Sustainable Agriculture Science Center at Alcalde
Annual Progress Report 2018
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.

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

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## 2018 Annual Progress Report
### Sustainable Agriculture Science Center at Alcalde

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Robert Heyduck, Editor

### Agricultural Experiment Station Staff

<table>
<thead>
<tr>
<th><strong>Full-time Staff</strong></th>
<th><strong>Part-time and Seasonal Staff</strong></th>
</tr>
</thead>
</table>
| Steve Guldan  
Superintendent and Professor | Anna Trujillo  
Administrative Assistant General |
| Shengrui Yao  
Associate Professor, Ext. Fruit Specialist | David Archuleta  
Farm/Ranch Supervisor |
| Robert Heyduck  
Senior Research Assistant | David Salazar  
Field & Shop Technician |
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Superintendent and Professor | Juan Lopez  
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| Augusta Archuleta  
Administrative Assistant Associate | Tory Hougland  
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Agricultural Specialist |  
|

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PhD Candidate |
| Jacqueline Cormier  
MS Candidate | José Juan Cruz-Chiron  
PhD Candidate |

**Cover Photo:** Margarito Hernandez irrigating a field. Photo by Adrienne Rosenberg
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Don Bustos
Sage Faulkner
Bobby Lopez
Gene Lopez
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Joanie Quinn
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# Table of Contents

NOTICE TO USERS OF THIS REPORT ................................................................. i

2018 Annual Progress Report ......................................................................................... iii

Sustainable Agriculture Science Center at Alcalde ........................................................... iii

  Agricultural Experiment Station Staff ............................................................................. iii

  Cooperative Extension Service Rural Agricultural Improvement and Public Affairs
  Project (RAIPAP) Staff .................................................................................................. 3

  Graduate Students ......................................................................................................... 3

  Advisory Committee ...................................................................................................... iv

Table of Contents .............................................................................................................. v

Table of Figures ................................................................................................................ vi

Table of Tables ................................................................................................................ vii

Introduction ....................................................................................................................... 1

  Mission ................................................................................................................................. 1

  History ................................................................................................................................. 1

  Setting ................................................................................................................................. 2

  Climate and Weather Summary ..................................................................................... 5

Research Projects .............................................................................................................. 9

Fruit Research ................................................................................................................... 9

  Jujube Cultivar Trial and Marketing ................................................................................ 10

  Jujube Fruit Processing and Value-added Products Research and Marketing ................ 12

  NC-140 Organic Apple Rootstock Trial at Alcalde ......................................................... 13

  High Tunnel Stone Fruit Production in Northern New Mexico .................................... 15

  Other Tree Fruit and Berries at Alcalde ......................................................................... 16

Vegetable Research ......................................................................................................... 17

  Organic Spinach Variety Trial in High Tunnel ................................................................. 18

  Organic High Tunnel Cucumber Production .................................................................. 20

  Early Maturity and Season Extension in the Jemez Pueblo Landrace Chile ................ 22

  Intercropping Winter Greens between Cane Fruit Rows for Year-Round High Tunnel
  Production ........................................................................................................................ 25

Agronomic and Agroecological Research ....................................................................... 29

  Implementing Soil Health Principles to Study Effects on the Soil Microbiome and Plant
  Health and Productivity in Organic Hoop house Tomato Systems .............................. 29

  Acequia Hydrology ......................................................................................................... 31

2018 RAIPAP Activity ........................................................................................................ 32
New Mexico Pueblos Beginning Farmers and Ranchers (NMPBFR) ......................... 32
Sustainable Farming Techniques in Northern New Mexico ................................. 35
Appendix ................................................................................................................................. 36
Cooperators/Collaborators ....................................................................................... 36
Grants .......................................................................................................................... 37
Publications .................................................................................................................. 37
Extension Publications ............................................................................................... 38
Tours and visiting groups ............................................................................................ 38
Presentations .............................................................................................................. 39
Workshops .................................................................................................................. 41
Press and Press Releases .......................................................................................... 41

Table of Figures

Figure 1. Main office SASC Alcalde, formerly the guest quarters of the San Gabriel Ranch. ............................................................................................................................................................ 1

Figure 2. Looking east over the Rio Grande, with the SASC grounds in the middle distance and Truchas Peak in the background. ................................................................. 2

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

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

Figure 5. Average monthly maximum and minimum temperatures for 2017 compared with long term averages from 1953-2017. ........................................................ 7

Figure 6. Monthly total precipitation for 2017 compared with long term average from 1953-2017. ........................................................................................................ 8

Figure 7. Spinach growing in a high tunnel at SASC Alcalde. ........................................ 17

Figure 8. Total yield of four harvests of seven spinach varieties. Yield (g) is from 30 ft² area within 640 ft² hoop house ........................................................................ 19

Figure 9. SPAD readings of seven spinach varieties ................................................................................................................................. 19

Figure 10. Total and marketable yield of two varieties of cucumbers grown in the high tunnel compared to those grown in the field. .................................................. 21
Figure 11. Kale and spinach mean yields by harvest day and year

Figure 12. Blackberry yield data for 2017 and 2018 as mean fresh weights (grams) by cultivar in field and high tunnel (T. Crown = ‘Triple Crown’ and Chester = ‘Chester Thornless’). Each harvested weight is shown as a data point, delineated by date of weeks. *Number of harvests per week dependent on availability of ripe berries.

Figure 13. Six ‘bioreactor’ compost bins assembled and filled during 2018.

Figure 14. Soil microscopy images: a) Nematode; b) amoeba (center); and 3) fungi (filamentous).

Table of Tables

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

Table 2. A (1953-2018) monthly maximum, minimum, and mean temperatures and extreme monthly maximum and minimum temperatures for 2018.

Table 3. First and last freeze dates and growing, 2008-2017, Alcalde, NM. Years sorted by length of 32°F frost free time period.

Table 4. Apple tree trunk circumference (mm), fruit number and weight (g), and sucker counts.

Table 5. Wet and dry maturity indices for three varieties of chile at Los Lunas, Alcalde, and Mora, 2017.

Table 6. Mature green and dry red yield of three varieties of chile at Los Lunas, Alcalde, and Mora, 2017.
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

Figure 1. Main office SASC Alcalde.
Chicago. Ms. Bartlett had the present offices of the Alcalde Science Center built in 1923 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 at 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
Soil and vegetation at the Alcalde Science Center include grasslands and shrublands (blue grama, fourwing saltbush, rabbitbrush, cholla), to xeric woodland (pinon, 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 shrublands, grazing is the primary agricultural activity. These lands were once part of land grant commons and are now managed largely by BLM (Bureau of Land Management) and the USFS (Forest Service).

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

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

<table>
<thead>
<tr>
<th>Map Unit Symbol</th>
<th>Map Unit Name</th>
<th>Acres</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Fruitland sandy loam, 0 to 3 percent slopes</td>
<td>68.6</td>
<td>43.9%</td>
</tr>
<tr>
<td>18</td>
<td>Abiquiu-Peralta complex, 0 to 3 percent slopes</td>
<td>15.9</td>
<td>10.2%</td>
</tr>
<tr>
<td>21</td>
<td>Werlog clay loam, 0 to 1 percent slopes</td>
<td>16.8</td>
<td>10.8%</td>
</tr>
<tr>
<td>34</td>
<td>Alcalde clay, 0 to 3 percent slopes</td>
<td>23.9</td>
<td>15.3%</td>
</tr>
<tr>
<td>151</td>
<td>Razito-Fruitland complex, 1 to 5 percent slopes</td>
<td>29.6</td>
<td>18.9%</td>
</tr>
<tr>
<td>W</td>
<td>Water</td>
<td>1.4</td>
<td>0.9%</td>
</tr>
</tbody>
</table>
Climate and Weather Summary

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 7 January, 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 14 July, 1971. In 2018, monthly mean temperatures were above average from January through September, below average for the remainder of the year, and the extreme high and low for the year were 99 °F and -6 °F, respectively.

Table 2. A (1953-2018) monthly maximum, minimum, and mean temperatures and extreme monthly maximum and minimum temperatures for 2018.

<table>
<thead>
<tr>
<th>Month</th>
<th>Average High</th>
<th>Average Low</th>
<th>Mean</th>
<th>Extreme High</th>
<th>Extreme Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>49.1</td>
<td>10.6</td>
<td>29.9</td>
<td>58.0</td>
<td>4.0</td>
</tr>
<tr>
<td>February</td>
<td>54.4</td>
<td>18.3</td>
<td>36.3</td>
<td>64.0</td>
<td>6.0</td>
</tr>
<tr>
<td>March</td>
<td>61.1</td>
<td>22.4</td>
<td>41.7</td>
<td>74.0</td>
<td>9.0</td>
</tr>
<tr>
<td>April</td>
<td>72.5</td>
<td>33.4</td>
<td>52.9</td>
<td>82.0</td>
<td>25.0</td>
</tr>
<tr>
<td>May</td>
<td>81.4</td>
<td>40.3</td>
<td>60.9</td>
<td>89.0</td>
<td>31.0</td>
</tr>
<tr>
<td>June</td>
<td>90.3</td>
<td>49.2</td>
<td>69.7</td>
<td>99.0</td>
<td>41.0</td>
</tr>
<tr>
<td>July</td>
<td>91.1</td>
<td>56.8</td>
<td>74.0</td>
<td>99.0</td>
<td>45.0</td>
</tr>
<tr>
<td>August</td>
<td>88.9</td>
<td>53.7</td>
<td>71.3</td>
<td>98.0</td>
<td>43.0</td>
</tr>
<tr>
<td>September</td>
<td>82.7</td>
<td>45.0</td>
<td>63.9</td>
<td>90.0</td>
<td>32.0</td>
</tr>
<tr>
<td>October</td>
<td>65.5</td>
<td>36.1</td>
<td>50.8</td>
<td>84.0</td>
<td>28.0</td>
</tr>
<tr>
<td>November</td>
<td>51.1</td>
<td>19.8</td>
<td>35.5</td>
<td>62.0</td>
<td>12.0</td>
</tr>
<tr>
<td>December</td>
<td>43.4</td>
<td>15.7</td>
<td>29.6</td>
<td>54.0</td>
<td>-6.0</td>
</tr>
</tbody>
</table>
Between 1953 and 2017, Alcalde received an average of 10.8 inches of snow per year, and an average of 9.73 inches of rain per year. Total precipitation during 2018 was slightly below average at 7.97 inches, and April was exceedingly dry with only 0.02 inches of rain. 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 2018, only 4.92 inches of rain fell during these months. Precipitation was below average from January through September, but above average for the remainder of the year. In fact, more rain fell (4.24 inches) during October, November and December than in the rest of the year (3.73 inches).

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 29 Apr to 13 Oct, and the average period with temperatures above 25 °F is 186 days from 17 Apr to 20 Oct. Table 2 shows first and last dates that these three temperature thresholds were reached, as well as the season length for those thresholds. Out of the previous ten years, 2017 had the latest 32 °F date and the second shortest frost-free season.

Table 3. First and last freeze dates and growing, 2008-2017, Alcalde, NM. Years sorted by length of 32°F frost free time period.

<table>
<thead>
<tr>
<th>Year</th>
<th>Last</th>
<th>First</th>
<th>Season length (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>5/3</td>
<td>10/15</td>
<td>165</td>
</tr>
<tr>
<td>2017</td>
<td>5/20</td>
<td>10/8</td>
<td>141</td>
</tr>
<tr>
<td>2016</td>
<td>5/8</td>
<td>10/5</td>
<td>150</td>
</tr>
<tr>
<td>2015</td>
<td>5/11</td>
<td>10/25</td>
<td>167</td>
</tr>
<tr>
<td>2014</td>
<td>5/15</td>
<td>10/13</td>
<td>151</td>
</tr>
<tr>
<td>2013</td>
<td>5/4</td>
<td>9/29</td>
<td>148</td>
</tr>
<tr>
<td>2012</td>
<td>5/28</td>
<td>10/7</td>
<td>132</td>
</tr>
<tr>
<td>2011</td>
<td>5/3</td>
<td>10/10</td>
<td>160</td>
</tr>
<tr>
<td>2010</td>
<td>5/11</td>
<td>10/15</td>
<td>157</td>
</tr>
<tr>
<td>2009</td>
<td>4/30</td>
<td>10/2</td>
<td>155</td>
</tr>
<tr>
<td>10-yr Mean</td>
<td>5/9</td>
<td>10/9</td>
<td>150</td>
</tr>
<tr>
<td>Long term Mean</td>
<td>5/11</td>
<td>10/4</td>
<td>146</td>
</tr>
<tr>
<td>Latest</td>
<td>6/8</td>
<td>10/25</td>
<td></td>
</tr>
<tr>
<td>Earliest</td>
<td>4/15</td>
<td>9/9</td>
<td></td>
</tr>
</tbody>
</table>
Figure 5. Average monthly maximum and minimum temperatures for 2017 compared with long term averages from 1953-2017.
Figure 6. Monthly total precipitation for 2017 compared with long term average from 1953-2017.
Research Projects

Fruit Research

The history of tree fruit—apples, apricots, peaches, cherries 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).
Jujube Cultivar Trial and Marketing

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

Background information
Late frost is the most critical issue challenging fruit production in central and northern New Mexico. Most growers had 2 crops or less from 2010-2014. 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 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
With variety trials at three locations throughout the state maturing and coming into full production, we hope that we can make realistic recommendations to growers based on variety fruitfulness, quality, and adaptability to the region. We also hope to identify which cultivars are best for fresh eating, drying, processing and multi-use.

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
At Alcalde, the average yield was 9.3 lb in 2018, the fourth season after planting. Some cultivars produced consistently like KFC, Redland, Daguazao, Chaoyang, Sugarcane, Maya, Li, Honeyjar, Pitless and Gagazao with average yields of 10-20 lb/tree for both 2017 and 2018. KFC had an average of 25 lb/tree in 2017 and 30 lb/tree in 2018.

We published two peer reviewed papers in the year about jujube pollen germination and unique germplasm and ornamental jujube cultivars. We are working on a manuscript about the performance of fresh eating cultivars in New Mexico and will recommend them to growers nationwide.
With pictures and data accumulated during the past eight years, a jujube cultivar webpage was established at http://aces.nmsu.edu/jujube/. Growers can use it to identify their cultivars or guide their cultivar selections.

2018 marked the fourth season after planting, but we do need a few more years to fully evaluate the tree growth, yield and fruit qualities of all those cultivars tested.

**Peer-reviewed Publications**


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 have 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 imported two separate machines from China in 2018: A pitter and a slicer.

Results
We sun dried and oven dried different cultivars at Alcalde in 2018. The sun drying process depended on weather. Fruit could be dried within 2 weeks in mid to late September, but it could take 3-4 weeks from late Sept to early Oct, when precipitation and cloudy days interrupted opportunities to dry the fruit. Oven drying was more efficient and dependable. Most fruit could be ready within 36-48 hr at 60 °C, depending on fruit size.

The jujube pitter and slicer worked well with some cultivars. Dry fruit, pitted fruit and fruit slices all could be marketed directly with small packages.

Future Project Plans
Pitting and slicing jujube will continue in late winter and spring of 2019. The 2019 growing season will bring another jujube crop for the continued evaluation of nutrition and development of products.
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 NC140 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, 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 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.

We installed an over-canopy sprinkler system for this organic apple rootstock trial in September 2017, to protect against late season frosts. This, and a relatively mild spring, allowed full bloom and the first “normal” crop of apples from this planting. In 2018, similar to 2016, G.890 had the largest trunk circumference among the 10 rootstocks tested, while G.222 and G.16 had the smallest trunk circumference. Rootstock G.890 had the highest yield among all rootstocks tested, followed by G. 935 and G. 30 which were also significantly higher than others while G.222 and G. 16 had the lowest yield. Rootstock G.16 had more suckers than G.214, M.9T337, G.969, G.11 and G.41. We noticed fire blight blossom damage and shoot damage, and damaged shoots were pruned out of the orchard on an ongoing basis. Two trees died of fire blight in 2018 and were completely removed.

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 4. Apple tree trunk circumference (mm), fruit number and weight (g), and sucker counts.

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>Stem circumference at 30 cm (mm)</th>
<th>Fruit (#)</th>
<th>Yield (g)</th>
<th>Suckers</th>
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<td>1.8 bc</td>
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<td>87.3 cd</td>
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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. A 30 x 72-ft Farmtek high tunnel was set up in March/April 2017, but plastic cover has not been put on yet.

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.

Because of the lack of local nurseries and the difficulty finding rootstocks tolerant of high pH soils, we special ordered some tissue cultured peach rootstocks GF677 from North America Plants and nurtured them at Alcalde until they were big enough size for bud grafting.

Problems and Delays
The 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.

Future Project Plans
The peach planting was replanted in 2018, and the high tunnel cover will be put in place in February and March, 2019. We will continue routine irrigation and fertility management through the season.
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. In general, peach, pear and sweet cherry bore no fruit in 2017 but some tart cherries did bloom and produce. Due to spotted wing Drosophila (fruit fly) concern, tart cherry trees were removed in 2017.

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. The winter green/blackberry intercrop study is reported separately.

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 with no crop in 2017 or 2018.

Honeyberries
Honeyberries were planted in 2014. They bloom early and are relatively cold tolerant. There was a small crop in 2018 of 2-3 pounds per bush. 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. 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 these 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.
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 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.

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). ‘Bloomsdale Longstanding’ yielded 6.5 kg and ‘Winter Bloomsdale’ the lowest at 5.1 kg. All yields are per total 30 ft² of each variety (six 5 ft² 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.

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. Phytonutrient analysis, which was initiated on the final harvest of the 2017/18 season, will hopefully shed light on the relation of leaf greenness and nutrient content.
Figure 8. Total yield of four harvests of seven spinach varieties. Yield (g) is from 30 ft² area within 640 ft² hoop house.

Figure 9. SPAD readings of seven spinach varieties.

Future Project Plans
The second season of this trial has been postponed until October 17, 2019. We plan to take leaf samples at each harvest 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.
Organic High Tunnel Cucumber Production

Robert Heyduck, Steve Guldan

Activities Performed
Most of the previous high tunnel research has focused on winter production of cold-hardy crop and frost protection or season extension for fruit tree and bramble crops. Without supplemental heating, growing cold-tender crops such as cucumbers or tomatoes would not be possible. However, during shoulder seasons in spring and fall, the high tunnels allow protection of crops within when outside temperatures drop to 24°F. We investigated whether this protection was enough to feasibly start cucumbers early and whether the protected environment of the high tunnel allowed for earlier and more plentiful harvest than field grown cucumbers.

In both 2017 and 2018, seed of two varieties of cucumber, ‘Picolino’ and ‘Corinto’, were sown in pots with organic potting media on April 17. Seeds were watered daily to ensure germination. Once plants were established, they were watered thrice weekly until ready for transplant.

On May 15 in both years, six 2 x 36-foot beds (three in high tunnel and three outside) were prepared with 30 pounds composted organic dairy cattle manure and 3 pounds of 4-2-2 organic chicken manure per bed. Plots were laid out in a randomized complete block design with 6 replicates. Treatments were a 2x2 factorial with variety (‘Picolino’ and ‘Corinto’) as one factor and transplant vs. direct seed as the other. Month-old plants were transplanted and seeds were sown and immediately watered by dripline for 30 minutes. Irrigation proceeded by evapotranspiration (ET) estimation and a prescription for cucumbers from United Nations Food and Agriculture Organization. All plants were trained to a single leader, and tied off to trellis strings. Fruit and flowers were removed from the plants until they reached 30 inches in height. The cucumber vines were given 4 cups Neptune’s Harvest Fish Fertilizer every 2 weeks through the driplines. Beginning in July, cucumbers meeting the marketable size criteria. In 2017 this was 95-135 mm for ‘Picolino’ and 165-205 mm for ‘Corinto’, but in 2018 maximum marketable length was extended to 150 for ‘Picolino’ and 250 for ‘Corinto’. Cucumbers were harvested every 2-3 days. Cucumber length, girth, and individual weight were recorded immediately and fruits were graded as marketable or cull for reasons of shape, scars, or overgrowth.

Results
Overall in 2017, the cucumber trial (combined high tunnel and field planting) yielded 2,919 fruit for a total weight of 390 kg. Across all treatments, an average of 63% of these fruit were marketable (as US grade No. 1 or better) for a marketable yield of 238 kg. Across all treatments, 19% were misshapen, 16% were scarred, and 8% were overgrown, but these percentages varied widely across all treatment factors.

High tunnel yield (160 kg) was greater than the field planting (78 kg), and high tunnel harvest began nearly two weeks earlier than the field planting. Across varieties and growing environment, transplants yielded slightly more (123 kg) than seeded plants (115 kg). Across environments and planting methods, ‘Corinto’ (160 kg) out-yielded
‘Picolino’ (78 kg), but this comparison is nearly meaningless, as ‘Corinto’ is a slicer-type and ‘Picolino’ is a cocktail-type cucumber. Average fruit weights for these varieties were 224 g and 83 g, respectively. In addition, even though ‘Picolino’ had smaller fruit, it produced 1869 fruit compared to 1050 for ‘Corinto’. A complete breakdown of yield weight by treatment is found in Figure 10.

In 2018, cucumber yields and quality were lower. A total of 1,998 fruit weighing 300 kg were harvested, but across all treatments, an average of 57% of these fruit were marketable for a total marketable yield of 171 kg. Across all treatments, 30% were misshapen, 25% were scarred, and only 2% were overgrown, but these percentages varied widely across all treatment factors.

Figure 10. Total marketable yield of two varieties of cucumbers grown in the high tunnel compared to those grown in the field.

High tunnel marketable yield (130 kg) was greater than the field planting (42 kg), and high tunnel harvest began nearly two weeks earlier than the field planting. Across varieties and growing environment, transplants yielded slightly more (104 kg) than seeded plants (68 kg). Across environments and planting methods, ‘Corinto’ (121 kg) out-yielded ‘Picolino’ (51 kg), Though ‘Picolino’ had smaller fruit, it produced 1,241 fruit compared to 757 for ‘Corinto’.

Future Project Plans

Two seasons of data have been collected for this study, and a thorough data analysis is underway. The findings of this study should help guide local growers optimize use of growing structures, and we hope to publish the results in a peer-reviewed journal.
Early Maturity and Season Extension in the Jemez Pueblo Landrace Chile

Charles Havlik, Stephanie Walker, and Robert Heyduck

Potential Impact
In New Mexico, many Native American Pueblo and Hispanic communities have long grown ‘native chile’, also known as New Mexico landrace chile. These landraces were developed through continuous seed saving by farming communities for at least four hundred years. They are currently becoming a rare crop due to numerous pressures. These chiles have been adapted to cooler and shorter growing seasons in northern New Mexico. ‘Jemez Pueblo’ was a consistent early maturing landrace chile in trials in 2011 and 2012 at the NMSU Agricultural Science Center at Los Lunas. An earlier maturing chile pepper can potentially expand the current growing regions in New Mexico.

Methods
Selections in the ‘Jemez Pueblo’ landrace were taken from the earliest maturing plants with a heavy fruit set. The experiment used season extension strategies to enhance the early maturity of chile peppers. In 2017, the experiment was duplicated at three NMSU Sustainable Agriculture Science Centers: Los Lunas, low elevation test, Alcalde the control, and Mora, the high elevation test. Two planting methods were used: transplants and direct seed. Each planting method had a control or row cover treatment. Three cultivars were evaluated: ‘Jemez Pueblo’ landrace, ‘NuMex Española Improved’ and ‘NuMex Sandia’. The field was planted in a randomized block design, with four replications at each site. The row covers were constructed with PVC pipe and used FrostGuard Light row cover, in order to provide frost protection and increase yields with low-maintenance. A ratio of fresh red pods to fresh green pods was determined to estimate the wet maturity index. Later, a dry maturity index ratio was used with the dry pods.

Results (2017)
Table 6 represents the wet and dry weights calculated for the maturity indices. The dry maturity index was recorded as a higher number, yet significance was the same. Among the transplants, there was no significance between the plants that were covered and the controls. This is an expected result at a high elevation with a short growing season. The Alcalde control test had no significance in maturity. However, 40 percent of the plots at Alcalde were affected by a Rhizoctonia solani infestation. The low elevation test at the Los Lunas station showed a high maturity wet index with ‘Española Improved’ cultivar in a direct seeded control treatment (3.9 a). The dry index for the same cultivar and treatment was (5.8 a). Table 2 represents the different marketable yields at the experiment locations. The highest green chile yield was at Los Lunas; the ‘Española Improved’ transplant control yielded approximately 9,390 lbs/acre. The lowest yields were at the Mora site; none of the direct seeded plots produced fruit. Dry red pods had similar results.

Weather played a role in the experiment. Low temperatures at the beginning of the season contributed to poor germination on direct seeded plots at all locations.
Results (2018):
This year’s data is currently being analyzed.

Table 5. Wet and dry maturity indices for three varieties of chile at Los Lunas, Alcalde, and Mora, 2017.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Treatment</th>
<th>Los Lunas</th>
<th></th>
<th>Alcalde</th>
<th></th>
<th>Mora</th>
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zMeans followed by the same letter within columns are not significantly different (P<0.05; Least Significant Difference Test).
Table 6. Mature green and dry red yield of three varieties of chile at Los Lunas, Alcalde, and Mora, 2017.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Treatment</th>
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<th>Alcalde</th>
<th>Mora</th>
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Intercropping Winter Greens between Cane Fruit Rows for Year-Round High Tunnel Production

Jacqueline Cormier, Robert Heyduck, Shengrui Yao, Steven Guldan, Ivette Guzman

New Mexico (NM) participates in the USDA-NRCS Environmental Quality Incentives Program (EQIP). This program is dedicated to helping state producers install sustainable and conservation measures to protect natural resources. Small growers may apply to receive funding from this program for the purchase of high tunnels used to extend growing seasons. In Alcalde, NM, a year-round study was designed to compare fruit yield between two varieties of uncovered blackberry canes to those intercropped in a high tunnel. The study’s objective is to test the feasibility of intercropping blackberries with winter greens in a high tunnel.

Activities Performed
For the study, ‘Chester’ and ‘Triple Crown’ blackberry varieties were grown at the NMSU Sustainable Agriculture Science Center at Alcalde as a long-term yield study which ended in 2015. Two rows of blackberry canes were planted in a field and two rows were planted in a high tunnel. Each row consisted of replicated and randomized plantings of both blackberry varieties. In winter, four beds of kale and spinach were intercropped in plots at the base of dormant canes in the high tunnel only. Blackberries were harvested July to September, and fresh weights were compared to determine which variety was suited to the intercropping system in the high tunnel. Winter greens were harvested January to April, and fresh yield weights were compared to discern fitness as a possible intercrop in this system.

Results
For both years ‘Red Russian’ kale produced higher total mean yields than ‘Bloomsdale Long Standing’ spinach. In the 2016 – 2017 season, the total kale amount harvested was 7,164 ± 641 grams more than the total spinach harvested, while the marketable kale amount was 2,360 ± 210 grams more than the total spinach harvested. In the 2017- 2018 season, the total kale amount harvested was 2,401 ± 504 grams more than the total spinach harvested, while the marketable kale amount was 679 ± 377 grams more than the total spinach harvested. Therefore, the 2016 - 2017 season was higher yielding for both marketable and total yields than the 2017 - 2018 season.

Over the course of the high tunnel trial, kale took less time to harvest in the ‘cut and come again’ method. Kale’s erect, upward growth habit and long petioles grew farther away from the damp soil compared to sprawling short growth of the spinach. This taller growth habit combined with the waxy leaf texture also kept the kale leaves cleaner and more attractive than spinach during harvests.

When blackberry buds were dissected through the 2018 winter season, buds from both varieties in the field appeared green and dormant. High tunnel buds dissected in early January were breaking dormancy, and by early February buds contained dead tissue. Actively growing live buds appeared more prolific on both varieties in the field both years, with even bud distribution on canes when measured on 9 June 2017 and 9 June
2018. In the field, ‘Chester Thornless’ and ‘Triple Crown’ had 75 and 91 live buds, respectively, in 2017 and 36 and 105, respectively in 2018. In the high tunnel, the number of live buds was observed to be lower. At the time of bud count in June, both varieties in the field showed complete break of bud dormancy and live buds were localized in the bottom section of high tunnel canes. Plants in the high tunnel did not have any active buds or fruit production on the top canes for the summer harvests of both 2017 and 2018 resulting from improper growth.

‘Triple Crown’ berries were earlier producing in the high tunnel and field settings for both years relative to ‘Chester Thornless’. Inside the high tunnel, the earliest harvests for ‘Triple Crown’ were on 6 July 2017 and 9 July 2018 while ‘Chester Thornless’ blackberry harvests were 13 July 2017 and 11 July 2018; seven and two days later than ‘Triple Crown’. In the field, the harvests for both cane varieties were later than that in the high tunnel. The first ‘Triple Crown’ harvests were 13 July 2017 and 16 July 2018. This is in comparison to ‘Chester Thornless’ harvests which were eleven and seven days later, respectively, on 24 July 2017 and 23 July 2018.

The peak 2017 harvest in the high tunnel was September 2, 2017 for ‘Triple Crown’ and September 7, 2017 for ‘Chester Thornless’ varieties. The peak of the 2017 season in the field was August 21, 2017 for both ‘Chester Thornless’ and ‘Triple Crown’ varieties. The peak week of the 2018 season in the high tunnel was August 7, 2018 for ‘Triple Crown’ and August 7, 2018 for ‘Chester Thornless’. The peak week of the 2018 season in the field was August 13, 2018 for ‘Triple Crown’ and August 27, 2018 for ‘Chester Thornless’.

In 2017, the difference in total yield means per bush in the high tunnel and field were 1,470.67 ± 599.42 and 1,538.46 ± 599.42, respectively. In the 2018 season, the total yield mean difference between ‘Chester Thornless’ and ‘Triple Crown’ in the high tunnel and field was significant in 2018. In 2018, the difference in total yield means per bush was 825.41 ± 221.78 in the high tunnel and 1,438.60 ± 221.78 in the field. ‘Triple Crown’ producing higher yields than ‘Chester Thornless’ was consistent with previous research growing both cultivars within a high tunnel (Yao et al., 2018).

Due to high temperatures, blackberry canes of both varieties inside the closed high tunnel appeared to not receive adequate chilling hours for optimal growth. The result was cane and bud damage due to premature bud break as the high tunnel canes were subjected to warmer air temperatures. Ideally chilling hours are between 40 – 50 °F, temperatures over 60 °F have a negative effect as often this can initiate bud growth and make it harder for the plant to readjust back to the cooler temperatures (Longstroth, 2013). In previously reported field studies between ‘Chester Thornless’ and ‘Triple Crown’ in Oregon, ‘Chester Thornless’ out-produced ‘Triple Crown’ in fruit yields due to its superior cold hardiness (Galletta et al., 1998a; Galletta et al., 1998b). Other high tunnel trials in New Mexico indicated that ‘Triple Crown’ consistently out-produced ‘Chester Thornless’ in yields (Yao et al., 2018). This leads to the conclusion that the cold hardiness for ‘Chester Thornless’ also may make it less tolerant to warmer temperatures in winters, making it less suitable for an intercropping high tunnel system where the sides of the high tunnel are kept down the entire winter season.
High tunnels get higher temperatures in the early spring, which while having the benefit of creating an early harvest when the sides are rolled up, may not be beneficial if the sides are rolled down (Yao, 2018). In studies with primocane fruiting blackberry, flowers of high tunnel cultivated plants have exhibited decreases in pollen competence of up to 75% due to high temperatures (Stanton et al., 2007). This temperature induced low pollen competence may be what is responsible for the low drupelet density of some berries in this study. Overall this study indicates that the phenology and climate needs of the two winter greens and blackberry varieties were not compatible for sustaining year-round high tunnel production.

**Literature cited**


Figure 11. Kale and spinach mean yields by harvest day and year. Harvests span from 18 Jan. to 14 Apr. and 19 Jan. to 20 Apr. in 2016 and 2017, respectively. *Error bars display minimum and maximum yields per plot.

Figure 12. Blackberry yield data for 2017 and 2018 as mean fresh weights (grams) by cultivar in field and high tunnel (T. Crown = ‘Triple Crown’ and Chester = ‘Chester Thornless’). Each harvested weight is shown as a data point, delineated by date of weeks. *Number of harvests per week dependent on availability of ripe berries.
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.

Figure 13. David Salazar and Robert Heyduck extracting baseline soil samples for nutrient and microbial analysis (left), and six ‘bioreactor’ compost bins assembled and filled during 2018 (right).
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.

Six ‘bioreactor’ compost bins have been built (see Figure 13). Figure 13. David Salazar and Robert Heyduck extracting baseline soil samples for nutrient and microbial analysis (left), and six ‘bioreactor’ compost bins assembled and filled during 2018 (right). Two replicates of three compost recipes with varying carbon-to-nitrogen ratios were used to construct the compost piles. Hourly temperature and weekly volume measurements are recorded. Compost samples were analyzed for quality indicators (nutrients, organic matter, etc) and for microbial community assessments (see Figure 14).

Phase II: Hoop house Trial Fall 2018 through 2019
The trial will examine crop management and fertilization variables and their effect on the health and productivity of transplanted hoop house tomatoes. The entire hoop house was planted with a cover crop mix (daikon radish, Austrian winter peas, hairy vetch, rye) in the fall of 2018. The cover crop will continue to grow until about a month before tomato starts are planted in mid-May, 2019. The experimental design includes four replicates of three treatments, as follows: T1: cover crop will be rototilled prior to transplanting tomatoes; T2: cover crop will be terminated by covering with weed barrier; and T3: cover crop will be terminated by covering with weed barrier and tomato transplant potting medium will be inoculated with microbially diverse compost made onsite.

Baseline soil quality, bulk density, and microbial assessments were completed in the fall of 2018 (prior to planting the cover crop) for all 12 plots in the hoop house. Soil microbial community (SMC) assessments will be conducted in the spring, fall, and after tomato harvest to determine if management practices had significant effects on SMC of the hoop house soil.

Tomato plant productivity and vigor will be assessed for each plot to determine whether and to what extent crop management techniques affect outcomes including yield, fruit nutrient density, and plant disease or stress.

Figure 15. Soil microscopy images (400x) a) nematode; b) amoeba (center); and c) fungi (filamentous structures).
A ‘Soil Regeneration and Health’ webpage was developed to house information pertinent to NM growers: https://alcaldesc.nmsu.edu/soil-regeneration-and-he.html

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 the ditch. 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 2019).

Literature cited
Agriculture has played an important role in the survival of the Pueblo People of New Mexico within the past eight hundred years and greatly contributes to their custom, culture and tradition. Today, their custom, culture, traditions and economic stability are threatened by lack of agricultural technical and educational assistance. Cooperative Extension Service Rural Agriculture Improvement and Public Affairs Project (CES RAIPAP) specialists, through the assistance of the USDA NIFA (National Institute of Food and Agriculture) BFRDP (Beginning Farmer and Rancher Development Program), have trained over 160 Native American beginning farmers and ranchers (BFRs) within the northern and southern pueblos, thus increasing farm income and maintaining cultural values and tradition.

Pillars: Food and Fiber Production and Marketing; and Environmental Stewardship

Objective 1: The overall goal of the project is to provide the best possible research based and proven sustainable educational and technical assistance to the Pueblo BFRs through culturally accepted methods in an effort to empower them with the skills and knowledge necessary to compete and succeed in their agricultural business endeavors.

Input 1: The BFR team coordinated the NMPBFR Conference on February 8-9, 2018 located at the IAIA campus, Santa Fe, NM.

Output 1: Subject matter presentation topics presented on February 8, 2018 included Small Field Vegetables (Dr. Stephanie Walker, NMSU Vegetable Specialist); Building Soil Health (Dr. Robert Flynn, NMSU Ext. Agronomist); Chile Production (Charles Havlik, NMSU Research Assistant); Hoop house Crops (Del Jimenez, NMSU Ag. Specialist); Greenhouse and Raised Beds Tour (Charlene Carr, Land Grant Director, IAIA); Tractor Safety (Del Jimenez NMSU Ag Specialist); and USDA Panel focused on crops (NASS, Longino Bustillos, State Statistician; FSA, Lisa Garay, County Executive Director; Allen Mackrain, District Farm Loan Manager; and NRCS, Ana Gomes, Area Program Specialist). Subject matter presentation topics presented on February 9, 2018 included Extension Risk Management Survey (Tom Dominguez, NMSU Ext. Ag. Agent); Bull Selection/EPD’s (Dr. Marcy Ward, NMSU Extension Livestock Specialist); Cow/Calf Management (Dr. Craig Gifford, NMSU Extension Beef Cattle Specialist); Horse Care (Dr. Jason Turner, NMSU Extension Horse Specialist); Cattle Diseases (Dr. John Wenzel, NMSU Extension Veterinarian); Beef/Cattle Marketing (Dr. Paul Gutierrez, NMSU Extension Specialist); and Alfalfa and Forages (Dr. Mark Marsalis, NMSU Extension Forage Specialist). During the NMPBFR conference, participants completed evaluations using an interactive clicker system.
Impacts 1: A total of 94 participants attended the two-day conference and 38 of the participants (non-duplicated) were BFR program participants. Participants gained crop and livestock knowledge to make decision making strategies for their farming and ranching operations.

Input 2: Charlene attended project team meetings on 3/6/18, 4/5/18, and 5/2/18.

Output 2: The BFR team meeting topics included a debriefing of the NMPBFR February conference, plan for upcoming workshops and update participant files. During the NMPBFR conference, participants completed evaluations using an interactive clicker system; results were discussed during the debriefing.

Impacts 2: Please see Appendix I for the “NMPBFR February 8-9, 2018 Conference - Evaluation Summary.” The assessment provided insight regarding participants’ knowledge level after one year’s participation in the NMPBFR program plus short answer question responses. The summary further provided direction of subject matter workshops to focus on for the months of March, April and May 2018.

Input 3: Charlene provided field visits on 2/16/18, 3/9/18, and 3/21/18.

Output 3: Charlene provided a field visit on 2/16/18 with Emilio Torivio and other Pueblo farmers at Acoma Pueblo and Elizabeth Martinez at Laguna Pueblo regarding soil interpretation results. Charlene and Joseph Garcia provided a field visit on 3/9/18 with Calvin Suina at Cochiti Pueblo regarding bull castration. Charlene provide a field visit on 3/21/18 with Gabe Trujillo at Cochiti Pueblo regarding soil/crop assistance and to deliver the 4/13/18 workshop flier (participant does not have access to computer/email).

Impacts 3: Farmers and ranchers were provided with on-farm technical assistance specifically regarding soil test results and calf management. Producers were able to consult with the agent at their field to design decision-making strategies for field and cattle operations.

Input 4: The BFR team coordinated a workshop on 4/5/18 at La Mesilla, NM.

Output 4: The Gopher Control Workshop was provided by Dr. Sam Smallidge, NMSU Wildlife Specialist. The workshop included hands-on trapping training.

Impacts 4: A total of 30 participants attended the workshop. Participants now have the skills and knowledge regarding proper gopher trapping and control to manage the incidence of gophers in their forage and crop fields.
Input 5: The BFR team coordinated a workshop on 4/13/18 at Cochiti Pueblo.

Output 5: The Part II Business Planning, provided by Ellen Shapiro (Business & Entrepreneurship Coordinator, IAIA) and USDA FSA/NRCS Loan & Application Assistance provided by Allen Mackrain (Farm Loan Manager, FSA), Lisa Garay, (County Executive Director, FSA), Ana Gomes (North Area Resource Conservationist, NRCS) and Luz Wanstall (Area Team Farm Bill Program Specialist) presented at Cochiti Pueblo. The “Building a Sustainable Business” resource guide was utilized to assist participants to develop and write their own business plans. Participants were able to write their thoughts into the resource guide templates.

Impacts 5: A total of 19 participants attended the workshop at Cochiti Pueblo. Participants were provided the resource guide as a tangible educational material to use beyond the instruction of the workshop. Participants gained knowledge to develop and write their own business plans. Charlene and Ellen Shapiro will provide upcoming office hours in the communities for further consultation and technical assistance to participants for their business planning needs.

Input 6: The BFR team coordinated a workshop on 4/23/18 at Sandia Pueblo.

Output 6: The Integrated Pest Management provided by Dr. Ashley Bennett, NMSU IPM Specialist and Introduction to Composting provided by John Zarola, Master Composter was presented at Sandia Pueblo.

Impacts 6: A total of 20 participants attended the workshop at Sandia Pueblo. Participants are able to identify pests in their corn, vegetables and other crops and have the knowledge to control the incidence of pests in their fields.

Input 7: The BFR team coordinated a workshop on 5/25/18 at Sandia Pueblo.

Output 7: The Integrated Pest Management provided by Dr. Ashley Bennett, NMSU IPM Specialist and Introduction to Composting provided by John Zarola, Master Composter was presented at Sandia Pueblo.

Impacts 7: A total of 20 participants attended the workshop at Sandia Pueblo. Participants are able to identify pests in their corn, vegetables and other crops and have the knowledge to control the incidence of pests in their fields.
Sustainable Farming Techniques in Northern New Mexico

DelJimenez, 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 Agriculture 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.

Pillars:
Food and Fiber Production and Marketing; and Environmental Stewardship
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 Science, NMSU

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

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

Dr. Stephanie Walker, Professor, Department of Plant and Environmental Science, NMSU

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

Dr. Carlos Ochoa, Assistant Professor, Watershed-Riparian Systems, Department of Animal and Range 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

Rocky Mountain Farmers Union Cooperative Development Center

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

Grants


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


Extension Publications


Tours and Visiting Groups

Description: Gave tour of SASC-Alcalde to family of Sam Fernald. (January 5, 2018).

Description: Co-hosted a Winter Greens Production Field Day at SASC-Alcalde (51 registered). (January 19, 2018).

Description: Gave tour of SASC-Alcalde to Matt B. (March 8, 2018).
Guest Lecture Description: Gave lecture and tour of SASC-Alcalde to AXED 565 course. (April 27, 2018).

Description: Visited with Cindy Brown about SASC-Alcalde's history and research. (June 29, 2018).

Description: Gave tour of compost facility and SASC grounds to Taos Land Trust staff and their Youth Conservation Corps. Team; 20 attendees. (July 20, 2018).

Description: Gave tour of SASC-Alcalde to Robert Myers, Regional Coordinator for North Central SARE. (August 1, 2018).

Description: Co-hosted the 2018 SASC-Alcalde Field Day (195 registered). (August 10, 2018).

Description: Gave tour and visited with Nina Sajovec and Sterling Johnson of Ajo Center for Sustainable Agriculture. Ajo, AZ. (September 26).

Description: Gave tour of SASC-Alcalde research projects to visiting group from Costa Rica. (December 6, 2018).

Description: Visit with Lily Conrad, prospective graduate student in the Water Science and Management program. (December 17, 2018).

Presentations


Guldan, S.J. (Presenter), Los Alamos Master Gardeners, NMSU CES, Los Alamos, NM, "Alcalde Sustainable Agriculture Science Center." (November 1, 2018).
Guldan, S.J. (Presenter), NMSU ACES Open House, Las Cruces, NM, "Sustainable Agriculture Science Center at Alcalde." (April 14, 2018).

Guldan, S.J. (Panelist), New Mexico Organic Farming Conference, NMDA/NMSU-CES/NM Farm & Livestock Bureau/Walking Trout Farm, Albuquerque, NM, "Irrigation in the Semi-Arid Southwest, a Panel." (February 16, 2018).


Lauriault, L.M. (Presenter), Guldan, S.J., PES Graduate Seminar, Plant and Environmental Sciences Department, Las Cruces, NM, "Relay Intercropping with Cover Crops Improves Fall Forage Potential of Sweet Corn Stover." (February 9, 2018).


Yao, S., Annual meeting of the Association of Chinese-American Engineers and Scientists of New Mexico (ACES-NM), Albuquerque, NM, "Jujube Cultivation and Cultivars in New Mexico." (December 1, 2018). 50+ attendees.

Yao, S., New Mexico Chinese Association winter gathering, Bernalillo County, Albuquerque, NM, "Growing jujubes in New Mexico." (November 10, 2018). 80+ attendees.


Yao, S., NMSU Alcalde Field Day, NMSU SASC, Alcalde, NM, "Fruit production in Northern New Mexico." (August 10, 2018).

Yao, S., NMSU Leyendecker Field Day, NMSU Leyendecker Center, Las Cruces, NM, "Jujube as an Alternative Fruit Crop in Southern New Mexico." (June 28, 2018).

Yao, S., Angel Fire Garden Club, Colfax County, Angel Fire, NM, "Growing Tree Fruit and Alternative Fruit in New Mexico." (July 9, 2018).


**Workshops**

Fruit Grower’s Workshop. NMSU SASC Alcalde. (March 1, 2018). 96-100 attendees.


Grant County Fruit Tree Grafting and Jujube Workshop. (March 23, 2018).


Jujube Flowering and Fruiting Habits and Fruit Tasting Workshop. NMSU SASC Alcalde (Sept 29, 2018).

**Press and Press Releases**

**NMSU to host winter greens field day at Alcalde Jan. 19**

Date: 01/02/2018
Writer: Jane Moorman, 505-249-0527, jmoorman@nmsu.edu

ALCALDE – Passive heating in low-cost high tunnels, also commonly referred to as hoop houses, allows growers to produce winter greens such as spinach, kale and lettuce during the winter months in northern New Mexico.

David Archuleta, farm and ranch supervisor at NMSU’s Sustainable Agriculture Science Center at Alcalde, picks spinach during a study on growing winter greens in hoop houses. A workshop Friday, Jan. 19, at the science center will inform producers about the findings of the study. (NMSU photo by Jane Moorman)
New Mexico State University College of Agricultural, Consumer and Environmental Sciences researchers will update the public on research results at a field day from 1 to 4 p.m. Friday, Jan. 19, at the Sustainable Agriculture Science Center at Alcalde.

The event is free and open to the public, and will include a tour of the hoop houses. Refreshments will be provided. For more information, or directions, contact the Alcalde center at 505-852-4241.

"We invite people to come and see the kind of growth possible during the winter in these unheated structures," said Steve Guldan, an agronomist in NMSU's Department of Plant and Environmental Sciences and the center's superintendent.

"We've seen that cool season crops can do well despite the low temperatures and short days. We keep experimenting with different crops, varieties and management practices to see how winter production can be maximized," said Robert Heyduck, NMSU senior research specialist.

Del Jiménez, NMSU Extension agriculture specialist with the Rural Agricultural Improvement and Public Affairs Project, will discuss the construction and durability of the hoop houses; Heyduck, and Ivette Guzmán, NMSU Department of Plant and Environmental Sciences horticulturalist, will give an overview of crop and temperature results to-date.

The Alcalde staff requests that visitors not bring dogs onto the farm property unless they are assistance dogs.

**NMSU to host annual fruit growers workshop at Los Luceros Ranch March 1**

**Date:** 02/01/2018  
**Writer:** Jane Moorman, 505-249-0527, jmoorman@nmsu.edu

ALCALDE – Trees in northern New Mexico orchards may be dormant during the winter months, but the fruit growers are looking ahead to next spring when the blooms will be forming on the plants.

New Mexico State University’s Sustainable Agriculture Science Center will host the annual fruit grower workshop at the historic Los Luceros Ranch on March 1. Updates will be given on the NMSU research being done on various fruits, including grapes, jujube, organic apples and stone fruit. (NMSU photo by Geraint Smith)

Part of the preparation is learning tips for managing the trees, pollinators and pests, as well as what research New Mexico State University is conducting at the Sustainable Agriculture Science Center at Alcalde.

NMSU’s College of Agricultural, Consumer and Environmental Sciences Cooperative Extension Service is hosting the annual Fruit Grower Workshop from 8:30 a.m. to 3:30 p.m. Thursday, March 1, at the historic Los Luceros Ranch north of Alcalde on County Road 41.

“This will be our second year to meet at the Los Luceros Ranch,” said Shengrui Yao, NMSU Extension fruit specialist. “The ranch provides us with a wonderful opportunity because of the established fruit orchard on the property.”

The 148-acre ranch, formerly owned by the family of Frank and Ann Cabot, is now property of the New Mexico Department of Cultural Affairs.
Presentations will begin at 9 a.m. Topics will include:

– An overview of the fruit industry in New Mexico by Patrick Torres, NMSU Extension Northern District Director.
– An overview of the historic Los Luceros Ranch by Patrick Moore, the ranch manager.
– Update on research on jujube cultivars, organic apple rootstock and high tunnel stone fruit by Yao.
– Grape varieties, rootstock and New Mexico “terroir” (how a particular region’s climate, soils and terrain affect the taste of wine) by Gil Giese, NMSU Extension viticulture specialist.
– Bee and pollination in fruit production by Ashley Bennett, NMSU Extension small urban farm integrated pest management specialist.
– Marketing and local farmers market discussion panel with Sabra Moore, Melissa Willis and other representatives from local growers’ markets.
– New Mexico organic certification and regulations by Ive Eddy, New Mexico Department of Agriculture organic program inspector.
– Acequia legacy in northern New Mexico by Steve Guldan, NMSU Alcalde Center superintendent.
– Tree planting, transplanting and management field demonstration by Gordon Tooley.
– Gopher management field demonstration by Tom Dominguez, NMSU Extension agricultural agent in Santa Fe County.

Registration is $12 per person before Feb. 20 and $15 after Feb. 20. Fee includes lunch and materials. Participants are encouraged to register before Feb. 20 to ensure enough food is prepared for lunch.

To pre-register, call Joy at the Santa Fe County Extension office, 505-471-4711.

NMSU to host jujube fruit tree growing habits, pruning workshop in Alcalde, Los Lunas
Date: 03/09/2018
Writer: Jane Moorman, 505-249-0527, jmoorman@nmsu.edu

LOS LUNAS – Interest in raising the jujube as an alternative fruit crop continues to grow among New Mexicans because of crop reliability and its ability to adapt well to a wide range of soil pH levels and weather conditions.

Shengrui Yao, New Mexico State University Extension fruit specialist, demonstrates how to prune a jujube fruit tree. She will host a pruning demonstration at NMSU’s Agricultural Science Center at Los Lunas at 2 p.m. Thursday, March 22; and a workshop on the growing habits of the tree, followed by a pruning demonstration at NMSU’s Sustainable Agriculture Science Center at Alcalde at 1:30 p.m. Thursday, March 29. (NMSU photo by Jane Moorman)

To help home gardeners and potential commercial growers better understand this fruit-bearing tree of Chinese origin, Shengrui Yao, New Mexico State University College of Agricultural, Consumer and Environmental Sciences Extension fruit specialist, will host a workshop on the growing habits of the tree, followed by a pruning demonstration.

The workshop will be from 1:30 to 3:30 p.m. Thursday, March 29, at NMSU’s Sustainable Agriculture Science Center at Alcalde.

Prior to this workshop, Yao will hold a pruning demonstration from 2 to 3 p.m. Thursday, March 22, at NMSU’s Agricultural Science Center at Los Lunas
“To serve the people in the central and southern areas New Mexico, we will have a pruning demonstration at Los Lunas,” Yao said. “If people want to learn about the growing habits of the tree they can attend the workshop in Alcalde.

“Our sunny and semi-arid weather makes the jujube fruit quality excellent,” she said. “Jujube fruit is very nutritious, with a vitamin C content of 200 to 600 mg per 100 grams of fresh fruit weight, which is four to 10 times higher than oranges.”

Jujube trees leaf and bud out four to six weeks later than most fruit tree species, which allows them to avoid the late frosts.

“With their late season start-up, wide adaptation, nutritional facts and mild flavor, jujubes are a perfect alternative fruit in New Mexico,” Yao said.

Register online at http://rsvp.nmsu.edu/rsvp/jujubehabits or contact Anna at 505-852-4241.

**NMSU to hold fruit tree grafting workshop at Alcalde July 19**

**Date:** 07/06/2018  
**Writer:** Jane Moorman, 505-249-0527, jmoorman@nmsu.edu  
**ALCALDE** – Grafting various cultivars to a fruit tree with a good root system can provide a wide variety of growing options.

Apples are one type of fruit tree that allow multiple varieties to be grafted to a root system. New Mexico State University Extension fruit specialist Shengrui Yao will host a workshop on grafting Thursday, July 19, at NMSU’s Sustainable Agriculture Science Center at Alcalde. (NMSU photo by Jane Moorman)

“A homeowner might only have one apple or peach tree, but they can have different kinds of apples or peaches in their backyard orchard,” said Shengrui Yao, New Mexico State University Extension fruit specialist. “They can accomplish this by grafting different cultivars to an established fruit tree.”

Other benefits of grafting fruit trees include changing the tree’s fruit variety, keeping an heirloom family apple alive, or establishing a pollination branch on a solitary apple tree to provide pollen for the blossoms.

Yao will explain the techniques for grafting fruit trees during a workshop Thursday, July 19, at NMSU’s College of Agricultural, Consumer and Environmental Sciences’ Sustainable Agriculture Science Center at Alcalde, 371 County Road 40 in Alcalde. The free workshop will be from 6 to 7:30 p.m.

The workshop will include a presentation and hands-on experience. Participants are asked to bring a small sharp knife or grafting knife to participate in the hands-on activities with budding, bark grafting and tasks.

To register, call Ana or Augusta at 505-852-4241.
NMSU’s extended lavender study produces varieties resistant to root diseases
Date: 07/17/2018
Writer: Jane Moorman, 505-249-0527, jmoorman@nmsu.edu

ALCALDE – Lavender is a promising high-value alternative crop for small-scale growers in the arid West and Southwest, especially if agricultural researchers can find a way to lessen the number one problem for the growers – root disease.

New Mexico State University research specialist Robert Heyduck at NMSU’s Sustainable Agriculture Science Center at Alcalde and Charles Martin, retired NMSU alternative crops researcher, look at a lavender plant that has survived an eight-year variety trial designed to determine which varieties are least susceptible to root disease by being tolerant to the conditions under which small-scale growers water their crops. Of the 2,000 individual plants of the 31 different varieties planted, 131 plants representing 21 varieties have survived. (NMSU photo by Jane Moorman)

A study at New Mexico State University’s Sustainable Agriculture Science Center at Alcalde may have found several lavender varieties that have a natural resistance against root disease.

Charles Martin, retired NMSU agricultural specialist and former alternative crops researcher at Alcalde, began research on lavender in 2003 while a faculty member of the university.

Lavender produces a high-value essential oil that can contribute to the overall profitability of small-scale farming situations.

During the 2003 variety trial Martin determined that both of the two main commercial species of lavender, English, or true lavender (Lavandula augustifola) and lavandin (Lavandula x intermedia) have potential to do well in New Mexico.

“Of the first varieties investigated, Grosso and Super, both lavandin varieties, performed best in hardiness and yield,” Martin said. “However, for growers wanting to enter the high-end commercial lavender oil market, English lavender oil is more valuable than lavandin oil. So we conducted further field trials focusing on English lavender varieties for suitability to northern New Mexico environmental conditions and traditional farming practices.”

In 2008 Martin began a second round of investigation to see which lavender varieties were least susceptible to root disease by being more tolerant to the conditions under which small-scale growers water their crops.

Ordinarily conventional lavender growers avoid root disease by converting to drip irrigation, which has high up-front costs and requires more maintenance. Additionally, farmers who rely upon acequias for irrigation would need to invest in expensive filtration equipment.

“Because traditional small-scale agriculture in our state relies on acequia-fed furrow or flood irrigation, overwatering or free-standing water found in this form of irrigation creates conditions that promote Phytophthora and Rhizoctonia root disease,” he said. “This became one of the critical factors preventing small-scale farmers from adopting this crop.”

Martin planted more than 2,000 individual plants of 31 different varieties to see which ones would be most adapted.
“I obtained seed from all over the world – the Netherlands, Czech Republic, Bulgaria, France, Canada, as well as places in the United States,” Martin said.

After planting the trial, a family health situation caused Martin to retire and return to his native Illinois to care for his mother. Science center superintendent Steven Guldan allowed the trial to continue in Martin’s absence, with fruit specialist Dr. Shengrui Yao and research specialist Rob Heyduck assuming responsibility for the lavender field.

“When I started the trial I didn’t expect it to last more than three years,” Martin said. “As it turned out, it lasted eight years, which fortuitously resulted in exposing the plants to a wider range of seasonal conditions.”

Lavender is a perennial plant that can survive for up to 10 years.

“This study proved to be a more realistic situation that actual farmers would face over the life of a lavender stand,” Martin said. “A typical three-year study would not have had the conditions or the degree of adversity that these varieties experienced.”

Over the past eight years, the plants experienced limited watering, dry winters, weed pressure and two years of grasshopper infestation. Twenty-two of the 31 varieties – 131 plants – survived.

“The result has been the natural selection of especially resilient individual plants. The survivors are truly special,” Martin said. “They are more likely to have disease resistance, drought tolerance, or other physiological traits that have enabled the plants to live so long under these less-than-ideal conditions.”

To determine what those traits are, Martin said the research needs to be taken to the next stage.

“These varieties could become foundation stock and seed for future breeding purposes, developed with New Mexico’s small-scale traditional farmer in mind,” he said. “Obtaining funds for further research and development is critical at this point in time because the survivors in the field are reaching the end of their natural life expectancy.

“Taking cuttings for clonal propagation to ensure the continuation of the plants, tissue culture to obtain virus-free research material and distribution of germplasm to other experiment stations in New Mexico for testing under other environmental conditions are all preliminary steps to take in reaching the ultimate goal of getting these valuable cultivars into the hands of traditional farmers.”
ALCALDE – Researchers at New Mexico State University’s Sustainable Agriculture Science Center at Alcalde continue to investigate the viability of alternative crops for northern New Mexico producers.

New Mexico State University’s Sustainable Agriculture Science Center at Alcalde will host a field day on Friday, Aug. 10. Visitors will learn about the wide variety of research being conducted at the farm. (NMSU photo by Jane Moorman)

The research includes growing a variety of crops in high tunnels, including blackberries, kale, cucumbers and fruit trees.

People interested in the science center may learn about the research during the Alcalde Field Day on Friday, Aug. 10. Registration begins at 7:30 a.m. with welcoming comments at 8 a.m.

Rolando A. Flores, dean of the College of Agricultural, Consumer and Environmental Sciences, will be among the speakers.

Field tours will begin at 9 a.m. Two routes will be available: fruits and insects; or acequia hydrology, high tunnels, crops and composting. A free lunch will be served at noon.

“Attendees will learn about current research, Extension and demonstration projects carried out at and through the science center, as well as view exhibits on other agriculture-related programs and projects serving farmers, ranchers and gardeners in the region,” said Steve Guldan, superintendent of the farm.

The fruit and insect tour will include reports on the research of berries, tree fruit, jujube fruit and organic fruit production by Shengrui Yao, NMSU Extension fruit specialist; beneficial insects by Ashley Bennet, NMSU small urban farm integrated pest management specialist; frost control by Tony Valdez, NMSU Taos County agricultural agent; ornamentals and edibles for backyard gardens by Marisa Thompson, NMSU urban horticulture specialist; and NMSU’s grape research by Gill Giese, NMSU Extension viticulturist.

The second route will include acequia hydrology research update by Guldan; research on traditional corn and tepary beans by Donald Martinez, Rio Arriba County agricultural agent, and Rob Heyduck, NMSU agricultural research specialist at Alcalde; chile maturity and season extension by Chuck Havlik, NMSU research assistant; lavender by Heyduck; high tunnels by Del Jimenez; growing blackberries and kale in high tunnels by Jacquie Cormier, NMSU graduate research assistant; growing cucumbers in high tunnels by Heyduck; alfalfa and grass forages by Mark Marsalis, NMSU Extension forage specialist; bio-control of alfalfa weevil by Jane Pierce, NMSU Extension entomologist; and Johnson-Su Bioreactor composting system by Amy Larsen and David Johnson.

Following lunch, special topic sessions will be held on tractor and implement maintenance by David Archuleta, Alcalde farm supervisor; bindweed mites and bio-control by Jimenez; and heritage grains trials.

The Alcalde staff requests that visitors not bring dogs to the field day unless they are service animals.
AmeriZao jujube fruit tasting workshop slated for Sept. 28 at Los Lunas
Date: 09/12/2018
Writer: Jane Moorman, 505-249-0527, jmoorman@nmsu.edu

LOS LUNAS – Have you ever tasted an AmeriZao? It has the texture of an apple, but not the tartness. It can also taste like a date. This fruit of many flavors is the American jujube, also known as Chinese dates, that have been propagated and tested by New Mexico State University’s College of Agricultural, Consumer and Environmental Sciences.

Participants of a tasting workshop enjoy the unique taste and texture of the Chinese date fruit of the jujube tree. There will be a jujube tasting 2-4 p.m. Friday, Sept. 28, at NMSU’s Sustainable Agriculture Center at Los Lunas. (Photo by Jane Moorman) Reddish brown fruit hanging on branch.

The AmeriZao jujube fruit trees bloom from late May to early August. The fruit ripens in late August through September depending on the climate zone. (NMSU photo)

The public is invited to a tasting workshop from 2 – 4 p.m. Friday, Sept. 28, at NMSU’s Agriculture Science Center at Los Lunas. NMSU Extension fruit specialist Shengrui Yao will lead the workshop where participants may sample 40-plus varieties.

“Since jujube cultivars are originally from China, where Zao is the word for this fruit, I wanted to keep the traditional name in the trademark,” Yao said.

Thirty-four varieties receiving a new trademark are propagated from cultivars Yao received from China in 2011. She has studied each cultivar for traits that will thrive in New Mexico’s various climate zones. Gradually, she will publish the top performers in each region and for different purposes.

“Jujube fruit trees are an excellent alternative fruit for growers in northern New Mexico,” Yao said. “The trees bloom from late May to early August, so late frosts will not prevent fruit from setting. They also do well in semi-arid conditions. Jujubes are low maintenance plants and produce a reliable crop annually."

Yao has discovered that jujube trees already exist around the state, but owners are often not aware what type of tree it is, or how to use the fruit. She has collected fruit from various locations in addition to those raised in her study, for the annual fruit-tasting event.

“People really like the different flavors that each cultivar offers,” she said. "They are excited about having the fruit in their diet.”

The workshop will include a presentation about jujube flowering and fruiting habits, followed by a fruit tasting session and a field tour.