College of Agricultural, Consumer and Environmental Sciences

Agricultural Science Center at Tucumcari
ANNUAL PROGRESS REPORT 2018








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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

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

This report was not prepared as a formal release. None of the data are authorized for release or publication, without the written prior approval of the New Mexico Agricultural Experiment Station.

Natalie P. Goldberg

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

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

2018
ANNUAL REPORT

Leonard M. Lauriault, Editor

Leonard Lauriault
College Professor
Forage Crop Management Scientist and Superintendent

Murali Darapuneni, Ph.D.
Assistant Professor
Semi-Arid Cropping Systems

Patricia Cooksey
Associate Administrative Assistant

Gasper Martinez
Agricultural Research Assistant

Jason Box
Farm/Ranch Manager

Shane Jennings
Research Lab Tech

Jared Jennings
Senior Laborer

Anthony Williams
Laborer

Alice Johnson
Custodian

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Acknowledgements

Agricultural Science Center Advisory Committee

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Several individuals and companies donated products and services to the Agricultural Science Center at Tucumcari during 2018. Appreciation is expressed to the following persons and organizations for their contributions.

Arch Hurley Conservancy District – Franklin McCasland
Tucumcari, NM .... Field Day Meal

Box Irrigation – Phillip Box
Tucumcari, NM .... Field Day Meal

Canadian River SWCD – Tommy Wallace
Tucumcari, NM .... Field Day Meal

Citizen's Bank – Cooper Glover
Tucumcari, NM .... Field Day Meal

Curtis & Curtis Seed & Supply, Blake Curtis
Clovis, NM. .... Field Day Meal

Everyone's Federal Credit Union – Andi Baum
Tucumcari, NM .... Field Day Meal

Farm Credit Services – Will Cantrell
Tucumcari, NM .... Field Day Meal

Farmers' Electric Cooperative, Inc. – Lance Adkins
Clovis, NM .... Field Day Meal

The Rex Kirksey Family
Tucumcari, NM .... Field Day Meal

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Tucumcari, NM .... Use of stock trailer

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Tucumcari, NM... Field Day Meal

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Tucumcari, NM... Field Day Meal

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Tucumcari, NM .... Field Day Meal

Tucumcari General Insurance – C.J. Wiegel
Tucumcari, NM .... Field Day Meal

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Walnut Creek, CA...................... Unrestricted Gift ($5,000) to Support Forage Testing

Wells Fargo Bank NA – Sandra Mapes
Tucumcari, NM .... Field Day Meal

Young Insurance Agency, Beverly Choate/Justin Knight
Tucumcari, NM .... Field Day Meal

Impacts of Studies Published in 2018 and Ongoing Research Summarized in this Report

New Mexico State University's Agricultural Science Center at Tucumcari is boldly shaping the future by conducting innovative, locally-driven, globally-relevant research designed to discover, develop, and disseminate knowledge related to crop (including forages) and livestock production under irrigated and dryland conditions to meet NMSU's College of Agricultural, Consumer and Environmental Sciences Pillars for Economic and Community Development (https://aces.nmsu.edu/aces_dean/pillars.html). We strive to enhance agricultural profitability; stimulate economic development using natural resources; improve the quality, safety and reliability of food and fiber products; sustain and protect the environment with ecologically sound practices; manage and protect natural resources; and thereby, improve the quality of life for the people of New Mexico. To that end, current research programs focus on semiarid cropping systems, irrigated forage crops and grazing management, genetic improvement of beef cattle through feed efficiency testing, and reuse of treated municipal wastewater for agricultural irrigation. New studies have been initiated and results of multiple studies were published in peer-reviewed journal articles and non-peer-reviewed variety test reports as Agricultural Experiment Station publications; Cooperative Extension Service publications were revised; presentations were made to in-state stakeholder groups reporting on completed research and other topics of interest. Additionally, the facility was used as a field laboratory by an NMSU graduate student and animal and plant science classes at Mesalands Community College and other outreach activities were held.

The immediately following impact statements are based on research that has been published after a peer-review, making the results accepted by the scientific community. The references are listed beginning on page 5 in the Introduction section of this report.

Strip tillage for corn production has environmental and economic benefits in New Mexico (Darapuneni, Idowu, and Lauriault. Corn constitutes about 17% of New Mexico’s irrigated crop area. Research conducted at Tucumcari estimates the strip tillage yield advantage in corn in New Mexico to be $12.9 million in value over conventional tillage, in addition to considerable energy savings. Additionally, conservation tillage has relative advantages of controlling soil erosion and improving water-and nutrient-use efficiency. This project addressed the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Planting legumes with sorghum forages increases forage nutritive value (Darapuneni, Angadi, and Lauriault). A $750,000 revenue increase annually could result if 5% of New Mexico’s growers implemented the practice. Research evaluating canopy development and light interception patterns of several sorghum - legume mixtures demonstrated that faster canopy coverage and greater light interception occurred early in the growing season compared with monoculture sorghum. Lablab, cowpea, lima bean, and pole bean are promising legumes. This project addressed the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Intercropping with turnip improved sweet corn stover forage nutritive value (Lauriault and Guldan). Corn stover is grazed in winter by livestock but the nutritive value is low. Research at NMSU’s Alcalde Sustainable Agriculture Science Center showed that turnip had greater nutritive value than oat and intercropping with turnip improved an indicator of sweet corn stover digestibility. Intercropping either oat or turnip into sweet corn increased animal gains compared to sweet corn-alone. This project addressed the Food and Fiber Production and Marketing, Water Use and Conservation, and

Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Cotton lines developed through interspecific introgression breeding of Upland and Pima cotton have been identified to improve Verticillium wilt (VW) resistance in cotton breeding programs (Martinez, Zhang, and Darapuneni). In a greenhouse study on NMSU's campus in Las Cruces, VW resistance was evaluated on 530 lines of which five showed resistance to VW, namely, NMIL348, NMIL518, NMIL405, NMIL290, NMIL307. This program addresses the Food and Fiber Production and Marketing Pillar for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Below are impact statements based on results from the ongoing research projects described in this report. Bear in mind that these impacts represent a single year of research and that multiple years of data are required to substantiate results. Please see the Table of Contents to find additional information and results.

Agronomic Research

<u>Semi-arid Cropping Systems</u>

Strip-till zone manure application in dryland increases the resource-use efficiency and on-farm profitability (Darapuneni, p. 20). Manure application costs can be cut by up to 60% by applying manure only in the strip-till zone. Additionally, three years after a single 10 tons /A manure application, with or without incorporation, grain sorghum biomass continues to be greater by no-till planting into the original strip-till zone. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Use of opportune/cover crops to replace the winter fallow period in semi-arid cropping systems could help farming communities achieve higher resource-use efficiency (especially water and nutrients) and productivity (Darapuneni, p. 23). Introducing diversity into a traditional rotation will ensure better soil health. Planting efficient winter crops in the fallow provides a forage source for cattle but also potentially generates additional income by producing seed under favorable weather conditions. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Use of opportune/cover crops to replace the summer fallow period in semi-arid cropping systems could help farming communities achieve higher resource-use efficiency (especially water and nutrients) and productivity as well as promote broader marketing opportunities economics (Darapuneni, p. 24). Understanding the water use dynamics of various cover crops and increasing diversity in the cropping systems could reduce the seasonal risk of crop failures due to water scarcity. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Canola has potential for producing not only high-valued oil grain but also excellent forage during the winter season as an alternate winter rotation option to winter wheat (Darapuneni, p. 27). Determining the appropriate N-application timing will not only help producers maximize the yield and quality of winter canola but also improve the N-use efficiency and on-farm economical returns in the semi-arid New Mexico. This project addresses the Food and Fiber Production and Marketing, Water Use and

Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Forage Crops

The application of a multi-nutrient source to potassium-deficient soils has tremendous potential for boosting alfalfa yield and nutrient value (Darapuneni, p. 28. Alfalfa (*Medicago sativa* L.) is among the top cash crops of New Mexico. In Alfalfa, potassium (K) alone constitutes about 2.5% of tissue weight. This multi-nutrient fertilizer also supplements sulfur (S) and magnesium (Mg) for better growth and development in alfalfa. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Alfalfa planting date has an effect on short and long-term alfalfa production and economics (Lauriault, p. 29). Previous results from research initiated in 2013 demonstrate that spring planting of alfalfa allows for recovery of some or all of the establishment costs in the seeding year, thereby, reducing interest in those inputs. Data collection concluded in 2018 demonstrates a more long-term benefit to earlier planting of semi-dormant varieties. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Irrigating with treated municipal wastewater may reduce alfalfa growth (Lauriault, p. 31). Municipalities seek to minimize the release of potential pollutants in treated wastewater into surface and ground water bodies. Alfalfa is adapted to a wide range of environmental factors. Ongoing research has discovered a potential effect of wastewater irrigation on seedling alfalfa growth and established alfalfa nutritive value and soil fertility characteristics. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Nematodes are adapted to New Mexico that may control whitefringed beetle in alfalfa (Lauriault, p. 34). Early stand decline in alfalfa throughout New Mexico is increasingly being associated with whitefringed beetle (WFB) larval feeding, but no insecticides are labeled or effective to control WFB adults or larva in alfalfa. Entomopathogenic nematodes that prey on a wide range of soil larvae, including WFB and its relatives are adapted to northeastern New Mexico's climatic and soil conditions. This project addresses the Food and Fiber Production and Marketing and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Perennial forage kochia may be an alternative to alfalfa (Lauriault, p. 36). Alfalfa growers in semiarid regions seek forages requiring less irrigation. Perennial forage kochia, known as "the alfalfa of the desert," is not invasive and has value for pasture in cool desert regions. Preliminary research has discovered that perennial forage kochia is adapted to the Southern High Plains and, with minimal irrigation, can potentially be as productive as alfalfa. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Planting legumes with cereal forages can increase yield and nutritive value (Lauriault, Darapuneni, and Martinez, p. 38). Pearl millet and cowpea are well-adapted and productive, but their performance in mixtures under irrigated and rainfed conditions has not been evaluated. Preliminary research indicates that, while nutritive value of the mixture was slightly increased compared the monocultures, mixture yield per unit of land was reduced when the species were planted in the same row. This project addresses the

Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Crop Variety Performance Evaluations

Chinese dates are a locally well-adapted potential alternative crop to help small-scale farmers (Lauriault and Martinez, p. 41). Low available water and late frosts challenge fruit production in eastern New Mexico. Chinese dates, also called Jujubes, are drought tolerant once established and avoid spring frosts by blooming later. Jujubes can be found growing in the wild in eastern New Mexico, but improved varieties must be evaluated. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, Family Development and Health of New Mexicans, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Alfalfa variety testing potentially returns $38 million to New Mexico's growers (Lauriault, p. 43) Variety selection is key to a highly productive alfalfa stand. Differences between the highest- and lowest-yielding varieties in irrigated alfalfa tests statewide ranged from 0.99 to 2.41 tons per acre in 2018. If sold as hay, this translates to a potential difference in returns of $213 to $518 per acre due to variety, or an increase of at least $38 million for the industry. This project addresses the Food and Fiber Production and Marketing Pillar for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Livestock Research

Interest is increasing in whether winter canola can be grazed as an alternative crop in wheat rotations in the Southern High Plains (Lauriault, Angadi, and Darapuneni, p. 45). Preliminary results of previous research indicates that beef cattle gains on canola in autumn were equal to those on pearl millet and greater than gains on haygrazer. Winter and spring grazing also must be evaluated for animal productivity as well as for effects on grain production. This project addresses the Food and Fiber Production and Marketing and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Grazing field bindweed may reduce clonal regeneration (Lauriault and Darapuneni, p. 46). Field bindweed is a competitive, summer-active weed that reduces productivity in irrigated pastures. No-tillage overseeded winter cereals could reduce competition by field bindweed when it begins growth in the spring and encourage encroachment by desirable species during the growing season. Preliminary results indicate a reduction in bindweed biomass and a reduction in the number of clones in the spring by grazing in the previous fall. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

The Tucumcari Bull Test and Sale continues to grow in scope and scale (Ward, p. 49). From 2013 to 2018, animals tested annually have grown from 75 bulls to 350 bulls and heifers entered by eight to 22 seedstock producers. Sale attendance has grown from approximately 75 cattle growers in 2013 to approximately 250 attending in person or online in 2018. In fall 2018, NMSU initiated a project to measure individual water consumption. This program addresses the Food and Fiber Production and Marketing and Water Use and Conservation Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Introduction

The New Mexico State University Agricultural Science Center at Tucumcari is located on U.S. Highway 54 three miles northeast of Tucumcari and Interstate 40, Exit 333. The center consists of 464 acres, with 170.9 acres having Arch Hurley Conservancy District water rights and a contract for 300 acre-feet annually for treated municipal wastewater to be delivered from the City of Tucumcari Wastewater Treatment Plant. In operation since 1912, the center is New Mexico State University's oldest continuously operating off-campus research facility. In addition to crop and livestock studies, historical research at the center evaluated trees for windbreak and farmstead plantings, which led to the establishment of over 50 species of trees and shrubs on the center grounds, making it an oasis of trees in a sea of native grassland.

Significant events at the Agricultural Science Center in 2018 included: (1) Another upgrade of the Tucumcari Beef Cattle Feed Efficiency Testing Facility by TFET, LLC; (2) an attendance of 101 at Field Day with a pre-field day program providing pesticide CEUs, and (3) purchase of a traveling gun portable sprinkler system to expand irrigation capacity. Other activities hosted or participated in by the staff at the Agricultural Science Center at Tucumcari along with ongoing research projects are described in this publication, which is available online at http://tucumcarisc.nmsu.edu/projects--results.html. A new feature in this year's report is a section at the beginning (pages ??-??), which includes impact statements for research published in 2018 and projects described in the report.

Outreach Events, Productivity, and Activities

Beef Cattle Feed Efficiency Testing

Information about the Tucumcari Feed Efficiency Tests are presented in a separate article beginning on page 49 of this report.

Pre-Field Day Program

The center hosted a special program during the afternoon of August 9, 2018, prior to the Annual Field Day with 10 in attendance. The program, held in the Conference Building, included presentations by Carol Sutherland, NMSU Extension Entomologist, and Leslie Beck, NMSU Extension Weed Specialist and provided 2 CEUs for pesticide applicators.

Field Day

The center hosted its Annual Field Day during the evening of August 9, 2018, with 101 in attendance. The program, held in the Bull Test Sale Barn, included dinner, sponsored by local businesses and catered by the Roadrunners 4-H Club as a fundraiser, preceded by a presentation by New Mexico State University President, Dr. John Floros. New Mexico State University Chancellor, Dr. Dan Arvizu, also made comments.

The field tour went to the center's North Farm Pivot and included the following presentations:

- Carol Sutherland, NMSU Extension Entomologist: Salt cedar beetle update.
- Leslie Beck, NMSU Extension Weed Specialist: Managing weeds.
- Jason Lamb, NMSU Quay County Cooperative Extension Service Agent for Agriculture: Quay County Beginning Farmers Land Access and Mentorship Program.
- Murali Darapuneni, NMSU Semiarid Cropping Systems Specialist: Opportune cropping.
- Gasper Martinez, NMSU Agricultural Research Assistant: Demonstration of soil moisture sampling for research.
- Leonard Lauriault, NMSU Forge Crop Management Scientist: Candidate summer annual forage legumes.

NMSU Chancellor Dan Arvizu (left) and President John Floros (3rd from left) interact with Field Day attendees (Photo by NMSU's Darrell Pehr).

Dinner and refreshments were sponsored by the local businesses listed on page iv.

Other Public Programs Hosted by the Agricultural Science Center in 2018

ON March 16, the center hosted a tour for the NM Ag Leadership Class.

On March 30, the center hosted a 4-H tagging day.

On October 17, the center hosted a field laboratory lecture for the Mesalands Community College Range Science Class.

On October 18, the center faculty participated in a Grains, Goats, Greens, and More activity for 4th and 5th grades from five area elementary schools. Participants included 219 students, 28 teachers and volunteers, and 8 presenters. The Quay County Cooperative Extension Service was the primary sponsor of this activity.


Leonard Lauriault talks with 4th & 5th graders about grains, greens, and goats' guts (Photo by NMSU's Joyce Runyan).

The center also remained open for tours of the Eastern New Mexico Outdoor Arboretum.

Quay County Cotton Boll Weevil Control District

The Agricultural Science Center at Tucumcari continued to assist the Quay County Cotton Boll Weevil Control District (QCCBWCD) with its activities in 2018. Jason Lamb, Quay County Cooperative Extension Service Agent for Agriculture, scouted for boll weevil and pink bollworm using traps with no captures.

Advisory Committee

The Advisory Committee to the Agricultural Science Center at Tucumcari met March 13 and December 13, 2018, at the PowWow Restaurant to provide input on research programs and continue development of their program enhancement initiative and infrastructure capital improvement plan. The committee began the process of developing bylaws. Minutes of both meetings are available upon request at the center's office. Advisory Committee members are listed on page iv.

Personnel and Facilities

Personnel

Gasper Martinez began as Agricultural Research Assistant at the center effective March 26, 2018, replacing Ashley Cunningham, who had resigned in December 2017. An ongoing labor shortage on the farm staff continued to limit completion of non-critical physical plant projects in 2018. Paperwork to hire a part-time Laborer, Sr., was initiated in December 2018.

A list of temporary employees at the center in 2018 is shown below:

Name	Job Title	Dates of Employment
Alice Johnson	Custodian	01/01/2018 – 12/31/2018

Internal and External Connections

Several College of Agricultural, Consumer and Environmental Sciences personnel from other locations worked cooperatively with staff at the Tucumcari center in 2016. These individuals included: Ram Acharya, Samuel Allen, Sangu Angadi, Leslie Beck, Sultan Begna, Ashley Bennett, Jane Breen-Pierce, Owen Burney, Shad Cox, Efren Delgado, Koffi Djaman, David DuBois, Glenn Duff, Nancy Flores, Robert Flynn, Rajan Ghimere, Befekadu Goraw, Lois Grant, Kulbhushan Grover, Steve Guldan, Ivette Guzman, Robert Hagevoort, Wendy Hamilton, Charles Havlik, Omar Holguin, John Idowu, Del Jimenez, Jason Lamb, Bernd Leinauer, Kevin Lombard, Steve Loring, Mark Marsalis, Abdel Mesbah, Mick O'Neill, Chris Pierce, Tom Place, Gino Picchioni, Rich Pratt, Naveen Puppala, Ian Ray, Joyce Runyan, Aaron Scott, Eric Scholljegerdes, Brian Schutte, Gerald Sims, Blair Stringham, Carol Sutherland, Dave Thompson, Marisa Thompson, April Ulery, Frank Ward, Marcy Ward, Margaret West, Shengrui Yao, and Jinfa Zhang.

Individuals from outside the NMSU College of Agricultural, Consumer and Environmental Sciences, who worked cooperatively with center staff in 2018 were:

New Mexico State University:
Robert Steiner (Economics, Applied Statistics & International Business Department)
Catherine Brewer, Reza Foudazi, and Umakanta Jena (Chemical and Materials Engineering Department)

New Mexico:
Arch Hurley Conservancy District: Franklin McCasland
Gary Balzano, Balzano Farms, Tucumcari
Phillip Box, Box Farms, Tucumcari
Canadian River Soil and Water Conservation District: Supervisors and Diana Cassidy/Sandy Morgan
Canadian River Riparian Restoration Project: Jack Chatfield
City of Tucumcari: Britt Lusk, City Commission, and Calvin Henson
Tom Goncharoff, Crystal Springs Farm, Tularosa
Greater Tucumcari Economic Development Corporation, Patrick Vanderpool and Board of Directors
Mesalands Community College: John Groesbeck, Staci Stanbrough, and students of Animal and Plant Science Classes
Northeast New Mexico Regional Water Planning Committee
Ute Lake Watershed Alliance: Jack Chatfield and Mark Murphy
New Mexico Department of Agriculture: Secretary Jeff Witte
New Mexico Department of Cultural Affairs: Eric Blinman
New Mexico Economic Development Department: Tim Hagaman
New Mexico Hay Association: Board of Directors
New Mexico State Legislature: Senator Pat Woods and Representative Dennis Roch/Representative-elect Jack Chatfield
New Mexico Transportation Department
New Mexico Water Trust Board
Quay County Cotton Boll Weevil Control District
Quay County Government: County Commission, Larry Moore, and Richard Primrose
Quay County Sun: Thomas Garcia, Steve Hanson, and Ron Warnock
Quay County TableTop Food Co-op: David White and others
Rocky Mountain Farmers Union: Susann Mikkelson
Tucumcari Bio-Energy and Aquaponics: Bob Hockaday and David White
Tucumcari Feed Efficiency Test, LLC dba Tucumcari Bull Test: Leadership and Members
Tucumcari Public Schools: Tonya Hodges and Veronica Hernandez
Tucumcari/Quay County Chamber of Commerce: Carmen Runyan
USDA: Kenneth Alcon (NRCS, Las Vegas, NM) and Relissa Nials (NRCS, Tucumcari, NM)
Western Mora Soil and Water Conservation District

USA:
Cornell University: Elson Shields and Antonio Testa
National Science Foundation
Louisiana State University, Bossier City: Syam Dodla
South Dakota State University, Brookings: David Clay
Syngenta Crop Protection, Bloomington, MN: Yujin Wen
Texas A&M University, College Station: Gaylon Morgan
Texas AgriLife Research and Extension: Jourdan Bell (Amarillo), G. Ray Smith (Overton), and Pat Porter and Calvin Trostle (Lubbock)
Texas Boll Weevil Eradication Foundation: Lyn Vandiver
University of Kentucky: Ben Goff
University of Nebraska, Scottsbluff: Gary Hergert, Jeff Bradshaw and Robert Harveson
University of Wisconsin – Madison: Francisco Contreras-Govea
University of Wyoming: Jonathan Brant
USDA: N.A. Cole and Prasanna Gowda (ARS, Bushland, TX), Aaron Miller (APHIS, Abilene, TX), Scott Van Pelt (Big Spring, TX), and Blair Waldron (ARS, Logan, UT)
USDA - NIFA

West Texas A&M University, Canyon: Bob Stewart and Brock Blaser
Valent USA Corporation: Chris Meador

Brazil:
University of Sao Paolo: S.C. Mello

India:
ICRISAT, Hyderabad, Telangana
Netaji-Subash ICAR, New Delhi: Debunkar Sanyal
Tamil Nadu Agriculture University, Kumulur, Tiruchirappalli: K. Annadurai
University of Agricultural Sciences, Raichur: M.R. Umesh

Mexico:
INIFAP, Sonora: Alejandro Suárez and Luis Tamayo
SENASICA: Mexico City: Gustavo Torres
Universidad Autónoma de Baja California: Leonel Avendaño-Reyes, David Calderon-Mendoza, Francisco Loya-Olguín, and Rafael Villa-Angulo

Pakistan:
Faculty of Agricultural Sciences, Ghazi University, Dera Ghazi Khan
Faculty at the University of Agriculture, Faisalabad
Faculty at MNS University of Agriculture, Multan

Punjab:
The Islamia University of Bahawalpur

United Kingdom:
Sirius Minerals, Scarborough: Kiran Pavuluri and Brad Farber

Buildings, Grounds, and Facilities

An engineering evaluation of the residence foundation in late 2017, received in early 2018, provided recommendations for remediating foundation settling that included removal of the chimney from the living room fireplace, maintaining a 6-foot vegetation-free zone around the foundation, and diverting rainwater/snow melt to at least 10 feet from the foundation. Storm water diversion was accomplished in 2018. A crack on each side of the mid-house load-bearing wall was designated for annual measurement (January 1 to January 1 of each year) for which the superintendent was trained. During 2018, the crack on the west side, on the living room south wall did not change. The crack on the east side, in the north wall of the foyer increased by approximately 1/16”.

Significant changes took place in 2018 in the Eastern New Mexico Outdoor Arboretum at the Agricultural Science Center at Tucumcari. The live oak finally perished and was removed; the Fremont’s cottonwood, crabapple, chinkapin oak, original smoketree, pyracantha, silky dogwood, willow baccharis, and Zabele honeysuckle were removed, having perished in 2017; and the Arizona ash was trimmed of dead limbs. The Zabele honeysuckle was part of the USDA onset of spring evaluations with honeysuckle plantings in 1968 throughout the western USA. Another honeysuckle from that planting still survives. It is likely that the center also had participated in or was added to an evaluation using purple common lilacs initiated in 1957 with two cultivars, both of which remain.

Other alterations and improvements to the grounds included trimming the juniper across the driveway from the office to remove dead limbs and the Siberian elm in front of the lab to remove limbs protruding into the driveway. Four Chinese arborvitae in a row southward from the residence garage were removed because they had perished. Mulberry trees west of both garages also perished and were removed.

Problems occurring in late 2017 with the application systems of both irrigation water sources were repaired in late May 2018. The wastewater system was shut down again for the second half of August due to a diesel fuel contamination at the wastewater treatment plant.

Irrigation Water

The annual Arch Hurley Conservancy District assessment for 2018 was $14.00 per water right acre and the delivery charge was $10/acre-foot. The center had retained a credit of $673.35 for pre-paid water from 2017. Water was first released into the canal on April 8, 2018, and turned off on October 31. While 18 in/A was initially allocated (the first full initial allocation since 1999), another 4 in/A were allocated on July 10, making the total allocation 22 in/A or 313.32 acre-feet for the center, of which only 13 acre-feet was ordered by the center. The center retained a credit of $543.35 for pre-paid water from 2018.

Delivery of treated wastewater from the City of Tucumcari Wastewater Treatment Facility for irrigation began in late May after the system was repaired, but it was interrupted again with no deliveries in the second half of August. A total of 65.7 acre-feet were applied from May through December through the three center pivots. The total amount paid by the center to the City for that water was $13,247.50, including $9,000 for the water, under a 20-year contract for 300 acre-feet/year, and $4247.50 in electricity for pumping and labor to read the meters. Wastewater delivery system upgrades to allow for greater storage capacity at the treatment plant using funds provided by the Agricultural Experiment Station in 2016 were not completed in 2018 due to city labor shortages; however, significant progress was made. The City is also planning to purchase land to develop greater storage capacity and additional application capacity to attain 100% reuse. Every six months a semi-annual report is submitted to NMED showing monthly water use, meter inspection, and amount of nitrogen applied to the water use area. Those reports are available from the center upon request. The original permit was renewed with some modification in June 2017 and the current permit will expire in June 2022.

Sustainability and Environmental Stewardship

Continuing with sustainability through recycling in 2018, staff at the Agricultural Science Center at Tucumcari recycled 215.2 lb plastic; 44.8 lb glass; 55.0 lb tin; 73 lb aluminum cans; 30 ink or toner cartridges; and 916.8 lb paper and other fiber products. Purchased paper totaled 199.2 lb for 2018. Additionally, approximately 36.3 gal of non-fuel petroleum lubricants were purchased in 2018 while 50 gal of oil was recycled.

Community Service

The center provided three soil pits for the Tucumcari FFA Land Judging Team to use for practice prior to attending the National Land Judging Event. After the practice, the location of each pit was noted for future use and then the pits were filled. Additionally, manure samples were provided to Tucumcari Bio-Energy to evaluate methanol potential and the USDA conducted wind erosion evaluations at two sites at the center as part of a regional study.

Students

Murali Darapuneni

Bilgi Sarihan (Master’s committee co-chair): Impacts of selected cover crops on wind erosion control

Randall Montgomery (Doctoral committee member): Blue corn evaluations under salt stress conditions. (completed December 31, 2019).

Sifat Sultana (Master’s committee co-chair): Tillage effects on corn and cotton. (completed December 31, 2018).

Brad Crookston, Josh Machicek (Master’s committee member as adjunct faculty at West Texas A&M University in collaboration with Brock Blaser): Pearl millet response to irrigation, row spacing, and tillage in the Texas High Plains (completed May 31, 2018).

Productivity

Peer-Reviewed Publications

Journal Articles

Bohara, H., Dodla, S., Wang, J. J., **Darapuneni, M. K.**, Acharya, B. S., Magdi, S., Pavuluri, K. (2019). Influence of poultry litter and biochar on soil water dynamics and nutrient leaching from a very fine sandy loam soil. *Soil and Tillage Reseaerch,* In press.

Bohara, H., Dodla, S., Wang, J. J., **Darapuneni, M. K.**, Kongchum, M., Fromme, D.D., and Harrell, D. (2018). Impacts of N-stabilizers and biochar on nitrogen losses, nitrogen phytoavailability, and cotton yield in poultry litter-fertilized soils. *Agronomy Journal, 110*, 2016-2024.

Darapuneni, M. K., Angadi, S., Umesh, M., Contreras-Govea, F., Annadurai, K., Begna, S., Marsalis, M. A., Cole, A., Gowda, P., Hagevoort, G. R., **Lauriault, L. M.** (2018). Canopy development of annual legumes and forage sorghum intercrops and its relation to dry matter accumulation. *Agronomy Journal, 110*, 939-949.

Darapuneni, M. K., Idowu, O. J., **Lauriault, L. M.**, Dodla, S., Pavuluri, K., Ale, S., Grover, K., Angadi, S. (2019). Tillage and nitrogen rate effects on corn production and residual soil characteristics. *Agronomy Journal,* In press.

Hergert, G. W., Nielsen, R. A., Schild, J. A., Hawley, R. L., **Darapuneni M. K.**. (2019). Row-applied iron chelate for correcting iron deficiency chlorosis in dry bean. *Agronomy Journal,* In press.

Lauriault, L. M., Guldan, S. J., Popiel-Powers, F., Steiner, R. L., Martin, C. A., Heyduck, R., Falk, C. L., Petersen, M., May, T. (2018). Relay intercropping with cover crops improved autumn forage potential of sweet maize stover. *MDPI Agriculture, 8(103)* (12 pp).

Martinez, G.K., **Darapuneni**, **M. K.,** Abdelraheem, A., McCarty, J., Jenkins, J., Zhang, J. (2018). Evaluation of a multi-parent advanced generation inter-cross (MAGIC) introgressed line population for Verticillium wilt resistance in Upland cotton. *Euphytica, 214*, 197 (8 pp.).

Mello, S. C., Neto, D. D., **Darapuneni**, **M. K.**, Pavuluri. K. (2018). Response of tomato to polyhalite as multi nutrient fertilizer in southeast Brazil. *Journal of Plant Nutrition, 41(6),* 2126-2140.

Wen, Y., **Darapuneni**, **M. K.**, Chen, D., Piccinni, G., Cothren, T., Leskovar, D., Pavuluri, K., Rowland, D. (2018). The phenotypical responses of cotton and their relation to lint yield under traditional and regulated deficit irrigation schemes in semi-arid environments. *Agronomy Journal, 110*, 1339-1353.

Conference Proceedings

Sultana, S. (graduate student), Idowu, J., **Darapuneni, M. K.,** Zhang, J., Omer, M. 920180. Reduced tillage effects on cotton growth and yield in New Mexico. Beltwide Cotton Conference Proceedings, San Antonio, TX, January 3-5, 2018.

Extension Publications

Lauriault, L. M., Marsalis, M. A., Ward, M. A. (2018). *Circular 586 (major revision with peer-review), Irrigated pasture management in New Mexico*. Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University. http://aces.nmsu.edu/pubs/_circulars/CR586.pdf.

Lauriault, L. M., Thompson, D., Pierce, J., Bennett, A., Schutte, B., Beck, L., Sutherland, C., Jimenez, D., Hamilton, W. (2018). *Circular 600 (major revision with peer-review), Managing Aceria malherbae gall mites for control of field bindweed* (pp. 12). Las Cruces: New Mexico State University. http://aces.nmsu.edu/pubs/_circulars/CR600.pdf

Non-Peer-Reviewed Publications

Experiment Station Publications

Lauriault, L. M., Ray, I., Pierce, C., Burney, O., Djaman, K., Flynn, R. P., Marsalis, M. A., Allen, S., Martinez, G., Havlik, C., West, M. (2018). *The 2018 New Mexico Alfalfa Variety Test Report*. Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University. https://aces.nmsu.edu/pubs/variety_trials/AVT18.pdf

Lauriault, L. M., Ray, I., Pierce, C., Burney, O., Flynn, R. P., Marsalis, M. A., O'Neill, M. K., Cunningham, A., Havlik, C., West, M. (2018). *The 2017 New Mexico Alfalfa Variety Test Report*. Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University. http://aces.nmsu.edu/pubs/variety_trials/AVT17.pdf

Marsalis, M. A., Flynn, R. P., **Lauriault, L. M.**, Mesbah, A., O'Neill, M. K. (2018). *New Mexico 2017 Corn and Sorghum Performance Tests*. Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University. http://aces.nmsu.edu/pubs/variety_trials/2017CornSorghumPerformanceReport.pdf

Other Publications Not Noted Above

Beck, L. L., Marsalis, M. A., **Lauriault, L. M.** (2018). In Jon Dockter (Ed.), Evaluation of the efficacy of various herbicides for control of broadleaf (*Plantago major*) and buckhorn (*Plantago lanceolata*) plantain in alfalfa. St. Paul, MN USA: National Alfalfa & Forage Alliance. https://www.alfalfa.org/pdf/researchArticels/17Beck.pdf (posted October 4, 2018).

Darapuneni, M. K., **Lauriault, L.**, Idowu, J. (2018) Water use and yield potential of winter and summer alternate/cover crops. ASA, CSSA, SSSA Meetings Abstracts, Baltimore, MD. November 4-7, 2018.
Lauriault, L. M. (2018). Spray rigs for rent (1st ed., vol. 1, pp. Page 2). Tucumcari, NM: Canadian River Soil and Water Conservation District newsletter, November 1, 2018.
Lauriault, L. M. (2018). What I learned at the 2018 Western Society of Crop Science Meeting. Self-published email.
Lauriault, L. M., Marsalis, M. A. (2018). Alfalfa planting date effects on nutritive value during early stand life. Western Society of Crop Science Annual Meeting Abstracts. June 19-20, 2018.
Sarihan, B. (graduate student), **Darapuneni, M .K.**, Idowu, O. J., DuBois, D., Grover, K. (2018). Impacts of selected summer cover crops on wind erosion control (poster abstract). In Culture, Climate, and Conservation.73rd SWCS International Annual Conference, Albuquerque, NM. Jul. 29-Aug.1. #10.
Sarihan, B. (graduate student), **Darapuneni, M .K.**, Idowu, O. J., DuBois, D., Grover, K. (2018). Impacts of selected summer cover crops on wind erosion control (poster). Western Society of Crop Science Annual Meeting Abstracts. Laramie, WY. June 19-20, 2018.
Sarihan, B. (graduate student), **Darapuneni, M .K.**, Idowu, O. J., DuBois, D., Grover, K. (2018). Impacts of selected summer cover crops on wind erosion control (poste abstract; **3rd prize in poster competition**). New Mexico Sustainable Agriculture Conference, Los Lunas, NM. December 12, 2018.
Sultana, S. (graduate student), Idowu, J., **Darapuneni, M .K.**, Zhang, J., Omer, M. (2018). Effects of tillage methods on cotton growth and yield in New Mexico (poster). Western Society of Crop Science Annual Meeting Abstracts. Laramie, WY. June 19-20, 2018.
Sultana, S. (graduate student), Idowu, J., **Darapuneni, M .K.**, Zhang, J., Omer, M. (2018). Reduced tillage effects on cotton growth and yield in New Mexico (poster abstract). 2018 Beltwide Cotton Conference, San Antonio, TX, January 3-5, 2018.
Sultana, S. (graduate student), Idowu, J., **Darapuneni, M .K.**, Beck, L., Steiner, J. (2018). Reduced tillage effects on corn silage yield and quality in Southern New Mexico (poster abstract). New Mexico Sustainable Agriculture Conference, Los Lunas, NM. December 12, 2018

Presentations

Lauriault, L. M. The New Mexico Sustainable Agriculture Conference, NMSU Cooperative Extension Service and WSARE, Los Lunas, NM, Fencing options for livestock, (December 12, 2018).
Lauriault, L. M. 9th Annual Forage Growers Workshop, NMSU Valencia County Cooperative Extension Service, Los Lunas, NM, Alfalfa management to maximize nutritive value, (December 4, 2018).
Lauriault, L. M., Quay County Private Applicators' Workshop, Quay County Cooperative Extension Service, Tucumcari, An update on whitefringed beetle research in Quay County, (November 27, 2018).
Darapuneni, M. K., **Lauriault, L.**, Idowu, J. ASA, CSSA, SSSA Meetings, Baltimore, MD, Water use and yield potential of winter and summer alternate/cover crops. (November 6, 2018).
Lauriault, L. M., Grains, Goats, Greens & More, NMSU Quay County Cooperative Extension Service Office, Tucumcari, NM, Grass, grains, goats, and more. (October 18, 2018).
Darapuneni, M. K., Grains, Goats, Greens & More, NMSU Quay County Cooperative Extension Service Office, Tucumcari, NM, Plant parts and functions, (October 18, 2018).
Darapuneni, M. K., Field Day, Agricultural Science Center, Tucumcari, NM, Opportune cropping. (August 9, 2018).
Lauriault, L. M., Field Day, Agricultural Science Center, Tucumcari, NM, Candidate summer annual forage legumes, (August 9, 2018).
Martinez, G. K., Field Day, Agricultural Science Center, Tucumcari, NM, Demonstration of soil moisture sampling for research, (August 9, 2018).
Lauriault, L. M., Employee Chemical Safety Training, Tucumcari Public Schools, Tucumcari, NM, Using cleaning products and pesticides safely, (May 11, 2018).
Lauriault, L. M., 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).
Lauriault, L. M., Marsalis, M. A., Annual Meeting of the Western Society of Crop Science, Western Society of Crop Science, Laramie, WY, Alfalfa planting date effects on nutritive value during early stand life, (June 20, 2018).

Grants and Contracts

Funded:

Darapuneni, M. K. (Principal), **Lauriault, L. M.** (Co-Principal), Sponsored Research, Alfalfa response to Polyhalite in New Mexico, Sponsoring Organization: Sirius Minerals Plc, Sponsoring Organization Is: Other, Total Award: $34,500.00. November 25, 2017-October 31, 2019.

Marsalis, M. A. (Co-Principal), **Lauriault, L. M.** (Co-Principal), Beck, L. L. (Principal), Sponsored Research, Evaluation of the Efficacy of Various Herbicides for Control of Broadleaf (*Plantago major*) and Buckhorn (*Plantago lanceolata*) Plantain in Alfalfa, Sponsoring Organization: National Alfalfa & Forage Alliance, Sponsoring Organization Total Award: $10,000.00. October 1, 2017-May 31, 2019.

Not Funded: None

Pending:

Darapuneni, M. K. (Principal), Sponsored Research, Profiling summer annual crops for water use- crop selection decision for improving water use efficiency and productivity in the semi-arid wheat based cropping systems., Sponsoring Organization: Western SARE. Research Credit: $49,560 PI Total Award: $49,560.00. May 15, 2019-December 31, 2020.

Other External Funding

Angadi, S., **Darapuneni, M. K.** Winter Canola Nitrogen Mangament, ASC-Clovis Collaboration, $4,000.00, Description: Collaborative project with Dr. Sangu Angadi, Status: Funded, Effective Start Date: September 15, 2018.

Darapuneni, M. K. AES Graduate Research Awards, Agricultural Experiment Station-NMSU, $40,000.00, Description: Graduate student will be starting Spring, 2017, Status: Funded, Effective Start Date: December 2016, Effective End Date: December 2018.

Darapuneni, M. K. Turkish Scholarship-Graduate Funding, Turkish Government, $50,000.00, Description: Will start his program Spring, 2017. The amount is funded for his Masters program, Status: Funded, Effective Start Date: December 2016, Effective End Date: December 2018.

Lauriault, L. M. Fee-based alfalfa variety testing, 2018, Multiple seed companies, $2425.00, Description: Entry fees for alfalfa varieties planted in one year and compared for the next three years at various NMSU locations across the state, Status: Funded, Effective Start Date: April 1, 2018, Effective End Date: December 31, 2021.

Lauriault, L. M. Fee-based alfalfa variety testing, 2017, Multiple seed companies, $2125.00, Description: Entry fees for alfalfa varieties planted in one year and compared for the next three years at various NMSU locations across the state, Status: Funded, Effective Start Date: April 1, 2017, Effective End Date: December 31, 2020.

Lauriault, L. M. Fee-based alfalfa variety testing, 2015, Multiple seed companies, $6,225.00, Description: Entry fees for alfalfa varieties planted in one year and compared for the next three years at various NMSU locations across the state, Status: Funded, Effective Start Date: April 1, 2015, Effective End Date: December 31, 2018.

Lauriault, L. M. Fee-based corn and sorghum variety testing, 2018, Multiple seed companies, $3850.00 (after refunding 50% due to planting but no harvesting), Description: Entry fees for corn and sorghum varieties, Status: Funded, Effective Start Date: April 1, 2018, Effective End Date: December 31, 2017.

Lauriault, L. M. Fee-based cotton variety testing, 2018, Multiple seed companies, $875.00 (after refunding 50% due to planting but no harvesting), Description: Entry fees for cotton varieties, Status: Funded, Effective Start Date: April 1, 2018, Effective End Date: December 31, 2018.

Lauriault, L. M. Donations for Field Day and other outreach activities, 2018, Local and regional businesses, $1575.00, Description: Funds solicited to support outreach and educational programs, Status: Funded, Effective Start Date: January 1, 2018, Effective End Date: December 31, 2018.

Lauriault, L. M. Gift, New Mexico Hay Association, $5,000.00 ($4000 were sent directly to Cornell University to cover laboratory analysis costs for a specific project), Description: Gift toward forage research program, Status: Funded, Effective End Date: December 31, 2018.

Lauriault, L. M. Gift, Valent, USA, $5,000.00, Description: Gift toward forage research program, Status: Funded, Effective End Date: December 31, 2018.

Other Activities

Jason Box

Arch Hurley Conservancy District: Attended and participated in monthly meetings whenever possible as an interested party.

New Mexico Environment Department: Maintained and submitted semi-annual reports for wastewater use at station including total water usage, nitrogen fertilizer applications, and septic tank conditions.

Murali Darapuneni

Member of Plant and Environmental Sciences Department Undergraduate Student Recruitment and Retention Committee. (August 2015-Present).

Responded to questions from New Mexico residents regarding crop rotation/selection/ management practices.

Associate Editor, American Society of Agronomy, Editor, Madison, WI, USA, Made decisions (Reject/Accept) on 2 manuscripts during 2016 (August 2016 - August 2018).

Reviewed 4 manuscripts for two scientific journals.

Leonard Lauriault

Conducted employee chemical safety training for Tucumcari Public School janitorial staff (May 11, 2018).

Judged Agricultural Products, Quay County Fair, Tucumcari, NM, USA (August 15, 2018).

Coordinated NMSU's statewide alfalfa variety testing program.

Responded to over 60 miscellaneous questions from New Mexico residents, including NMSU NRCS, and FSA personnel, as well as residents and extension personnel in other states.

Tucumcari Feed Efficiency Test, LLC. Assisted with test weigh days and sale.

Continued program to distribute forage nitrate toxicity screening test kits to all interested AES and CES personnel in New Mexico.

Canadian River Soil and Water Conservation District: Attended and participated in monthly meetings whenever possible as an interested party; supervised maintenance and handled reservations for two seed drills and a tree-planter owned by the District for use by producers; assisted with the development of a rental agreement for two ATV-mounted sprayers.

Set up booth display about the activities of the Agricultural Science Center at the Quay County Fair (Tucumcari, August 15-18, 2018), as well as at the center's Bull Sale (March 10, 2018) and Field Day (August 9, 2018).

Quay County Table Top Food Co-op Exploration, Tucumcari, NM.

Reviewed 12 manuscripts for eight scientific journals.

Reviewed PhD research plan for student at MNS University of Agriculture, Multan, Pakistan.

Member of Certified Crop Advisor Board of New Mexico.

Member of Northeastern New Mexico Regional Water Plan Steering Committee.

Member of Ute Reservoir Watershed Alliance.

Member of AOSCA C655.4 National Alfalfa & Misc. Legumes Review Board, Alternate Liaison.

Member of Plant and Environmental Sciences Department (College Rank Spring and Fall Review).

Member of College of Agricultural, Consumer and Environmental Sciences Promotion and Tenure Committees.

Professional Development Activities and Other Meetings Attended Not Previously Mentioned

Jason Box

Continuing Education, Grazable Acres. Webinar (December 6, 2018).

Continuing Education, Amarillo Farm and Ranch Show, Amarillo, TX (November 29, 2018).

Continuing Education, Spray Equipment Setup. Webinar (September 6, 2018).

Continuing Education, Tucumcari ASC Field Day. Tucumcari, NM (August 9, 2018).

Continuing Education, Quay County Weed Workshop. Tucumcari, NM (April 4, 2018).

Continuing Education, Breakfast Round Table. Tucumcari, NM (February 27, 2018).

Continuing Education, High Plains Irrigation Conf. Amarillo, TX (February 7, 2018).

Murali Darapuneni

Conference Attendance, ASA, CSSA, and CCS meetings, Tri Societies, Baltimore, Maryland, USA. (November 5-7, 2018).

Conference Attendance, Western Society of Crop Science Annual Meeting, Western Society of Crop Science, Laramie, WY (June 19-20, 2018).
Seminar/Workshop, Quay county weed management workshop, NMSU Quay County Extension, Tucumcari, NM (April 4, 2018).

Leonard Lauriault
Continuing Education, The New Mexico Sustainable Agriculture Conference, NMSU Cooperative Extension Service and WSARE, Los Lunas, NM (December 12, 2018).
Continuing Education, The 9th Annual Forage Growers Workshop, NMSU Valencia County Cooperative Extension Service, Los Lunas, NM (December 4, 2018).
Continuing Education, Annual Meeting of the Western Society of Crop Science, Western Society of Crop Science, Laramie, WY (June 19-20, 2018).
Seminar/Workshop, Big Impact: Why impactful reporting matters and how to do it well, NMSU, Las Cruces, NM (May 22, 2018).
Short Course, Conflict, Communication and Change, New Mexico Risk Management Division Office of Alternative Dispute Prevention and Resolution, Las Cruces, NM, USA, 14 credit hours, approximately 14 hours spent per year, Certificate of Completion (May 3, 2018 - May 4, 2018).
Continuing Education, Tractor Safety, NMSU Environmental Health and Safety, Tucumcari, NM, USA, 1.25 credit hours (April 16, 2018).
Continuing Education, Let's Talk! Breakfast in Town, NMSU Corona Range and Livestock Research Center and Quay County Cooperative Extension Service, Tucumcari, NM (February 27, 2018).
Continuing Education, Mesquite Control Seminar, Local grassroots promotion, Tucumcari, NM (February 24, 2018).
Continuing Education, Beef Quality Assurance Training, New Mexico/Quay County Cooperative Extension Service, Tucumcari, NM (January 24, 2018).
Continuing Education, Southwest Hay and Forage Conference, New Mexico Hay Association, Ruidoso, NM (January 17, 2018-January 19, 2018).

Memberships

Murali Darapuneni
American Chemical Society, Invited Member, Scope: International.
Crop Science Society of America, Scope: International.
American Society of Agronomy, Scope: International.
Soil Science Society of America, Scope: International.
The Association of Agricultural Scientists of Indian Origin, Scope: International.
Sigma-Xi Scientific Society, Scope: International.

Leonard Lauriault
Western Society of Crop Science, Scope: International
Crop Science Society of America, Scope: International.
American Society of Agronomy, Scope: International.
New Mexico Hay Association, Ex-officio Director, Scope: State.
American Forage and Grassland Council, Scope: National.
Sigma-Xi Scientific Society, Scope: International.

Certifications:

Jason Box
New Mexico Beef Quality Assurance Trained Producer, New Mexico Livestock Board.
First Detector Certification, National Plant Diagnostic Network.
Public Pesticide Applicator’s License.
Private Pesticide Applicator’s License for Rodent Control.
NMSU Assurance of Actual Training, IACUC.
Agricultural Science Center Hazard Communication Standard.
Worker Protection Standard, Pesticide Handler.
Forklift Certification

Murali Darapuneni
HAZMAT, CPN Neutron Gauge. (August 2014 - Present).
Nuclear Gauge Safety Certification CPN. (August 26, 2014 - Present).
Neutron Gauge Operation, New Mexico State University.
Agricultural Science Center Hazard Communication Standard.
Worker Protection Standard, Pesticide Handler.

Leonard Lauriault
Certified Forage and Grassland Professional, American Forage and Grassland Council (through December 31, 2019).
Certified Hay Sampler, National Forage Testing Association (December 1, 2017 - Present).
Worker Protection Standard - Train-the-Trainer for Workers, Iowa State University Extension and Outreach. (February 16, 2017 - Present).
Worker Protection Standard, Pesticide Handler.
Public Pesticide Applicator’s License (categories 1a&b, 3a&b, and 10), New Mexico Department of Agriculture.
Private Pesticide Applicator’s License for Rodent Control (PRRO), New Mexico Department of Agriculture.
NMSU Assurance of Actual Training, IACUC.
Agricultural Science Center Hazard Communication Standard.

Gasper Martinez
NMSU Assurance of Actual Training, IACUC.
Working with Cattle in Agricultural Research Settings.
Agricultural Science Center Hazard Communication Standard.
Worker Protection Standard, Pesticide Handler.
Neutron Gauge Operation, New Mexico State University (July 18, 2018 – Present).

Patricia Cooksey
Agricultural Science Center Hazard Communication Standard.
Ten Stress Management Tips.
Time Management.
Fiscal Year End Review.
Eastern District Administrative Training.

Farm Staff
NMSU Assurance of Actual Training, IACUC.
Agricultural Science Center Hazard Communication Standard.
Worker Protection Standard, Pesticide Handler.
Forklift Certification.

Annual Weather Summary

The first documented weather observations in the Tucumcari area were from a weather station near the Tucumcari Post Office, which was operational from December 1904 through February 1913. The weather station at the Agricultural Science Center at Tucumcari has remained in continuous operation since establishment at its current location in January 1912. Weather observations at the Agricultural Science Center at Tucumcari from 1905 – 2002 have been summarized in an Agricultural Experiment Station Research Report available online (http://aces.nmsu.edu/pubs/research/weather_climate/RR751.pdf). Observations include maximum and minimum air, soil, and water temperatures, precipitation, wind speed, and aboveground pan evaporation. From 1918 until 2017 pan evaporation and wind speed were reported for April through September. Beginning in 2018, they also will be reported for October.

Total precipitation for 2018 was 14.10 inches, 2.69 inches less than the long-term average of 16.79 inches, and less than that reported in for 2015 and 2017, but near 2014 and 2016 (Table 1). The record of 34.96 inches was set in 1941 (Table 2).

Table 1. Summary of monthly precipitation amounts (inches) recorded at the NMSU Agricultural Science Center at Tucumcari.

Month	2018	2017	2016	2015	2014	Long-term Average (1905-2018)
January	tr.	1.02	0.01	1.44	0.01	0.40
February	0.03	0.17	0.94	0.89	0.03	0.51
March	0.16	2.16	0.08	0.38	0.22	0.77
April	0.51	2.73	0.67	1.93	0.21	1.17
May	1.82	1.82	1.30	4.02	2.42	1.99
June	0.56	0.98	3.28	2.07	4.00	2.02
July	1.16	1.58	1.11	7.56	2.54	2.80
August	3.63	6.48	2.33	2.03	0.82	2.84
September	0.78	2.65	0.41	1.31	2.73	1.64
October	4.27	3.62	1.39	0.81	0.19	1.33
November	0.56	0.01	0.08	1.23	0.37	0.68
December	0.62	0.00	0.37	2.85	0.38	0.64
Total	14.10	23.22	11.97	26.52	13.92	16.79

Table 2. Highest and lowest monthly precipitation (inches) recorded at the NMSU Agricultural Science Center at Tucumcari, 1905-2018.

Month	Highest	Year	Lowest	Year
January	1.68	1999	0.00	1967
February	2.40	1912	0.00	2000
March	3.69	1919	0.00	1966
April	4.89	1997	0.00	1996
May	8.72	1921	0.00	1927
June	6.39	1919	0.00	1947
July	11.28	1950	0.24	1987
August	8.38	1933	0.12	1951
September	7.23	1941	0.00	1948
October	7.51	1923	0.00	1975
November	4.00	1905	0.00	1989
December	4.27	1959	0.00	1933
Growing Season (April - October)	31.14	1941	5.14	1934
Annual	34.96	1941	6.13	1934

Note: Where minimum records are shared by more than one year, only the most recent year is listed.
In previous years, Growing Season data were reported for April - September.

Near average precipitation was recorded in May, November, and December, while August and October were well-above average and the remaining months were well-below average (Table 1). The greatest amount of precipitation falling within a 24-hour period (1.55 inches) was measured on May 22nd. Record high and low amounts of precipitation, by month, are shown in Table 2. No precipitation records were set in 2018.

The mean maximum temperature for 2018 was 74ºF, the mean minimum temperature was 44ºF, and the mean annual temperature for 2018 was 59ºF, all of which were near the respective long-term averages (Table 3).

Table 3. Summary of mean monthly temperatures at the NMSU Agricultural Science Center at Tucumcari.

Date	2018	2017	2016	2015	2014	Long-term average (1905-2018)	
	……………Mean Maximum Temperature (°F)…………………						
January	55	52	53	49	56	53	
February	62	65	63	57	56	57	
March	69	57	70	65	66	65	
April	72	72	73	75	75	73	
May	88	80	81	75	82	81	
June	95	94	93	91	91	91	
July	96	96	100	94	93	93	
August	92	88	91	92	93	91	
September	86	84	88	91	82	85	
October	69	75	83	73	79	75	
November	57	69	66	63	61	62	
December	52	57	53	55	55	53	
Annual	74	75	71	71	74	73	**
	……………Mean Minimum Temperature (°F)…………………						
January	22	25	24	24	22	24	
February	27	34	30	26	26	27	
March	35	31	35	35	32	33	
April	39	44	41	42	42	42	
May	56	48	51	49	51	51	
June	66	61	62	62	62	61	
July	66	67	68	66	64	65	
August	64	62	63	64	64	63	
September	57	56	58	62	58	56	
October	45	45	49	49	47	44	
November	29	38	38	33	30	33	
December	25	24	25	28	25	25	
Annual	44	45	45	43	44	44	
	……….……………..Mean Temperature (°F)………………………						
January	38	39	38	36	39	38	
February	44	50	47	42	42	42	
March	52	44	53	50	49	49	
April	56	58	57	58	58	58	
May	72	64	66	62	66	66	
June	81	78	78	76	76	76	
July	81	82	84	80	79	79	
August	78	75	77	78	79	77	
September	72	70	73	76	70	71	
October	57	60	66	61	63	60	
November	44	54	52	48	45	48	
December	38	41	39	49	40	39	
Annual	59	60	60	57	59	59	

Note: *Indicates 1 year of missing data
**Indicates 2 years of missing data
Some records from previous years have been corrected

The lowest recorded temperatures in 2018 of were recorded on January 2nd and December 30th (6ºF). The highest temperature for the year, 106ºF, was recorded on July 20th, which was a record for that date. A 105ºF temperature on July 23rd tied the record for that date set in 2016. Record lows were set on October 15th and 16th (28 ºF and 31ºF, respectively). Highest and lowest recorded temperatures and mean temperature extremes are shown in Table 4. No new daily or monthly record extreme high or low temperatures were set in 2018 (Table 4).

Table 4. Highest and lowest recorded temperatures (°F) and mean temperatures (°F), by month, at the NMSU Agricultural Science Center at Tucumcari.

	Daily Record Extremes (1913-2018)				Monthly Mean Extremes (1905-2018)			
Month	Highest Temp	Date	Lowest Temp	Date	Highest Max	Year	Lowest Min	Year
January	80	1/17/1974	-22	1/13/1963	62	2006	12	1963
February	84	2/11/2017	-16	2/7/1933	67	1976	17	1929
March	92	3/12/1989	-3	3/5/1948	75	1974	24	1965
April	97	4/26/2012	12	4/3/1920	81	2012	37	1983
May	103	5/24/2000	25	5/6/2017	90	1996	46	1983
June	109	6/28/2013	37	6/1/1919	99	2011	55	1983
July	108	7/11/2016	52	7/5/1995	101	2011	61	1967
August	108	8/21/2007	49	8/29/1988	100	2011	57	1965
September	105	9/1/2011	30	9/26/1970	92	2010	51	2006
October	97	10/4/2000	12	10/30/1993	83	2016	39	2009
November	90	11/9/2006	-2	11/28/1976	71	1999	26	1929
December	82	12/17/1980	-18	12/31/1918	66	1980	17	1983
Annual					79	2011	41	1963

Note: Where records are shared by more than one year, only the most recent year is listed.

The last spring temperature of 32ºF in 2018 was recorded on April 19th (Table 5). The first temperature of 32ºF in autumn was recorded on October 15th. Average last spring and first autumn freeze dates are April 4th and October 14th, respectively. The 2018 growing season was 179 days, 15 days shorter than the long-term average. The longest and shortest growing seasons on record are 225 and 136 days, respectively, which were recorded in 2015 and 1945, respectively.

Table 5. Summary of last spring and first fall temperatures of 32°F and 28°F and growing season at the NMSU Agricultural Science Center at Tucumcari.

						Long-term average	Record Extremes			
	2018	2017	2016	2015	2014	(1913-2018)	Earliest	Year	Latest	Year
32°F or less										
Last in Spring	19-Apr	30-Apr	30-Apr	26-Mar	15-Apr	4-Apr	24-Mar	1943	15-May	1945
First in Autumn	15-Oct	10-Oct	9-Nov	6-Nov	11-Nov	14-Oct	17-Sep	1965	19-Nov	1989
Growing Season (Days)	179	163	193	225	210	194	136	1945	222	1989
28°F or less (Hard Freeze)										
Last in Spring	10-Apr	26-Mar	2-Apr	6-Mar	15-Apr	26-Mar	6-Mar	2015*	6-May	1917
First in Autumn	15-Oct	9-Nov	18-Nov	12-Nov	11-Nov	25-Oct	8-Oct	1970	27-Nov	2001**
Number of Hard Freeze-Free Days	188	247	230	251	210	213	169	1917	256	2001

*Also in 1935

**Also in 1965 & 1923

Total snowfall in 2018 was 15.48 inches. The last snowfall in spring 2018 was recorded on February 11th and the first snowfall in autumn fell on November 11th. The last snowfall in spring has occurred as late as

May 18th in 1935 and 1980. The first snowfall in autumn has been recorded as early as October 8th in 1970.

Summaries of pan evaporation and wind run at the center are shown in Table 6. Readings for October are included beginning in 2018. Except for daily evaporation in June and September, daily, monthly, and season total (April - September) evaporation were above their respective long-term averages and the season total was well below the record set in 2011 (97.44 inches). April, August, and September were at or near the average for wind speed. May, June, and July wind speeds and the season average were below the long-term average, but the season average (April – September) was still greater than the calmest season on record of 2.3 mph in 1979. The windiest April - September was in 1918 (7.7 mph).

Table 6. Summary of pan evaporation (inches) and wind run (average miles per hour) at the NMSU Agricultural Science Center at Tucumcari.

	Pan Evaporation				Wind Run	
	2018		Long-term (1953 – 2018)		2018	Long-term (1918 – 2018)
Month	**Total**	**Daily Average**	**Monthly Average**	**Daily Average**	**Daily Average**	**Daily Average**
	………………………….inches………………………..				mph	mph
April	11.43	0.36	10.75	0.35	5.4	5.4
May	14.84	0.41	12.57	0.40	4.2	4.8
June	15.77	0.46	13.94	0.46	2.2	4.5
July	14.54	0.44	13.53	0.43	3.4	3.7
August	13.95	0.45	11.58	0.37	3.4	3.3
September	9.53	0.31	9.26	0.31	3.7	3.6
October*	5.76	0.20	5.76	0.20	3.6	3.6
April - September total/average	80.06	0.41	71.50	0.39	3.7	4.2
April – October total/average*	85.82	0.38	77.26	0.36	3.7	4.1

*Pan evaporation and wind run readings for October were initiated in 2018. Consequently, the October and April – October long-term totals/averages are based on a single year of data.

Operational Revenues and Expenditures

The Agricultural Science Center at Tucumcari received $98,882.00 in operational funds in FY 2017-2018 (Table1).

The center billed itself $29,252.00 for vehicle and equipment use based on established mileage rates and hourly charges for vehicles, tractors, and other equipment.

The alfalfa variety-testing program generated $2,600.00, the corn & sorghum variety tests generated $6,602.50 and the cotton variety test generated $1,052.28 in FY 2017-2018.

The center's operational expenditures in fiscal year 2017-2018 totaled $156,610.00 (Table 1). The largest expenditure ($34,284.00) was Capital Equipment purchase of a KIFCO AG-Rain Water Reel Traveling Irrigation System). Irrigation Services was the second largest expense totaled 20.648.00. The third largest expenditure was Farm/Ranch Service Services which includes Tractor/Equipment Use including vehicle use ($15, 529.00). Although Tractor/Vehicle Use and Irrigation Services are in the expenditure category of Table 1, they also are a revenue source for the Irrigation Index (120592) and the Tractor/Vehicle Index (101507).

Expenditures for Other Supplies (which includes non-office supplies, irrigation supplies, and pest control supplies, etc.) was $4,545.00 in FY 2017-2018. The total for seed and chemicals was $3,204.00.

Major purchase during the 2017-2018 Fiscal Year are listed in Table 2.

Table 1. NMSU Agricultural Science Center at Tucumcari, Approximate Expenditures by Index and Account Codes FY 2017-2018.

Item	Admin Plan 121851	Station Sales 120435	Forage Mgmt. 125881	Dryland Cropping 124581	Tucumcari Pastures 123736	Tractor & Vehicle 101507	Renewal & Replacement 107346	Field Day 902395	Forage Foundation 903124	Murali Start-up 124497	Bull Test 120176	Irrigation 120592	Grand Total
REVENUE													
Beginning Balance	70,392	15,114	12,490	15,000	191	44,193	5,422	1,118	0	12,168	23,540	13,244	212,872
Sales/Fees Generated		15,996									23,121		39,117
Private Gifts								2,100	4,750				6,850
Cattle Gain													0
Irrigation Services												10,175	10,175
Vehicle/Tractor Usage						16,007							16,007
TOTAL REVENUES	70,392	31,109	12,490	15,000	191	60,199	5,422	3,218	4,750	12,168	46,661	23,420	285,021
EXPENDITURES													
PERSONNEL													
Temporary/Term Salary	4,654			6,316									10,970
Temporary Fringes	935												935
Overtime													0
Regular Finges	130												130
TRAVEL													0
Domestic Travel	1,317	102	3,757			67							5,243
Foreign Travel													0
SUPPLIES													0
Auto/Tractor Supplies						3,228							3,228
Fuels & Lubricants	437		172	247		3,357					(170)		4,042
Office Supplies	2,521		605			329							3,455
Other Supplies	3,212		977	276							14	66	4,545
Lab Supplies													0
Cleaning/Janitorial Supplies	366												366
Medical/Safety Supplies	344				80								424
Feed/Seed/Fertilizer	2,571	14	5	614									3,204
Keys													0
Dues/Fees/Taxes	266	50	567	470		287					(1)	2,393	4,032
Business Meals/Food Items	442							1,724					2,166
Books	145		44			140							329
Publications/Films/Periodicals	159		72										231
Furn/Office Equip<=$5000	1,428		794	130									2,352
Small Tools	749					259							1,008
Bldg. Repair & Maint Parts													0
Equip. Repair/Maintenance Parts	162			452		1,036						1,007	2,657
Computer/Electronic Supplies													0
TOTAL SUPPLIES & MATERIALS	19,837	165	6,993	8,504	80	8,703	0	1,724	0	0	(157)	3,466	49,314

Table 1. (continued) NMSU Agricultural Science Center at Tucumcari, Approximate Expenditures by Index and Account Codes, FY 2017-2018.

Item	Admin Plan 121851	Station Sales 120435	Forage Mgmt. 125881	Dryland Cropping 124581	Tucumcari Pastures 123736	Tractor/ Vehicle 101507	Renewal & Replacement 107346	Field Day 902395	Forage Foundation 903124	Murali Start-up 124497	Bull Test 120176	Irrigation 120592	Grand Total
SERVICES													
General Services													
Medical/Vet Services													0
Postage	308	28	156	189						7		7	695
Telephone	1,277												1,277
Cellular Expense	360												360
Internet	1,664												1,664
Printing/Reproduction				51									51
Repair/Maint. Bldg	5,012												5,012
Repair/Maint. Electric	179												179
Repair/Maint.Equipment	707					1,223						1,703	3,633
Utilities - Electric	5,639											1,779	7,418
Utilities - Gas	1,168												1,168
Trash Hauling	520												520
Seminar/Training	30												30
Vehicle Insurance													0
Advertising	292							114					406
Sales Tax	6			(7)		1							0
Prof/Contract Services	191			219								75	485
Rental	552												552
Lab Analysis	32	114	1,516	1,415					1,745				4,822
Vehicle Usage	670												670
Irrigation Services	5,655		1,173	767								13,053	20,648
Farm/Ranch Services (Tractor ho	7,376	2,580	2,212	3,606							(245)		15,529
Freight	51		320	21									392
Support Tax		7,500											7,500
Computer Software													0
TOTAL SERVICES	31,688	10,221	5,377	6,262	0	1,225	0	114	1,745	7	(245)	16,617	73,012
Furn/Equipment >= $5000	19,000						3,117			12,168			34,284
TOTAL EQUIP. & CAP. OUTLAY	19,000	0	0	0	0	0	3,117	0	0	12,168	0	0	34,284
TOTAL EXPENSES	70,526	10,386	12,370	14,766	80	9,927	3,117	1,837	1,745	12,175	(402)	20,083	156,610
ENDING BALANCE	(134)	20,723	120	234	111	50,272	2,306	1,381	3,005	(7)	47,063	3,337	128,411

Table 2. Listing of major purchases paid for during FY 2017-2018, NMSU Agricultural Science Center at Tucumcari.

Index	Description		Cost
101507	Repair Kawasaki Mule, David Brwon Sports Center		$1,066.98
120592	Parts for Nelson Valve on North Pivot, Ag Services		$1,006.80
120592	Treated Effluent Wastewater, City of Tucumcari	$9,000.00	
	Electric to deliver wastewater	$2,852.67	
	Miscellaneous fees (operation, maintenance. repair)	$1,200.00	$13,052.67
120592	Annual Irrigation Water Assessment, AHCD		$2,392.59
120592	Repair to center pivot. Ashcraft Enterprises		$1,702.99
121851	Structural investigation to ASC-Tucumcari buildings		
	Occam Engineers, Inc		$4,534.64
121851	Traveling Irrigation System. Sierra Irrigation Supply	$19,000.00	
124497		$12,167.53	
107346		$3,116.61	$34,284.00
121851	Pumped septic tanks. RBM, Inc.		$700.00
120435	Landscape Rake, Tractor Supply		$617.02
	Support Tax		$7,500.00
	Total		$66,857.69

Temporal Changes in Grain Sorghum Yield and Residual Soil Characteristics-Three Years after Single Beef Cattle Manure Application

Investigator(s):

M. Darapuneni[1], G. Martinez, L.M. Lauriault[1], J. Box[1], P.L. Cooksey[1], J. Jennings[1], S. Jennings[1], and A. Williams[1]

[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401

Potential Impact(s):

Manure application costs can be cut by up to 60% by applying manure only in the strip-till zone. Additionally, three years after a single 10 tons /A manure application, with or without incorporation, grain sorghum biomass continues to be greater by no-till planting into the original strip-till zone. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Method(s):

A study was established in 2018 into an area where single manure application was previously made in 2016 in combination with strip-tillage treatments using an Orthman 1tRIPr strip tillage machine set on 30-in. centers. The field is located along US 54 on the east side of the center's driveway where the soil was Canez fine sandy loam. The treatment combinations applied in 2016 were 0, 5, or 10 ton/A of manure rates [0T (control), 5T, and 10T, respectively) applied at the surface of a previously strip-tilled band that was either left at the surface or incorporated to a 6-8inch depth by a second pass of the strip-till machine. Manure application rates were calculated on %w/w basis and applications were made manually on June 7, 2016. The experiment was a split-plot design with 4 replications with the main treatment being manure application rate and subplot as the incorporation method. Each experimental unit was a 30x10 ft. with four rows on 30-in. row spacing. Before applying the manure in 2016, three random samples were collected from a manure pile and composited before being sent to Ward Laboratories, Kearney, NE for chemical analysis. Results of that analysis has been reported in the 2016 Annual Progress Report of the Agricultural Science Center at Tucumcari (https://tucumcarisc.nmsu.edu/documents/2016-annual-report.pdf).

Grain sorghum was planted at 43,344 seeds/A on May 29, 2018, with a John Deer row crop planter fitted with a front coulter for no-till planting into a seedbed with good soil moisture for germination. Plots were given 1.5 in. of supplemental irrigation on June 30, 2018, because little precipitation had fallen since planting and seedlings were obviously stressed. Roundup (N-(phosphonomethyl) glycine) was sprayed on July 29, 2018 to control broad leaf and grass weeds.

At two-week intervals from immediate post-planting to immediate post-harvest, soil moisture samples were collected to a 30-in. depth from two locations each from within the strip-tilled row without affecting plants using a Giddings Hydraulic Soil Sampling Machine. Initial soil samples were collected on June 1, 2018. Upon collection, samples were divided into 6-in. increments. Incremental samples from same soil depth within plot were stored in a paper bag and wrapped in a plastic bag then weighed. The samples were then dried at 221°F for 24 hours and reweighed to determine the gravimetric weight (%w/w).

On October 26, 2018, 10-ft.of the center two rows of each plot were hand harvested to assess stalk yield characteristics and plant chemical composition. Sub-samples of biomass were collected and sent to Ward laboratories, Kearney, NE, for tissue nutrient analysis.

Soil moisture and nutrient data and plant biomass and nutrient data were analyzed using SAS software (SAS Institute Inc., Cary, NC, 2013). An alpha level of 5% was required to show a significant difference. When a difference among treatments was found, means were separated by least significant difference.

Results:

The trial was managed under dryland conditions, with lifesaving irrigation. Total precipitation received from planting to harvesting was 7.3 inches. Supplemental irrigation was provided due to low precipitation after planting to sustain good stand establishment; however, extremely dry conditions at the critical pollination and grain filling stages resulted in no grain production in 2018. Therefore, only biomass yields were reported.

Post-harvest soil chemical analysis after three years of grain sorghum production showed a significant increase in the residual nitrate-N and Olsen-P contents at the top 0-24 inches soil depth in the 10T rate (Table 1). Incorporation of 10T had a significant advantage over surface application in accumulating residual soil nitrate-N and Olsen-P, with an exception of 0-12 inches in the residual nitrate-N. The 5T manure rate was not consistent in showing residual nitrate-N and P advantage over the control. Other chemical characteristics, such as pH and organic matter, were not influenced by either manure rate or application method at both depths (Table 1).

Table 1. Effect of manure and strip-tillage treatments applied in 2016 on grain sorghum post-harvest soil chemical characteristics at Tucumcari, NM, in 2018

	Soil depth							
Manure Treatment	**0-12"**	**12-24"**	**0-12"**	**12-24"**	**0-12"**	**12-24"**	**0-12"**	**12-24"**
	No3-N (ppm)		**Olsen-P (ppm)**		**pH**		**Organic Matter (%)**	
Control	1.69 b	1.73 bc	20.4 d	23.01 c	8.1	8.0	1.01	1.10
5T+ S	1.62 b	1.64 c	22.23 c	22.77 c	8.2	8.1	1.09	1.09
5T+ I	1.66 b	1.77 b	22.95 c	23.15 c	8.2	8.0	0.97	1.10
10T+ S	1.94 a	1.82 b	27.44 b	26.92 b	8.1	8.1	1.01	1.09
10T + I	1.99 a	2.04 a	31.24 a	30.67 a	8.1	8.2	1.16	1.12
P-value	0.0417	0.0498	0.0137	0.0484	0.7804	0.5678	0.6782	0.4352

Means within a column followed by the same letter are not significantly different based on the 5% LSD.

Biomass yield of grain sorghum was significantly affected by manure treatments (Table 2). Manure incorporation at a 6-inch depth in 10T significantly improved the biomass yield over its corresponding surface application. This advantage from incorporation of 5T was not apparent. Tissue N and P elemental composition of grain sorghum was till significantly impacted by manure treatments after three years. Incorporation, especially of 10T, significantly increased the biomass P content (Table 2).

Table 2: Effect of manure and strip-tillage treatments applied in 2016 on no-till grain sorghum biomass yield and composition at Tucumcari, NM, in 2018.

Manure Treatment	Biomass (lb/A)	Biomass N (%)	Biomass P (%)
Control	977 c	1.33 c	0.10 c
5T+ S	996 c	1.31 c	0.11 c
5T+ I	1045 c	1.42 b	0.12 bc
10T+ S	1479 b	1.53 ab	0.14 b
10T + I	2075 a	1.59 a	0.18 a
P-value	0.0135	0.0378	0.0211
CV (%)	22.3	7.2	8.7

Although statistically not significant, there was a trend that showed slightly elevated levels of the tissue N in the manure incorporation treatments over surface applications (Table 2). This may be due to significant increase in the soil nitrate-N and Olsen-P with incorporation compared to surface application.

Water dynamics and water use efficiency of grain sorghum in third year following a single application of manure are presented in the Table 2.

Table 3: Effect of manure and strip-tillage treatments applied in 2016 on water use and water productivity of no-till grain sorghum at Tucumcari, NM, in 2018.

Manure Treatment	Total Water Use (in)	Water Productivity (lb ac in^{-1})
Control	4.86 c	201 d
5T+ S	4.45 c	224 cd
5T+ I	4.49 c	233 c
10T+ S	5.60 b	264 b
10T + I	6.61 a	314 a
P-value	0.034	0.022
CV (%)	10.74	9.2

Total plant water use was statistically higher in the 10T manure rate in both surface and incorporation application methods compared to control and 5T rate. Water productivity (biomass yield/acre-inch of water use) was significantly affected by manure treatments. Both manure rates had significantly higher water productivity compared to the control (Table 2), especially with incorporation. Incorporation of 10T increased the water productivity by 50 lb ac-in^{-1} compared to its corresponding surface application; however, this significant difference between the two application methods was not observed for the 5T treatments.

Evaluation of Fall Planted Cover/Rotation Crop Alternatives for Semi-Arid Cropping Systems

Investigator(s):

M. Darapuneni[1], G.K. Martinez[1], L.M. Lauriault[1], P.L. Cooksey[1], J. Box[1], J. Jennings[1], S. Jennings[1], and A. Williams[1]

[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401.

Potential Impact(s):

Use of opportune/cover crops to replace the winter fallow period in semi-arid cropping systems could help farming communities achieve higher resource-use efficiency (especially water and nutrients) and productivity. Introducing diversity into a traditional rotation will ensure better soil health. Planting efficient winter crops in the fallow provides a forage source for cattle but also potentially generates additional income by producing seed under favorable weather conditions. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Materials and Methods:

To evaluate the production and input-use efficiency of several winter cover crops/rotation crops for semi-arid environments, a study was planted under both limited irrigation and dryland conditions using multiple legumes and canola. Cultivars and seeding rates for winter cover/rotation crops can be found in Table 1. The legumes were inoculated with appropriate strain of *Rhizobium*.

Table 1. Species, cultivars, and seeding rates for irrigated and dryland winter cover crops planted at Tucumcari in 2018.

Crop	Scientific Name	Cultivar(s)	Irrigated Rate	Dryland Rate
Austrian winter pea	*Pisum sativum*	Unknown	150lb/A	80lb/A
Berseem clover	*Trifolium alexandrinum*	Balady, Frosty	44lb/A	20lb/A
Winter canola	*Brassica napas*	DKW45-25	7lb/A	5lb/A
Red clover	*Trifolium pratense*	Medium	12lb/A	8lb/A
Rose clover	*Trifolium hirtum*	Overton R18	13lb/A	7lb/A
Hairy vetch	*Vicia villosa*	Unknown	35lb/A	15lb/A

The study was established under the North Farm center pivot irrigation system (Canez fine sandy loam soil) in an area designated for limited irrigation and in an area designated for dryland conditions. The experiment was planted in a randomized block design with four replications with plot dimensions of 10x20ft. The plots were planted using a plot drill with a metering cone and set to 8 in. row spacing on September 25, 2018, into a conventionally tilled seedbed. Soil samples were collected from each plot with a Giddings Machine using a 48 in. by 2 in. diameter sampling tube with view slots on November 19-20, 2018. These samples were broken down into 1ft increments for nutrient analysis. Access tubes were installed to 5ft deep in the holes left after soil sampling to measure water use efficiency using a CPN Hydroprobe. Irrigation totaling 2 in. was applied to both tests in 0.5 in. increments on alternating days to facilitate seed germination. .

The study is in progress and data will be collected throughout the season. The results will be reported in 2019 research report.

Evaluation of Spring Planted Cover/Rotation Crop Alternatives for Semi-Arid Cropping Systems

Investigator(s):

M. Darapuneni[1], G.K. Martinez[1], L.M. Lauriault[1], P.L. Cooksey[1], J. Box[1], J. Jennings[1], S. Jennings[1], and A. Williams[1]

[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401

Potential Impact(s):

Use of opportune/cover crops to replace the summer fallow period in semi-arid cropping systems could help farming communities achieve higher resource-use efficiency (especially water and nutrients) and productivity as well as promote broader marketing opportunities. Understanding the water use dynamics of various cover crops and increasing diversity in the cropping systems could reduce the seasonal risk of crop failures due to water scarcity. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Methods:

To evaluate the production and input use efficiency of several warm-season cover/rotation crops for semi-arid environments, a study was planted under both irrigated and dryland conditions. Crop selections and seeding rates for this study can be found in Table 1. Legumes were inoculated with the appropriate species of rhizobium.

Table 1. Species, cultivars, and seeding rates for irrigated and dryland warm-season cover/rotation crops at Tucumcari in 2018.

Crop	Scientific Name	Cultivar	Irrigated Rate	Dryland Rate
Pearl millet	*Pisum sativum*	Wonderleaf	25lb/A	6lb/A
Cowpea	*Vigna unguiculata*	Iron & Clay	50lb/A	12.5lb/A
Spring canola	*Brassica napas*	DKL30-20	6lb/A	5lb/A
Chickpea	*Cicer arietinum*	CDC Frontier	250lb/A	150lb/A
German millet	*Setarua italica*	Unknown	20lb/A	10lb/A
Proso millet	*Panicum miliaceum*	Dove	20lb/A	12.5lb/A
Pole bean	*Phaseolus coccineus*	Kentucky wonder	45lb/A	20lb/A
Lima bean	*Phaseolus lunatus*	Jackson wonder	60lb/A	30lb/A
Lablab	*Lablab purpureus*	Rongi	26lb/A	13lb/A
Sesbania	*Sesbania sesban*	Unknown	40lb/A	15lb/A
Pearl millet + cowpea	see above	see above	50:50 @ half rate	

The study was established under the center pivot irrigation system at the North Farm. The soil type was Canez fine sandy loam. The experiment was planted in a randomized block design with four replications with plot dimensions of 10x20ft. The plots were planted using a plot drill with a metering cone and set to 8in row spacing on May 30-31, 2018. After planting, soil samples were collected and access tubes were installed into each plot with a Giddings Machine using a 48 in. by 2 in. diameter sampling tube with view slots. Soil samples collected were broken down into 6in increments for nutrient analysis. Access tubes were installed to 5ft deep in the plots to measure water use efficiency using a CPN Hydroprobe every two weeks.

Irrigated plots received 17.9 in. of water to supplement 10.4 in. growing season (June to October) precipitation. Two 1 in. lifesaving irrigations were given to dryland plots to encourage proper germination and establishment at the beginning of the trial.

When appropriate, weed management (Table 2) was used in addition to hand weeding plots to control large weed infestations.

Table 2. Pesticides used during the warm-season cover/rotation crop study at Tucumcari in 2018.

Trade Name	Rate	Crop	Date
RoundUp	3% vol/vol	canola and borders	7/5/2018
Detonate	3% vol/vol	grass species	7/11/2018
Sevin	2oz/gal	legume species	7/17/2018

Both dryland and irrigation experiments were harvested on October 16 and 22-23, 2018. A sample of harvested material from each plot was collected and dried for 48 h at 140°F to determine dry matter content and yield. Aboveground biomass for cowpeas and millets were harvested using $1m^2$ sampling frames at three random locations within each plot. Seed heads and biomass were placed into separate bags. Seeds were cleaned using a combination of sieves and forced-air seed cleaner. Seeds and biomass samples were dried for 48 h at 140°F and weighed to determine yield. The yield data were analyzed using SAS Proc GLM and treatment means were separated using LSD test with 5% alpha level.

Results:

Under irrigated conditions, most of the crop species failed to produce measurable amounts of seed yield (Table 3). Pearl millet+cowpea intercrop produced significantly higher seed yield compared to cowpea sole crop ($P<0.05$). Biomass yield was significantly higher in cowpea, pearl millet+cowpea intercrop, pearl millet, lablab, and proso millet compared to other species, with the same amount of supplemental irrigation (Table 3). In the intercrop mix, in addition to the soil health benefits and high yield potential, the legume produces high-value protein-rich animal feed when the existing low quality feed sources cannot meet the nutritional requirements of cattle, if livestock is an integral component of the farming system.

Table 3. Yield characteristics of various cover/rotation crops under irrigated conditions in Tucumcari during summer, 2018.

Crop	Seed yield (lb/A)	Biomass yield (lb/A)
Cowpea	1015 b	11736 a
German Millet	-	1778 b
Lablab	-	10935 a
Lima Bean	-	3451 b
Pearl Millet	-	9011 a
Proso Millet	-	7106 ab
Pearl Millet + Cowpea	2426 a	11436 a
Sesbania	-	1944 b
CV (%)	24	34

All crop species failed to produce measurable amounts of seed yield under dryland conditions (Table 4).

Table 4. Yield characteristics of various cover/rotation crops under dryland conditions in Tucumcari during summer, 2018.

Crop	Seed yield (lb/A)	Biomass yield (lb/A)
Cowpea	-	139 c
German Millet	-	1075 b
Lablab	-	547 bc
Pearl Millet	-	2182 a
Proso Millet	-	2209 a
Pearl Millet + Cowpea	-	1893 a
Spring Canola	-	672 bc
CV (%)	-	32

In addition to the non-uniform and untimely precipitation received during summer of 2018, a large number of weeds in the dryland cropping area suppressed the crop growth and development to the most extent. Weed control options in the study were limited due to the complexity of treatment structure that includes both broadleaf and grass species in adjacent plots. Biomass yield was significantly higher in both sole pearl millet and its combination with cowpea (Table 4; $P<0.05$).Under irrigated conditions, biomass water-use efficiency (WUE) of the pearl millet+ cowpea intercrop was statistically greater than all other crops tested, except cowpea sole crop (Table 5).

Table 5. Water use efficiency of various cover/rotation crops under both irrigated and dryland conditions in Tucumcari during summer, 2018.

Crop	Irrigated		Dryland	
	Total Water Use (in.)*	Biomass WUE (lb ac-in-1)	Total Water Use (in.)	Biomass WUE (lb ac-in-1)
Cowpea	18.7 a	628 ab	4.2 b	33 d
German Millet	11.9 d	149 e	6.5 ab	165 b
Lablab	18.2 a	601 b	6.7 ab	82 c
Lima Bean	12.4 d	278 d	–	–
Pearl Millet	15.7 bc	574 b	6.9 a	316 a
Proso Millet	14.9 c	477 c	7.3 a	303 a
Pearl Millet + Cowpea	*17.1 ab	669 a	7.1 a	267 a
Sesbania	13.2 cd	147 e	–	–
Spring Canola	–	–	6.9 a	97 c
CV%	21	19	17	22

*Total water use for producing both seed and biomass yield

However, it should be noted that the total water use data reported for pearl millet+ cowpea intercrop and cowpea sole crop in Table 5 are for producing both seed and biomass yield. Therefore, although biomass WUE of the pearl millet+ cowpea intercrop was not significantly different from cowpea WUE, the intercrop managed to produce more seed and biomass yield with less water compared to cowpea sole crop. In addition, generally, the amount of water to produce a unit of seed is twice as much as the amount to produce a unit of biomass. In this study, pearl millet+ cowpea produced more than twice the seed yield compared to cowpea (Table 3). Hence, the intercrop is more water-use efficient than cowpea sole crop.

Under dryland conditions, pearl and proso millets showed significantly higher biomass WUE than the other tested species, except pearl millet+ cowpea intercrop. The millets belong to C4 species and are known to be physiologically more efficient in producing more yield with less water.

Winter Canola Nitrogen Management

Investigator(s):

M. Darapuneni[1], G.K. Martinez[1], S. Angadi[2], L.M. Lauriault[1], P.L. Cooksey[1], J. Box[1], J. Jennings[1], S. Jennings[1], and A. Williams[1]

[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401
[2]New Mexico State University, Agricultural Science Center at Clovis, NM 88101

Potential Impact(s):

Canola is an alternate winter rotation option to winter wheat that has potential for producing not only high-valued oil grain but also excellent forage during the winter season. Determining the appropriate N-application timing will not only help producers maximize the yield and quality of winter canola but also improve the N-use efficiency and on-farm economical returns in the semi-arid New Mexico. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Method(s):

A study was established during the fall of 2018 under the center pivot irrigation system at the North Farm. Crop cultivars and seeding rates used in the study are mentioned the Table 1.

Table 1. Cultivars and seeding rates for irrigated canola study at Tucumcari in 2018.

Crop	Scientific Name	Cultivar	Seeding Rate
Canola (Hybrid)	*Brassica napus*	Pioneer 46W94	6.2lb/A
Canola (Open Pollinated)	*Brassica napus*	Riley	4.0lb/A

The soil type was Canez fine sandy loam. The experiment was planted in a randomized block design with four replications with plot dimensions of 10x30 ft. The plots were planted on September 18, 2018, using a plot drill with a metering cone and set to 8 in. row spacing. After planting, soil samples were collected using a Giddings Machine with a 48 in. long by 2 in. diameter sampling tube with view slots. Soil samples were broken down into 6 in. increments for nutrient analysis.

Nitrogen timing treatments planned for the experiment are mentioned in the Table 2. The N-source used in the study was 28-0-0-5 and initial applications were made via a boom sprayer. Intermittent plant samples and final soil samples will be collected to estimate the yield, quality, and N-use efficiency.

Table 2. Treatments structure for fall planted canola study at Tucumcari in 2018.

Treatment	Rate	% Application	Date Applied
T1	120lb/A	100% Fall	10/30/2018
T2	120lb/A	50% Fall+ 50% Spring	Fall – 10/30/2018
T3	120lb/A	25% Fall+ 50% Spring+25% Flowering	Fall – 10/30/2018
T4	120lb/A	100% Spring	-

The study is in progress and the results will be published in the annual report of 2019.

Alfalfa Response to a Multi-Nutrient Potassium Fertilizer in New Mexico

Investigator(s):

M. Darapuneni[1], L.M. Lauriault[1], G.K. Martinez[1], P.L. Cooksey[1], J. Box[1], J. Jennings[1], S. Jennings[1], and A. Williams[1]

[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401.

Potential Impact(s):

Alfalfa (*Medicago sativa* L.) is among the top cash crops of New Mexico. In Alfalfa, potassium (K) alone constitutes about 2.5% of tissue weight. The application of a multi-nutrient source to potassium-deficient soils has tremendous potential for boosting alfalfa yield and nutrient value. This multi-nutrient fertilizer also supplements sulfur (S) and magnesium (Mg) for better growth and development in alfalfa. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Materials and Method(s):

A study was initiated on alfalfa planted on October 11, 2018, at Crystal Springs Farms near Tularosa, NM, to evaluate the effects of a multi-nutrient fertilizer (MN) on alfalfa yield and nutritive value. The experiment is a randomized block design with four replications of 12x15 ft plots. Three random soil samples were collected from each plot on September 11, 2018, to a depth of 24 in. and composited by 12-in. increment depths. These composite samples were air-dried for 72 hours and sent to Ward Laboratories (Kearney, NE) for initial nutrient analysis, which indicated low potassium concentration (about 80 ppm). Optimum rates of N, P_2O_5, K_2O, and S removal in each ton alfalfa hay are 50 lb of N, 12 lb of P_2O_5, 60 lb of K_2O, 45 lb of S, and 4.5 lb of Mg. The fertilizer treatment (Table 1) combination amounts will be calculated based on anticipated nutrient removal by target alfalfa yields. The study is maintained under center pivot provided fully irrigated conditions. The fertilizer treatments will be applied around last week of February, when growth resumes. Yield and quality measurements will be taken at monthly intervals, starting in early spring of 2019.

Table 1: Treatments planned for the multi-nutrient study in alfalfa

Treatment.No	Treatment
1	NP[¶]
2	NP + KCl
3	NP + K2SO4
4	NP + MN
5	NP + KNO3
6	NP + KCl + (NH4)2SO4
7	NP + K2SO4 + (NH4)2SO4
8	NP + KNO3 + (NH4)2SO4
9	NP + KCl + CaSO4.2H2O
10	NP + K2SO4 + CaSO4.2H2O
11	NP + KNO3 + CaSO4.2H2O
12	NP + KCl + MN
13	NP + K2SO4 + MN
14	NP + KNO3 + MN

[¶] Nitrogen and Phosphorus from various nutrient sources

Alfalfa Planting Date Evaluation

Investigator(s):

L.M. Lauriault[1], G. Martinez[1], P.L. Cooksey[1], J. Box[1], J. Jennings[1], S. Jennings[1], and A. Williams[1]

[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401

Potential Impact(s):

Previous results from this research, initiated in 2013, demonstrate that earlier planting of alfalfa allows for recovery of some of the establishment costs in the seeding year, thereby, reducing interest in those inputs. Data collection concluded in 2018 demonstrates a more long-term benefit to earlier planting of semi-dormant to slightly non-dormant varieties. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Method(s):

The Advisory Committee to the Agricultural Science Center at Tucumcari requested an evaluation of the effects of earlier than recommended planting of alfalfa due to first delivery of water in mid- to late May and the availability of Roundup Ready® varieties as a summer weed control option during establishment. Alfalfa variety WL 454HQ.RR (semi-dormant fall dormancy 6) was planted on June 5 & 26, July 17, August 7 & 28, and September 18 in 2013 and 2014 in adjacent tests under the highway center pivot irrigation system, in the field fronting US 54. The test area (Redona/Canez fine sandy loam) was conventionally tilled and formed into a flat seedbed for each test. Plots were sown using a disk drill fitted with a seed-metering cone at 20 lb inoculated seed/A in a Randomized Complete Block design with 3 replications. Other details about planting are given in The 2014 Annual Progress Report of the Agricultural Science Center (https://tucumcarisc.nmsu.edu/documents/2014-annual-report.pdf). Irrigations with Class 1B treated municipal wastewater were applied approximately twice weekly to the test area to supplement precipitation. Due to a system failure at the wastewater treatment plant in October 2017, no water was applied until late May 2018 and another issue at the plant caused a system shutdown from August 19-30. Prior to the last harvest of 2018, irrigations with treated municipal wastewater totaling 13.5 inches were applied to supplement 12.9 inches of pre-growing season and growing season precipitation (November 2017 through October 2018). On June 26, 2018, 17 lb N and 56 lb P_20_5 were applied to both tests.

Both tests were harvested with a self-propelled forage plot harvester equipped with a weighing system on July 10, Aug. 14, Sep. 11, and Oct. 30 in 2018. A subsample from each plot was collected and separated into alfalfa and weed. These samples were weighed, dried at 140°F for 48 hours, and reweighed for calculation of dry matter percentage and dry matter yield of alfalfa, and weed proportion. Alfalfa samples were ground to pass a 1-mm screen and delivered to the lab for NIRS analysis of nutritive value

Fourth production year total annual yield and cumulative dry matter yield from the year after seeding (the first production year) through the fourth production year from both tests were subjected to SAS MIXED procedures for tests of significance to compare test (seeding year) and planting date and their interaction. Means were separated using an alpha level of $P < 0.05$ when a significant difference was observed. Replicates were defined as unique within each test and replicate x test was considered random.

Result(s):

Despite irrigation system problems in 2014, the seeding year x planting date interaction was not significant for 4th year yield or cumulative yield from the seeding year and four production years (Table 1). The irrigation system failures in 2014 did lead to a significant seeding year effect on 4th year yields because the first two harvests were missed for the 2014 seeding while all six harvests were taken in 2017 from the 2013 seeding. Differences among planting dates in 4th year yields were not significantly different, but they were consistent to previous years continuing to contribute to differences in cumulative yield over the four production years (Table 1).

Consequently, as previously demonstrated in The 2014 Annual Progress Report of the Agricultural Science Center (https://tucumcarisc.nmsu.edu/documents/2014-annual-report.pdf), producers could plant on June 5 or possibly earlier instead of late summer and harvest at least twice in the seeding year to recover a considerable amount of the establishment costs. Even after the seeding year, consistent single year nonsignificant yield differences can contribute to cumulative yield differences (Table 1). Nonetheless, planting earlier in the summer than previously recommended, about mid-summer (August 7th) as opposed to late summer, may still be feasible, but that would limit the amount of forage harvested in the seeding year to a single harvest.

Table 1. Fourth production year and four-year cumulative dry matter yields (tons/acre) of alfalfa planted on various dates in 2013 & 2014 in separate tests at Tucumcari, NM. Data are the means of 3 replicates within each seeding year.

Seeding year	4th Production year yield	4-Year cumulative yield
2013	5.20	18.77
2014	2.23	18.27
SEM	0.55	1.61
Planting date		
5-Jun	4.19	22.81 A
26-Jun	3.40	19.24 B
17-Jul	3.58	17.96 BC
7-Aug	4.23	19.77 AB
28-Aug	3.54	15.76 C
18-Sep	3.34	15.58 C
SEM	0.47	1.54
	P-values	
Seeding year (SY)	0.0193	0.8387
Planting date (PD)	0.1215	0.0020
SY x PD	0.2528	0.4770

Planting date means within a column followed by different letters are significantly different at the 5% alpha level.

Impact of Water Source (Canal Water or Treated Municipal Wastewater) on Alfalfa Establishment and Production

Investigator(s):

L.M. Lauriault[1], M.K. Darapuneni[1], G.K. Martinez[1], J. Box[1], P.L. Cooksey[1], J. Jennings[1], S. Jenings[1], and A. Williams[1]

[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401

Potential Impact(s):

Municipalities seek uses for treated wastewater, which is generally safe to apply to animal feed and fiber crops, to minimize the release of potential pollutants into surface and ground water bodies. Alfalfa is the most important forage crop worldwide being adapted to a wide range of environmental factors. Determining the potential impact of irrigating alfalfa with treated municipal wastewater could assist producers with deciding whether to use the water. Preliminary results of ongoing research at New Mexico State University's Agricultural Science Center at Tucumcari has discovered a potential effect of wastewater on established alfalfa nutritive value and soil fertility characteristics. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, Family Development and Health of New Mexicans, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Method(s):

Alfalfa variety, 6829R, was planted under the West Pivot irrigation system on August 18, 2017, and another test was planted in the same field on September 14, 2018, using SW8421S alfalfa. Both varieties were selected based on performance in New Mexico Alfalfa Variety Tests. Both test areas (Redona fine sandy loam) were conventionally tilled and formed into a flat seedbed for sprinkler irrigation. Each water source area had been designated for irrigation by that source for the previous 30 or 18 months with canal water on the southeast side and treated municipal wastewater on the southwest side. Plots (5 ft x 20 ft) were sown using a disk drill fitted with a seed-metering cone at 20 lb inoculated alfalfa seed/A in a Randomized Complete Block design with 4 replications. The effective planting width was 4 ft (8, 6-inch rows). Soil samples had been collected immediately pre-planting from each test area for fertility and soil microbial community by phospholipid fatty acid (PLFA) analyses. Seeding year results for the 2017 planting are reported in The 2017 Annual Progress Report of the Agricultural Science Center at Tucumcari (https://tucumcarisc.nmsu.edu/documents/annual-report-2017.pdf).

An irrigation system failure occurring in October 2017 was not repaired until late May 2018 and another shutdown took place from August 19 – 30, 2018, preventing irrigation of the 2017 test during those periods and delaying planting of the 2018 test. In 2018, the 2017 planting received 11.0 inches of irrigation from May through October 2018 to supplement 12.9 inches of precipitation from November 2017 through October 2018. For the 2018 planting, irrigations totaling 1.23 inches were applied in September to supplement 5.15 inches of precipitation (September 14, through November 20, 2018). On June 26, 2018, 17 lb N and 56 lb P_20_5 were applied to both tests.

The 2017 test was harvested on July 10 and Oct. 30, 2018. A subsample from each plot was collected and separated into alfalfa and weed. These samples were weighed, dried at 140°F for 48 hours, and reweighed for calculation of dry matter percentage and dry matter yield of alfalfa, and weed proportion. Alfalfa samples were delivered to the lab for NIRS analysis of nutritive value. On November 20, 2018, two soil cores from each plot were collected to 12 inches and combined for PFLA analysis.

All plants in 1 ft of all rows (4 ft^2) from the east end of each plot of the 2018 planting were counted, hand-clipped to ground level on November 20, 2018 (67 days after planting), weighed, dried at 140°F for 48 hours, and reweighed for calculation of dry matter percentage and dry weight. These samples were delivered to the lab unground for NIRS analysis of nutritive value. The soil surrounding one plant (crown and root) from each of the two center rows was also sampled to 3 inches within the clipped area and combined for PFLA analysis. During the sampling, nodulation was verified on each seedling with intact root.

Forage dry matter yield and nutritive value and soil fertility and PLFA data from the 2017 test and plant count, plant dry wt., and nutritive value and soil fertility and PLFA data from the 2018 test were subjected to SAS MIXED procedures for tests of significance to compare water source treatments (canal water or treated wastewater). Replicates were defined as unique within water source and considered random.

Results and Discussion:

Inconsistent availability of irrigation water significantly reduced yields and limited measurable harvest of the 2017 seeding to two cuttings. Alfalfa yields were not different between the two irrigation water sources (data not shown). Weed pressure, as indicated by the proportion of alfalfa in harvested forage for both harvests, was greater when irrigated with wastewater than when irrigated with canal water. Additionally, crude protein, neutral detergent fiber (NDF) digestibility, and P of canal water irrigated alfalfa were greater and acid detergent fiber (ADF) and NDF were lesser in the 10-Jul harvest than wastewater-irrigated alfalfa, but not in the 30-Oct harvest. There was a trend toward lesser NDF and greater Mg in wastewater-irrigated alfalfa in the 30-Oct harvest.

Data and results of statistical analysis for selected PLFA and soil fertility variables collected in 2018 from the 2017 seeding are presented in Table 2.

Table 1. Canal water or treated municipal wastewater irrigation effects on yield proportion and selected nutritive value variables in 2018 of alfalfa established in 2017. Data are the lsmeans of four replicates.

Water source	Alfalfa	CP	ADF	NDF	NDFD	P	Mg
	%	%	%	%	%	%	%
			10-Jul Harvest				
Canal water	48	28.1	14.9	17.5	63.5	0.31	0.45
Wastewater	20	23.3	17.1	20.4	48.8	0.25	0.45
P-value	0.0410	0.0001	0.0223	0.0125	0.0005	0.0010	0.9667
			30-Oct Harvest				
Canal water	80	28.1	16.8	19.9	62.8	0.30	0.28
Wastewater	59	28.2	15.6	17.2	73.8	0.32	0.34
P-value	0.0039	0.9761	0.1705	0.0504	0.0229	0.7365	0.0069

CP, ADF, NDF, and NDFD signify crude protein, acid detergent fiber, neutral detergent fiber, and NDF digestibility, respectively.
If the P-value is less than 0.0500, the lsmeans in that column are considered to be significantly different.

Table 2. Canal water or treated municipal wastewater irrigation effects on selected soil fertility variables in fall 2018 after alfalfa sown in 2017. Data are the lsmeans of four replicates.

Variable	Microbial Biomass	P	SO4-S	Cu	Ca	K	Mg	Na	CEC	Cl
	ng/g	ppm	ppm	ppm	ppm	ppm	ppm	ppm		ppm
Canal water	2493	10.58	8.13	0.37	1768	422	360	76	13.21	11.80
Wastewater	8216	39.11	22.18	0.49	2529	915	498	200	20.60	7.75
P-value	0.0022	0.0017	0.1049	0.0015	0.4249	0.0641	0.0062	0.1298	0.1263	0.4793

CEC signifies cation exchange capacity.
If the P-value is less than 0.0500, the lsmeans in that column are considered to be significantly different.

Regarding the PLFA analysis, while there had been no difference between water sources for total microbial biomass in 2017, canal water-irrigated soil had significantly less microbial biomass than soil irrigated with treated municipal wastewater in 2018; otherwise no differences were detected in PLFA data. Differences in soil P, Cu, and Mg and a trend for K, were observed (Table 2).

Data and results of statistical analysis for selected variables from the 2018 seeding are presented in Table 3. Without regard to level of significance, in 2018 water sources were ranked consistently to the 2017 seeding for all variables, except total microbial biomass. Similarly to the seedling alfalfa in the 2017 planting (data not shown), there was no difference between water sources for plants m^{-2}; however, the late planting may have greatly reduced seedling growth in the autumn compared to the 2017 leading to the lack of difference for plant dry weight in 2018 when there had been a difference in 2017 (Table 3; 2017 data not shown). Otherwise, dry matter percentage, crude protein, and NDFD were significantly different in both years, and there was a trend for NDF that was consistent to NDF in 2017. Values for ADF and NDF were considerably less in 2018 than 2017 (19.6 and 25.9% average ADF and NDF, respectively in 2017) and NDFD was considerably greater (54.2% in 2017), likely due to the later planting and smaller, less mature plants at sampling time.

Table 3. Plant and soil phospholipid fatty acid analysis data from a new alfalfa seeding irrigated with canal water or treated municipal wastewater at Tucumcari in 2018.

Source	Plants	Dry Wt.	Dry Matter	CP	ADF	NDF	NDFD	Microbial Biomass	Diversity Index	Arbuscular Mycorrhizae
	#/m^2	g/m^2	%	%	%	%	% of NDF	ng/g		% of Total Biomass
Canal Water	221	5.97	23.8	25.1	15.3	17.5	78.0	1228	1.5	2.2
Wastewater	301	4.99	22.5	26.5	14.9	16.6	82.0	941	1.3	1.0
P-value	0.0759	0.3086	0.0208	0.0166	0.2746	0.0603	0.0212	0.3549	0.2842	0.2714

CP, ADF, NDF, and NDFD signify crude protein, acid detergent fiber, neutral detergent fiber, and NDF digestibility, respectively.

If the P-value is less than 0.0500, the lsmeans in that column are considered to be significantly different.

Unlike the 2017 seeding in 2017, the percentage of total microbial biomass as arbuscular mycorrhizae was not different between water sources. Similarly to the 2017 seeding, Rhizobia were not detected or minimally detected in the PLFA samples (data not shown), although, the alfalfa roots included in the soil sample were nodulated.

Adaptation of Entomopathogenic Nematodes for Control of Whitefringed Beetle in Alfalfa in the Tucumcari Irrigation Project

Investigator(s):

L.M. Lauriault[1], E.J. Shields[2], T. Testa[2], J. Box[1], P.L. Cooksey[1], J. Jennings[1], S. Jenings[1], and A. Williams[1]

[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401
[2]Cornell University, Ithaca, NY 14850

Potential Impact(s):

Early stand decline in alfalfa throughout New Mexico is increasingly being associated with whitefringed beetle (*Naupactus leucoloma*, WFB) infestations, but no insecticides are labeled to control WFB in alfalfa or effective for controlling the larvae. Entomopathogenic nematodes (EPN) known to prey on a wide range of soil larvae, including WFB and its relatives have been found to be adapted to northeastern New Mexico's climatic and soil conditions. Since, this finding could have significant implications for New Mexico's alfalfa industry. This project addresses the Food and Fiber Production and Marketing and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Methods:

A local producer who had suffered loss from WFB provided an alfalfa field sown the previous summer to evaluate local adaptation of the EPN. Nematodes [*Steinernema carpocapsae* (Sc) 'NY 001', *S. feltiae* (Sf) 'NY 004', and *Heterorhabditis bacteriophora* (Hb) 'Oswego'] had been released in replicated plots in combinations of Sf + Sc and Sf + Hb with control plots defined elsewhere in the field. Details of the release and results of soil sampling in 2017 are given in the 2017 Annual Progress Report of the Agricultural Science Center (https://tucumcarisc.nmsu.edu/documents/annual-report-2017.pdf). The field was grazed by horses during the winter of 2017-18. In spring 2018, 200 lb/ac of 11-52-00 were applied uniformly to the field based on soil test recommendations.

As in November 2017, 20 soil samples for the 0-2" and 2-6" depths each were collected from each plot on November 28-29, 2018, and delivered to the entomology laboratory at Cornell University to be evaluated for the presence of the nematodes. Another soil sample was collected for fertility. Soil moisture at sampling time was near field capacity and soil temperatures at 4 inches were 46 and 38F and air temperatures were 72 and 44F, for the daily highs and lows, respectively. The alfalfa was in a semi-rosette growth phase with patches of prostrate rosettes and patches of upright growth comingled. The horses had not been turned in to graze yet; however, there was evidence of moderate grazing by mule deer.

Data from the 2018 sampling, as a percentage of each EPN species released, were analyzed using SAS PROC MIXED procedures to determine where differences between treatments existed. Means were separated by protected least significant difference ($P < 0.05$).

Results and Discussion:

Similarly to 2017, no Sc were found in the upper 2 inches of the soil core. Unlike 2017, no Hb were found in the 2-6 inch soil depth. In other studies, it has taken 1-2 years for sufficient dispersion of the EPNs, and well-dispersed Hb become most active below 6 inches. Consequently, they may be at that depth already in this field. The presence of Sf in 15 and 21% of the samples for the SfHb and SfSc treatments, respectively, in 2018 was slightly less than 2017 levels and what has been typically found in northern New York (20-30%), but still significantly greater than the untreated control at 0% presence ($P < 0.0011$).

While these levels are typical of the long-term persistence levels observed in NY alfalfa fields, they suggest that a large number of insect hosts have not been present in the treated areas. If a large number of insect hosts had been present, the levels of EPNs would be in the 35-50% range. However, experience suggests that the current levels of 15-21% are sufficient to respond to an invasion of susceptible hosts.

Kochia Entry, Site, and Planting Date Evaluation

Investigator(s):

L.M. Lauriault[1], B. Waldron[2], P.L. Cooksey[1], J. Box[1], J. Jennings[1], S. Jennings[1], and A. Williams[1]

[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401
[2]USDA-ARS Forage and Range Lab, Logan, UT 84322

Impacts(s):

Alfalfa growers in semiarid regions seek forages requiring less irrigation. Perennial forage kochia, known as "the alfalfa of the desert," is not invasive like its weedy annual relative and has value for pasture in cool desert regions with a moist winter/dry summer precipitation pattern. Preliminary research at NMSU's Agricultural Science Center at Tucumcari has discovered that perennial forage kochia is adapted to the semiarid dry winters/moist summers of the Southern High Plains of the USA and, with minimal irrigation, can potentially be as productive as alfalfa. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Method(s):

The Advisory Committee to the Agricultural Science Center at Tucumcari requested a local evaluation of perennial forage Kochia [*Bassia prostrata* (L) A.J Scott (syn. *Kochia prostrata*)]. Consequently, four entries [subspecies *virescens* "Immigrant," a late maturing and high winter forage value, and "PustC2," an early maturing experimental, and subsp. *grisea* "Snowstorm" (a late maturing and tall enhanced winter forage value, and "KZ6xC2," an early maturing and salt tolerant *grisea* experimental] were acquired from the USDA-ARS Forage and Range Lab.

The test is a strip (site: cropland irrigated with Class 1B treated municipal wastewater or rainfed range) – split (planting date: a winter seeding accompanied by snow and a spring seeding accompanied by rain) – split (variety) plot treatment arrangement with four randomized complete blocks within each site. The soil at both sites was Canez fine sandy loam. Additional site and planting details are given in The 2014 Annual Progress Report of the Agricultural Science Center at Tucumcari (http://tucumcarisc.nmsu.edu/documents/2014-annual-report.pdf) and management in 2015 and 2016 and results of canopy cover analyses in 2016 are presented in The 2016 Annual Progress Report of the Agricultural Science Center at Tucumcari (http://tucumcarisc.nmsu.edu/docu-ments/2016-annual-report.pdf). The range site was abandoned in 2016 due to unsatisfactory establishment and the first replicate of the irrigated site was located on a steep slope and had 5% stand in one plot while the rest were ≤2% stand. Consequently, that replicate was deleted from the study with no data collected.

On January 24, 2017, the study area was rotary mowed to promote seed-to-soil contact and stand thickening. In 2017, the irrigated site received 16.2 inches of irrigation during the growing season to supplement 23.2 inches of annual precipitation and 8.4 inches of precipitation fell from January through September 2018, which was supplemented with 13.8 inches of irrigation water. Lightning struck the pumps at the city wastewater plant on October 5, 2017, causing irrigation system failure and repairs were not completed until late May 2018. A system contamination at the plant also led to an irrigation system shut down from August 19-30, 2018. Consequently, no irrigation was applied during those periods.

Whole plot canopy cover was rated on August 2, 2018, after plots were delineated by mowing. On September 5, 2018, a 0.5 m^2 area having ≥50% canopy cover within each possible plot was rated for percent canopy cover and sampled for biomass to near ground level (Fig. 1) after average canopy height was measured. The number of plants were counted as they were hand-clipped. Harvested biomass was dried for 4 days at 150°F and weighed to determine biomass. The number of plants within the quadrat was extrapolated to estimate potential plant population.

Percent whole plot canopy cover, potential plant population extrapolated from the 0.5 m^2 areas, and biomass data collected in 2018 from the 3 replicates of the irrigated strip plot were analyzed using the Mixed procedure of SAS to determine if differences existed between planting dates (March and May) and among *B. prostrata* genotypes and for the interaction. Replicates were considered random. When differences among *B. prostrata* genotypes or within any interaction were significant ($P \leq 0.05$) or a trend ($0.05 < P < 0.10$) was evident, lsmeans were separated at $P \leq 0.05$ by least significant difference.

Results:

Consistent to measurements in 2016, there was no significant effect of planting date for whole plot canopy cover under irrigation (Table 1). Immigrant tended to have greater canopy coverage than KZ6xC2 with PustC2 being intermediate. The planting date x genotype interaction was significant because Immigrant had the greatest canopy cover for the March planting, while PustC2 had the greatest canopy cover for the May planting (7, 40, 5% cover for KZ6xC2, Immigrant, and Pust2C planted in March, respectively, and 15, 22, and 37% cover for KZ6xC2, Immigrant, and PustC2 planted in May, respectively; SEM = 10). For potential plant population, neither the planting date nor the planting date x genotype interaction were significant; however, KZ6xC2 had approximately twice the number of plants as Immigrant and PustC2 (Table 1). The planting date and the planting date x genotype interactions were not significant for canopy height, but PustC2 had greater canopy height than Immigrant with KZ6xC2 being intermediate and closer in height to PustC2 than to Immigrant. For biomass production, the May planting tended to have greater biomass than the March planting and PustC2 had the greatest biomass production, although the genotype effect was not significant.

Figure 1. One-year growth of Bassia prostrata (L) A.J. Scott sampled on September 5, 2018, at New Mexico State University's Agricultural Science Center at Tucumcari. Planting took place May 22, 2014.

Table 1. Planting date (PD) and genotype effects on whole plot canopy cover and potential plant population, canopy height, and biomass estimated in September 2018 from a 0.5 m^2 area of *Bassia prostrata* (L) A.J. Scott genotypes sown in 2014 at Tucumcari, NM USA. Data are the lsmeans of three replicates.

Effect/treatment	Whole plot canopy cover	Potential plant population	Canopy height	Biomass
PD	%	Plants ha^{-1}	cm	kg ha^{-1}
March	18	104304	64.3	8909
May	25	94747	71.2	12357
SEM	7	18784	6.2	2454
Genotype				
KZ6xC2	11	151016 A	72.6 AB	11060
Immigrant	31	86325 B	55.1 B	8106
PustC2	21	61235 B	75.5 A	12732
SEM	8	18288	5.9	2410
		***P*-values**		
PD	0.3195	0.5380	0.3065	0.0953
Genotype	0.1047	0.0302	0.0509	0.1021
PD*Genotype	0.0443	0.4657	0.4631	0.1554

Genotype means within a column followed by the same letter are not significantly different at $P < 0.05$, based on least significant difference analysis.

Pearl Millet Cowpea Forage Mixture Preliminary Evaluation

Investigator(s):

L.M. Lauriault[1], M.K. Darapuneni[1], G Martinez[1], P.L. Cooksey[1], J. Box[1], J. Jennings[1], S. Jennings[1], and A. Williams[1]

[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401

Impacts(s):

Planting legumes with cereal forages can increase yield and nutritive value. Pearl millet and cowpea are well-adapted and productive in the Southern High Plains, but their performance in mixtures under irrigated and rainfed conditions has not been evaluated. Preliminary research indicates that, while nutritive value of the mixture was slightly increased compared the monocultures, mixture land equivalency ratio (yield per unit of land) was reduced when the species were planted in the same row compared to the monocultures. Subsequent studies will evaluate planting arrangements to minimize competition and maintain yields with increased nutritive value. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Method(s):

The test is a strip (IRR: irrigated with Class 1B treated municipal wastewater or rainfed) – split [Forage: monoculture pearl millet (millet; 25 lb ac^{-1}), monoculture cowpea (cowpea; 50 lb ac^{-1}), or millet-cowpea mixture (MIX; half the seeding rate of each species) (Fig. 1)] plot treatment arrangement with four randomized complete blocks within each IRR strip plot. The soil at both sites was Canez fine sandy loam. Plots (10 ft x 20 ft) were planted on May 30-31, 2018, making two passes with a disk drill fitted with a single cone to plant eight 8-inch rows; mixture species were combined in the same seed packet to be planted together in rows.

Figure 1. Irrigated pearl millet – cowpea mixture.

From January through September 2018, 23.2 inches of precipitation fell on the study area and the irrigated strip-plot received 15.2 inches of irrigation during the growing season (June through September). A system contamination at the wastewater treatment plant led to an irrigation system shut down from August 19-30, 2018. Consequently, no irrigation was applied during that period. Millet plots were treated with 3% Detonate to control broadleaf weeds on July 11, while the cowpea plots were treated with Sevin (2 oz gal^{-1}) on July 17 to control blister beetles that were feeding on the stem surfaces into the phloem. Affected plants outgrew the damage well before harvest took place.

On August 31, 2018, a 0.5 yd^2 area within each plot was hand-clipped to near ground level to estimate forage yield. Species in MIX were bagged separately. Harvested biomass was weighed, dried for 2 days at 150°F, and reweighed to determine dry matter (DM) concentration and yield of each species, proportion of cowpea DM in MIX, and land equivalency ratio (LER), where LER of MIX = (MIX millet yield/monoculture millet yield) + (MIX cowpea yield/monoculture cowpea yield), and LER of monocultures = 1. Dried samples from the irrigated strip plot were ground to pass a 1-mm screen and delivered to the laboratory for nutritive value analysis by near infrared spectroscopy.

Dry matter concentration and yield of each species and the total yield and nutritive value of the monocultures and MIX, proportion of cowpea DM in MIX, and LER were analyzed using the Mixed procedure of SAS to determine if differences existed for IRR and among Forage and for the IRR x Forage interaction. Replicates were identified to be unique within IRR and considered random. When differences among Forage or for an IRR x Forage interaction were significant ($P \leq 0.05$), lsmeans were separated at $P \leq 0.05$ by least significant difference.

Results:

Results of statistical analysis and main effect means of nutritive value data for Forage in the irrigated strip plot are presented in Table 1. As expected, monoculture cowpea had the greatest crude protein and monoculture pearl millet had the least with the mixture intermediate and different than the monocultures. While there was no difference among Forage treatments for acid detergent fiber, cowpea had lesser neutral detergent fiber (NDF); however, cowpea NDF was less digestible than treatments including pearl millet leading to lesser total digestible nutrients (Table 1).

Results of statistical analysis and main effect means of yield data for IRR and Forage are presented in Table 2. There was no difference between IRR or Forage treatments or their interaction for DM concentration of millet; however, irrigated cowpea had lower DM concentration than rainfed cowpea due to the additional water applied. There also was a significant IRR x Forage interaction for cowpea DM concentration because rainfed monoculture cowpea had greater DM concentration than irrigated monoculture cowpea, while there was no difference between IRR treatments for cowpea in MIX. (Tables 2 & 3). Cowpea proportion was not different due to IRR treatment and there was no significant interaction, but all Forage treatments differed because Mix had greater cowpea proportion than monoculture millet, but less than monoculture cowpea, as expected. For DM yield of the individual species and the total, both main effects and the interaction were significant (Table 3). For the individual species, millet yielded greater with irrigation than when rainfed and the monocultures outyielded their counterparts in MIX, but only when irrigated, while cowpea in MIX was not different than rainfed cowpea either as a monoculture or in MIX (Table 3). For total DM yield, millet always yielded more than cowpea, but MIX was not different than either monoculture when rainfed. Only the Forage treatment was significant for LER because MIX was less than either of the monocultures (Table 2).

A main goal of mixing grasses and legumes for forage is to improve the nutritive value of the harvested product; however, yield also is an important component, and LER, a measure of the efficacy of mixing species vs. growing them separately, should be ≥1.00 for the mixture to be feasible. That was not the case with this study, possibly due to direct competition among species planted in the same row. Nonetheless, nutritive value was improved. The low proportion of cowpea in the mixture likely attributed to the only slight improvement in nutritive value, but even at that low proportion, yield of the pearl millet was reduced. Future studies with these species will include planting arrangement treatments under irrigation to determine how close together the pearl millet and cowpea can be planted in separate rows regarding the minimal number of adjacent rows needed for each species to maintain mixture yield and improve nutritive value by increasing the cowpea proportion.

Table 1. Nutritive value of the total yield of monoculture pearl millet, monoculture cowpea, and their mixture when irrigated with treated municipal wastewater at NMSU's Agricultural Science Center at Tucumcari in 2018.

Forage	CP	ADF	NDF	NDFD	TDN
Cowpea	19.6 A	37	42 A	50 B	55 B
Millet	5.6 C	37	69 B	64 A	61 A
MIX	7.4 B	36	67 B	64 A	60 A
SEM	0.3	1	1	1	1
P-values	<0.0001	0.8656	<0.0001	<0.0001	<0.0001

CP, ADF, NDF, NDFD, TDN, MIX and SEM signify crude protein, acid detergent fiber, neutral detergent fiber, NDF digestibility, total digestible nutrients, the millet – cowpea mixture, and standard error of the mean, respectively.

Means within a column having the same letter are not significantly different at the 5% alpha level.

Table 2. Dry matter yield components of monoculture pearl millet, monoculture cowpea, and their mixture when rainfed or irrigated with treated municipal wastewater at NMSU's Agricultural Science Center at Tucumcari in 2018.

	Dry matter concentration		Cowpea proportion	Dry matter yield			LER
	Millet	Cowpea		Millet	Cowpea	Total	
Irrigation (IRR)	- - - - - - - - - - - - -%	- - - - - - - - - - - -		- - - - - - - - -Tons/ac	- - - - - - - - -		
Rainfed	32.51	17.88	37	0.57	0.07	0.43	0.88
Irrigated	30.69	15.99	37	3.52	1.38	3.27	0.82
SEM	0.70	0.32	1	0.35	.020	0.36	0.04
Forage							
Millet	31.71	16.95	0 C	2.48	-------	2.48 A	1.00 A
Cowpea	---------	--------	100 A	-------	1.25	1.25 C	1.00 A
MIX	31.49	16.92	11 B	1.61	0.20	1.81 B	0.56 B
SEM	0.59	0.45	1	0.26	0.19	0.37	0.05
			P-values				
IRR	0.1161	0.0054	0.5959	0.0010	0.0036	0.0014	0.3651
Forage	0.7261	0.9529	<.0001	0.0050	0.0061	<.0001	<.0001
IRR x Forage	0.8341	0.0201	0.7369	0.0188	0.0071	0.0082	0.4106

LER, MIX, and SEM signify land equivalency ratio [= (MIX millet yield/monoculture millet yield) + (MIX cowpea yield/monoculture cowpea yield)], the millet – cowpea mixture, and standard error of the mean, respectively.

Forage means within a column for having the same letter are not significantly different at the 5% alpha level.

Table 3. The effect of irrigation (rainfed or irrigated with treated municipal wastewater) and forage treatments (monoculture pearl millet and cowpea and pearl millet – cowpea mixture) on selected yield components at Tucumcari in 2018.

	Rainfed	Irrigated
	Cowpea dry matter concentration, %; SEM = 0.45, P < 0.0201	
Cowpea	18.60 A	15.30 C
MIX	17.17 AB	16.67 BC
	Pearl millet dry matter yield, tons/ac; SEM = 0.38, P < 0.0188	
Millet	0.69 C	4.28 A
MIX	0.46 C	2.76 B
	Cowpea dry matter yield, tons/ac; SEM = 0.27, P < 0.0071	
Cowpea	0.09 B	2.41 A
MIX	0.05 B	0.35 B
	Total dry matter yield, tons/ac; SEM = 0.38, P < 0.0082	
Millet	0.69 D	4.28 A
Cowpea	0.09 E	2.41 C
MIX	0.51 DE	3.11 B

SEM and MIX signify standard error of the mean and the millet – cowpea mixture, respectively.

Means within an interaction having the same letter are not significantly different at the 5% alpha level.

Jujube Cultivar Evaluation

Investigator(s):

L.M. Lauriault[1], S. Yao[2], G. Martinez[1], P.L. Cooksey[1], J. Box[1], J. Jennings[1], S. Jennings[1], and A. Williams[1]

[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401
[2]New Mexico State University, Sustainable Agriculture Science Center at Alcalde, NM 87511

Potential Impact(s):

Low available water and late frosts are critical problems challenging fruit production in eastern New Mexico. Jujubes, also called Chinese dates, are a potential alternative crop to help small-scale farmers produce a crop every year because they are drought tolerant once established and they avoid spring frosts by blooming later. Jujubes are nutritious with 4-10 times more vitamin C than oranges. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, Family Development and Health of New Mexicans, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Method(s):

In an area of native grass east of the office (Quay loam soil), two replicates of 36 grafted jujube cultivars were transplanted on April 11-12, 2016. Each experimental unit consisted of two trees of the cultivar planted adjacent to each other and each replicate consisted of 4 rows of 18 trees (Figure 1). The intra-row spacing was 10 ft and there was 15 ft between rows. Each replicate was irrigated by two irrigation zones, each servicing two adjacent rows in series, using above surface drip tubing with one 4-gph emitter for each tree. Other details of infrastructure development and planting are provided in the 2016 Annual Report of the Agricultural Science Center at Tucumcari (available http://tucumcarisc.nmsu.edu/documents/2016-annual-report.pdf). Specimen plants identified as dead in 2016 or 2017 were replaced on April 3, 2018; in some cases, a different cultivar was used due to availability. Figure 1 shows a revised plot plan.

The irrigation system controller that led to inconsistent watering throughout the 2017 growing season was replaced over winter 2017-18. Irrigation application rates through emitters to trees not performing well or dead along with those on either side that were thriving were monitored. Weak or dead plants received equal amounts of water to their thriving neighbors [1.73 (n = 11) vs. 1.84 (n = 41) ± 0.68 gph for weak/dead plants vs. thriving plants, respectively). One zone (the southernmost two rows of Rep 2) still did not function properly, likely due to a crushed water line (0.89 gph for rows 7 & 8 vs. 2.08 gph for rows 1-6); consequently, those trees were manually watered throughout 2018. This likely led to less plant available water due to surface runoff, compared to the application through the drip system at 2 gpm. Grasshoppers were controlled with Semaspore Bait (38 lb/acre; Planet Natural, Bozeman, MT) applied on June 29.

Specimen trees were observed for survival and evaluated weekly for the presence of flower buds and then biweekly for fruit set. On October 3, 2018, fruit were harvested, counted, weighed, and measured for height (blossom end to stem end) and largest diameter.

Result(s):

Figure 1 also shows results of survival and bloom and fruit set evaluations. Only the replanted specimens of Dragon, Xingguang, and Globe in Rep 2 (southernmost) did not survive transplant shock.

All, but four trees planted in 2016 bloomed by May 21 in 2018. Once blooming had begun, there was a continuous flush of flowers throughout the growing season. All established plants of Debailing, Gagazao, Honey jar, Redland, and Shuimen had fruit set despite the irrigation difference between rows 1-6 and rows 7-8 (Figure 1). All plants of Bonzao, Capri, Hui, Junzao, Pitless, and Sihong bloomed, but set fruit only when irrigated through the system. All specimens of Dagazau, Jinchang, Jing 39, Jixinzao, Kongfucui, Li, Mayazao, Qiyuexian, Russian 2, So, and Sugarcane were watered only through the drip system and all set fruit (Figure 1; although two replants of Qiyuexian in the hand-watered rows did not bloom). Established specimens of Globe set fruit in the drip-irrigated rows, but not in the hand-watered rows while Dragon bloomed when drip-irrigated, but not when hand-watered. GA866, Jinkuiwang, Jinsi 2, Sherwood, and Xingguang only bloomed. The remaining cultivars with established plants (Jinsi 3, Lang, Liuyeuxian, Mushroom, Xiangzao, and Zaocuiwang) were not consistent within and/or across replicates or irrigation differences. Replants did not generally bloom and those that did set no fruit, except for the one specimen of Shuimen, which was in a hand-watered row. There is only one specimen of Russian, which was a replant that did not bloom in one of the hand-watered rows.

Figure 1. Jujube cultivars planted at NMSU's Agricultural Science Center at Tucumcari in April 2016 and observed in 2018.

	Rep 1					Rep 2			
	Row 1	Row2	Row3	Row4		Row5	Row6	Row7	Row8
1	Banzao	Jinchang	Lang	Shuimen		Jixinzao	Chaoyang	Honeyjar	Junzao
2	Banzao	*Chaoyang	Lang	Shuimen		Jixinzao	Chaoyang	Honeyjar	Junzao
3	Capri	Jing 39	Li	Sihong		Mushroom	Sugarcane	Pitless	Capri
4	Capri	Jing 39	Li	Sihong		Mushroom	Sugarcane	Pitless	Capri
5	Dabailing	Jinkuiwang	Liuyuexian	So		So	Kongfucui	Jinkuiwang	Dragon
6	Dabailing	Jinkuiwang	Liuyuexian	So		So	Kongfucui	Jinkuiwang	Dragon
7	Daguazao	Jinsi 2	Mayazao	Xingguang		Liuyuexian	Daguazao	Jinsi 2	Redland
8	Daguazao	Jinsi 2	Mayazao	Xingguang		Liuyuexian	Daguazao	Jinsi 2	Redland
9	Dragon	Jinsi 3	Mushroom	Sugarcane	Gas line	Zaocuiwang	Qiyuexian	Banzao	Sihong
10	Dragon	Jinsi 3	Mushroom	Sugarcane		Zaocuiwang	Qiyuexian	Banzao	Sihong
11	GA866	Chaoyang	Pitless	Xiangzao		Lang	Xiangzao	Dabailing	Xingguang
12	GA866	Chaoyang	Pitless	Xiangzao		Lang	Xiangzao	Dabailing	Xingguang
13	Globe	Jixinzao	Qiyuexian	Zaocuiwang		Jinsi 3	*Capri	Gagazao	Globe
14	Globe	Jixinzao	Qiyuexian	Zaocuiwang		Jinsi 3	Jinchang	Gagazao	Globe
15	Gagazao	Junzao	Redland	Russian 2		Mayazao	GA866	Sherwood	Russian
16	*Daguazao	Junzao	Redland	Russian 2		Mayazao	GA866	Sherwood	Hui
17	Honeyjar	Kongfucui	Sherwood	Hui		Jing 39	Li	Shuimen	Qiyuexian
18	Honeyjar	Kongfucui	Sherwood	Qiyuexian		Jing 39	Li	Shuimen	Qiyuexian

The left of the page is north.

Rows 1-6 were irrigated through the drip system Monday, Wednesday, and Friday with 2 gph; rows 7-8 were hand-watered with 2 gal on the same days in 2018.

Yellow highlight signifies replants on 4/3/18.

*Signifies different cultivar replanted due to unavailability of original cultivar.

Red highlight signifies replants that did not survive transplant shock

Blue highlight signifies observed bloom, but no observed fruit set in 2018; orange highlight signifies a replant that bloomed, but set no fruit.

Green highlight signifies observed fruit set in 2018; olive highlight signifies a replant that set fruit.

Purple highlight signifies the only plant from which fruit was harvested in 2018.

By season's end, only one plant, a specimen of Honey jar in Rep 1, had any remaining fruit (4 fruit: 1 with green skin, 2 with intact red skins, and 1 with red skin cracking; all were still firm and slightly tart; 20.20g total weight). The green fruit was smaller: 15.7 mm tall, 17.6 mm largest diameter; than the red fruit: 19.8 mm tall, 20.1 mm largest diameter. Due to the presence in the test area of turkey and deer tracks and coyote and/or raccoon droppings with jujube content, as well as an observation that leaves and fruit appeared to have been stripped from stem tips, it is speculated that predation occurred by any or all of those wildlife. Measures will be determined to minimize this predation in the future.

Alfalfa Variety Testing in the Tucumcari Irrigation Project

Investigator(s):

L.M. Lauriault[1], G.K. Martinez[1], P.L. Cooksey[1], J. Box[1], J. Jennings[1], S. Jennings[1], and A. Williams[1]

[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401

Potential Impact(s):

Variety selection is key to a highly productive alfalfa stand. Differences between the highest- and lowest-yielding varieties in irrigated alfalfa tests statewide ranged from 0.99 to 2.41 tons per acre in 2018. If sold as hay, this translates to a potential difference in returns of $213 to $518 per acre due to variety, or an increase of at least $38 million for the industry. This project addresses the Food and Fiber Production and Marketing Pillar for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Method(s):

A standard alfalfa variety test with 19 entries was planted May 12, 2015, in the field fronting US 54. The test area (Canez fine sandy loam) was conventionally tilled and formed into a flat seedbed for sprinkler irrigation with treated municipal wastewater. Plots (5 ft x 20 ft of which the center 5 ft x 15 ft were harvested for yield) were sown using a disk drill fitted with a seed-metering cone at 20 lb inoculated seed/acre in a Randomized Complete Block design with 4 replications set up for nearest neighbor analysis. The 2015 Annual Report of the Agricultural Science Center at Tucumcari (available at https://tucumcarisc.nmsu.edu/documents/2015-annual-report.pdf) provides more details about establishment. In early October 2017, the wastewater distribution system failed and only 0.03 inch of precipitation fell from then until the last harvest. Repairs were not complete until late May and the system was off again during the last half of August. Irrigations with treated municipal wastewater totaling 10.7 inches were applied to supplement 12.9 inches of precipitation (November 2017 through October 2018). On June 26, 2018, 17-56-0-1.4 lb N-P-K-Zn/A were applied, but no pesticides were applied in 2018. Because of the irrigation system problems, the test was harvested only four times in 2018, compared to six harvests taken in 2016 and 2017.

A new test was planted with 15 entries on September 14, 2018, which will also be irrigated with treated municipal wastewater.

Result(s):

Yield data from the 2015 test collected in 2018 were subjected to detrending by nearest neighbor analysis and statistical procedures for tests of significance and means separation and are presented in Table 1 with varieties arranged by descending 3-yr average total yield. Yield differences over the three years of this study between the average of those varieties that yielded equally to the highest yielding variety (varieties in the table with an asterisk for the 3-yr average) compared to the average of those varieties yielding less than the highest yielding variety (varieties in the table without an asterisk) was approximately 0.7 tons/year. At the average price for alfalfa hay in New Mexico for 2016 ($170/ton), 2017 ($177/ton), and 2018 ($215/ton), selecting a variety that yielded equal to the highest yielding variety would have returned approximately $393/acre over the three years for the same production costs.

Reports giving results from statewide testing in 2018 and previous years are available at the New Mexico State University College of Agricultural, Consumer and Environmental Sciences' Publications and Videos Variety Test Reports webpage (http://Aes.nmsu.edu/pubs/variety_trials/welcome.html#alfalfa) as well as from the Agricultural Science Center at Tucumcari and county Cooperative Extension Service offices.

Table 1. Dry matter yields (tons/acre) of alfalfa varieties sown May 12, 2015, at NMSU's Agricultural Science Center at Tucumcari and sprinkler-irrigated twice per week with treated municipal wastewater†.

Variety Name	2016 Total	2017 Total	2018 Harvests‡ 10-Jul	14-Aug	11-Sep	30-Oct	2018 Total	3-Yr Average
NuMex Bill Melton	4.62**	5.85**	0.79*	0.66**	0.51*	0.19*	2.14**	4.20**
6829R	4.38*	5.68*	0.76*	0.53*	0.57**	0.23**	2.08*	4.05*
NM14BMHS1	4.19*	5.36*	0.84**	0.56*	0.50*	0.20*	2.09*	3.88*
African Common	3.65	5.59*	0.76*	0.54*	0.51*	0.19*	1.99*	3.74*
NM14BMHR2	4.17*	5.33*	0.65	0.46	0.39	0.13	1.63	3.71
Mallard	3.98*	5.23*	0.58	0.54*	0.43	0.13	1.68	3.63
NM14BMC0	3.99*	5.26*	0.62	0.37	0.42	0.13	1.53	3.59
Malone	3.77	5.22*	0.66	0.43	0.45	0.15	1.68	3.55
NM14BM1008251	3.94*	5.00	0.69	0.39	0.42	0.19*	1.68	3.54
NM14MalHS3	3.69	5.12	0.64	0.55*	0.44	0.16	1.78*	3.53
NM Common	3.52	5.10	0.70*	0.42	0.46	0.17	1.74	3.45
Zia	3.23	4.94	0.64	0.49*	0.47*	0.17	1.76*	3.31
NM14MLLS2	3.65	4.50	0.56	0.34	0.32	0.15	1.37	3.17
SW 5213	3.27	4.93	0.52	0.30	0.32	0.11	1.24	3.15
ICON	3.33	4.51	0.63	0.42	0.37	0.14	1.56	3.13
SW 5909	3.27	4.61	0.52	0.34	0.38	0.10	1.33	3.07
Red Falcon BR	3.19	4.19	0.52	0.35	0.42	0.12	1.40	2.93
SW 5113	3.10	4.28	0.53	0.35	0.39	0.11	1.38	2.92
Roadrunner	3.03	4.50	0.52	0.25	0.29	0.09	1.15	2.89
Mean	3.68	5.01	0.64	0.43	0.42	0.15	1.64	3.44
LSD (0.05)	0.72	0.72	0.15	0.19	0.11	0.05	0.39	0.48
CV%	13.85	10.18	16.49	30.51	18.46	23.64	16.60	17.12

†Data were detrended using nearest neighbor analysis and analyzed using analysis of variance.
‡Irrigation water delivery system failures at the wastewater plant prevented irrigation from October 2017 through May 2018 and in August 2018.
2016 Harvest dates: 24-May, 22-Jun, 9-Aug, 13-Sep, and 8-Nov.
2017 Harvest dates: 19-May, 20-Jun, 19-Jul, 15-Aug, 11-Sep, and 30-Oct.
**Highest numerical value in the column.
*Not significantly different from the highest numerical value in the column based on the 5% LSD.
NS means that there were no significant differences between the varieties within that column at the 5% level.

Evaluation of Winter Canola for Winter/Spring Pastures for Beef Steers

Investigator(s):

L.M. Lauriault[1], S.V. Angadi[2], M.K. Darapuneni[1], E.J. Scholljegerdes[3], G. Duff[4], J. Box[1], G.K. Martinez[1], P.L. Cooksey[1], J. Jennings[1], S. Jennings[1], and A. Williams[1]

[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401
[2]New Mexico State University, Agricultural Science Center at Clovis, NM 88101
[3]New Mexico State University, Department of Animal and Range Sciences, Las Cruces, NM 88003
[4]New Mexico State University, Clayton Livestock Research Center, Clayton, NM 88415

Potential Impact(s): Interest is increasing in whether winter canola can be grazed as an alternative crop in wheat rotations in the Southern High Plains. Preliminary results of previous research indicates that beef cattle gains on canola in autumn were equal to those on pearl millet and greater than gains on haygrazer. Winter and spring grazing also must be evaluated for animal productivity as well as for effects on grain production. This project addresses the Food and Fiber Production and Marketing and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Method(s):

Winter canola and cereal rye pastures were arranged in a randomized complete block design with three replicates in the West Pivot and two additional replicates of canola in the North Farm pivot. Because wastewater irrigation delivery system was off during the last half of August, land preparation was delayed and seed drilling on 7-inch spacing took place from September 10-12 and 26-28, 2018, for canola at the North Farm and West Pivots, respectively. Rye was sown from October 4-5, 2018, at the West Pivot. Seeding rates were 35 and 10 lb/A for rye and canola, respectively. The North Farm pastures received 4.5 inches of irrigation from September through December and the West Pivot received 3.9 inches from October through December, both with treated municipal wastewater to supplement 6.2 inches of September through December precipitation. The West Pivot pastures received 12 lb N/A and the North Farm pastures received 25 lb N/A, both through the sprinklers on December 5, 2018.

Due to the lateness of planting, beef cattle to be used on this trial were held at the Clayton Livestock Research Center until after the New Year. Consequently, no data were collected in 2018.

Impact of No-Tillage Overseeding Bindweed-Infested Grass Pastures with Winter Cereals on the Bindweed

Investigator(s):

L.M. Lauriault[1], M.K. Darapuneni[1], P. Box[2], G.K. Martinez[1], J. Box[1], P.L. Cooksey[1], J. Jennings[1], and S. Jennings[1]

[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401
[2]Owner, Box Farms, Tucumcari, NM 88401

Potential Impact(s):

Field bindweed is a competitive, summer-active weed that reduces productivity in irrigated pastures. No-tillage overseeded winter cereals could reduce competition by field bindweed when it begins growth in the spring and encourage encroachment by desirable species during the growing season. Preliminary results indicate a reduction in bindweed biomass and a reduction in the number of clones in the spring by grazing in the previous fall. This project addresses the Food and Fiber Production and Marketing, Water Use and Conservation, and Environmental Stewardship Pillars for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

Method(s):

In response to a request by the Advisory Committee to the Agricultural Science Center at Tucumcari to conduct projects off-site, an opportunity presented itself to evaluate the impact of grazing winter cereals on field bindweed competition. Locally grown combine-run triticale seed was no-till drilled on September 15, 2017, into two existing predominantly native, warm-season grass, irrigated pastures that were heavily infested with field bindweed. The seeding rate was 60 lb/A. Flood irrigation (0.65 in./A) was applied from September 20-27 to supplement 6.30 inches of precipitation that fell in September and early October. In August, 6.48 inches of precipitation had fallen.

After establishment of the triticale and prior to grazing, three 16 ft x 16 ft exclosures were uniformly distributed in each pasture. In 2017, grazing was initiated on October 16 by cows and calves, which were removed on November 25, 2017, when forage became limited as part of the managed rotation. Immediately prior to initiation of grazing, standing forage was hand-clipped to ground level near each exclosure and, approximately every 28 days thereafter, aboveground plant material within a 3.33 sq.ft. quadrat was hand-clipped to ground level in and near each exclosure. Sampling locations outside the exclosures were selected to represent the standing forage within the exclosure, but far enough away to avoid trampling adjacent to the exclosures. Clipped material was bagged separately as bindweed, other weed, triticale, and other grass without regard to whether or not it alive or dead. Bindweed clones were counted as they were clipped. Harvested material was dried in a forced-air oven at 140°F for 48 hours to determine dry matter yield. After drying, samples were held for prospective estimation of nutritive value by NIRS analysis. At the December 2017 sampling it was determined that sampling should not be resumed until March 5, 2018, if there is sufficient growth.

In 2018, irrigation was applied when possible to supplement 12.9 inches of precipitation, of which 0.7 inches fell from January through June. Sampling took place on April 17, May 24, and July 3. Cattle (48 cow/calf pairs and 2 bulls) grazed rotationally between the two pastures from May 26 until November 11.

Bindweed and forage data collected in 2018 were analyzed using SAS Proc Mixed to compare sampling location, sampling period, and their interaction. When the F-test for sampling date or the interaction was significant ($P < 0.05$) means were separated using least significant differences.

Results:

Sampling location and sampling period data and results of statistical analysis are presented in Table 1. The effects of sampling location, sampling period, and their interaction were all significant for the number of bindweed clones. Table 2 shows that the interaction occurred because the number of clones in May increased in the ungrazed locations, which, by July, returned to mid-April levels, while under grazing, there was no significant change in clone numbers. The May sampling was taken after the initiation of rapid growth for bindweed, but before grazing had been initiated in the spring. Consequently, the lack of increase in clones from April to May in the grazed area (Table 2) is likely a result of grazing the previous October and November that may have reduced photosynthate provided to the field bindweed root system, also possibly compromising its future ability to survive and compete with desirable species and other weeds.

Trends (0.05 < P < 0.10) were observed for reduced bindweed dry matter and increased other grass dry matter under grazing (Table 1). The reduction in bindweed biomass under grazing was also observed in autumn 2017 (see the 2017 Annual Progress Report: https://tucumcarisc.nmsu.edu/documents/annual-report-2017.pdf). Other grasses were predominantly desirable perennial warm-season grasses that were encouraged to encroach by using no-tillage to establish the cereal in one of the pastures.

Bindweed dry matter was also greater in May than in the other months, as was triticale dry matter (Table 1). The increases from April to May were expected since the May sampling was taken after the period of rapid growth for both bindweed and the triticale, but before grazing had been initiated, as mentioned regarding clone numbers. The reduction in bindweed dry matter (Table 1) from May to July would be largely due to grazing as the July measurement was taken before bindweed reduced growth from summer heat. The reduction in triticale biomass from May to July would be due to a combination of grazing and cessation of growth after reproduction.

Table 1. Bindweed clonal population and dry matter (DM) yield of bindweed, other weeds, triticale, and other grasses in bindweed-infested pastures at Tucumcari in 2018. Data are the lsmeans of two pastures and three subsamples within each pasture.

Treatment effect	Bindweed clones	Bindweed	Other weed	Triticale	Other grass
	# /sq. m	- - - - - - - - - - - - - - g DM / sq. m - - - - - - - - - - - - - -			
		Sampling location (SL)			
Ungrazed	68.6	41.07	50.94	64.90	30.76
Grazed	38.1	27.38	41.86	62.08	57.86
SEM	4.2	4.09	30.90	16.35	12.21
		Sampling period (SP)			
17-Apr	34.5 B	19.15 B	19.56	41.37 B	33.12
24-May	87.0 A	66.85 A	49.22	101.07 A	58.23
3-Jul	38.5 B	16.67 B	70.42	48.04 B	41.59
SEM	5.1	4.91	32.21	17.52	13.54
		P-value of F			
SL	0.0045	0.0528	0.6378	0.8319	0.0690
SP	0.0017	0.0011	0.1647	0.0220	0.2942
SL x SP	0.0088	0.6874	0.7864	0.9998	0.6645

Grazing took place in October and November 2017 and began again on 26-May 2018.
Sampling period means within a column with the same letter are not significantly different based on the 5% LSD.

Table 2. The effect of fall and spring grazing on the number of bindweed clones in spring 2018.

Date	Ungrazed	Grazed
17-Apr	33.39 B	35.54 B
24-May	124.94 A	49.01 B
3-Jul	47.39 B	29.62 B

Grazing took place in October and November 2017 and began again on 26-May 2018.

Lsmeans with the same letter are not significantly different based on the 5% LSD (SEM = 7.25)

Cereal forage will be sown again during winter 2018-19 and sampling will continue in 2019 to determine if competition by the cereal has a sustained effect on spring and summer growth of field bindweed as measured by a reduction in the number of clones and other variables over time.

Tucumcari Beef Cattle Feed Efficiency Testing

Investigator(s):

M. Ward[1], S. Jennings[2], J. Box[2], J. Jennings[2], A. Williams[2], P.L. Cooksey[2], L.M. Lauriault[2], and G.K. Martinez[2]

[1]New Mexico State University, Department of Extension Animal Sciences and Natural Resources, Las Cruces, NM 88003
[2]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401

Impacts:

The Tucumcari Bull Test has grown both in scope and scale since Dr. Marcy Ward, New Mexico State University's Extension Livestock Specialist, took over as the test director, in 2014. The number of animals tested has grown by 300% since 2013, from 75 bulls tested annually to 350 bulls and heifers tested in 2018. To put the impact of this expansion in perspective, 75 bulls can pass on their genetics to approximately 1500 offspring per year, where 350 tested animals pass on their proven genetics to over 6300 offspring per year.

In 2013, there were 8 active producers and the facility tested 75 bulls, selling only 43. By 2018, the test was measuring performance on 155 bulls, and had 22 producers involved from four states. The economic impact for producers has also been significant. Until 2015, Tucumcari Bull Sale averages were consistently $300-$500 lower per bull than other production sales in the state. The 2018 sale was heavily impacted by the bull market and a new competitor located in Tucumcari. Given these challenges, the sale average of the Tucumcari Bull Sale still remained above that of other multi consignor sales in the region.

The test and sale audience has widened as well. In 2013, approximately 75 producers attended the Tucumcari Bull Sale. In 2018 the sale was broadcast live on line, reaching over 130 people from 30 states and two Canadian provinces. Combining the in-house and online attendance, approximately 250 people participated in the sale. The other audience to consider are the visitors to the website and sale catalog pages. The Tucumcari Bull Test is in the top 6 of bull tests listed on Google's main search page for bull efficiency tests. This exposure has generated interest from across the United States. The 2017 sale catalog was also posted on the American Angus Association website. There were over 3200 visits to the catalog page when published.

In fall 2018, TFET agreed to allow NMSU to initiate a water intake project with their cattle. Dr. Ward and her colleagues are developing technology to measure individual water consumption of purebred animals. This technology will continued to be used to allow for a significant multiyear study.

Summary:

There are two primary types of beef cattle producers in New Mexico. The largest sector of this industry is the commercial producer. These producers raise cattle to be sold for beef. The "seed stock" producer is the other sector. These producers raise pure bred cattle that are sold to the commercial producers as herd replacements. Even though the seed stock industry represents approximately 10% of the cattle inventory in New Mexico (NMDA Census, 2016), it contributes a significant proportion (50%) of the genetics to the commercial cow herd.

Seed stock producers collect data on their animals and utilize genetic parameters to make selection decisions that help optimize the genetic potential of their herds. The more information these producers are able to collect, the more quickly they can make genetic improvements. If the seed stock producer improves the performance and efficiency of their cattle, those superior genetics can be carried on through to the commercial producers who purchase their bulls or heifers.

Objectives:

The extension specialist will interpret and distribute the information gained from this outlet to beef cattle producers throughout the region for educational and marketing purposes.

1. For New Mexico beef cattle producers, increase knowledge base in genetic selection methods that can improve herd performance and productivity and
2. For seed stock operators potentially supplying New Mexico beef cattle producers, provide an outlet where they may gain additional information on their cattle.

2018 Outcomes:

In 2018, management of the increase in capacity of the feed efficiency testing facility and use was the primary focus. More cattle require more attention. The aging facilities also were need of repair and updates. Both issues can impact the quality of the testing and the image to the public. As a result, the Tucumcari Feed Efficiency Test, LLC (TFET) hired a new person to see to the daily care of the cattle and help with any facility repairs. The water system has been greatly improved and cattle health more intensely evaluated.

Dr. Ward was also involved in the development of a scholarship program collaboration with Mesalands College in Tucumcari, New Mexico in 2017. That program continues today. Additionally, Wyatt Bishop, one of the winners of last year's scholarship did so well, he was the individual hired by TFET to care for the cattle. Shane Jennings received a plaque in gratitude for 10 years of service and continues to assist as needed and train the new hire.

Outputs:

The ACES-NMSU Tucumcari Bull Test and Sale Website is the primary source for dissemination of performance data and genetic and pedigree information. Sonja Jo Serna, ACES Media Specialist, serves as the primary administrator of the website, and the Livestock Specialist provides content. Four performance reports, pedigrees of each animal, and their genetic information are made available on the website every year. These reports and genetic information are used by both the test participants and potential buyers to help make educated decisions on how to improve the genetics within their herd. To date, Dr. Ward has generated over 400 summary and individual reports to these producers.

A hard copy catalog is also generated to promote the bulls consigned to the Tucumcari Sale. The catalog contains the same information as the website, but is distributed through the mail to over 1000 producers from NM, TX, CO, and OK.

In the fall of 2018, Dr. Ward submitted a $50,000 USDA/NIFA Western Sustainable Agriculture Research and Education grant with six of the current cooperators. The purpose of the grant is to further fund the water intake study efforts.

Water Intake Stanchions in Large Growsafe Pen

Shane Jennings Receives Plaque for 10 Years of Service to Feed Efficiency Testing

TUCUMCARI BULL TEST EST. 1961

Studies with Failed Satisfactory Establishment or Completion in 2018

Investigator(s):

L.M. Lauriault[1], M.K. Darapuneni[1], G. Martinez[1], P.L. Cooksey[1], J. Box[1], J. Jennings[1], S. Jennings[1], and A. Williams[1]

[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401

Data collection from several studies continuing from previous years or initiated in 2017/2018 (listed below) did not establish or were not completed as scheduled.

Darapuneni: Dryland/irrigated winter cover crop study planted in 2017 (lack of precipitation/irrigation system failure).

Darapuneni: Winter canola fertilizer study planted in 2017 (lack of precipitation/irrigation system failure).

Darapuneni: Dryland wheat/sorghum/alternate crop rotation study (lack of precipitation in 2018).

Darapuneni/Sultana: Tillage effects on cotton growth.

Darapuneni/Sultana: Tillage effects on corn growth.

Lauriault: Comparison of alfalfa planting dates (early and mid-season irrigation system failures prevented consistent data collection across seeding years within 2018, concluding the studies).

Lauriault: Dry matter yield and nutritive value of sorghum forage – legume mixtures under single-cut management (poor establishment/survival due to early and mid-season irrigation system failure).

Lauriault: Dry matter yield and nutritive value of corn and sorghum forages relay intercropped with brassicas and oat for autumn forage (poor establishment/survival of corn and sorghum due to early and mid-season irrigation system failure).

Lauriault: Varietal performance evaluations for irrigated grain sorghum, single- and multiple-cut forage sorghum and sorghum x sudangrass, and cotton (poor establishment/survival due to early and mid-season irrigation system failure).

Lauriault: Late summer/autumn grazing of sorghum-sudangrass, pearl millet, and canola by beef yearlings (due to an early-season irrigation system failure, pastures were not planted in 2018).

Lauriault: Effect of selected OMRI certified herbicides on field bindweed and the bindweed mite (insufficient mite populations).