the pandemic of COVID-19, there were some management issues especially irrigation. Table 1 is the yield data of different jujube cultivars in 2020.

We published one peer-reviewed paper in 2020 assessing the early performance of drying and multipurpose jujube cultivars in HortScience 55:1804-1810.

The last two late touches of frost in spring were April 26 (30° F) and May 23 (29.7° F) and the earliest frosts in the fall were Sept 30 (29.8° F) and Oct 1 (29.7° F). Some jujube new growth may have survived the May 23 Frost and the Sept 30/Oct 1 frosts. An early-season cold snap on Sept 9-10, 2020, however, really affected the jujube trees and fruit. The highest temperature was 93° F on Sept 8 and dropped to 48° F on Sept 10 with a minimum temperature of 35.6°F which greatly shocked the trees. Trees started to senescence and yellow leaves appeared before the first early frost on Sept 30. In general, the growing season was longer than 2019 and early and mid-season cultivars matured much better than 2019, but late-maturing cultivars did not.

JUJUBE FRUIT PROCESSING AND VALUE-ADDED PRODUCTS RESEARCH AND MARKETING

*Investigators: Shengrui Yao, Robert Heyduck, Steven Guldan, a*nd David Archuleta

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 fruits will be the key to the 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 concentrated the compounds of interest for encapsulation.

RESULTS

Graduate student Govinda Sapkota continued working on jujube nutrient analysis in 2020.

A graduate student of Dr. Delgado finalized the micro-capsulation of total phenol extracts from jujube fruit.

We have oven-dried or sun-dried fruit of different jujube cultivars from Leyendecker and Los Lunas Centers and some early cultivars from Alcalde. We will run some small-fruited cultivars through the pitter and slicer and test their suitability for different cultivars early next year when the COVID-19 situation is getting better.

NC-140 ORGANIC APPLE ROOTSTOCK TRIAL AT ALCALDE

Investigators: Shengrui Yao, Robert Heyduck, Steve Guldan, and David Archuleta

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 NC140 organic apple rootstock trial to test different rootstocks for organic planting With a 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 a 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, G690, 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 a 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 2020, G.890 still had the largest trunk circumference among the 11 rootstocks tested, while G.222 and G.16 had the smallest trunk circumference, similar to 2019. Rootstocks G.890 and G.30 had the highest yield among all rootstocks tested, followed by G. 969, G. 214, and G.935. while G. 202 and G.41 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 did not have a fire blight problem and no tree loss in 2020.

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 their allowed spacing. On the other hand, we may need some relatively stronger rootstocks for organic apple production in New Mexico with high pH soil and nitrogen as limiting factors. The weak rootstocks could end up with small trees

With the COVID-19 pandemic, we did not have a chance to turn the overhead sprinklers in 2020, so it was a light crop for most rootstocks due to late frosts during flowering. We will consider increasing the nitrogen amount in 2021.

Table 2. Appletree coverage yield/tree (kg), fruit number per tree, tree circumference (mm), and sucker counts per tree in 2020 at Alcalde, NM.

Rootstock	Fruit #	Yield (kg/tree)	Sucker	Circumference (mm)	Yield Efficiency (kg/cm^2)
G.11	13.0	1.39	0.2	103.2	0.163
G.16	18.9	1.82	2.1	91.6	0.272
G.30	39.8	4.05	1.0	133.0	0.186
G.41	8.8	0.94	0.3	126.3	0.109
G.202	11.1	0.95	0.8	128.5	0.308
G.214	28.3	2.63	1.2	103.5	0.110
G.222	15.0	1.38	1.4	95.8	0.129
G.890	52.5	5.83	2.6	158.0	0.293
G.935	23.8	2.44	2.5	121.7	0.207
G.969	38.0	3.52	0.7	114.6	0.337
M9-337	15.4	1.48	0.5	101.9	0.179

ASSOCIATED LONG-TERM PROGRAM OF RESEARCH (HATCH)

Sustainable Fruit Production in Northern New Mexico, Accession Number: 1008597, Project Number: NMYao-15H

FUNDING SOURCE AND FUNDING DURATION

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

COLLABORATION WITH EXTENSION

Shengrui Yao has split appointment of research (51%) and Extension (49%).

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

Investigators: Shengrui Yao

BACKGROUND INFORMATION

"The USDA imported various lines/varieties of jujubes in the early 1900s. Some breeding and line development took place at the USDA Chico, CA, research station. These and other jujube lines/varieties have become dispersed throughout the U.S. but their identities are unclear. Cultivars can be named differently in different areas or imported cultivars were renamed, and some may be synonymous. We will try to identify the synonyms and group jujube germplasm that exists in the U.S. There has not been much genetic or molecular work on jujubes for cultivar classification and grouping in the U.S. This essential work on cultivar classification will allow effective and efficient research on jujubes in the future. Producers will benefit by having reliable information on jujube cultivars and characteristics.

ASSOCIATED LONG-TERM PROGRAM OF RESEARCH (HATCH)

Sustainable Fruit Production in Northern New Mexico

FUNDING AMOUNT

$63,888

FUNDING SOURCE AND FUNDING DURATION

New Mexico Department of Agriculture 10/1/20-9/30/23

COLLABORATOR

Dr. Dapeng Zhang—USDA-ARS Beltsville

FIELD EVALUATION AND MARKETABILITY OF 15 TABLE GRAPE CULTIVAR VARIETIES IN NEW MEXICO

Investigators: Gil Giese, Shengrui Yao, Kevin Lombard

BACKGROUND INFORMATION

Table grapes are a popular fruit among consumers. In New Mexico, there is potential to expand production and direct-market in farmers' markets, schools, and grocery stores. There is a lack of information on appropriate table grape varieties that producers can grow in northern New Mexico. This statewide effort to evaluate 15 cultivars for suitability to New Mexico's unique edaphic and climatic growing conditions is coupled with ongoing testing of each and in comparison to current market standard cultivars in various retail market venues to gauge and quantify consumer acceptance of locally produced table grapes. The project will have three sites: Los Lunas, Alcalde, and Farmington.

New table grape varieties offer advantages in cold hardiness, cluster architecture, phylloxera tolerance, and staggered ripening/timing in addition to improved taste/aroma and texture characteristics. Farmers and home gardeners need reliable identification of suitable varieties for local conditions. This project will accomplish evaluation trials at three sites with substantially different climates and soils that represent a substantial portion of New Mexico growing environments.

Table grapes offer a potential economic outlet for NM commercial grape producers, provide small and local market farmers an avenue of income diversification, and can increase the healthfulness of local diets, especially in regards to increasing the consumption of fresh fruit by children aged 6 to 12.

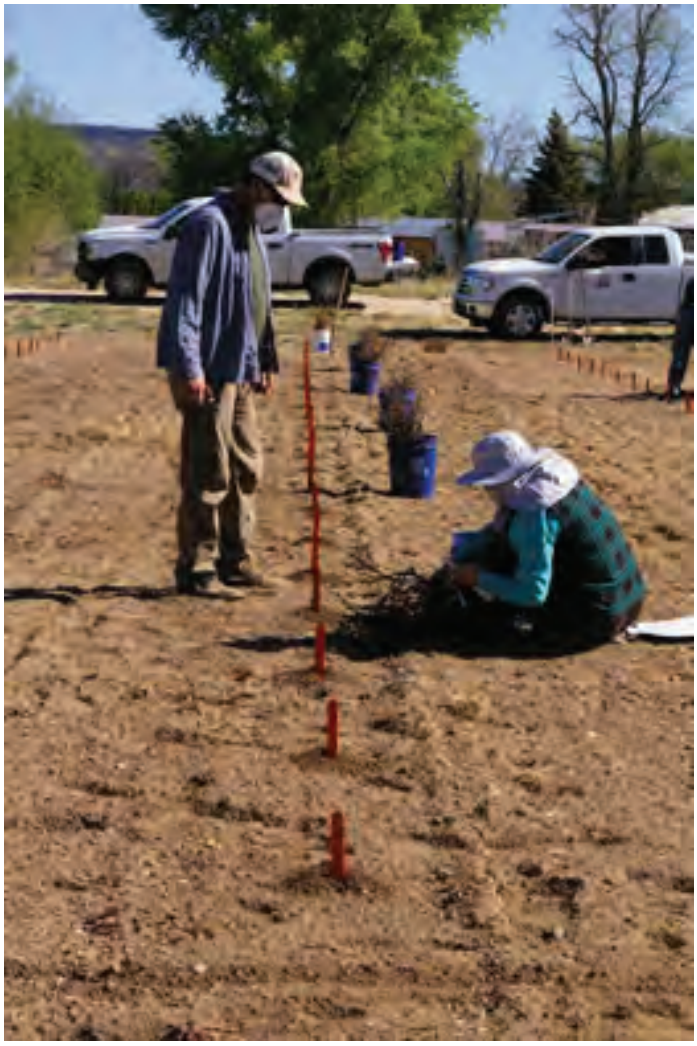


Figure 2. Grapes being transplanted into field at Alcalde, NM, May 6, 2020 (Photo by Amy Larsen).

ACTIVITIES PERFORMED

Grapes were transplanted May 6, 2020, but only 6 of 15 cultivars were available at that time: Faith, Gratitude, Everest, Himrod, Joy, and Swenson. Plants were watered by hand until a drip system was installed on May 20.

FUTURE PLANS

Varieties unavailable in 2020, will be planted in 2021, and a trellis will be constructed.

FUNDING AMOUNT

$52,818

FUNDING SOURCE AND DURATION

New Mexico Department of Agriculture, and Specialty Crop Research Initiative, 2019 to 2023

ORGANIC SPINACH VARIETY TRIAL IN HIGH TUNNEL

Investigators: Robert Heyduck, Steve Guldan

BACKGROUND INFORMATION

In previous studies with spinach, the commonly available variety 'Bloomsdale Longstanding' was used. While the total season-long yield of this variety ranged from 7.0 to 8.7 kg per 30 ft2 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.

ACTIVITIES PERFORMED

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, 2019, and were watered by hand until germination. By early December, gophers had dug into the high tunnel and damaged about half of the plots. Partial harvest of three replicates was made on January 24, February 26, and March 26, 2020, but the final harvest in April was postponed and finally canceled due to COVID-19 related restrictions.

Figure 3. Gopher mounds amongst spinach trial plots. Gophers affected approximately 50% of test plots (Photo by Robert Heyduck)

RESULTS

In the first year of the study, all hybrid spinach varieties outperformed 'Bloomsdale Longstanding' and 'Winter Bloomsdale'. Despite gopher damage, remaining undamaged plots grew and yielded well, with some varieties approaching a similar total yield with only three out of four harvests. 'Palco', which yielded a total of 10.5 kg in year one yielded 10.2 kg in year 2 while 'Corvair' and 'Renegade' both had much lower yield than year 1. However, 'Bloomsdale Longstanding' and 'Yukon' yielded higher in year 2 than in year 1, and 'Winter Bloomsdale' was the lowest overall yielder again in year 2.

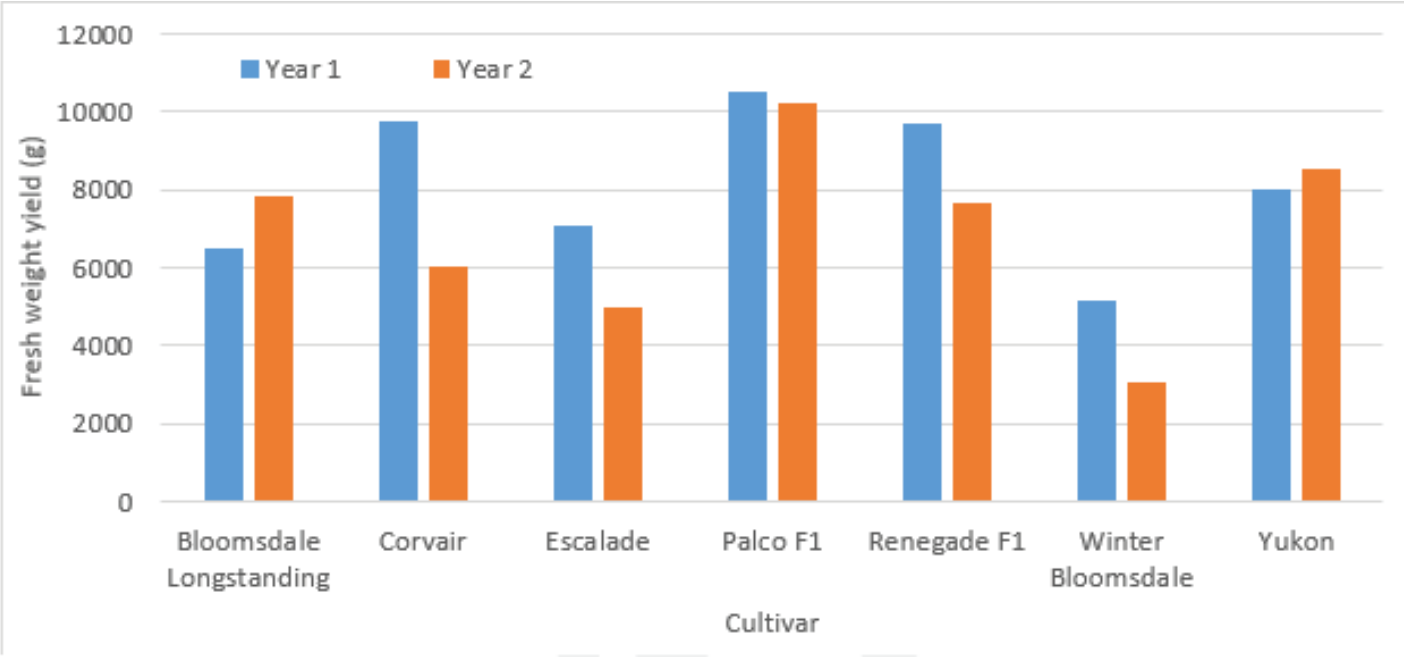


Figure 4. Combined season-long fresh weight yield (g) of seven organic spinach varieties grown in a high tunnel at Alcalde, NM.

FUTURE PROJECT PLANS

With gopher damage to the crops and COVID-19-related work restrictions compromising the completeness of this data set, we hope to do another season of this spinach variety trial to have at least two years of reliable data from which to conclude.

ROOT GROWTH, GROUND COVER, AND BIOMASS OF TWO VARIETIES OF DAIKON RADISH SOWN ON FOUR DATES

Investigators: Robert Heyduck, Steve Guldan

BACKGROUND

Cover crops provide several benefits including reducing wind and water erosion, fixing nitrogen, and increasing soil organic matter. They also can provide habitat for beneficial insects and promote a more diverse and functional soil microbiome. At Alcalde, we have been experimenting with mixes of cover crop species to achieve maximum soil-building functions.

Daikon radish produced a long, edible taproot, which can penetrate deeply into soil-improving water infiltration and porosity. Daikon radishes usually die in winter, so seeding at the proper time is important to achieve the desired soil management effects. We planted two varieties of daikon—organic (VNS) from Albert Lea Seed and Tillage radish' from BestForage—on four dates beginning in mid-August.

ACTIVITIES PERFORMED

We roto-tilled and created 8 rows of 2-ft beds and arranged four replicates of eight plots each 12 feet long in a randomized complete block design. Using a custom modified 2-row Earthway push seeder, we sowed two rows a foot apart at the shoulders of the beds. Planting dates were August 17, August 31, September 14, and September 28. The field was furrow irrigated after planting on the same date, and again 3 days later. The Field received two additional irrigations in October.

Figure 5. Radish 2 weeks after first planting (L) and 4 weeks after first planting (R) (Photos by Robert Heyduck).

RESULTS

Radish planted on the first two dates germinated well and grew to dominance over surrounding weedy species. The two later dates had poor germination and competition with weeds that had germinated with earlier irrigations. The main weed species were amaranth and lovegrass, two opportunistic annuals that will germinate even in late summer. The later plantings may have done better if weeds could have been controlled early on. As of this reporting, the tops of the radishes are dying back. Early in 2021, a ground cover assessment will be made with photographic measurements before digging and measuring a sample of root depth and biomass.

FUTURE PROJECT PLANS

We hope to continue this project for at least another year. Perhaps weed control between planting dates would give later dates a better chance or a more balanced evaluation of the fitness of later planting dates.

IMPLEMENTING SOIL HEALTH PRINCIPLES TO STUDY EFFECTS ON THE SOIL MICROBIOME AND PLANT HEALTH AND PRODUCTIVITY IN ORGANIC HOOP HOUSE VEGETABLE SYSTEMS

Investigators: 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 principles in hoop house soils can improve soil fertility, plant health, and plant production.

METHODS

Phase I: Compost Production Spring 2018- Spring 2019

Aerated, no-turn 'bioreactor' compost was produced by a process designed by New Mexico State University research scientist Dr. David Johnson. This process allows for longer compost maturation, favoring the development of a diverse microbial community with higher fungal-to-bacterial ratios. This compost will be used to inoculate the hoophouse 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) on November 8, 2018. 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 on-site, which was added to the potting medium for the tomatoes. Tomatoes were transplanted on May 21, 2019. 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.

Phase II: Hoop house Trial Fall 2018 through 2019

After tomatoes were terminated by frost, the soil management regime treatments were held in place and those plots which received tillage received tillage again. The same blend of cover crops was broadcast across the entire floor of the hoop house on October 31, 2019. A cucumber crop was planned for transplanting into the hoop house in the summer of 2020, but COVID-19 restrictions curtailed this phase of the project. Cover crops were terminated by roller crimping on May 12, 2020, and the weed barrier was placed over to smother. In June, those plots which were on the tillage regime received tillage. The hoop house was fallow through the summer, and again in the fall, tillage plots were tilled. Cover crops were sown once more on October 2, 2020, and irrigated to establish.

Figure 6. Cover crop of hairy vetch, winter rye, Austrian winter pea, and daikon radish growing in the high tunnel, April 2020. (Photo by Amy Larsen).

RESULTS

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).

FUTURE PROJECT PLANS

Cover crops will be irrigated periodically through the winter and spring and terminated in April. We are planning now to transplant a crop of cucumbers into the hoop house in May 2020, and are working on research protocols that will be COVID compliant and eliminate close contact.

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

BUILDING SOIL HEALTH AT PATA VIVA FARM IN LAS CRUCES, NM

Investigators: Amy Larsen, Steven Guldan, Robert Heyduck

BACKGROUND

Beginning in the fall of 2019 and continuing through 2020, Amy Larsen has collaborated with Cruces Creatives and a group of farmers focused on regenerative agriculture. The project will include a series of presentations to farmers on lab and field testing specific to regenerative agriculture in New Mexico as well as an on-farm research trial to help farmers understand how to incorporate soil health practices on their lands. To date, Larsen has managed the project involving multiple NMSU researchers and collaborators and incorporated feedback into a research design including a plot plan, soil test schedule, and details of treatments and soil health strategies. One recorded video documentary has been produced in December 2020 and two more workshop presentations will be recorded in the early spring of 2021.

The goal of the project is to measure changes in soil health in an irrigated intensive vegetable cropping system as it relates to land management. Changes in soil health will be assessed by measuring soil biological, chemical, and physical indicators and by comparing the results over 5 years. Land management decisions include conservation tillage, cover crops, reduced fertilizer application over time, and addition of microbially diverse compost.

Figure 7. Bryce & Shelly Richard's farm stand (L); daikon harvest at Pata Viva Farm (R) (Photos by Bryce Richard).

RESEARCH DESIGN

There will be three replications of four treatments, planned as follows: 1) cover crop; 2) cover crop plus compost; 3) compost, no cover crop; and 4) control: no cover crop or compost.

Within each replicated plot, four crops will be sown in this order, east to west: pepper, okra, tomato, and squash. Each year, the crop will be planted one subplot over (westward) until in the fifth year, the crops are planted in the same location as the first year.

All plots will be managed similarly concerning conservation tillage and fertilizer; while the cover crop vs. non-cover crop treatments may require different levels of irrigation, depending on the need. Cover crops will be terminated by roller crimping. The first year, all plots will receive 750 lbs./ac. poultry meal (10-0-0). The fertilizer rate will be reduced by about half on years 2 and 3; by years 4 and 5 no fertilizer will be applied.

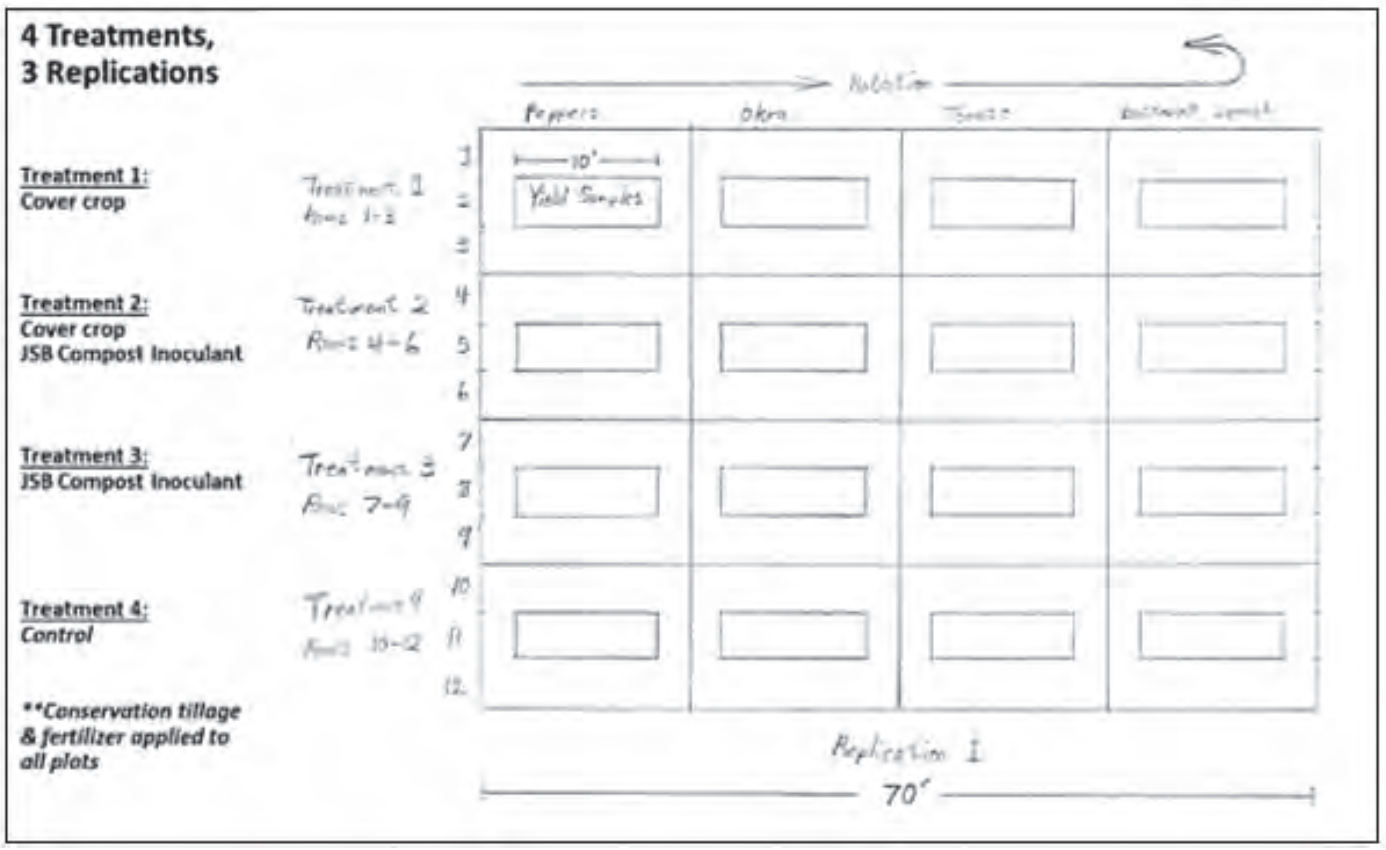


Figure 8. Plot Plan Detail of Replicate 1 at Pata Vita Farm.

Both field and laboratory tests will be performed annually. Soil samples will be collected in fall 2020 for baseline measurements and every spring for all subsequent years. Soil cores will be collected and then aggregated into one soil sample per plot. Laboratory analyses will include soil chemistry and salinity, Haney, PLFA, POxC, total nutrient, and plant tissue analysis. Field tests will include soil texture, aggregation, compaction, infiltration, earthworm counts, soil surface observations, and net primary productivity.

ASSOCIATED LONG-TERM PROGRAM OF RESEARCH (HATCH)

Sustainable Agriculture in North-Central New Mexico

FUNDING AMOUNT

$20,000.00

FUNDING SOURCE AND DURATION

New Mexico Zone Grant from the Santa Fe Community Foundation, through collaboration with Cruces Creatives. 2020-2021.

COLLABORATORS

Cruces Creatives, Pata Viva Farm, Patrick DeSimio, Hui Chun Su Johnson, David Johnson, John Idowu, Robert Flynn, and Rajan Ghimire

STREAMLINED NATIVE BEE MONITORING PROTOCOL FOR ASSESSING POLLINATOR HABITAT AND BEE BOWL COLLECTION

Investigators: Adrienne Rosenberg

BACKGROUND INFORMATION

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 and cash 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.

Figure 9. Visitors attending pollinator field day September 24, 2019. (Photo by Amy Larsen).

ACTIVITIES PERFORMED

The project established one native wildflower plot (44 x 103 ft) (2019) and used a section of an existing alfalfa field (44 x 103 ft) (2020). The wildflower plot was plowed, tilled, and broadcast planted in 2019. Watering was from the acequia and distributed through overhead sprinklers with a micro-sprinkler head attachment. Weeding was conducted during the 2019 season to keep weed species from suppressing the wildflowers, but in 2020 minimal weeding was conducted. For the alfalfa plot, water was delivered from the acequia through gated irrigation pipes. No weeding was necessary, and a 10-12 ft strip was cut around the plot to isolate the area from the larger field for the native bees. The field was cut three times for the alfalfa crop throughout the season.

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 several times throughout the season on each plot.

Also, 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 each plot for several daylight hours. Bee samples were collected and placed into vials on the same days the monitoring protocol was administered. The samples were then delivered to an entomologist to be pinned and identified. The plots were also photographed and Floral and weed presence noted.

PROBLEMS

The alfalfa plot did not establish well enough to measure in 2019. No data were gathered in 2019 on the alfalfa plot. This plot was replaced by the plot within the existing alfalfa field.

RESULTS

The research is still in progress. No results yet. The bees from the 2019 and 2020 seasons have been pinned and are being identified.

Figure 10. From top to bottom: Bee bowl traps for pollinator collections and identification; pinned, sampled specimens; bumble bee (Bombus sp.) on blanketflower, Gaillardia pullchella.; Plains coreopsis, Coreopsis tinctoria (Photos by Adrienne Rosenberg except second photo by Julieta Bettinelli).

COMMUNITY HYDROLOGY RESEARCH WITH THE RIO HONDO ACEQUIAS

Investigators: Lily Conrad

BACKGROUND

Commonly, complex water-sharing agreements in acequia irrigation communities of northern New Mexico are based on water data gathered irregularly by local water leaders. The Rio Hondo watershed in northern New Mexico is experiencing drought-induced flow reductions and changing water-sharing dynamics between the acequia networks, which rely on water from the same river. These changes in surface water availability and water-sharing agreements resulted in local water managers expressing a need for available data to appropriately distribute water between irrigators. The purpose of this research is to address community needs by installing a telemetry monitoring system on participating ditches and analyze the resulting impacts on community adaptive capacity.

Figure 11. The general instrumentation present at each telemetry site where A) shows the flume, stilling well, and equipment box and B) shows the equipment found inside each box. Each site has a pressure transducer recording water level. The datalogger is programed with a site-specific rating curve equation to derive discharge from the stage (Photo by Lily Conrad).

ACTIVITIES PERFORMED

Founded based on public impact research and community science, this research is just the beginning of giving irrigators the ability to become stewards for local water resources information by having real-time access to water data through a web interface. A telemetry monitoring network was installed in collaboration between researchers and irrigators on participating irrigation ditches to remotely collect water stage, discharge, and conductivity data every 15 minutes (Figure 1).

Data are automatically updated on a web interface first made available to the acequia communities for the 2020 irrigation season. Researchers maintained constant contact with the acequias and adjusted the monitoring website as necessary, to ensure it was meeting community needs. Telemetry discharge values were verified with manual flow measurements over the irrigation season and used to improve the accuracy of the rating curve equations on the dataloggers (Figure 2). Researchers hypothesize that improving water data accessibility will likely increase community adaptive capacity in this rural, traditionally irrigated valley. The impact of the telemetry system will be evaluated with pre-telemetry and post-telemetry surveys targeting several community-level adaptive capacity indicators. Preliminary survey results indicate that besides delivering irrigation water, respondents from the Rio Hondo acequias greatly value increased groundwater recharge associated with acequia ditches and irrigation. Due to this strong value, researchers installed monitoring stations on two flood-irrigated fields growing pasture grass within the Rio Hondo Valley to estimate shallow groundwater recharge from flood irrigation using a water budget approach. This portion of the research strives to provide a more accurate and fine-scaled estimate, compared to previous research, of groundwater recharge given the different geologic contexts of the study fields to better inform water and land use management within the watershed.

RESULTS AND NEXT STEPS

This research is still in progress and only has preliminary results. Initial groundwater recharge estimates have been calculated; however, data will continue being collected through the 2021 irrigation season. Researchers will continue maintaining the telemetry monitoring system and conducting manual flow measurements throughout the 2021 irrigation season as well. The initial Principal Component Analysis conducted on the pre-survey data demonstrates the selected indicators adequately represent adaptive capacity. Post-surveys are currently being distributed. Researchers have received positive feedback from the web interface's first season in use and look forward to formal feedback collected through the post-surveys.

Essentially, by making water data more accessible, researchers hope to help preserve the acequia network and acequia lifestyle by listening to local concerns and enabling better water management. In an era of climate uncertainty, Increasing population, and changing socio-economic dynamics, applied citizen and community-relevant hydrologic research to better address gaps in knowledge surrounding water management decisions are only becoming more critical, especially in the arid southwest.

Figure 12. Student field assistants (Madison Groven and Coury Dorn) manually calculating discharge in an acequia (Photo by Lily Conrad).

SUSTAINABLE FARMING TECHNIQUES IN NORTHERN NEW MEXICO

Investigators: Del Jimenez, Agricultural Specialist

HIGH TUNNEL PROGRAMS

To date, we have a total of 1695 high tunnels up and producing incomes for our limited resource producer in Northern New Mexico. This year a total of five workshops were performed: two in New Mexico, two in Wyoming, and one in Colorado. It has increased season extension to where they have money coming in over a longer period throughout the year. Thirty-two copies of NMSU Circular 606 (High Tunnel Hoop House Construction for New Mexico) were mailed to individuals and groups requesting it and were given out to 48 people taking the high tunnel workshop.

VEGETABLE GARDENING PROGRAM

The gardening project has helped families produce food and improve the level of nutrition. I have seen an increase and interest in gardens in recent years. I have had requests for materials and information on gardening from 12 different people or groups.

SEED PROGRAM

This project helps put land back in agriculture production and helped 44 individuals grow food for themselves and their community. I receive free seed from NMDA and give this seed free of charge to whoever needs seeds for gardens, pastures, or landscaping.

BINDWEED MITE PROGRAM

Field bindweed is a serious problem in New Mexico's cultivated land. Its roots can reduce soil moisture below the wilting point of many crop plants. Besides competing for nutrients and water, field bindweed can pull plants to the ground and smother them completely. The Bindweed mite program uses a biological mite to help control this weed. This year we did not dispatch any bindweed mites because the nursery had not been irrigated due to the lack of labor at the Alcalde Research Center.

LIVESTOCK PROGRAMS

This program helps livestock producers develop and implement sustainable ranching practices appropriate for their needs. It introduces alternative production techniques practical and applicable to the producer's requirements. Over 80% of agriculture receipts come from cattle sales in Northern New Mexico. I did the tagging in Rio Arriba County for all livestock showing at the Rio Arriba County Fair. In Mora County, we discussed the importance of pregnancy testing of cattle with 26 people attending.

SMALL ANIMAL PROGRAM

This program promotes small animal production. We instruct growers on production practices of small animals that are sustainable. More family units are looking at small animals to produce food for their immediate use. A Workshop in Rio Arriba, Santa Fe, Jemez Pueblo, was done with an emphasis on poultry and rabbits. We had 48 people participate.

Sustainable Agriculture Science Center at Alcalde

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Superintendent and Professor

Elena Arellano

Superintendent and Professor

Robert Heyduck-MS

Research Scientist, Associate

Shengrui Yao-PhD

Associate Professor, Ext. Fruit Specialist

David Archuleta

Farm/Ranch Supervisor

Part-time and Seasonal Staff

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Adrienne Rosenberg-MA

Editor

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Gabrielle Rodriguez-MS

Extension Outreach Agriculture Agent

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NC-140 Collaborators

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NMSU Science Centers and Researchers

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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 Science
Dr. Nancy Flores—Food Technology
Dr. John Idowu—Extension Plant Science
Dr. Robert Flynn—Artesia ASC

Other Research Institutions

Dr. Dapeng Zhang—USDA-ARS Beltsville, MD

Others

Dr. Olivia Carril
La Montanita Co-op
Cruces Creatives
Pata Viva Farm

Sustainable Farming Techniques in Northern New Mexico

Del Jimenez, Agricultural Specialist

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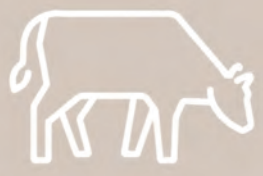
Livestock Programs



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OUTREACH ACTIVITIES

VIRTUAL TOUR AND VIRTUAL UPDATE

As a response to COVID-19, SASC worked with NMSU main campus to produce a series of clips to serve as a stand-in for the biannual field day that was slated to be held this year. Researchers were interviewed about their ongoing projects and research at the Science Center. These 3-5 minute vignettes will be edited together as the 2020 Virtual Update for farmers, ranchers, gardeners, parciantes, and citizens of North Central New Mexico.

In conjunction with the Virtual Update, a Virtual Tour was also filmed to represent the Sustainable Agriculture Science Center in Alcalde's presence on the larger NMSU website.

Each film will be available in 2021 via SASC's website and NMSU ACES Youtube channel.

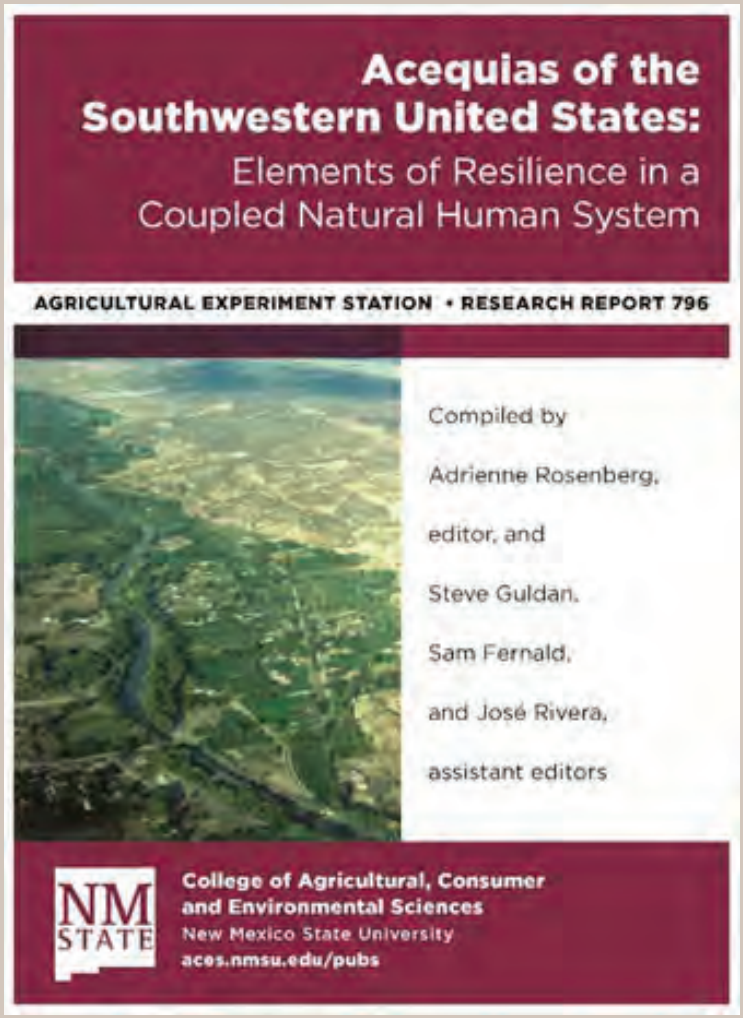
BOOK PUBLICATION

Acequias of the Southwestern United States: Elements of Resilience in a Coupled Natural and Human System. Research Report 796. NMSU Agricultural Experiment Station.

n 2010, under the leadership of Principal Investigator Sam Fernald, the research project, Acequia Water Systems Linking Culture and Nature: Integrated Analysis of Community Resilience to Climate and Land Use Changes, was awarded a $1.4 million grant by the National Science Foundation (NSF). NSF's specific grant program, Dynamics of Coupled Natural and Human Systems (CNH), "supports interdisciplinary research that examines human and natural system processes and the complex interactions among human and natural systems at diverse scales." The goals of the Acequia Water Systems Linking Culture and Nature project were to understand the links between culture and nature in

the context of acequias. The central hypothesis was that acequias create and maintain the relationships between humans and nature that will allow for resilience in the face of climate change and increasing population growth.

From an ambitious list of project deliverables, Acequias of the Southwestern United States: Elements of Resilience in a Coupled Natural and Human System, was conceived to document the researchers' various findings and to bridge the chasm between the academic analysis of a subject(s) and its translation for the public. The book has 16 coauthors that largely represent New Mexico State University, the University of New Mexico, and Sandia National Laboratories, and draws from the fields of hydrology, anthropology, ecology, agronomy, regional studies, animal and range sciences, natural resource management, and agricultural economics. Overall in the spirit of the commons, this unique interdisciplinary, interinstitutional book strives to provide useful information and access for all persons.



In December, Sam Fernald presented the book at the 2020 New Mexico Acequia Association's (NMAA) Congreso. A subsequent workshop through NMAA will be offered in the Winter of 2021 to relate the research and its implications to parciantes and the wider acequia community. Furthermore, a limited number of physical books have been printed for contributing acequia communities, researchers, and rural libraries.

Coauthors: Sylvia Rodriguez, José A. Rivera, Kenneth G. Boykin, Elizabeth A. Samson, Guillermo Alvarez, Carlos G. Ochoa, Steven J. Guldan, Sam Fernald, Stephanie C. López, Andrés F. Cibils, Lilian Cibils, Ursula R. Smedly, Brian H. Hurd, Laura Mayagoitia, Ben L. Turner, and Vincent C. Tidwell.

Editor: Adrienne Rosenberg

Associate Editors: Sam Fernald, Steve Guldan, and José Rivera

PEER-REVIEWED ARTICLES

Cormier, J., R. Heyduck, S. Guldan, S. Yao, D. VanLeeuwen, and I. Guzman. 2020. Intercropping winter greens between blackberry rows for year-round high tunnel production. HortTechnology 30:47-54.

Heyduck, R.F., D.M. VanLeeuwen, and S.J. Guldan. 2020. Effect of harvest schedule on organic kale grown during the winter in high tunnels. HortTechnology 30:570-575. DOI: https://doi.org/10.21273/HORTTECH04584-20

Liu, M., J. Wang, L. Wang, P. Liu, J. Zhao, Z. Zhao, S. Yao, F. Stanica, Z. Liu, L. Wang, C. Ao, L. Dai, X. Li, X. Zhao and C. Jia. 2020. The historical and current research progresses of jujube- a super fruit for the future. Horticulture Research 7:119. https://doi.org/10.1038/s41438-020-00346-5 .

Omer, M.F., O.J. Idowu, A.L. Ulery, D. VanLeeuwen, S.J. Guldan, M.M. Marsalis, and R. Ghimire 2020. Impacts of selected management practices on soil quality in an irrigated arid agroecosystem. J. Soil and Water Conservation 75(2):143-152.

Uchanski, M.E., D.M. VanLeeuwen, S.J. Guldan, C.L. Falk, M. Shukla, and J. Enfield. 2020. Temperature and light characterization during winter production season in high tunnels in the southwestern United States. HortTechnology 30:259-267.

Yao, S., R. Heyduck, S. Guldan, and G. Sapkota. 2020. Early performance of jujube drying and multipurpose cultivars in the southwestern United States. HortScience 55:1804-1810. DOI: https://doi.org/10.21273/HORTSCI15344-20

PRESENTATIONS, WORKSHOPS, AND VISITS

"Microirrigation: Big results with smaller inputs" Presentation—Robert Heyduck, New Mexico Organic Farming Conference February 21, 2020.

2020 Annual Fruit Grower Workshop, Santa Fe fairground building, 8:30-4:00, March 12, 2020.

Amy Larsen provided a half-day training to a Rio Arriba County farmer on the production process of a static, aerated composting system, including a detailed compost recipe. This assistance enabled the trainee to fulfill the obligations of her NM Healthy Soils Grant, as well as give her tools to improve the soil health of her working farm. Aug. 12, 2020.

"Irrigation: History, concepts, and management" Presentation—Robert Heyduck, San Juan County New Farmer and Rancher Training with Bonnie Hopkins, SJC Extension. October 30, 2020.

Water Outlook and Drought Management. ZOOM meeting from The Southwest Border Food Protection and Emergency Preparedness Center. 5:00 - 6:30 pm, November 10th, 2020.

"Building Healthy Soil at Pata Vita farm" Amy Larsen and Bryce Richard. YouTube video presentation. https://www.youtube.com/watch?v=TrfcyOFNmxE&feature=emb_logo

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